ASSESSMENT OF CHARCOAL VALUE-CHAIN IN JOS METROPOLIS, PLATEAU STATE, NIGERIA

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ABSTRACT

Charcoal production has been perceived to be harmful to the environment, however, the industry is important in meeting household energy needs, in employment creation and provision of household income. This study assessed the value-chain of charcoal industry with a view to providing relevant information for good policy direction in both energy and environmental sector. The research employed snowball sampling techniques to reach charcoal retailers, transporters, wholesalers and producers. Semi-structured and key informant Interviews were conducted with the charcoal retailers and transporters and forestry department respectively, while Focus Group Discussion (FGD) was conducted with the charcoal wholesalers and producers. Analysis was done based analysis, using constant comparison and micro interlocutor analysis. The result shows that, many people are employed in different phases of production and supply chain, and additional employment was created. The study also reveals that the majority of the charcoal used in Jos metropolis comes from Bauchi and Plateau states. The finding also shows that, stakeholders neglecting charcoal activities result to lack of programmes and strategies that regulate charcoal production. The level at which charcoal is produced and brought to Jos metropolis is of great concern, putting the present forest resources of the production areas at risk of extinction. In order to protect the forest

resources from being depleted by charcoal producing communities, the study recommends, improving living standards of people, provision of sufficient forest management, forest investment, supervision and control practices by stakeholders to reduce the level of trees falling by charcoal activities in charcoal producing communities.

***Key words**: Charcoal, Value-Chain, Production, Users*

1. INTRODUCTION

The extraction, processing and consumption of wood from trees in our forest which is used for the purpose of generating fuel for households and small industries are activities undertaken for survival (Alimba, 2004 cited in Yisa, et al., 2012). Large-scale charcoal production in sub-Saharan Africa has been a growing concern due to its threat of deforestation and land degradation. It is cited as the most environmentally devastating phase of the traditional energy supply chain, and despite increase in per capita income, electrification, and significant renewable energy potential, charcoal still remains the dominant source of cooking and heating energy for more than 80% of household in sub Saharan Africa (Zulu & Richardson, 2013).

The influx of charcoal trucks and cars into Jos metropolis are from sources which are not known by the many men and women selling and using charcoal in their homes. The population of those who have discovered the economic benefits in the charcoal trade in Jos Metropolis have increased in droves over the years, with some wealthier and middle class people involved in the trade at the bulk commodity level. Thus, there is a great need for clear study that will assess the charcoal value chain in the aspect of consumption, trade and production with a view to providing effective data for sustainable management.

Charcoal has been an important domestic product for many years, and has wide market acceptance. Charcoal constitutes the primary urban fuel in most of Africa and some developed countries and is a major source of income. The production, transport and combustion of charcoal constitute a critical energy and economic cycle in the economies of many developing nations (Jamala et al., 2013).

Charcoal marketing and cost-benefit analysis depend on a study of commercial possibilities as indicated by source and cost of raw material, availability and cost of labour, price, distribution and the market for the charcoal produced. Charcoal is found in abundance in Jos, Minna and Kaduna (Jamala et

al., 2013). Charcoal marketing and distribution is a sequence of business activities that involves the producer, supplier, wholesaler or retailer, and the consumer (Jamala et al., 2013). Kalu and Izekor (2007) maintained that charcoal enterprise is adopted to meet some socio-economic benefits and energy needs of the people. Therefore, its production would not stop because available alternatives are limited and expensive. Yisa et al (2012) in their study noted that charcoal production is more profitable than firewood, with the average return realized by the charcoal producers per quantity produced in bags /month as N 7800. The number of people engaged in the charcoal business is notable. A study in Kenya estimated that up to 200,000 in Kenya were directly employed in production and an estimated 500,000 people involved in transportation and vending of charcoal, who were in turn believed to be supporting 2.5 million dependants (Mutimba and Barasa, 2005). Global wood charcoal production has trebled over the last 50 years from 17.3 million tons in 1964 to 53.1 million tons in 2014 (FAO, 2016). Sixty-one percent of current global production occurs in Africa (FAO, 2016), primarily to satisfy demand for cooking fuel from urban and peri-urban households (Mwampamba et al., 2013; d'Agostino et al., 2015). With Africa's population projected to double between 2015 and 2050 (UN, 2015), and with increased rural-urban migration in key producing countries, including Tanzania, Ethiopia, and Nigeria (FAO, 2016), demand for charcoal is projected to increase. As Charcoal is the main cooking fuel for urban populations in many African countries (Doggart & Meshack, 2017).

