Journal of Energy Technologies and Policy
ISSN 2224-3232 (Paper) ISSN 2225-0573 (Online)
Vol.5, No.11, 2015
www.iiste.org

Charcoal Production and Producers' Tree Species Preference in Borgu Local Government Area of Niger State, Nigeria

Adeniji, O.A. [1] Zaccheaus, O.S. [2] Ojo, B.S[1] Adedeji, A.S[2]
1 Department of Forestry Technology, Federal College of Wildlife Management, P.M.B 268, New-Bussa, Nigeria
2 Department of Basic Science, Federal College of Wildlife Management, P.M.B 268, New-Bussa, Nigeria

Abstract
A survey of charcoal production in Borgu Local Government Area of Niger State, Nigeria, was carried out to determine the demographic characteristics of the producers, examine and explore charcoal production methods and processes, identify the tree species used in charcoal production and explore their desirable qualities, as well as examining the sustainable charcoal production in the study area. Purposive sampling technique was employed in the study. Four villages; Yangba, Gada-Oli, Tamanai and Tunga-Boka, where charcoal production is prevalent were selected. Fifty (50) copies of questionnaire were purposively administered to charcoal producers in the four villages, with thirty four (34) copies retrieved. Descriptive statistics tools were used to analyze the variables of interest. Variables which were analysed include sex, age, educational status, marital status, methods of charcoal production, e.t.c. The results of the study revealed that earth mound kiln (65%) and earth pit kiln (35%) are the two methods of charcoal production employed by the producers in the study area. *Prosopis Africana* (73%) is the most preferred tree species used by charcoal producers in the study area for charcoal production.The study has revealed that commercial charcoal production is gradually becoming one of the major sources of sustenance and currently plays a major role in promoting entrepreneurial development in Borgu L.G.A of Niger State with earth mound kiln method (65%) mostly employed. There should be increased supply of wood for charcoal production through plantations and woodlots; unchecked harvesting of trees without replacement should be addressed as well as development and implementation of short and long-term plans for massive tree planting.
Keywords: charcoal, tree, specie, borgu, preference

INTRODUCTION

Charcoal production and demand are on the increase in developing countries and international market respectively (Bhattarai, 1998). Charcoal is one of the major components or fractions of wood fuel. Wood charcoal is processed from wood and wood materials from trunk, branches and other parts of trees and shrubs, processed by burning and passing through fire. According to the Food and Agriculture Organization of the United Nations (FAO), charcoal is the solid residue derived from controlled combustion of a wide range of materials under condition of limited supply of oxygen (FAO, 1983). The United States Department of Agriculture (Forest Service) documented the production of charcoal in a 1961 report (USDA, 1961) which indicates that high-temperature heating of wood products result in the production of a wide range of by-products that include a solid object known as "Charcoal". The resulting object is a black, charred material that has a distinct texture and appearance and used mainly for cooking, heating or generating energy through direct combustion (Food and Agriculture Organization, 1981).
Kammen and Lew (2005) reported that half of the world's population uses biomass fuel for cooking and that in 1992; 24 million tonnes of charcoal were consumed worldwide, with developing countries accounting for nearly all the consumption while Africa alone accounted for 50%.

According to Centre for International Forestry Research (2005), wood fuel is Africa's primary energy source for at least 70% of households. It is the major source of energy in rural areas both for domestic uses, in small-scale traditional industries and commercial enterprises. Though inefficient, wood charcoal production and distribution contribute to some extent, the national balance of payments at the macro level as foreign exchange. In Nigeria, the wood charcoal enterprise is one of the major components of the wood fuel industry and it is the main source of domestic fuel in urban areas, accounting for more than half of the domestic energy consumption (Enete and Agbugba, 2008).

