VOL. 05 NO. 4,
AUGUST, 2024
E-ISSN 3026-9210
P-ISSN 3026-815X

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Built Env. & Geological Research (JBEGR)

Assessment of Gender Role in Commercial Charcoal Production Processes in Some Parts of Nasarawa State, Nigeria

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Abstract
This study examines the role of gender in the commercial charcoal production processes in Nasarawa State, Nigeria, with a focus on understanding the contributions of both men and women in this industry. Charcoal production, a significant source of income in the region, is a major driver of environmental degradation, including deforestation and biodiversity loss. The research adopts a multi-method approach, utilizing both quantitative and qualitative data collected through questionnaires, interviews, focus group discussions, and field observations across three local government areas: Akwanga, Karu, and Doma. A total of 450 charcoal producers were sampled using a stratified and purposive sampling technique, with data analysed through descriptive, inferential, and geospatial methods. The findings reveal that while both genders participate in various stages of charcoal production, there are distinct differences influenced by cultural norms that restrict certain activities to specific genders. The age range of participants, predominantly between 15-50 years, underscores the labour-intensive nature of charcoal production, which is dominated by the most physically active segment of the population. Despite awareness of the environmental consequences, the financial benefits drive continued participation in the industry. The study recommends the formation of a charcoal producers' association to promote specialization according to gender strengths and to encourage sustainable practices. Additionally, it suggests involving the Forestry Department in sensitizing producers about alternative methods that reduce environmental impact. Emerging policies should focus on improving the socio-

economic status of those involved in charcoal production while providing viable alternatives to traditional energy sources. This research highlights the need for gender-inclusive approaches to resource management that balance economic livelihoods with environmental sustainability in Nasarawa State.

Keywords: Gender Role, Sustainability, Woodland Exploitation, Charcoal Production, Environmental Impact.

Introduction

Developmental efforts are dependent on a sustainable environment to strife, unfortunately the environment today is being overburdened by human dependence on it for social, economic and physical wellbeing. The exploitation of forest resources remains a hard-hitting challenge to most pastoral communities in North Central Nigeria (FAO, 2011). Human activities, such as charcoal production, are increasing the pace of biodiversity degradation.

Charcoal business in sub-Saharan Africa has often been perceived as a male-dominated occupation (Schreckenberg, 2017). In reality, women are evidently engaged from the extraction, production, transport and sale. Their involvement is significant in sustaining rural livelihoods, (Markus Ihalainen 2020). Gender barriers not only hinder equal participation and benefits in the sector, but they can also undermine the efficiency and environmental sustainability of the value chain as a whole. As the charcoal business expands to cater to the continent's growing population, it is ever more important that policies identify and address these barriers in each of the countries. The importance of the charcoal sector is growing rapidly in Sub- Saharan Africa. In addition to providing an affordable energy source for residents in the continent's growing urban centres, the charcoal value chain offers a critical income source for millions of people (IEA, 2014). While studies assessing employment and socioeconomic benefits in charcoal value chains have steadily increased in recent years (Sola 2017), sex disaggregated data is scarce, the role of women and the influence of gendered power relations in the male- coded charcoal production has remained understudied (Smith 2017). The importance of gender equality for a sustainable future has been established in sustainable development goal 5 - achieve gender equality and empower all women and girls. However, it is not a stand-alone objective; rather, gender equality is important for the achievement of other global goals, including those related to environmental challenges. Women's participation in decision-making is essential in environmental governance.

The fourth UN Environment Assembly (UNEA-4) recognized the importance of promoting gender equality and the human rights and empowerment of women and girls in environmental governance. To promote decent work, there needs to be a comprehensive and integrated strategy cutting across a range of policy areas that eliminates the negative aspects of informality, while preserving the significant job creation and income-generation potential of the informal economy, and that promotes the protection and incorporation of workers and economic units in the informal economy into the mainstream economy (ILO, 2007a: 1). From a gender perspective, the current challenge is to develop and implement research, policy and practical initiatives which "combine employment creation and social protection with rights at work and representation" in ways that ensure gender equality and enable empowerment for workers situated as far down, and in as many sectors of, the continuum as possible (ILO, 2007).

According to global forest watch (2020), Nasarawa state had 13.8kha of tree cover in 2010, extending to 2.4% of its land Area, it lost 20.3ha of tree cover equivalent to 6.05kt of CO2 of emission. The sustenance of the North central region's forest is critical as replacement efforts (seen in afforestation programs) do not commensurate exploitation. Therefore, more inclusive approaches such as assessing gender roles as one of the drivers of the activity and having solutions to improve their livelihoods will further limit dependency on the natural woodland for charcoal production.

The Government of Nigeria (2004) estimates that, about 150 trucks transport charcoal to markets within and beyond North Central region per week. Households produce about 25 maxi bags of charcoal per month and sell about 95 percent of the output either within or outside the region. This poses a worrying threat to the natural existence of tree biodiversity in the study area and the assertion (i.e. threatened forest) is underpinned by the Resource Watch Agenda's claim that extractions from the forest outpace the rate of forest replacement (Resource Watch Agenda, 2010). In view of the continuous global call to conserve the environment against the overdependence on tree biodiversity for energy with its ascending environmental threats, research of this sort is very crucial in achieving results that would inform the on-going discourse. The current efforts in combating global climate change are traceable to environmental imbalances. The study could contribute to the identification and formulation of global strategies, plans and programs of action for the conservation and sustainable utilization of biological diversity.

However, tackling deforestation and forest degradation requires a good understanding of the players in the extraction of forest resources, what drives them and the roles they play. In the process, other possibilities including alternative pathways, lived-in landscapes, or respond adaptively to less equilibrium people–forest relations, are adopted. (Leach and Scoones 2013). Hence, this study will assess charcoal production

and the role of gender in the degradation of tree biodiversity in Nasarawa State and explore ways of maintaining a balance between its sustainability and the charcoal industry. A comprehension of the dynamism of gender involvement in charcoal production and tree biodiversity relationship will inform the way forward toward flora and fauna sustainability, livelihood improvement and provision.