If charcoal production and its use are to contribute to sustainable development and poverty reduction, the entire charcoal value chain needs to be understood and addressed in a holistic manner (Gichu, 2013). Based on this understanding of the value chain, strategic interventions can then be developed geared towards promoting enabling framework conditions that create business opportunities for a wide range of value chain actors while fostering rural and urban employment and incomes. The value-chain approach thus brings out the charcoal business from the difficult to regulate informal sector and enables policy makers to harness its potential for sustainable development. This necessitates a comprehensive analysis of existing constraints and the restructuring of response strategies.

Since charcoal has very high potential to be a renewable resource, this study is intended to stimulate and encourage an informed charcoal debate, based on the importance of large number datasets to better understand the clear benefits of charcoal production, trade and utilization as a poverty reduction strategy as Zulu and Richardson (2013) suggested in their paper charcoal and poverty reduction. The need for further empirical research to support the hypothesis that a legalized and regulated charcoal industry can help

alleviate poverty for a larger number of participants in the charcoal value chain, particularly the rural poor is apparent (Neufeldt et al., 2015). Evidence gathered through value chain assessment would support policy interventions that ensure small-scale producers and retailers retain more of the total value of charcoal. Two main theories underpin this study- the tragedy of the commons and the energy ladder theory.

Tragedy of the Commons Theory

The tragedy of the commons concept is important in understanding of environmental degradation of our society. The basic idea espoused by the tragedy of the commons concept is that if a resource is held in common for use by all, then ultimately that resource will be destroyed (Tesot, 2014). The resource shared in common in this case is the trees that are cut down for charcoal production. This theory assumes that every human exploiter of the shared common resources is driven by self-interest (Ostrom *et al*., 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 actions would be "Communized", therefore they will not give up their actions (Hardins, 1968). Because the privatized gain would exceed his share of the communized loss, a self-seeking exploiter would not change his behaviour (Hardin, 1968). Others reasoning in the same way, would follow the suit and ultimately, the common property would be ruined (Ostrom et al., 2002).

This theory underpins the activity of charcoal producers. Unsustainable fuel wood exploitation for charcoal burning results in forest destruction which charcoal producers are aware of but continue because of the selfish economic gains which however have general ramifications. The long term adverse impacts of their actions thus do not matter to them. The theory is therefore relevant to the study as it explains how unsustainability comes in charcoal business as a result of the need to fulfil self-interest and energy requiring for survival.

Energy Ladder Theory

The current energy discourse frequently differentiates among "modern" and "traditional" fuels, assuming that there is a linkage between the income level of households and their fuel choice; this is generally referred to as the "energy ladder theory". Petroleum products such as kerosene and LPG as well as electricity are considered to be modern fuels at the top of the energy ladder whereas traditional fuels such as wood fuels and agricultural waste end up at the bottom. Charcoal is often considered as a transition fuel (Figure 1), being that it is

a marketable commodity with a higher level of convenience than traditional fuels (Sepp, 2014).