Awoyemi *et al*. (2006) maintained that charcoal is virtually available all over Nigeria as many local communities have perfected the technology of charcoal production. Some known charcoal depots are found in places like Oyo, Iseyin, Saki, Igbo-Ora, Ogbomoso- all in the western part of the country. We also have depots in Jebba, Omu Aran, Egbe, Kabba in the Central States. Charcoal is found in abundance also in Minna, Jos and Kaduna.

For many urban poor, charcoal provides a reliable, convenient and accessible source of energy for cooking at a stable cost. While electricity and gas may be considered the most desired cooking fuels in urban areas, even if these are available most poor households cannot afford both the energy resources and the devices required to use these forms of energy. Many households, therefore, turn to using kerosene or charcoal. Since kerosene is not always available or too costly for many, this leaves charcoal as the most readily available fuel (Mugo and Ong,

2006).

Firewood has always been the major traditional source of energy for most rural and urban dwellers in Borgu Local Government Area of Niger State, Nigeria, with some households making use of kerosene and cooking gas. The high cost of cooking fuels coupled with the incessant scarcity of the product makes it become important to provide an alternative means of energy for the sustenance of the people. Charcoal enterprise has been adopted to meet some socio-economic benefits and energy needs of the people.

This study was therefore conducted to determine the demographic characteristics of charcoal producers, examine and explore the charcoal production methods and processes, identify the tree species used in charcoal production and their desirable qualitiesas well as examining the sustainable charcoal production in the study area.

METHODOLOGY

Study Area

The study was carried out in Borgu Local Government Area of Niger State. New-Bussa, headquarter of the Local Government is in the semi-arid zone of Nigeria (Figure 1) and is located between latitude 9º51‟N– 10º55‟N and longitude 4º23‟E – 4º45‟E. Four villages; Yangba, Gada-Oli, Tamanai and Tunga-Boka, where charcoal making is prevalent were purposively selected.

Fig. 1: *Map of Nigeria showing Niger State and New-Bussa*
Source: *(Nnaji and Omotugba, 2014).*

Climate and Vegetation

Borgu Local Government Area has a tropical continental climate characterized by a shorter wet season (May to September) and a longer dry season (October to April) with a temperature of 15ºC to nearly 40ºC. Annual rainfall is about 1000mm but there is considerable variation in amount and distribution of rainfall among years. Rainfall is concentrated in the months of June, July and August. The town is bordered by the Kainji Lake created by the damming of River Niger at Kainji. The vegetation in New-Bussa is guinea savannah which is characterized by undistributed woodland with trees 15m – 18m tall. The soil is generally alluvium but is highly variable in physical composition, low in phosphorus and nitrate but rich in potassium. The upland savannah soils are almost totally lacking in humus materials. (Nnaji and Omotugba 2014).

Sampling Technique

Purposive sampling technique was employed in the study. Four villages; Yangba, GadaOli, Tamanai and TungaBoka, where charcoal making is prevalentwere selected. Fifty (50) copies of questionnaire were purposively

administered to charcoal producers in the four villages, with thirty four (34) copies retrieved.
Those who could not read had the questionnaire read and interpreted to them and they supplied the answers. Names of trees were mostly given in Hausa Language. The scientific equivalents were identified using "Hausa names for plants and trees" (Blench and Dendo, 2007). Variables which were analysed include sex, age, educational status, marital status, occupation e.t.c. Descriptive statistics tools were used to analyse the variables of interest.

Results and Discussion

Demographic characteristics of the respondents

In Table 1, result of the demographic characteristics of the thirty-four (34) respondents involved in charcoal production in the study area shows that most of the respondents 31 (91%) are male, this is as a result of the tedious nature of commercial charcoal production which requires a lot of energy. 20 (59%) of the respondents are between ages of 20 – 39 years, this is not surprising since this is generally the active age group in human life especially that the activity is an energy exacting one. 73% are married while 24% are single. 47% of the respondents attained secondary school education, while 29% have no formal education, 41% have between 10-14 years experience of charcoal production, 41% also have less than 10years experience. The years of experience of the charcoal producers indicate that commercial charcoal production started in the study area not long ago.