To achieve the desired result in this research, various literatures, concept and theories were reviewed and consulted in the course of this study but just in specifics the concept of driving force – Pressure – State – Impact – Response (DPSIR) and theory of social cost was adopted. The concept of the Driving force – Pressure – State – Impact – Response (DPSIR) is an appropriate basis for analytical framework used in environmental problems by identifying the cause-effect relationships between the environment and various anthropogenic activities in a wider socio-economic context (Goll II et al., 2014; Song & Frostell, 2012). In the framework, socio-economic and cultural forces drive (D) (livelihood and energy needs) certain human activities (i.e. commercial charcoal production) that exert pressures (P) (excessive tree harvesting) on the environment. The pressures change the state (S) (reduction in the intensity and specie of tree) of the environment, which results in some impacts (I) (land use conflicts, woodland and environmental degradation, climate change) on the environment and subsequently on human well-being and development. The resulting state of the environment requires societal responses (R) (alternative rural livelihood, empowerment, subsidy, alternative energy, regulations, reforms, re-afforestation) to the corresponding drivers, pressures, state of the environment or impacts to minimize the effects on human well-being and the environment itself.

LITERATURE

Given the growing significance of charcoal in rural and urban livelihoods, particularly in Nasarawa state, the attention of several authors has been recently drawn to the environmental consequences of its production.

Omoakin et al 2015, who studied Charcoal Production in Oriire Local Government Area, Oyo State, Nigeria: examined the processes involved in charcoal production and evaluated its environmental and socio-economic correlates in Oriire Local government area of Oyo state, Nigeria. Also, Ajadi et al 2012 looked at Subsistence Living and Global Climate Change: Implications of Bio Charcoal Production for Farmers in Rural Areas of Nigeria. They used a 25-item questionnaire to examine socio-econo7mic implications of charcoal production for farmers of rural communities in Nigeria. Tunde et al 2013 studied the Impact of Charcoal Production on the Sustainable Development of Asa Local Government Area, Kwara State, Nigeria. In their study, they conducted a survey on the inhabitants and producers to explore their views on method of production and the effects on their health and environment

respectively and Jamala et al 2013 looked at Socio-Economic Implications of Charcoal Production and Marketing in Nigeria.

It is unfortunate that there is still limited quantitative information about some of the key elements of commercial charcoal production and its effect on forests and woodland. Hence, most of the studies on the subject were characterized with absence of maps to show the locations and they were also salient on some of the major drivers of the activities. This study seeks to close this gap by applying geospatial techniques which will enable the production of such maps and also expose the roles of major drivers in Nasarawa State.

Women and charcoal production

This is an aspect of charcoal production that is usually ignored and misrepresented women are unfortunately the major drivers of charcoal production worldwide. Recent findings from the centre for international forestry research (2018) deduced that women involvement in a traditionally male dominated industry has increased across the developing worlds. They play roles as traders and retailers, In Zimbabwe, Lusaka to be precise there is obvious involvement of women in charcoal production, attributed to the rising economic insecurities. Ivy setordjie (2017) examined women empowerment in hohoe and found out that women claim to enhance their economic status through the utilization of bamboo for commercial charcoal production in mocuba Mozambique, charcoal production is a major source of income for rural dwellers which is done by women and concludes high rate of deforestation. Tom (2008) noted that women have managed the charcoal industry in San-Pedro for decades, earning a fair deal of economic upliftment for their community; unfortunately, their contributions cannot be equated to the effects it poses on the future of their environment. Brielle (2017) in a World Bank supported study in Senegal on environmental sustainability noticed that one of the prominent environmental degradation is the involvement of women in forest reserve exploitation; therefore, to curb such a menace is to involve the women in policies made and for sustainability. This study was done in Nasarawa State. However, three Local Government Areas (Akwanga, Doma and Karu) which are home to extensive woodlands were selected for the study based on the three senatorial zones of the State. From each of the local government areas, two communities known for commercial charcoal production were then selected from each of the three LGAs. Aricha and Gudi were selected from Akwanga LGA, Idadu and Agwashi from Doma and Saningye-Panda and Songo-Gitata from Karu LGA.

STUDY AREA

Nasarawa State is located in the basement complex of North-Central geo-political zone of Nigeria, between longitude 6º.45'03'' and 9º 45' 03'' of the Greenwich meridian and latitude 7o 45' 00'' and 9o 35' 00'' of the equator. The State is predominantly agrarian with land area of 27,116.8 square kilometres and population of 2523400 (NPC 2016 population projection). It shares geographical boundaries with Kaduna State in

the north, Abuja Federal Capital Territory (FCT) in the west, Kogi and Benue States in the south, Taraba and Plateau States in the east respectively. The state is characterised by a tropical sub-humid climate with two distinct seasons and experience average rainfall range from 1100-2000mm from April through November, while the mean temperature ranges from 20°C to 34°C. The vegetation of the state is Guinea savannah and the floristic composition is heterogeneous with a variety of species made up of small trees (scattered), interspersed with shrubs, grasses and arable crops. *Parkiabiglobosa* is the dominant and major economic tree species found in the area.