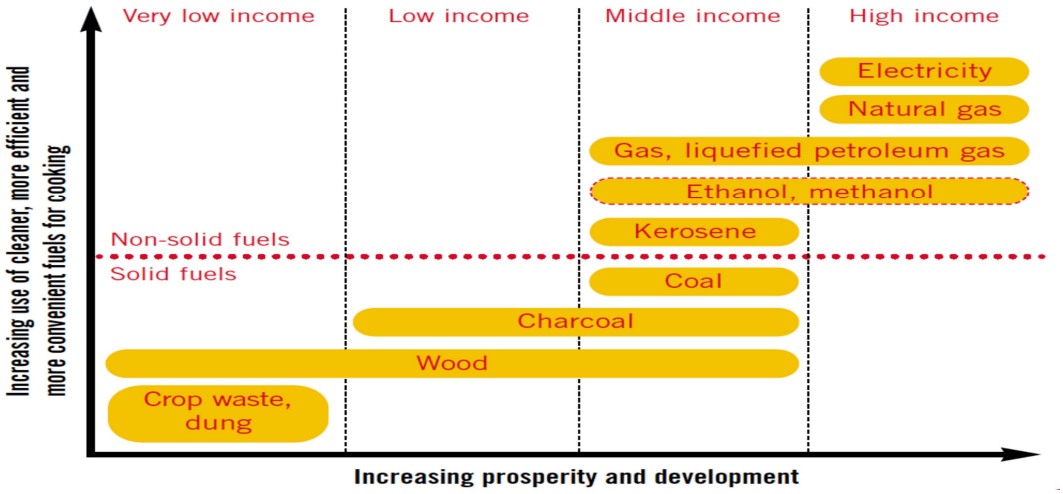

Figure 1: Energy Ladder Theory
Source: WHO, 2006

2. THE STUDY AREA

Jos metropolis is situated in the north-western part of Plateau state in north central Nigeria. The city is situated at the northern edge of a pear-shaped upland known as the Jos Plateau, the area is bounded by latitudes 10º 00'N and 9º 50'N and longitudes 9º 00'E and 8º 55'E (Figure 2). This study area covers parts of four local government areas namely Jos north, Jos south and Jos east, and Bassa local government areas of Plateau State, Nigeria. The study area covers an area of about 340 km^2, extending for about 18 km from north to south, and 18.5 km from east to west. The area is accessible through a major road passing from Toro and Zaria road in the north; it passes through Jos metropolis and heads towards Buruku at the southern end (Aga, et al.,2010). Jos metropolis shares a common boundary with Riyom, Barikin-Ladi and Mangu local government areas of Plateau State by the south, Toro local government area of Bauchi State by North-East and Kaduna state by the west (Ampitan & Oyerinde, 2015).

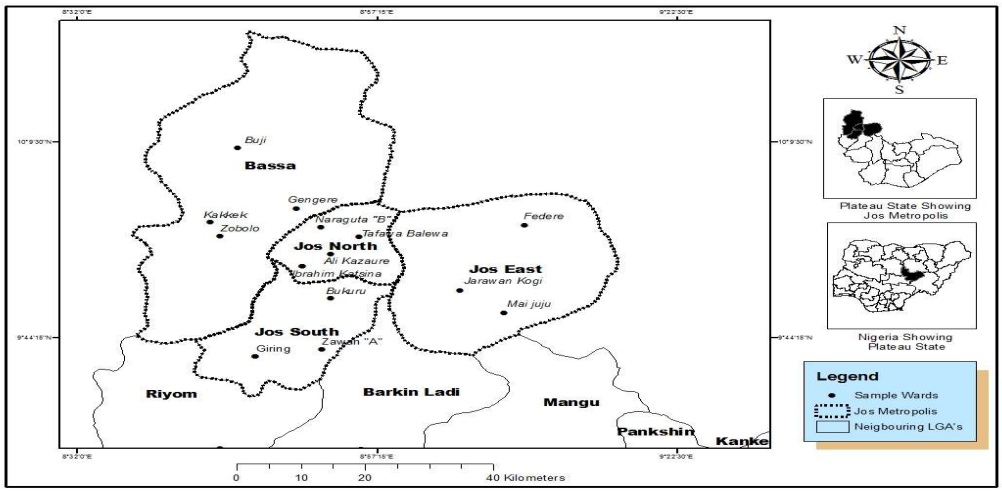

Figure 2: Study Area (Jos Metropolis).
Source: Cartography Lab. Geography Department, BUK, 2017.