Table 1: Demographic characteristics of the respondents involved in charcoal production in the study area

Demographic	**Categories**	**Frequency**	**Percentage (%)**
Sex	Male	31	91
	Female	3	9
	Total	**34**	**100**
Age (Years)	Below 20	1	3
	20-39	20	59
	40-59	13	38
	60 and above	-	-
	Total	**34**	**100**
Marital Status	Single	8	24
	Married	25	73
	Widowed	1	3
	Total	**34**	**100**
Education	No Formal Education	10	29
	Primary Education	8	24
	Secondary Education	16	47
	Tertiary Education	-	-
	Total	**34**	**100**
Year of experience	Below 10 years	14	41
	10-14 years	14	41
	15-19 years	6	18
	20 years and above	-	-
	Total	**34**	**100**

Source: Field survey, 2015.

Methods of charcoal production in the study area

One of the objectives of this work is to examine and explore the methods employed in charcoal production and production procedures in the study area. Charcoal production according to the producers started fully in the study area some twenty years ago. According to them, most of these producers are farmers but engage in charcoal production. Some engage in it during dry season before another farming season sets in, while others combine it with farming.

As revealed in Table 2, traditional method of charcoal production (earth mound kiln and earth pit kiln) is used in the study area. (22) 65% of the producers use earth mound kiln method while (12) 35% use earth pit kiln method. The most prominent among the two methods is earth mound kiln (65%). Agyeman *et al.* (2012), also reported the prominent use of earth mound kiln method for charcoal production. The use of drums and improvised kilns methods are not adopted, this may be due to the fact that they are expensive, (Ottu-Danquah, 2010). However, the methods of production are always constant over time.

Table 2: Methods of charcoal production in the study area

Method of charcoal production	Frequency	Percentage (%)
Earth mound kiln	22	65
Earth pit kiln	12	35
Use of drum	-	-
Improved kilns	-	-
Total	**34**	**100**

Production processes

In the study area, charcoal is being produced using both earth mound kiln and earth pit kiln methods, the only difference between these two methods, is that, the latter is done by digging a large pit and stacking wood into it. Charcoal producers go to their farmland or nearby forest to fetch wood using chainsaw and in some cases cutlass. Trees species like *Prosopis africana* (Kirya), *Anogeissus leiocarpus* (Markee), *Vitellaria paradoxa* (Kadee), *Burkia Africana* (Kolo), *Pterocarpus erinaceus* (Madobiya), *Khaya senegalensis* (Madachi), *Parkia biglobosa* (Dorowa), *Isober linadoka* (Dookaa), *Afzelia africana* (Kaawoo), *Pericopsis laxiflora* (Markafo) e.t.c are used (Table 3). *Prosopis africana* is the most preferred specie for charcoal production in the study area (Table 4). According to Essiet (2009), Mangrove and *Pericopsis laxiflora* are used for charcoal production all over the world.

The desired tree species are cross cutted to about two metres long and are allowed to lose moisture content after which they are stacked to give a rectangular shape in most cases (Plate1) leaving a hole where it will be lit and then covered with a layer of grass and sand, two or three holes are made to facilitate smooth burning. The kiln is lit and left to burn slowly (Plate2) for up to one week or two weeks and at times three weeks depending on the type of tree species used. After this, the charcoal is ready and all the sand and grass used to cover it are removed. Charcoal is then removed and bagged (Plate3) to be sold usually to the charcoal merchants who transport them to the urban centres for prospective buyers or at times to individuals who are in need of it.

Plate1: *Trees cut into woods stacked into a kiln*
Source: *Field survey, 2015.*

Plate 2: *An earthmound kiln burning slowly*
Source: *Field survey, 2015.*

Plate 3: Charcoal packed in bags
Source: Field survey, 2015.