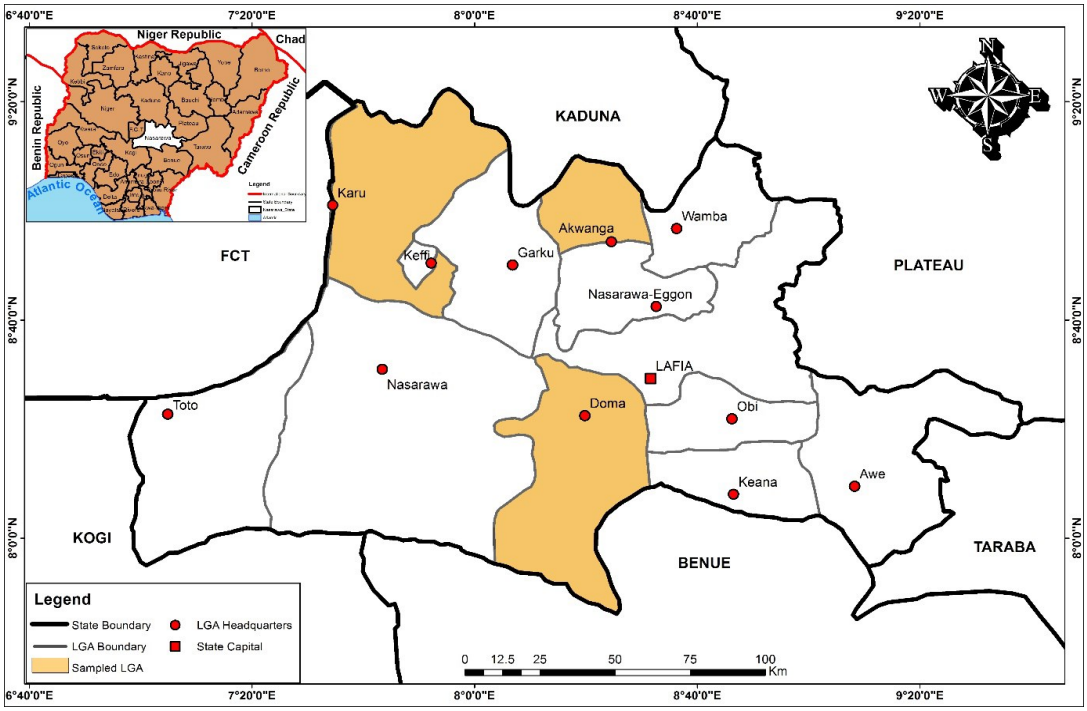

Figure 1: Nasarawa State Showing Study Area

METHODOLOGY

This study adopted a descriptive-survey research design. Both primary and secondary sources of data were employed. An open-ended questionnaire was used to source data from in commercial charcoal producers in Akwanga, Doma and Karu LGAs of Nasarawa state. These local government areas were purposively selected based on the observed on-going intensity of savannah woodland utilization for commercial charcoal production. Thereafter, two communities constituting major commercial charcoal production sites were selected from each of the local government areas. Physical aspects relevant to the study were observed, measured and recorded using GPS, measurement tools and Digital camera to get information on charcoal production activities, physical features of degraded woodland areas, stages of charcoal production activity as well as the gender roles and technique techniques adopted for charcoal.

Questionnaire was administered and focus group interview was conducted to enquire from the sampled population on the various roles in commercial charcoal processes and their specific roles. Using the Krejcie and Morgan's sample size determination table (Krejcie and Morgan 1970) 450 persons were derived from the sample population of producers.

Table 1: Sample Size Determination

LGA	Community	Population	Sample Size
Akwanga	Aricha	85	70
	Gudi	85	70
Doma	Agwashi	55	48
	Idadu	90	73
Karu	Songo-Gitata	120	92
	Saningye-Panda	130	97
Total			**450**

Source: Authors Field Work 2018

Quantitative data acquired was analysed using descriptive (Charts and Tables), inferential (Cross Tabulations) and geospatial techniques (Image overlay). Qualitative data was analysed using the Milles and Huberman (1994) method of data reduction, data display, and conclusion drawing and all analysed data was presented in tables and charts.

RESULTS AND DISCUSSIONS

Charcoal production is an essential part of the informal economy of several developing countries. Its producers usually involve small farmers and rural poor people. Charcoal production is commonly one of the most lucrative activities among forest related activities and also creating a major source of income and employment among rural settlers. In the study, two distinct groups of charcoal producers were identified. The first group comprised of farmers who engage in charcoal production as a secondary activity whereas the second were charcoal making specialists whom charcoal production forms their main economic activity.

Locations of Commercial Charcoal Production Activity in the Study Area

Kiln locations and density are good indicators of tree cover loss, hence this study explored the locations and the density of the kilns identified in the production areas of Akwanga LGA (Akwanga and Gudi), Doma LGA (Idadu and Agwashi) and Karu LGA (Mararaba-Pand and Gitata).

Kiln Locations and Density

Figure 1 show the spatial locations of the kilns while figure 2a– 2b presents the density of the kilns in each location. Fifure3 shows that the production area of Akwanga LGA where a total of 61 kilns were identified, had a kiln density range of 1 to 4 kilns per 100m by 100m grid cells (10,000m2 or 1 hectare) and an approximated average density of 2 kilns. Furthermore, figure 3b revealed that the kiln density in Doma production area with a total of 31 kilns, ranged between 1 and 3 kilns per hectare while the average density stood at 2 kilns per hectare. Higher number of kilns (95), kiln density range (1 – 5) as well as higher average kiln density (3 kilns per hectare) was observed in Karu production area. The spatial distribution of kilns shows the existence and intensity of commercial charcoal production.