The area falls largely within the northern guinea savannah zone which consists mainly of short trees, grasses and the Plateau type of mosaic vegetation. Near some villages are thick hedges of cacti, which have been planted around household farms or compound lands. Fringing woodlands or gallery forests can be found along some river valleys (Plateau State Diary, 2001 in (Ogbonna *et al*., 2011).

3. MATERIALS AND METHODS

This research was basically field survey. Using Interview Survey and Focus Group Discussion (FGD), three components of the study were undertaken in sequence: first, the household and the informal business activities, survey of charcoal utilisation; second the charcoal trade survey; and finally the charcoal production survey. In this way, it was possible to follow the charcoal industry upstream from utilizers, along the market chain and back to the producers.

All persons associated with charcoal industry in Jos metropolis constitute the population for this study. The population thus comprised charcoal producers, charcoal transporters, charcoal sellers (wholesalers and retailers), charcoal users and then government officials such as from Ministry of Agriculture, Department of Forestry and Ministry of Environment. Since it was not possible to undertake an outright study of the entire households using charcoal in Jos metropolis, the metropolis was stratified into four local government areas: Bassa, Jos East, Jos North and Jos South. These Local Government areas were further stratified into 52 wards (Independent National Electoral Commission, 2015). 14 wards were

selected as sampling unit using Stratum Estimation Method. In this regard four wards were selected from Bassa, three from Jos East, four from Jos North, and three from Jos South. Proportional allocation method, originally proposed by Bowley and captured by Pandy and Verma (2008) was used to assign sample for the stratums. The Stratum Estimation Method formula is: $\mathbf{n_i = N_i/N}$

…….…… (i)

i = 1, 2, 3, and 4

Where n = Number of sampling wards

N_i = Number of wards in each L.G.A

N = Number of first Stratums (L. G. As)

$\mathbf{n_1 = N_i/N}$	$\mathbf{n_2 = N_i/N}$	$\mathbf{n_3 = N_i/N}$	$\mathbf{n_4 = N_i/N}$
= 16/4	= 10/4	= 14/4	= 12/4
= 4	= 3	= 4	= 3

These sampling wards were selected using simple random sampling, since the check list of the wards in each Local Government Area was generated through the record of the Independent National Electoral Commission INEC (2015). However, multi-stage sampling was adopted.

3.1 Sample Size and Sampling Techniques

A sample size indicate the proportion of a research population adequately selected to represent the study population (above 1,000,000.00). The sample size of this study was (s = 383) and it was determined based on Krejcie and Morgan's (1970) formula for calculating sample size (Darabinia, Gorji & Gholami, 2017).

$\mathbf{s = X^2\ NP\ (1\text{-}P) \div d^2\ (N\text{-}1) + X^2\ P\ (1\text{-}P)}$……..…….. (ii)

Sample Proportional Allocation to the Stratums (Local Governments) and substratum (sampling wards) in (Table 4).

$\mathbf{n_i = n\ x\ N_I/N}$…… (iii)

$\mathbf{n_1 = n\ x\ N_1/N}$	$\mathbf{n_2 = n\ x\ N_2/N}$	$\mathbf{n_3 = n\ x\ N_3/N}$	$\mathbf{n_4 = n\ x\ N_4/N}$
= 383 x 16/52	= 383 X 10/52	= 383 X 14/52	= 383 X 12/52
= 118	= 74	= 103	= 88

3.2 Data Collection

To examine the charcoal value-chain situation, semi-structured interview was used to acquire data from retailers and transporters after snowballing them through users. The work used an interview guide developed around the issues central to the charcoal value-chain. On the other hand, focus group discussion

(FGD) was used to acquire data on charcoal value-chain situation from wholesalers and producers of charcoal in a particular charcoal usage or production area. Both semi-structured interview and focus group discussion (FGD) used to allow the participants to have freedom to give information in their own words without restriction.

