



Effect of Charcoal Production on the Environment: Evidence from Bosso Local Government Area of Niger State

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Abstract

This study examines the impact of charcoal production on deforestation in Bosso Local Government Area of Niger State. The study employed both primary and secondary data sources. The primary data collected via questionnaire was analyzed by the use of statistical package for social sciences (SPSS) and descriptive statistics presented in frequency tables, charts, graphs and percentages. Chi-square statistical tool was used to test the hypotheses. The study yielded a number of findings. First, the study revealed a significant correlation between charcoal production and deforestation. Second, there is a strong positive relationship between charcoal production and household level of income. Third, there is a lack of awareness of the environmental impacts of charcoal among the producers. Fourth, the current regulatory rules for charcoal production was found to be grossly inadequate to protect the environment. Consequently, the study recommends as follows the improvement and the enforcement of the regulatory laws, increase public awareness and encourage the use of alternative energy sources.

Keywords: Charcoal Production, Charcoal Marketing, Deforestation, Environmental Degradation.

1. Introduction

The environment can be broadly categorized into physical environment: land, air and water and the non-physical environment: cultural and socio-economic environment (Smart, 2020). All these culminate to form the sum total of all conditions that surround man at any point in time on the earth surface. When one component is impacted upon, all or, at least one other component feels the impulse. Man being a rational animal is endowed with knowledge, wisdom and skills to modify the natural environment to suit his needs at any point in time. Of paramount importance to man is the need for energy from different sources like the sun (solar), water (hydro-electric), fossil fuels (oil, gas and wood) for survival and sustenance. The extent to which these energy sources are exploited depends on the available technology, financial resources and the level of demand for energy. These energy sources generate power that is applied for both domestic and industrial purposes. Demand for electricity, which appears to be one of the major energy sources, has been on the increase in Nigeria for long. However, this energy source is considered to be grossly inadequate for the teeming population of the country. This rapid population growth, coupled with uncontrolled urbanization, overused infrastructures and the resultant increased poverty level makes people and firms to fall back on natural



sources of energy such as firewood otherwise referred to as fuel wood and charcoal (Ogwumike & Ozughalu, 2021). The social conditions in Nigeria in general present a perplexing paradox. In spite of a robust endowment in natural and human resources, the level of poverty of her people stands in contrast to the country's enormous wealth (Babatunde, Olorunsanya & Adejola, 2008). The problem has been a serious issue since the 1980s when international oil price crashed, and compounded by the mal-administration of the successive military regimes of the 1980s and 1990s. For example, available statistics from the National Bureau of Statistics (2012), cited in Oseni et al (2012) has it that the incidence of poverty in the country rose from 28.1 percent in 1980 to 42.7 and 65.6 in 1992 and 1996 respectively. Though, declined to 54.4 percent in 2004 as a result of gains of democratic rule of the early 2000s, it also gathered momentum and increased to about 69 percent in 2010, and perhaps higher today due to the low capability of the present administration to tackle the problems of civil unrests, insurgencies, political and ethno-religious crises, which have bedeviled the country since 2009 and 2010, and more recently the decline in crude oil price in the world market. All this confirms the fact that there is poverty in the land. What is the nexus between this poverty phenomenon and the environment or environmental sustainability, particularly in Nigerian context?

It is also observed that the increased use of firewood and charcoal is an indication that the general welfare of the people is yet to improve substantially. However, the use of firewood and charcoal as explained by Ogwumike and Ozughalu (2001) have adverse effects on the environment, as most of the activities associated with charcoal production are carried out without the knowledge of its consequences, which may include its environmental cost, health implications, environmental degradation, decline in environmental productivity, loss of biodiversity, increase in evaporation and transpiration, disruption of hydrological cycle, accumulation of greenhouse gases which heighten unsustainable environment. In most developing countries including Nigeria, the problem of poverty and increased demand for fuel has made the use of charcoal a popular phenomenon. The demand for this has been on the increase because most people cannot afford petroleum products such as kerosene and gas for cooking due to its incessant price increase and artificial scarcity. Charcoal and firewood are therefore seen as the available alternatives, but the use of charcoal is preferred in the sense that it produces little or no flame; it is portable and has a better energy efficiency (Eweoya, 2006). The study examines the effect of charcoal production on the environment of Bosso Local Government Area of Niger State. It also investigates the socio-economic impact of charcoal production in Bosso Local Government Area. More specifically, to examine the level of poverty of the residents, to evaluate the perceived environmental impacts of charcoal production in the affected villages, and to assess the level of residents awareness of the implications of charcoal production on the environment in Bosso Local Government Area of Niger State.