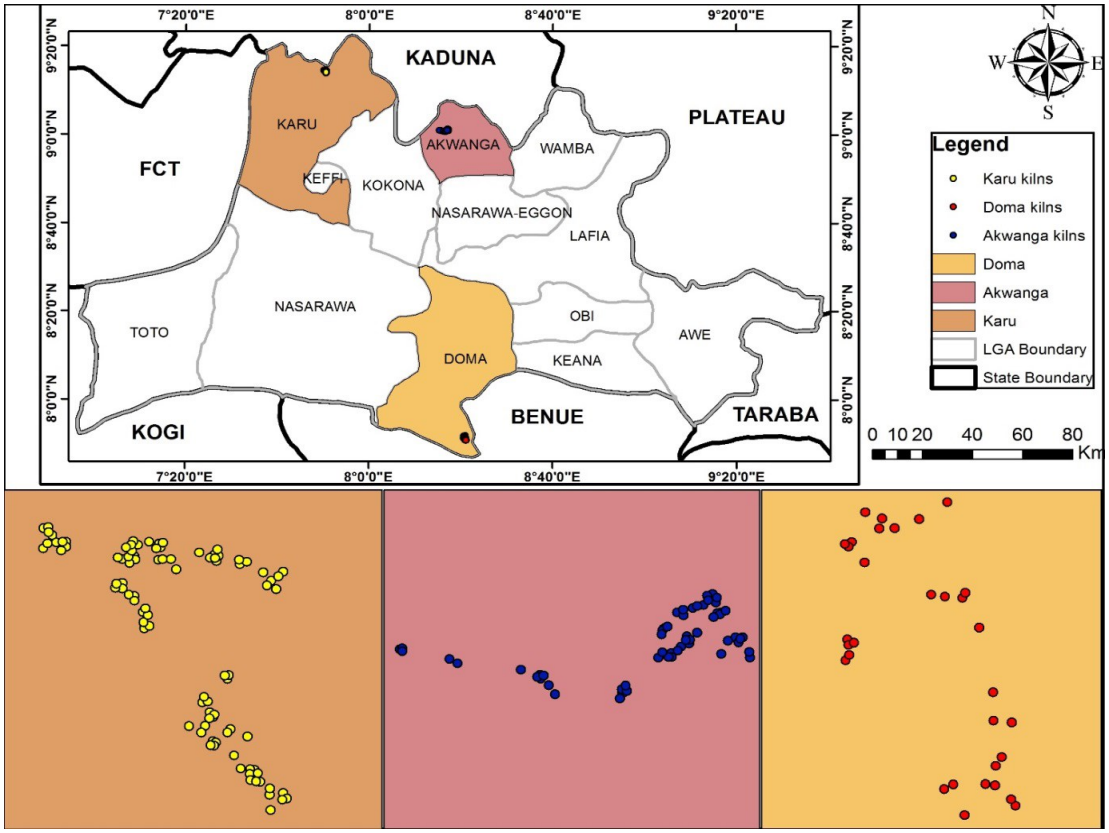

Figure 2: Spatial Distribution of Kilns in the Sampled Production Areas

Socioeconomic Status of Respondents

The socioeconomic status of the respondents in terms of their age, gender, education, and household size of the 150 sampled respondents.

Age Distribution of Respondents

The age distribution of the respondents is shown in figure 6 Majority (78.2%) of the respondents were between the ages of 21 and 50 years. Those between 31 and 40 years

constituted 30.9% of the respondents, followed by those in the age bracket of 41 – 50 years (24.2%) and those between the ages of 21 and 30 years (23.1%). Those who were 20 years and below accounted for 14.9% while the rest 6.9% constituted those whose ages were above 50. It is not a surprise that majority of the charcoal producers in the study area were between the ages of 21 and 50 since the age category depicts the active periods of human life, given especially that the activity of charcoal production is an energy demanding venture. The implication is that more trees are likely to be cut for the purpose of commercial charcoal production since most producers are energetic to embark on consistent production which guarantees their economic wellbeing. This finding is corroborated by those of Adeniji et al., (2015) and Beatrice et al., (2014) who also in their study discovered dominance of the active age categories in charcoal production.

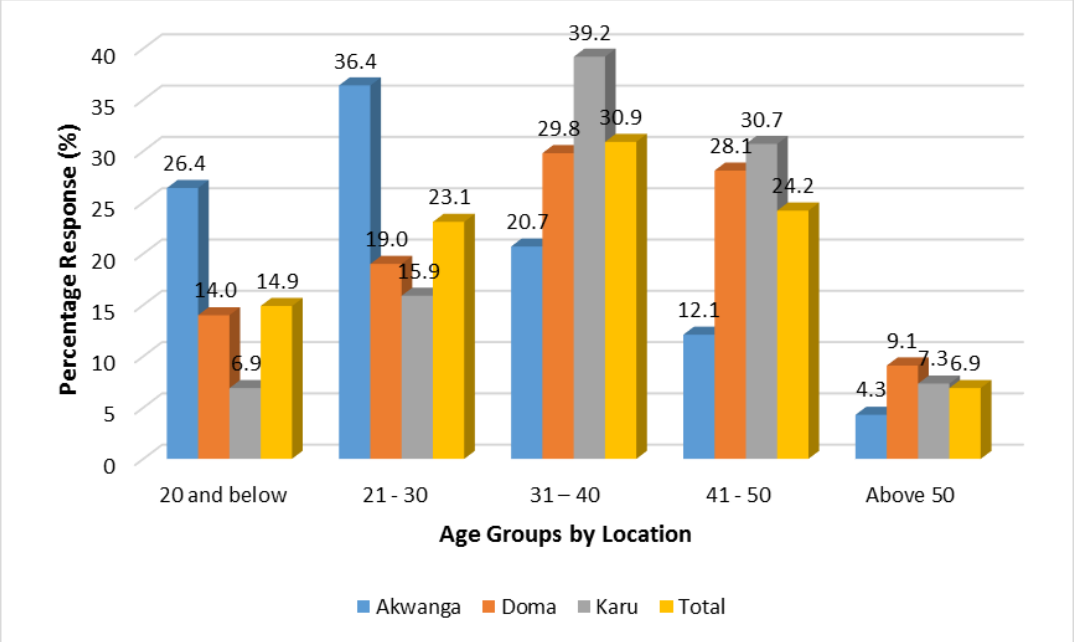

Figure 3: Age Distribution of Respondents

Furthermore, age distribution of the respondents based on Local Government Areas revealed that in Akwanga, majority (36.4%) of the charcoal producers were within the 21 – 30 years age bracket. Those who were 20 years or below accounted for 26.4%, followed by 20.7% who were between 31 and 40 years of age. Those between ages of 41 and 50 and those who were above 50 years accounted for 12.1% and 4.3% of the sampled charcoal producers in Akwanga respectively. There was evidence of child labour among charcoal producer in Akwanga and this could be attributed to high participation of women in the activity within the area as most women tend to use their children to augment their energy and ensure effective production.

Fig 4: Charcoal Production site

Gender Distribution of the Respondents

It was revealed that out of the 150 charcoal producers sampled for the study, 90 representing 52.4% were female while the male counterpart accounted for 47.6%. The dominance of female in the charcoal production business was mostly noticed in Akwanga Local Government Area where out of 70 sampled respondents, 64.3% were female and 35.7% male. This highlights the important role of women in the charcoal production venture and could be attributed to the culture and religious believe in the area which permits women to engage in such venture as well as lack of alternative economic ventures that best suits their gender. This high presence of women in commercial charcoal production within the study area indicates increasing involvement of people of diverse gender in the business due to the quick financial reward as found in this study. This in turn poses adverse effect on the surrounding woodlands as their operations were found to be solely based on traditional method which requires more trees to be cut to ensure lucrative production. Plate 1 shows the presence of women in commercial charcoal production in Akwanga production area. This finding disagrees with that of Beatrice et al., (2014) who found that more male are involved in charcoal production than there are women and also that of Herd (2007) who reported that charcoal production in the ChicaleRegulado, Mozambique is dominated by males (77%) and that high number of women in the population was not expected due to the physical nature of the activity. This could be due to differences in culture, religious believe and economic opportunities between the study locations.