The discussion during interview and focus group discussion were audio recorded. Observational notes and relevant photographs were taken as well.

3.3 Data Analysis

Qualitative statistics method was employed for data analysis in this research. Descriptive statistic was used in analysing the charcoal value-chain issues. The Mode of analysing data from interview and focus group in this research was tape-based analysis, wherein the researcher listens to the audio of focus group and interview then creates an abridged transcript. This transcript is usually much shorter than the full transcript in a transcript-based analysis. Notwithstanding, this type of analysis is helpful because the researcher can focus on the research question and only transcribe the portions that assist in better understanding of the phenomenon of interest. Constant comparison analysis developed by Glaser and Strauss (Glaser, 1992) and micro-interlocutor analysis were used in this research. Constant comparison analysis, also known as the method of constant comparison as Leech and Onwuegbuzie (2008) have discussed can also be used to analyse many types of data, including focus group data, especially when there are multiple focus groups within the same study. Thus, emergent-systematic design was adopted since the study involved multiple focus groups and interviews that have many themes (Onwuegbuzie, Dickinson, Leech & Zoran, 2009).

4. RESULTS AND DISCUSSION

4.1 Sources of Charcoal to Jos Metropolis

This section identifies the sources of charcoal to Jos metropolis. The respondents revealed that majority of charcoal used in Jos metropolis comes from Toro Local Government area of Bauchi state, which shares boundary with the study area of this research by the north east. Bassa Local Government area of Plateau state, which forms part of the study area for this research is another source. Many charcoal traders and transporters respondents reveals that they source their charcoal from Toro Local Government area, some source their charcoal from Bassa Local Government area. While some charcoal traders and transporters respondents state that they source their charcoal from both Bassa, Jos

East and Toro Local Governments areas (Table 1), with high preference of charcoal from Toro Local Government area due to availability of many good tree species for charcoal production, among which are: *Anogeissus leiocarpus* (Marke), *Prosopis africana* (Kirya), *Isoberlinia doka* (Doka), *Khaya senegalensis* (Madaci), *Pterocarpus erinaceus* (Madobiya), *Parkia biglobosa* (Dorawa). This result is in agreement with the finding of Tukur (2016) which shows that Bauchi state has highest percentage of charcoal producing communities. Charcoal from Bassa has less quality and therefore less preferred due to scarcity of species for good charcoal production in the area, mostly produced with *Erythrophleum suaveonlens* (Gwaska) and *Parkia biglobosa* (Dorawa) that hardly catch fire and produce more smoke during usage. These lead to neglecting Bassa sources by many transporters and buyers in Jos metropolis.

Table 1: Sources of Charcoal to Jos Metropolis

S/N	State	Sources
1	Plateau (Bassa)	Kawan, Lishin, Mumbisa, Majada, Tokobo, Kotoko, Zallaki, Sarkin Shau, Fuskar mata, Gurun, Jingir, Kasuru
	Jos East	Angware, Mai gemu
2	Bauchi (Toro)	Tulu, Zalau, Gumau, Saminakan Gwa, Leme, Kobi, Mahanga, Rimin Zayan, Nabardo, Takan Dangiwa, Kogga, Magama, Danbore, Filin Kokawa, Fanshanu, Tashan Maiturare, Tashan Mairijiya, Bega
3	Nasarawa	Keffi, Akwanga, Kokona, Nassarawan Keffi, Wamba
4	Kaduna	Kuddaru, Gidan Waya
5	Kano (Doguwa)	Shere, Dakori

Source: Field Work, 2017

Some respondents revealed that they also source charcoal around Keffi and Akwanga, Kokona, Wamba and Nassarawan Keffi Local Government's areas of Nassarawa State. Few respondents revealed that they extend their search for charcoal sources during scarcity period around Shere and Dakori areas of Doguwa Local Government area of Kano State. Also very few respondents from data collection on charcoal utilization in Jos metropolis reveals that their husbands are drivers at times they buy charcoal on their way coming back home from Gidan Waya along forest in part of Kaduna State (Table 1 & figure 3). This result is in agreement with the findings of Tukur (2016) which stated that charcoal supplying region excluding Kano are: Bauchi in North East. Niger, Plateau and Kwara in North central region and Kaduna in North West with Bauchi State having the highest charcoal producing communities. Figure 2 depicts the charcoal supply routes as well as the level of charcoal supply to Jos Metropolis.