2. Literature Review

Theoretical Framework

The tragedy of the commons theory was propounded by Garret Hardin in 1986 and was later modified and explained by Prof. Elinor Ostrom, A professor of political science from Indiana State University in the United States of America. The theory employed to explore and analyze this work is the Tragedy of the Commons theory. The tragedy of the commons concept is important in understanding of environmental degradation of our society. It is a dilemma in itself rooted to the situation in which multiple individuals, acting independently, rationally consulting their own self-interest, will ultimately deplete a shared scarce resource, even when it is clear that it is not in anyone's long term interest for this to happen (Hardin, 1986).

The basic idea espoused by the tragedy of the commons concept is that if a resource held in common for use by all, then ultimately, that resources will be destroyed (Hardin, 1986). The resource shared in common in this case is the trees that are cut down for charcoal production, to avoid the ultimate destruction, the human values and ideas of morality must be changed (Foddy *et al.*, 1999). This theory assumes that every human exploiter of the shared common resources is driven by self- interest (Ostrom, 2002). When the carrying capacity of the commons is fully reached, the exploiters might find themselves in a dilemma of whether to continue with their actions or not. The gain of doing so would go solely to them, but the loss from their action would be communized. Therefore, they will not give up their action (Hardin, 1986). Because the privatized gain would exceed his share of the communized loss, a self-seeking exploiter would not change his behavior (Hardin, 1986). Other reasoning in the same way, would follow suit and ultimately, the common property would be ruined (Ostrom *et al.*, 2002).

Empirical Review

Kokou, Nuto and Atsri (2011) assessed the impact of charcoal production on the vegetation in Togo. The survey research design was employed, and data of the study were obtained through semi-structured questionnaires, oral interviews and group discussions (focus groups) which were analyzed using the descriptive statistics of frequency count, and simple percentage. It was discovered that charcoal production has negative effect on the natural ecosystems as a result of depletion of the biodiversity, density, height, diameter of the stands and basal area of the woody species. Also, using the survey design, Anang, Akuriba and Alerigesane (2012) investigated the effect of charcoal production in Gushegu District of the Northern Region of Ghana. Data of the study were gathered through semi structured questionnaires and focus group discussions. The data were analyzed using the descriptive statistics. It was discovered that charcoal production is an important economic activity in the study area involving mostly women as a means of livelihood. It also revealed deforestation, diminishing wildlife population, bush fires and soil nutrient depletion as the most critical environmental effects of charcoal production in the study area. Lurimuah (2013) examined the economic and environmental effects of commercial charcoal production in the Upper West Region of Ghana. The survey design was adopted for the



study. Both structured and unstructured questionnaires were used for data collection. The data were analysed using descriptive statistics. The study revealed that charcoal production is an income generating activity, although it presents severe environmental consequences to forest resources.

Absolom (2014) assessed the socio-economic impacts of charcoal enterprise in Narok-South Sub-County, Narok County, Kenya. The study employed the descriptive survey design. Data of the study were collected through observation, photography, interview and questionnaires. Data analysis was done using statistical package for social sciences software (SPSS) Version 20. The study found out that the charcoal enterprise activities as practiced in Narok south sub county is unsustainable, and detrimental to environmental sustainability. This led to forest cover reduction and environmental degradation and is a threat to biological diversity in the area which attracts tourists. Onekon and Kipchirchir (2016) assessed the effect of charcoal production and use on the transition to a green economy in Kenya. The study adopted a research survey design involving the use of semi-structured questionnaire. Descriptive statistical data techniques were used to analyze the field data. The findings revealed that about 1264 hectares and 15174 hectares of forest cover are depleted on monthly and yearly basis respectively. Forest cover depletion is predicted by charcoal consumption. The study also revealed that Kenya would lose about 65.6% of its forest cover to charcoal production and use by 2030. Aboh and Zhangqi (2016) examined environmental impacts of charcoal and fuelwood consumption in Cote d'Ivoire. The survey research design was employed for the study. Data were obtained via interviews, questionnaires and observations. Data were qualitatively and quantitatively analyzed. A qualitative analysis through the households has showed that charcoal was the fuel mostly used in households and even the choice of its poor energies mainly socio economic. Moreover, the production and consumption have a negative impact on the health of producers and consumers. Kadafa, Medugu, Dennis and Medan (2017) investigated the health impact of fuel wood utilization on users, and the possible means of controlling the identified impact on households in Yelwa village, Toto LGA, Nasarawa State, Nigeria. The study adopted survey research design. Data of the study were collected through questionnaire. Obtained data were analysed with descriptive statistics. The study found that fuelwood utilization in the study area is increasing on daily basis as a result of the lack of access to clean and affordable energy. Consequently, poverty, household's size, income level of the dwellers, among others are the drivers of fuel wood utilization in the study area, leading to several health problems.