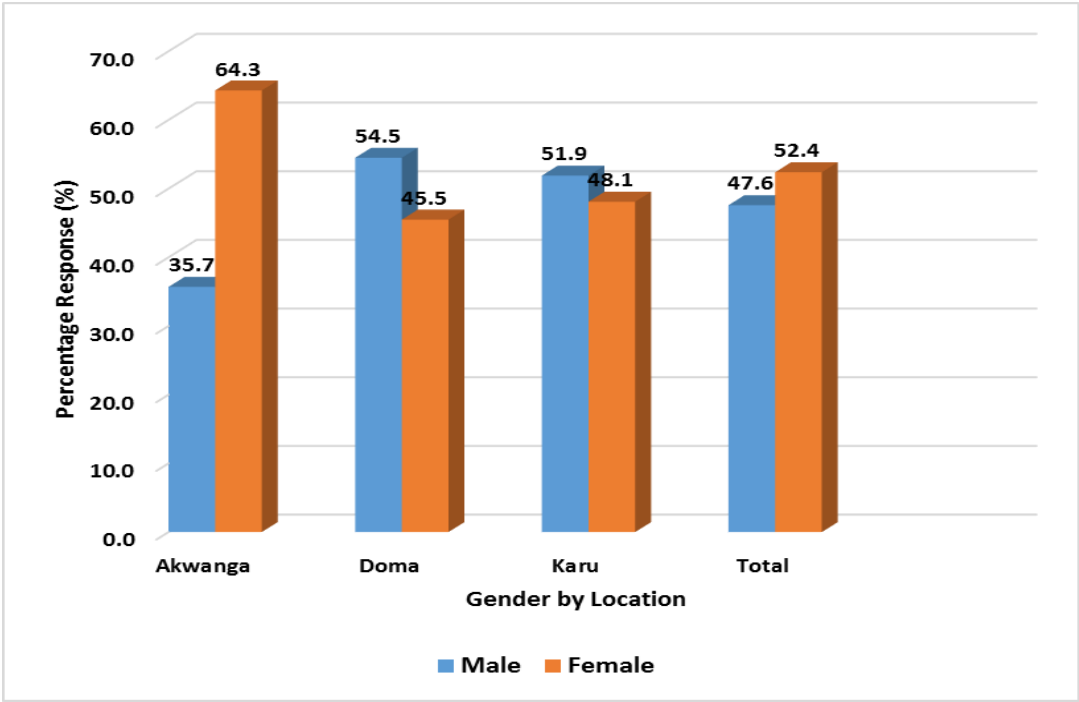

Figure 5: Gender of Sampled Charcoal Producers

Conversely, more male producers than female were observed in Doma and Karu Local Government Areas (LGA). Out of the 121 sampled respondents in Doma LGA, 54.5% were male and 45.5% female whereas in Karu LGA, out of 80 respondents, males accounted for 52% and female 48%. The dominance of male in these two locations could be attributed to the tedious nature of commercial charcoal production which requires a lot of energy as well as gender roles and responsibility based on the local

culture. Alaannah (2012) found that cultural factors pertaining to religion, human strength and land dictated gender roles

Educational Attainment of the Respondents

Table 2: Educational Status of Charcoal Producers

Level	Akwanga		Doma		Karu		Total	
	Freq	%	Freq	%	Freq	%	Freq	%
Tertiary	10	10.0	3	4.1	2	7.4	33	7.3
Secondary	35	39.3	7	25.6	24	39.1	160	35.6
Primary	22	45.7	16	46.3	12	41.3	198	44.0
No Formal Education	3	5.0	9	24.0	7	12.2	59	13.1
Total	**70**	**100**	**35**	**100**	**45**	**100**	**150**	**100**

Freq. = Frequency, % = Percentage

Source: Field Data Analysis, 2018

The educational attainment of commercial charcoal producers in the study area indicates that they may not be well informed about the consequences of their actions and inactions as it concerns vegetation cover. This implies increasing trend of forest degradation as most of the producers approaches the use of forest resources (trees) for their business with the common-goods attitude. The general pattern of educational attainment was also mirrored in the three LGAs except for Akwanga where those who had attained tertiary education (10%) were found to be more than those who had no formal education (5.0%). This could be due to the presence of colleges of education in the area which most of the respondents hinted to have attended. Those who had attained primary and secondary levels of education in the LGA accounted for 45.7% and 39.3% respectively. In Doma, majority (46.3%) of the respondents had primary education, followed by 25.6% with secondary education, 24% with no formal education and 4.1% who had attained tertiary educational level. Similarly in Karu, 41.3% had primary education, 39.1% secondary, 12.2% had no formal education and those with tertiary education accounted for 7.4percent .The findings on educational attainment concur with Shively et al. (2010) who argued that charcoal producers in Uganda have the lowest level of education. It also affirms the theory of social cost which explains that the actions of charcoal producers are driven by an undesirable effect – poverty.

Distribution of Respondents by Household Size

Table 3: Household Size of the Respondents

Number of Persons	Akwanga LGA		Doma		Karu		Total	
	Freq	%	Freq	%	Freq	%	Freq	%
1 – 3	26	18.6	10	8.3	31	16.4	67	14.9
4 – 6	81	57.9	40	33.1	96	50.8	217	48.2
7 – 9	27	19.3	32	26.4	35	18.5	94	20.9

10 – 12	4	2.9	31	25.6	16	8.5	51	11.3
Above 12	2	1.4	8	6.6	11	5.8	21	4.7
Total	**50**	**100**	**30**	**100**	**70**	**100**	**150**	**100**

Source: Field Data Analysis 2018

It was observed that the inhabitant of the study area believed strongly in extended family system, hence their household size was determined by the husband, wife(s), children and relatives.Shows that almost half of the respondents (70) representing 48.2% had family sizes of 4 - 6 persons, followed by 20.9% who had family sizes of 7 – 9 persons. Those who had family sizes of 1-3 persons accounted for 14.9%, those from family sizes of 10-12 persons represented 11.3% while the rest 4.7% were those whose family sizes were above 12 persons. Findings from the study indicate that large family sizes serve as major sources of labour for commercial charcoal production. The implication is increased pressure on the forest resources existing in an already fragile ecosystem of the study area evident by the deforested environment.