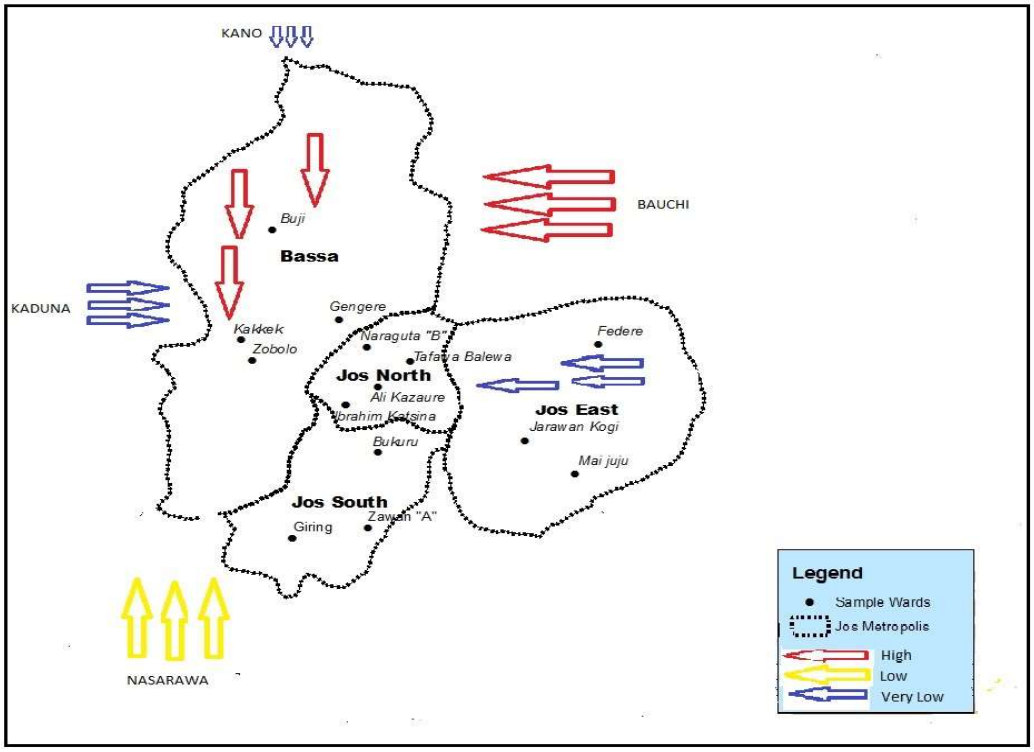

Figure 3: Charcoal Supply Routes to Jos Metropolis
Source: Field Work, 2017

Bauchi State and Bassa Local Government Area (which forms part of Jos Metropolis) have the highest volume of charcoal supply to Jos Metropolis. Nasarawa state has low volume of charcoal supply to Jos Metropolis and Kaduna, Kano, and Jos East (which forms part of Jos Metropolis) have very low volume of charcoal supply to Jos Metropolis (Figure 4.1).

4.2 Charcoal Value-Chain Situation in Jos Metropolis

4.2.1 Sources of trees for charcoal production

The survey shows that the tree species used in charcoal production are sourced from both government reserves and private land. Most of the participants reveal that tree species from government reserves through illegal agreement with the forest staff is a very common source of raw materials for charcoal production in Jos metropolis. The findings also reveal that even among the forest staff there are some involved in charcoal production process, and they possess equipment such as saw machines for cutting and resizing tree species for charcoal production. Because of the economic benefit involved. The other aspect of species sourcing

that is considered legal is sourcing trees from private land. This require the producer to buy the tree species from the owner before the production process. This result is in agreement with the findings of Kakuru (2012) which identifies land owners and forest authorities at the local level in wood production section for charcoal production.