Olarinde and Olusola (2018) examined socio-economic impacts of charcoal production in Oke-Ogun, Oyo State, Nigeria. Descriptive survey design was adopted for the study. Two Local Government Areas were selected based on the accessibility and the availability of charcoal farmers among ten Local Government Areas. Structured questionnaire was used for data collection. Obtained data were analyzed using descriptive statistics including bar chart, frequency distribution, tables and percentages. It was disclosed that charcoal production was profitable in the study area, though production was carried out mainly



during off seasons, when rainfall was minimal and when income of the farmers was at a low state, and in most cases not at all. The farmers now found solace in charcoal productions, which now stands as another source of revenue for them. Both the extent of deforestation and ozone layer depletion in the study area is alarming. Eniola and Odebode (2018) examined health effects of charcoal production among rural dwellers in the derived savannah agro-ecological zone of Nigeria. The researchers adopted survey design for the study. Data were collected through the use of structured interview schedule and focus group discussion (FGD). Data were analysed using both descriptive and inferential statistics. It was discovered that charcoal production has negative impacts on human and environmental health.

Emeodilichi (2018) assessed environmental impact of charcoal production processes in Kaduna State, Nigeria. The survey research design was adopted for the study. Data were collected through interviews, and discussion with charcoal producers. Analyzed data disclosed that there is increase in quantity of production over the years due to high demand of the product, and at the same time more trees are being cut down which contributes to depletion of forests. Eniola, Odebode and Ayandele (2018) investigated the socioeconomic contributions of charcoal production to rural dwellers livelihood in the rainforest zone of Nigeria. Survey design was employed for the study. Data were obtained through the use of structured interview. The data were subjected to descriptive statistics, analysis of variance and regression analysis at $p=0.05$. It was revealed that charcoal production contributed significantly to the economic sustenance of the rural dwellers. Harindintwari and Ngendahayo (2019) assessed socioeconomic and environmental impact of charcoal production in Nyamasheke District of Tanzania. The survey design was employed, data were gathered through in-depth interview with local leaders, and the data were analyzed with both descriptive and inferential statistics. It was revealed that charcoal production has positive economic effects. However, it poses negative effects on the environment. The environment-related impact discovered include loss of forest cover, permanent reduction in the density of the forest, removal of vegetation cover, and thinning of woodlands, among others.

3. Methodology

The study area is located between Longitude $9^{\circ} 38'0''$ North and Latitude $6^{\circ} 25'0''$ East (Figure 1). It covers a total area of about 297.5 km^2 and has a population of about 147,359 as at 2006 census. The study area has two distinct seasons the dry and wet season. Precipitation per year varies between 1000-1400 mm on the average. The duration of raining season ranges from 150 to 210 days or more from the north to the south. Mean maximum temperature remains high throughout the year, hovering about 37°C and 20°C respectively (Adeoye, 2018). However, the lowest minimum temperature occurs usually between December and January when most parts of the state come under the influence of the tropical continental air mass which blows from the north.

Geological mapping shows the study area is underlain by granite and schist with granite occupying a greater portion of the area. Specifically, three major soils types can be found in



Bosso LGA. These include the Ferruginous tropical soils, hydromorphic soils, and ferrosols. Hydromorphic or waterlogged soils are largely found in the extensive flood plain of the Bida basin. These soils are poorly drained and are liable to heavy flooding. Ferrosols which developed on sandstone formations are commonly found within the Bida basin. Their characteristic red color enriched with a clay subsoil is noticeable in the landscape. Termite hills dot the landscape, particularly between Mokwa, Bida and Kontagora axis. The vegetation is mainly guinea savanna which is characterized by grasses shrubs and trees. The study area lies within the middle belt of Nigeria which is a transitional zone between the rainforest of southern Nigeria and the guinea savanna of northern Nigeria. This is characterized by tall grasses with light forest, evenly distributed trees along the major river channel. Almost all the Bosso LGA is occupied by a moist, so-called Guinean high-grass savanna. The plots of these savannas alternate with the park savannas and border the banks of the rivers with gallery forests. The so-called elephant grass predominates. Groups of trees rise above the grassy sea: drought-resistant *kaya*, *isoberlinia*, *mitragina*. Some of them have trunks twisted from annual fires. In the first half of the dry season, the savanna looks lifeless; the trees stand bare. In the middle of this season, a smoke screen rises over the savanna: the dry grass burns, which is burnt from year to year with the purpose of preparing the land for crops.