Tree species for charcoal production, most preferred ones and their desirable qualities

Table 3 presents the list of tree species used for charcoal production in the study area, *Prosopis africana (Kirya), Anogeissus leiocarpus (Markee), Vitellaria paradoxa* (Kadee), *Burkia africana* (Kolo) and *Pterocarpus erinaceus* (Madobiya) are used by most of the charcoal producers in the study area for production of charcoal, while other species such as *Khaya senegalensis* (Madachi), *Isober linadoka* (Dookaa), *Parkia biglobosa* (Dorowa), *Afzelia africana* (Kaawoo), *Pericopsis laxiflora* (Markafo), and *Terminali aglaucoscens* (Baushe) are used only to different degrees. The ranking of the list of tree species for charcoal production in the study area as revealed by Table 3 indicates that 33 (97%) of the charcoal producers listed *Prosopis Africana* (Kirya*)* as one of the species used for charcoal production, 31 (91%) listed *Anogeissus leiocarpus* (Markee), 27 (79%) listed *Vitellaria paradoxa* (Kadee), 19 (60%) listed *Burkia africana* (Kolo) and 16 (47%) listed *Pterocarpus erinaceus* (Madobiya) e.t.c

According to Table 4, *Prosopis Africana* is the most preferred tree species used by charcoal producers in the study area for charcoal production with 73% which indicates that 25 out of the 34 charcoal producers in the four villages prefer to use this specie, it was revealed that *Prosopis africana* is widely used because it is hardwood; they further revealed that hardwoods give higher charcoal yield than soft woods. This is in agreement with Bhattarai (1998) and Essiet (2009) who stated that Prosopis is used all over the tropics, and hardwoods are likewise the wood of choice all over the world wherever charcoal is produced. *Anogeissus leiocarpus* and *Burkea Africana* were ranked second with 9%, others are *Vitellaria paradoxa*, *Pterocarpus erinaceus* and *Isober linadoka* with *3%.* Although any hard savannah tree could be carbonised for charcoal, the six species identified above are mostly sought after, due to their hardness that makes their charcoal non-bristling. Additionally, Abbiw (1990) stated that trees with higher specific gravity make better charcoal than those with lower specific gravity.

Table 3: List of tree species used for charcoal production in the study area

Tree species Scientific	Hausa (Local Name)	Frequency (34)	Percentage (100%)
Prosopis africana	Kirya	33	97
Anogeissus leiocarpus	Markee	31	91
Vitellaria paradoxa	Kadee	27	79
Burkia africana	Kolo	19	60
Pterocarpus erinaceus	Madobiya	16	47
Khaya senegalensis	Madachi	7	21
Isober linadoka	Dookaa	6	18
Parkia biglobosa	Dorowa	6	18
Afzelia africana	Kaawoo	4	12
Pericopsis laxiflora	Markafo	2	6
Terminalia glaucoscens	Baushe	1	3

Table 4: Most preferred tree species for charcoal production in the study area

Tree species Scientific	Hausa (Local Name)	Frequency (34)	Percentage (100%)
Prosopis africana	Kirya	25	73
Anogeissus leiocarpus	Markee	3	9
Burkia africana	Kolo	3	9
Vitellaria paradoxa	Kadee	1	3
Pterocarpus erinaceus	Madobiya	1	3
Isober linadoka	Dookaa	1	3
Total		**34**	**100**

Sustainability of charcoal production in the study area

Table 5 shows responses on sustainability of charcoal production in the study area. (8) 24% of the 34 charcoal producers replant trees after felling for charcoal production, while (26) 76% out of the 34 charcoal producers do not bother to carry out replanting of felled trees. Also, (32) 94% of the 34 producers believe trees will be available for future charcoal production while (2) 6% do not believe that trees will be available in the future for charcoal production. This is in agreement with Van der Plas (1995) report, which stated that since charcoal producers can use free raw materials (wood from the natural forests) and turn them into a marketable commodity in high demand, they do not have much respect for the sustainability of the resource.