4.2.2 Types and preferred species for charcoal production in Jos metropolis

Most of the participants reveal that the types of tree species used in charcoal production are: *Pterocarpus erinaceus* (Madobiya), *Khaya senegalensis* (Madaci), *Isoberlinia doka* (Doka), *Prosopis Africana* (Kirya), *Erythrophleum suaveonlens* (Gwaska), *Parkia biglobosa* (Dorawa) and *Anogeissus leiocarpus* (Marke). But the overwhelming majority of the participants stated that *Anogeissus leiocarpus* (Marke) is the ‘’best and most preferred species for good and quality charcoal because of its high flammability which make them to absorb little or no water and produce less smoke during usage’’. Majority of the participants reveal that charcoal produced with *Erythrophleum suaveonlens* (Gwaska) and *Prosopis Africana* (Kirya) are not good for cooking due to their hard nature, they are mostly use by iron smelters (Makera).

4.3 Charcoal Production Method in Jos Metropolis

The survey shows that charcoal production in all production sites use traditional earth-pit kiln by mounting the wood on earth and stacked compactly in a pit covered with soils and leaves to reduce air flow and prevent complete burning (Plate 1). It reveals that the capacity of production depends on the quantity of wood load into a kiln and the type of tree species which determines the time taken to produce a single run. This result is in agreement with the findings of FAO (2010) that in most of the developing world, charcoal makers use traditional means or build temporary earthen kilns for each batch.

4.4 Stakeholders along the Charcoal Value-Chain in Jos Metropolis

The findings reveals that charcoal production and marketing in Jos metropolis employ and generate income to many people. It reveals that stakeholders participation start from wood producers for charcoal, charcoal producer, charcoal transporters, charcoal wholesalers, charcoal retailers and consumers who are households and small and micro scale informal business. This findings deny agents as second stakeholders after producers as identify by Shively et al. (2011) in their study aimed at generating data on profits and margins along Uganda’s charcoal value-chain. Charcoal value-chain in Jos metropolis reveal two phase of charcoal value-chain depending on the way charcoal followed from producers to the consumers: the first phase was from producer to primary buyer to

consumer, where by the buyer purchased charcoal from producer and take it directly to consumers. The second phase was from producer to primary buyer to secondary buyer to consumers, where by the primary buyer (charcoal transporter) buy charcoal from producer and take it to the secondary buyer (wholesaler or retailer) and then secondary buyers take it to consumers (households and informal business) Figure 4 illustrates the two phase of charcoal value-chain in Jos metropolis. This results is in agreement with the findings of Kambewa et al. (2007) though there is a little difference at the first scenario, this result show that, producers don't sale charcoal directly to consumers, while Kambewa et al. (2007) stated that producers take charcoal directly to the consumers.