Rating of the Drivers of Commercial Production

Table 4: Relative Importance Index of the Drivers of Commercial Charcoal Production

AKWANGA	
Drivers	**Relative Importance Index**
Source of income	0.955
Family business	0.509
Lack of alternative employment	0.784
Medicinal purpose	0.495
Seasons	0.664
Crisis	0.445
No skill required	0.641
Availability of usable trees	0.711
Natural disasters' effect on farms	0.361
DOMA	
Source of income	0.950
Family business	0.645
Lack of alternative employment	0.808
Medicinal purpose	0.698
Seasons	0.705
Crisis	0.934
No skill required	0.640
Availability of usable trees	0.597
Natural disasters' effect on farms	0.678
KARU	

Source of income	0.940
Family business	0.413
Lack of alternative employment	0.786
Medicinal purpose	0.567
Seasons	0.562
Crisis	0.698
No skill required	0.646
Availability of usable trees	0.728
Natural disasters' effect on farms	0.602
TOTAL	
Source of income	0.948
Family business	0.508
Lack of alternative employment	0.791
Medicinal purpose	0.580
Seasons	0.632
Crisis	0.683
No skill required	0.643
Availability of usable trees	0.687
Natural disasters' effect on farms	0.547

The respondents were asked to rate the identified drivers of commercial charcoal production based on their relative importance. The results of the analysis of their ratings are presented in table. It was found that income generation with a Relative Importance Index (RII) of 0.948 had the most influence on peoples' involvement in commercial charcoal production in the study area. Lack of alternative employment ranked as the second most important driver of commercial charcoal production involvement in the study area with a RII of 0.791, followed by availability of usable tree species 0.687, crisis (0.683) and requirement of no skills (0.643). Seasonal changes (climate and festivities) ranked as the fifth (6th) most important reason why people go into commercial charcoal production in the area with an index of 0.632 while medicinal purpose (0.580), natural disasters effect on farms (0.547) and family business (0.508) ranked as the seventh, eighth and ninth in the order of importance. It is not surprising that income generation ranked as the top most important reason for involvement in commercial charcoal production among producers since every commercial undertaking is rooted in money making. The finding is in support of Agyeman et al., (2012) that charcoal industry play significant role in economic development of some communities in the Upper West Region of Ghana. This could be due to the role of charcoal as a consistent energy source for the activities of such industries as metal smelting, chemical processing and other local craft industries in the

developing countries besides being a major source of energy for domestic heating and cooking. Boutette and Karch, (1984), as cited by Hibajene and Kalumiana, (2003) also noted that charcoal burning benefits immensely from access to the needed raw material.

There were some variations in the relative importance of the drivers of commercial charcoal production across the three sampled LGAs. Income generation maintained its rank as the most important driver of commercial charcoal with RII of 0.955 in Akwanga, followed by lack of alternative employment with 0.784, availability of usable trees with 0.711 and seasonal changes with 0.664. None skill requirement, family business, medicinal purpose, crisis and natural disaster's effect on farms ranked fifth, sixth, seventh, eighth and ninth with RII of 0.641, 0.509, 0.495, 0.495 and 0.361 respectively. Although income generation (0.950) was also ranked as the most important determinant of involvement in commercial charcoal production in Doma LGA, crisis was ranked as the second most important with RII of 0.934 contrary to what was obtainable in Akwanga. Lack of alternative employment opportunities ranked third with RII 0.808, followed by seasonal changes (0.705), medicinal purpose (0.698) and natural disaster's effect on farms (0.678). Family business, none requirement of skills and availability of usable tree species with RII of 0.645, 0.640 and 0.598 ranked seventh, eighth and ninth respectively. The ranking of crisis as the second most important driver of commercial charcoal production in Doma LGA was further highlighted by several discussants during FGD. One of the discussants from Idadu community stated that:

"Due to the ongoing farmers-herdsmen crisis in the study area, particularly the Tiv communities of Idadu and Agwashi, many farmers have been forced to venture into other economic activities as a result of the fear of being killed in the farms and commercial charcoal production is one of such activities".

Also in Karu LGA, venturing into commercial charcoal production as a source of income ranked as the most important driver with RII of 0.940, lack of alternative employment with 0.786 ranked second, followed by availability of usable tree species (0.728), crisis (0.698), none skill requirement (0.646) natural disaster's effect on farms (0.602), medicinal purpose (0.567) and seasonal changes (0.562) while going into the business through inheritance from parents or close relatives ranked as the least important driver with RII of 0.413. The disparities in the ranking of commercial charcoal production across the three study locations could be attributed to the differences in social and natural processes of the locations.

Distribution of Roles in Commercial Charcoal Production by Gender and Age Group

The chi-square and cross-tabulation result of the test of association between the roles commonly performed by commercial charcoal production and their gender and ages are presented in tables 9 to 14

Table 5: Chi-Square Result of Commercial Charcoal Production Roles by Gender

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	162.379[a]	5	.000
Likelihood Ratio	199.728	5	.000
Linear-by-Linear Association	94.163	1	.000
N of Valid Cases	150		

Table 6: Roles and Gender Cross-tabulation

		Gender				
LGA	**Role**	**Male**	**%**	**Female**	**%**	**Total**
Akwanga	cutting of tree	23	100	0	0	23
	Stacking of logs	34	81	8	19	42
	Covering of stacked logs with sand/grasses	43	35.2	79	64.8	122
	Burning and monitoring of charcoal	40	31.3	88	68.8	128
	Raking and separation of dirt/debris from newly formed charcoal	24	27.6	63	72.4	87
	Packing/bagging of charcoal	42	33.1	85	66.9	127
Doma	cutting of tree	37	100	0	0	37
	Stacking of logs	43	100	0	0	43
	Covering of stacked logs with sand/grasses	49	51	47	49	96
	Burning and monitoring of charcoal	60	52.2	55	47.8	115
	Raking and separation of dirt/debris from newly formed charcoal	24	33.3	48	66.7	72
	Packing/bagging of charcoal	44	48.4	47	51.6	91
Karu	cutting of tree	44	100	0	0	44
	Stacking of logs	70	97.2	2	2.8	72
	Covering of stacked logs with sand/grasses	82	51.3	78	48.8	160
	Burning and monitoring of charcoal	97	52.7	87	47.3	184
	Raking and separation of dirt/debris from newly formed charcoal	44	55	36	45	80