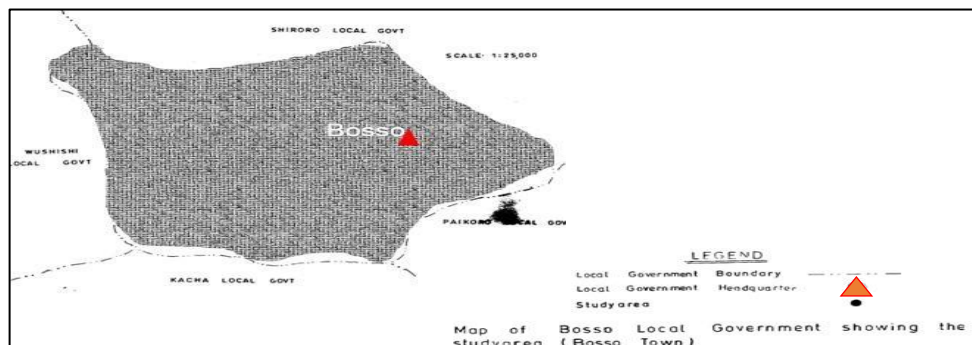


Figure 1. The study area. Source: Minna Survey Division

Agricultural activities form the mainstay of the economy of the people. Majority of the people in Bosso LGA are farmers, while the remaining smaller portion are engaged in other locations such as white-collar job, manufacturing, business production of craft and art. The main crops grown are grain and tuber which include guinea corn, groundnut, cassava, and yam, etc. This is normally grown during the raining season. Minor occupation during the raining season includes blacksmithing and sell of labor to rich farmers. In the dry season immediately after the harvest, hunting, fuelwood exploitation, pottery making, etc. become the main economic activities.

Both primary and secondary data were used in this study. Primary data were sourced through questionnaire administration, personal observations and recordings. Secondary



data used in this research include base map, population size and other relevant information obtained from the local government headquarters. A reconnaissance survey of the study area was also carried out to have an overview of the socio-economic activities and environmental state of the study area. The entire population of the three villages provided a convenient sample frame. An adult was selected based on convenience from each dwelling unit for interview guided by structured questionnaire. Out of 59 houses in Maitumbi, only 50(84%) had residents at home and available for questionnaire administration, 50 (75.76%) residents were sampled out of a total of 66 dwelling units in Beji and 20 (80%) of the total 25 dwelling units in Shakwatu village was sampled. Descriptive statistics such as frequency counts and percentages, as well as charts were used to summarize the data. The perceived effects of charcoal production on the people was assessed using Likhert scale, giving weights of 5,4,3,2,1 to such responses as: strongly agree, agree, indifferent/no response, disagree and strongly disagree respectively.

4. Result

Processes of Charcoal Production in Bosso Local Government Area.

Materials needed for Charcoal Production include: logs of wood, grasses, leaves, Earth and source of fire. In setting up the logs of wood for the production, two or more long slender stems are placed parallel to one another at equidistance, and then the logs are placed perpendicularly on them. The essence of the initial long slender stems is to avoid direct contact between the logs and the ground/soil/earth. The logs are covered with grasses/leaves and thereafter, the leaves are covered with earth. The leaves/ grasses serve as a logging material between the logs of wood and the earth covering the entire setup. While covering, a small portion of the heap is left uncovered on any side of the entire setup for the introduction of fire. After lighting, the opening is covered and many tiny holes are created in various parts of the heap so as to enable the inflow of oxygen for combustion. An exit of white fumes through the holes created indicate successful combustion into charcoal while exit of red smoke on the other hand signifies an unsuccessful combustion into charcoal but rather, into ashes. The duration of combustion is subject to the state of logs in terms of dryness, quantity and prevailing weather conditions at the time of production. Harvesting is done after the entire logs are transformed into charcoal. The harvested charcoal is bagged and transported to the point of sale.