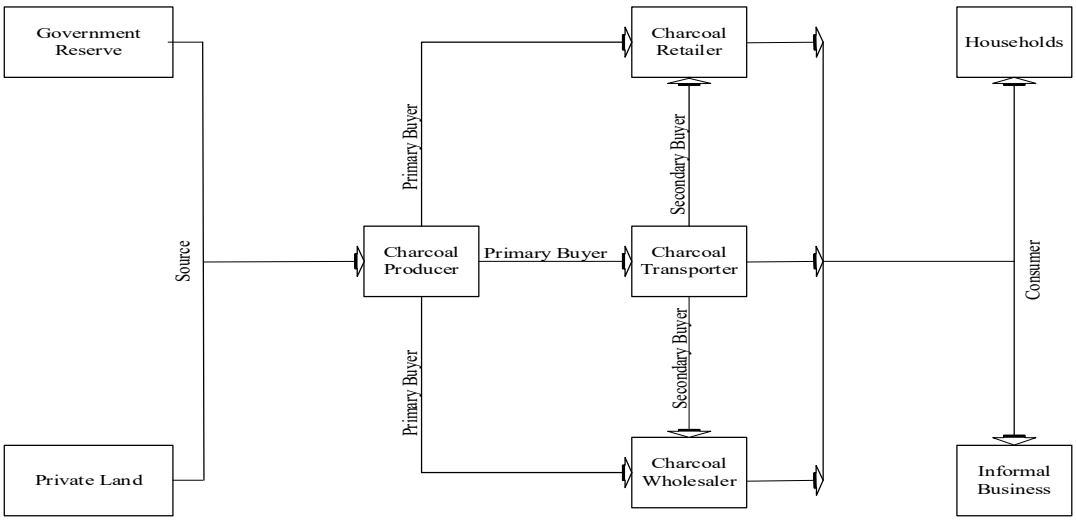

Figure 4: Model of Charcoal Value-Chain in Jos Metropolis
Source: Author's (Field Work), 2017

Charcoal production process in all site of production show monopoly with no division of labour, some participants reveal that they involved their children. It reveal that most of the people producing charcoal are youth struggling to improve their livelihood and that of their family, overwhelming majority of charcoal producers are farmers taken charcoal production as seasonal job.

4.5 Value of Charcoal in Jos Metropolis

The findings reveal that the price of charcoal in Jos metropolis varies with seasons and overwhelming majority of the participants agree that this is because most of the charcoal producer are farmers who they usually go back to farm during rainy season. This leads to the scarcity of charcoal and rise in the demand

of charcoal which in turn lead to increase in price of charcoal. This is in agreement with the findings of Maria (2012) that charcoal price fluctuations occur when charcoal production is hamper during rainy season. Some of the participants reveal that demand of charcoal increase during rainy season as many users of woodfuel shifted to charcoal use due to difficulties in woodfuel usage which in turn give rise to price of charcoal during rainy season, this findings is in agreement with the findings of Kiyawa (2016) that households who use woodfuel on a regular basis switch to charcoal during rainy season because it is difficult to use woodfuel during rainy season.

The result shows that price of a sack of charcoal during dry season is N500 to N600 from the producers, who sell at N1000 to N1200 to the consumers, while during rainy season is, it is bought at N1050 to N1300 and sold at N1600 to N1800 to the consumers. Both the legal and illegal fiscal charges are paid by stakeholders that buy charcoal from producers. These charges are paid to the forest staff at a cost of N50 per sack. The other fiscal charges are paid to all Police and Army roadblocks that they frequently come across, which is not specific but ranges from N50 to N300.

5. CONCLUSION AND RECOMMENDATIONS

To this end, the charcoal market exists in unstable and often unregulated circumstances. The charcoal activities in Jos metropolis are not only unsustainable, but the entire value chain is characterised by local and illegal practices that are not motivating the sustainability of the entire charcoal value chain. These activities include indiscriminate cutting of trees for charcoal production, traditional method of charcoal production that generates greenhouse gases (GHG), and illegal taxes that

Based on the findings of this study, the following recommendations arise from the work:

1. There is need for sufficient forest management, supervision, control practices and increasing forest investment by both forest authorities and other stakeholders involved in charcoal activities in Bauchi and Plateau states, in order to protect the present forest resources from being depleted in charcoal producing communities.
2. The sequential value-chain of charcoal in Jos Metropolis is broken at the centre of the chain, as many wholesalers and retailers of charcoal shun charcoal transporters. They access their charcoal directly from the sources (Charcoal Producers). There is need for provision of license to all stakeholders within the charcoal value-chain, in order to avoid job overlapping and profit pinching.

3. There is need for effective measures to reduce the impacts of charcoal such as: introduction of modern method of charcoal production using new technologies like metal kiln or build block kiln in order to reduce the volume of trees converted to charcoal and also reduces the greenhouse gases emission.
4. There is also need for further researches that will assess the impacts of charcoal production on density and biodiversity of tree species.

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