	Packing/bagging of charcoal	73	45.6	87	54.5	160
Total	cutting of tree	104	100	0	0.0	104
	Stacking of logs	147	93.6	10	6.4	157
	Covering of stacked logs with sand/grasses	174	46.0	204	54.0	378
	Burning and monitoring of charcoal	197	46.1	230	53.9	427
	Raking and separation of dirt/debris from newly formed charcoal	92	38.5	147	61.5	239
	Packing/bagging of charcoal	159	42.1	219	57.9	378

Source: Data Analysis 2018

Table above show the relationship between gender and the various roles performed by performed in the process of commercial charcoal production within the study area. Table presents the Pearson Chi-Square result of the association between gender and roles and it shows that there was a statistically significant (p-value < 0.01) association between gender and the roles performed by commercial charcoal producers. Furthermore, a cross-tabulation of gender and roles in commercial charcoal production as presented in table shows that cutting of tress for charcoal production and stacking of woods at the kiln location were mainly the role of men. Out of the 104 respondents who engaged in tree cutting and wood stacking, 100% and 93.6% were male respectively. Although covering of the stacked wood with grasses and/or sand proved to also be a female dominated role in the State, the situation was quite different in Karu LGA. Overall, out of 378 respondents who engaged in the role, 54% were female while the male counterpart accounted for 46%. In Karu LGA, out 160 participants in the role, 51.3% were male while 48.8 were female.

This situation confirmed the statement by a discussant from Songo-Gitata community that: "Women here mostly engage in less energy demanding roles of charcoal production process in order to meet their small-small needs such as buying of their toiletries, hence they only sell their labour to main producers whenever such needs arises. Also, those who engages in the production proper often contract out the energy sapping aspects of the production males".

Furthermore, burning and monitoring of charcoal burning aspect of the production process shows that both gender were very well represented with slightly male dominance. Out of 127 participants, 53.9% were male while the rest 41.6% were female. This slight male dominance of male in this role was also reflected in Doma and Akwanga production areas. However, in Akwanga, more women were found to be engaging in the role where out of 128 participants, 68.8% were female and 31.2% were male. This could be attributed to the high involvement of women in the business

as observed in the LGA coupled with more socio-cultural freedom that is being enjoyed by women in the area as indicated by a discussant from Gudi community during FGD. Conversely to the case of tree cutting and wood stacking, the raking and separating of dirt from formed charcoal was found to be female dominated role with 61.5% female participant out of 239. Packing/bagging of charcoal was similarly dominated by women in the study area, out of 378 participants, 57.9% were female. This finding implies that although there is a pronounced involvement of women in commercial charcoal production in the study area, they were mostly concerned with less tedious aspects of the production process as male participants assisted them with such roles. This is in corroboration with the findings of Beatrice et al (2017), Eneji et al (2015), Alannah (2012) and Aguilar et al (2011) who found that women in commercial charcoal production often contract the tedious aspects of the production process to payed labour or rely on the services of adult male member of their families.

Table 7: Chi-Square Result of Commercial Charcoal Production Roles by Age

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	173.218[a]	20	.000
Likelihood Ratio	207.345	20	.000
Linear-by-Linear Association	6.071	1	.014
N of Valid Cases	450		

a. 3 cells (10.0%) have expected count less than 5. The minimum expected count is 2.40.

Table 8: Roles and Age group Cross-tabulation

		Age					
LGA	Role	20 and below	21 - 30	31 - 40	41 – 50	Above 50	Total
Akwanga	cutting of tree	15 (65.2)	1 (4.3)	4 (17.4)	3 (13.0)	0 (0.0)	23
	Stacking of logs	19 (45.2%)	7 (16.7)	6 (14.3)	10 (23.8)	0 (0.0)	42
	Covering of stacked logs with sand/grasses	26 (21.3)	38 (31.1)	28 (23.0)	30 (24.6)	0 (0.0)	122
	Burning and monitoring of charcoal	23 (18.0)	38 (29.7)	37 (28.9)	30 (23.4)	0 (0.0)	128
	Raking and separation of dirt/debris from newly formed charcoal	18 (20.7)	33 (37.9)	32 (36.8)	4 (4.6)	0 (0.0)	87
	Packing/bagging of charcoal	20 (15.7)	41 (32.3)	37 (29.1)	29 (22.8)	0 (0.0)	127
Doma	cutting of tree	6 (16.2)	24 (64.9)	5 (13.5)	2 (5.4)	0 (0.0)	37

	Stacking of logs	7 (16.3)	19 (44.2)	13 (30.2)	4 (9.3)	0 (0.0)	43
	Covering of stacked logs with sand/grasses	7 (7.3)	26 (27.1)	54 (56.3)	9 (9.4)	0 (0.0)	96
	Burning and monitoring of charcoal	8 (7.0)	33 (28.7)	65 (56.5)	9 (7.8)	0 (0.0)	115
	Raking and separation of dirt/debris from newly formed charcoal	8 (11.1)	12 (16.7)	52 (72.2)	0 (0.0)	0 (0.0)	72
	Packing/bagging of charcoal	6 (6.6)	23 (25.3)	55 (60.4)	7 (7.7)	0 (0.0)	91
Karu	cutting of tree	11 (25.0)	14 (31.8)	12 (27.3)	7 (15.9)	0 (0.0)	44
	Stacking of logs	13 (18.1)	23 (31.9)	16 (22.2)	9 (12.5)	11 (15.3)	72
	Covering of stacked logs with sand/grasses	26 (16.3)	21 (13.1)	16 (100)	67 (41.9)	30 (18.8)	160
	Burning and monitoring of charcoal	25 (13.6)	28 (15.2)	20 (10.9)	81 (44.0)	30 (16.3)	184
	Raking and separation of dirt/debris from newly formed charcoal	19 (23.8)	12 (15.0)	11 (13.8)	24 (30.0)	14 (17.5)	80
	Packing/bagging of charcoal	23 (14.4)	23 (14.1)	20 (12.5)	68 (42.5)	26 (16.3)	160
Total	cutting of tree	32 (30.8)	39 (37.5)	21 (20.2)	12 (11.5)	0 (0.0)	104
	Stacking of logs	39 (24.8)	49 (31.2)	35 (22.3)	23 (14.6)	11 (7.0)	157
	Covering of stacked logs with sand/grasses	59 (15.6)	85 (22.5)	98 (25.9)	106 (28.0)	30 (7.9)	378
	Burning and monitoring of charcoal	56 (13.1)	99 (23.2)	122 (28.6)	120 (28.1)	30 (7.0)	427
	Raking and separation of dirt/debris from newly formed charcoal	45 (18.8)	57 (23.8)	95 (39.7)	28 (11.7)	14 (5.9)	239
	Packing/bagging of charcoal	49 (13.0)	87 (23.0)	112 (29.6)	104 (27.5)	26 (6.9)	378