Socio- Economic Characteristics of Charcoal Production

A large proportion of the sampled population is male (76%, 76% and 95% in Maitumbi, Beji and Shakwatu respectively). The level of literacy in these villages is very low as it was observed that up to 44%, 48% and 40% of population had no formal education. This encouraged early marriage as it was also observed that 62%, 72% and 75% of the people living in these three villages were already married. Moreso, it accounts for their uncontrolled involvement in charcoal production, as they hardly appreciate the implications of uncontrolled falling of trees and burning of logs for charcoal. None of the sampled respondents is in the civil service. They are either farmers (66%) or traders (24%). Meanwhile a considerable proportion (10%) of the entire population were artisans, engaged



in vocations like carpentry, tailoring among others, many of whom are unskilled labourers. It is interesting to observe however, that virtually all adult males in the village have at one time or the other engaged in the process of charcoal production, and the production is assuming a significant and dominant industry of the local economy, as the product (charcoal) is not only sold to the local market but also taken to as far as neighboring countries like Chad and Cameroun, among others.

Incidence of Charcoal Production in the Study Area

On the average, about 12 bags of charcoal are produced per week per village in the area. This may, however, vary from week to week and village to village from about 5 to 20 bags per week. Only on rare cases do they produce larger quantities. Nevertheless, the rate of production is higher in Beji than in other villages. A large percentage of the wood used in the production of charcoal in these three villages is obtained from trees intentionally felled for the purpose of charcoal production. Only a few proportion of such woods are obtained from trees that die naturally. This reveals the high rate of deforestation tendency in these villages without any effort towards afforestation. This result into a great loss of bio diversity and the forest region at large as well as increased soil erosion. Machines rather than manual tools such as cutlass and axe are mainly used for falling trees in the study area. These machines produce a high intensity of noise which scare away forest animals and also constitute air pollution by earring loss and other psychological damages. No doubt, charcoal production has contributed significantly to atmospheric contamination in the study area. One could readily perceive the odour of obnoxious gasses that are released during the production process. Residents in the three villages strongly agree with this and also with the fact that charcoal production has equally been a source of income for them. On the other hand, they disagree with the fact that charcoal production has equally a negative impact on crop yield especially on the land where such activity is carried out. While this is their perception on crop yield, they agree largely that charcoal production has increased the rate of soil erosion in the area. This conflict in their response can therefore be attributed to their low level of education. However, the study shows that even though the residents are aware of the negative impacts of charcoal production, they still support it due to the fact that it is their major source of income and it has ripple effect in promoting other trade sectors of their economy as well as reducing social vices, which some poverty ridden elements of the communities may have perpetrated, were it not for charcoal production.

Table 1: Charcoal Production

No of Bags	Beji		Maitumbi		Shakwatu		Total	
	No	%	No	%	No	%	No	%
1-20	15	75	10	66.6	11	78.6	36	73.6
21-40	3	15	-	-	3	21.4	6	12.2
41-60	2	10	3	20	-	-	5	10.2
61-80	-	-	2	13.4	-	-	2	4
Total	20	100	15	100	14	100	49	100

Source: Authors' Field Survey, 2023



5. Conclusion and Recommendation

The demand for charcoal has extended from national to international market, and the supply can hardly meet up with the demand. Even though wood which is the major raw material for its production is obtained from a renewable source, its source cannot be renewed if deliberate efforts are not taken. Prohibition of charcoal production in a bid to prevent ecological disaster is not feasible because of the absence of cheaper alternatives and its direct linkage with the economy of the study area.

In order to enjoy the benefits of this charcoal as well as ensure minimal adverse effects, the practice should adopt all the recommendations offered in this work. Job opportunities should be provided by the local government authorities to the residents to combat the menace of poverty which is one of the major factors encouraging charcoal production as a means of livelihood. Environmental friendly technology such as fuel efficient stoves should be provided by the government at affordable prices to the masses as alternative to the unsustainable production and utilization of charcoal in the local government area. Extensive awareness creation on benefits of sustainable forest resource management amongst the general public. Forest resource management should be integrated into educational curricular as part of being considered a civic education. Establishment of research organizations that will look into improvement of affordable, healthy, safe and efficient energy production and use in households should be encouraged. Government should monitor tree cutters so as to ensure that not just single species of tree is being cut down. This will help to prevent the extinction of such endangered species.

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