Table 5: Responses on sustainability of charcoal production in the study area

S/n	Variable	Frequency	Percentage (%)
1	**Replanting of trees after felling**		
	Yes	8	24
	No	26	76
	Total	**34**	**100**
2	**Availability of trees in the future**		
	Yes	32	94
	No	2	6
	Total	**34**	**100**

Conclusion and Recommendations

From the foregoing, it is inferred that, the cry for alternative energy source has put charcoal business as lucrative, although, there was alarm raised by environmentalist over massive logging of indigenous trees for charcoal production as revealed in Tables 3 and 4, but still charcoal business has played a major role in promoting entrepreneurial development in Borgu Local Government Area of Niger State.

The demand for charcoal is usually high due to inadequate supply and high cost of kerosene and cooking gas. Therefore, the government should ensure adequate supply of kerosene at much subsidized rate. This would ensure accessibility to kerosene and cooking gas by households and reduce the pressure on forest trees.

There should be increased supply of wood for charcoal production through plantations and woodlots; unchecked harvesting of trees without replacement should be addressed as well as development and implementation of short and long-term plans for massive tree plantings.

Policies should be formulated at both Federal and State Government levels to incorporate charcoal production with logging so as to utilize all the wastes generated from logging.

References

Abbiw, D.K. (1990). Useful Plants of Ghana. Intermediate Technology Publications and the Royal Botanic Gardens.

Agyeman, K. O., Amponsah, O., Braimah, I. and Lurumuah, S. (2012).Commercial Charcoal Production and Sustainable Community Development of the Upper West Region, Ghana. Journal of Sustainable Development Vol. 5, No. 4.

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

Bhattarai, T.N. (1998). Charcoal and its Socio-economic importance in Asia. *Paper Presented at the Regional Training on Charcoal Production*, Pontianak, Indonesia, Organised by RWEDP. 12pp.

Blench R. and Dendo M. (2007). Hausa names for plants and trees. 2nd edition. 77pp. www.rogerblench.info/RBOP.htm. Retrieved April 3, 2015

Enete, A. A. (2003). *Resource use, marketing and diversification decision in cassava producing households of sub Saharan Africa*. PH.D thesis, KU Leuven

Essiet, D (2009). Future is Charcoal export business. *The Nation Newspaper.* http://thenationonlieng.net/web2/articles. Retrieved June 13, 2015.

FAO. (1981). *The wood fuel situation in developing countries*. Food and Agricultural organization, Rome, Italy.

FAO, (1983).Simple technologies for charcoal making.FAO Forestry Paper 41. Rome.

Kammen D.M. and Lew D.J. (2005). Review of Technologies for the Production and Use of Charcoal. Renewable and Appropriate Energy Laboratory Report.University of California, Berkeley, USA.

Mitchell, Andrew (2009). "Big business to measure forest-footprint". Cited in Developments, Issue 46, 2009, www.developments.org.uk; www.forestdisclosure.com P.7. Retrieved, April 5, 2015.

Mugo F. and Ong C. (2006). Lessons from eastern Africa's unsustainable charcoal trade.

Nnaji, J. C. and Omotugba, S. (2014). Physico-chemical Quality of Drinking Water in New Bussa, Niger State, Nigeria *International Research Journal of Pure & Applied Chemistry 4(4): 437-446, 2014*

Otu-Danquah, K.A. (2010). Current Status of Charcoal Demand and Supply, and Initiatives on Improved Cook-Stoves. A presentation made during a kick-off meeting for TEC/ESMAP survey on the energy access and productive uses for the urban poor, held in the SSNIT Guest House Conference Room, Accra on 11/08/2010

Van der Plas, R. (1995). Energy issues.Burning charcoal issues.The World Bank Group.FPD Energy Note No. 1.