Table 7 shows that there is statistically significant association between the ages of commercial charcoal producers and the roles they performed. The Pearson Chi-Square result was significant at p-value < 0.01. Furthermore, Table 8 presents the breakdown of the roles different ages engaged in. Out of the 104 participants of tree cutting those within the ages of 21 and 30 years (37.5%) dominated the role, followed by those

whose ages were 20 and below (30.8%), 31 – 40 years (20.2%) and 41 – 50 (11.5%). In Akwanga LGA, those who participated in tree cutting were mostly (65.2% out 23 participants) 20 years and below, while in Doma and Karu LGAs, it was those between 21 and 30 years of age and they accounted for 64.9% of 37 and 31.8% of 44 participants respectively. Similarly the role of stacking the cut wood for burning was mostly dominated by people of younger ages in the study area. Out of the 157 participants, 31.2 % were those between 21 and 30 years, 24.8% were 20 years and below, 22.3% were 31 – 40 years while the least age group that participated in this role were those between 41 and 50 (14.6%) and above 50 years (7.0%). This is in conformity with the statement by a discussant from Idadu community that:

"Even though people of different ages participate in this work, some aspects of the work can only be accomplished by young people who are energetic and very active. For example, older people cannot go through the rigours of tree cutting/transporting as well as carrying logs around for the purpose of stacking, hence they often rely on the services of younger producers to accomplish such tasks"

Another female discussant from Aricha added: "I cannot carry heavy logs, so I tip my younger male children or neighbours to assist me stack the woods which I usually purchase from operators I cannot also cut the trees by myself"

Although the role of covering stacked logs with sand/grasses was quite spread across the various age groups in the study area, it was observed to be mostly performed by those in the 41 – 50 years age bracket (28%), followed by 31 – 40 years (25.9%) and 21 -30 years (22.5&). Similarly, burning and monitoring of the charcoal burning process was also dominated by same age groups as in covering of stacked logs. Out of 427 participants, 28.6% were between 31 and 40 years, 28.1% were between 41 and 50 years and 23.2% were in the range of 21 – 30 years. In the same vain, out of 239 respondents who participated in raking and separation of dirt/debris from newly formed charcoal, 39.7% were between 31 and 40 years, 23.8% accounted for those in the 21 – 30 years age group and 18.8% 20 years and below. Furthermore, dominance of same age groups was recorded for packing/bagging of charcoal product. Out of 378 participants, those between 31 and 40 years accounted for 29.6%, followed by those between 41 and 50 years (27.5%) and those who were 20 years and below (23.0%). This finding indicates that the more tedious aspects of commercial charcoal production are handled by those within the active age brackets and the participation in different production roles decreases with increase in age. Beatrice et al (2017) noted that due to the tedious nature of commercial charcoal production, its operations are mostly carried out by energetic adults within the productive age bracket. Plate 4.5 and 4.6 shows some of the roles in charcoal production processes and the participating gender and age groups in the study area.

Table 9: RII of Perceived Challenges of Sustainable Commercial Charcoal Production

Challenge	RII
Charcoal is not recognized as key source of energy	0.97
There is no specific institution, a government parastatal that implements wood energy (charcoal) policies	0.80
Producers and traders are not organized into a formal association recognized by government	0.83
There is no clear production/marketing arrangement and rules	0.70
Lack of fiscal incentives that reward sustainably produced charcoal and place additional fines on illegal products	0.60
Lack of support to communities to retain and reinvest charcoal revenues in revenue collection and sustainable forest management	0.90
Charcoal production is largely left to the informal sector	0.90
Lack of fund to implement existing related policies	0.57

Source: Field Data Analysis 2018

CONCLUSION

Based on the findings of the study, it was concluded that commercial charcoal production has over time become an indispensable means of livelihood among rural settlers in Nasarawa State. However, the production process has remained undeveloped with the traditional earth mound kiln being the only charcoal processing technology adopted by the producers. Though cost effective in comparison to other technologies, the traditional earth mound has been proven to be both inefficient and ineffective towards sustainable utilization of savanna woodland resources in the state. Most of the preferred trees species have been depleted to the point that they are no longer commonly found for use among commercial charcoal producers in the state. Materials (basically trees) for charcoal production are now scarce and difficult to come by. The inefficiency of commercial charcoal production technology in the study area has resulted in the depletion of 14.9% of woodland forests and the loss of 28928.88 hectares of tree covers in Nasarawa State between 2001 and 2018.

Although commercial charcoal producers in the state were aware of the environmental consequences of their activities, they are motivated by the associated financial benefits to carry on with the destruction of natural environment. Continued uncontrolled wood species extraction for commercial charcoal production to meet market demand without corresponding measures towards restoration or conservation, will reduce the capacity of trees cover to provide pasture, control soil erosion, medicine and energy requirement for society and livestock in study area.

There are no species policies targeted specifically at ensuring the sustainability of commercial charcoal production in the study area. Some related policies under the National Forest Policy (2006) of the Federal Ministry of Environment were mostly end-user based which only intends to reduce charcoal consumption/demand and were barely implemented. Even small reductions in charcoal use can be significant with regards to deforestation and land degradation impacts. However, the decreased consumption, and therefore decreased demand, will further exacerbate the standard of living for the numerous rural charcoal producers. Non-recognition of charcoal as key source of energy; the informal state of the charcoal sector; Lack of support to communities to retain and reinvest charcoal revenues in revenue collection and sustainable forest management as well as absence of formal charcoal producers' association recognized by government, were among the major causes of unsustainable woodland resource utilization for commercial charcoal production in the study area. There is equally the need to provide affordable and accessible sources of energy like biomass briquette.

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