



## **Identification of Trees Used in Charcoal Production in Bauchi State, Nigeria**

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### ***Abstract***

With an aid of validated copies of structured questionnaire, charcoal tree species, method of charcoal production and conservative effort of those involved in charcoal business were examined in Bauchi State, Nigeria. Out of the twenty Local Government Areas (LGAs) of Bauchi State, six were randomly selected using stratified according to the prevailing tree ecological zones which include: Northern Guinea savannah, Sudan Savannah and Sahel Savannah. The LGAs selected were Toro and Dass from Northern Guinea Savannah, Kirfi and Warji from Sudan Savannah and, Jama'are and Dambam from Sahel Savannah. The study reveals that twenty nine (29) forest tree species from eighteen botanical families were being used FOR charcoal production. The families that had the highest utilization were *Fabaceae*, and *Combretaceae* with four species each used for charcoal production. *Moraceae* had three species; *Caesalpinieae*, *Verbanaceae* and *Anarcadiaceae* had two species each. The families of *melaceae*, *Sapotaceae*, *Myrtaceae*, *leguminaceae*, *balanitaceae*, *Bambacaceae*, *Rhamnaceae*, *Euphobiaceae*, *Boraginaceae*, *Ebonaceae* and *Burseraceae* had the least of one specie each. The results also shows that those involved in charcoal business have never participated in tree planting for environmental rejuvenation but have indicated their interest to

take part in future when planting stock and extension services will be made available. In order to lessen the utilization of charcoal, provision of improved stoves and alternative to fuel wood were recommended among others.

**Keywords:** Charcoal, Conservation, Rare species, Abundant species, Planting stock

## Introduction

Forest is a store house for food and feed, ameliorator of whether, bahitat to a variety of faunal resources and a primary source of renewal energy for domestic and industrial uses. Biofuel is a major source of energy in many urban centres and rural areas of Nigeria. Cooking and most food processing are dependent on fuel wood. Indirectly, therefore, forest affects the stability and quality of food supplies (Wakili, 2008).

Past and present generations were supported by vegetation close to their homes through the provision of valuable woody and non-woody resources. For example, it was reported that about 14 tree species used as a source of fuel wood, fodder, timber, pulp and fibre, and medicine by the people living around the forested area of Madya Pradesh in India (Purashothaman *et al.*, 2000). Over 50 plant species were found to be used as a solution to socio economic problems of people living around

Maladumba Lake and Forest Reserve in Misau, Bauchi State-Nigeria (Abdullahi *et al.*, 2010).

Forest in the tropical developing countries are extensively used for grazing, fuel wood collection and other numerous subsistence needs by rural people even inside Protected Areas (PAs) that have been prioritized for biodiversity conservation (Kothari *et al.*, 1989). The heavy dependence on forest for wood resources has contributed to the accelerating forest and wood land deterioration. This is particularly severe in rural areas and urban centres neighbouring forest estates. Wood is collected and sold directly as fuel wood or processed in to timber of different sizes, and of near recent, is burning the wood in to charcoal which made its transport easy and its associated high economic benefit.

Population explosion is associated with increasing demand for forest resources and its attendant

indiscriminate cutting of tree. The destruction of forest and wood lands accelerates soil degradation, erosion, flood, and loss of biodiversity (Wakili et al., 2009). The design of this study was basically to identify a) Trees used for charcoal b) Method of making charcoal c) Ecological status of charcoal trees in Bauchi State and, d) Conservation effort of those in charcoal business.

## **MATERIALS AND METHODS**

### **Study Area.**

Bauchi State has a land area of 49,259.01 km<sup>2</sup> with a population of 4.6 million people and located between latitude of 9° 12' 30" north of the equator and longitude 8° 50' and 11° east of the Greenwich meridian. The state has a typical tropical climate marked clearly by the dry and rain seasons. The average annual rainfall is 700mm in the northern part and 1300mm in the southern parts. The wettest months are July, August and September, dry season start in November and ends in April. This is a period of harmattan, when the dust loaded North East trade wind from Sahara desert has a marked drying effect on the vegetation and the general climate of the state. Bauchi is one of the state in Northern part of Nigeria that span three district vegetation zones, namely, the Northern Guinea Savannah, Sudan Savannah and Sahel Savannah with Sudan Savannah dominating. Guinea Savannah become manifest as one move along a belt that stretches from extreme western part of the state to the extreme southern part covering Local Government Areas of Toro, Tafawa Balewa, Dass and Bogoro. The Sudan Savannah type of vegetation covers LGAs of Ningi, Warji, Darazo, Kirfi, Alkaleri and Bauchi respectfully. The Sahel zone also known as Semi desert type, becomes manifest from the middle of the state as one moves from south to the north. The character vegetation of the zone is isolated stance thorny shrubs interspersed by short trees (BSOD, 2013).

### **Experimental Design**

Out of the twenty LGAs of Bauchi State, six were randomly selected using Stratified random Sampling Technique in which the state was stratified according to the prevailing three ecological zones that include: Northern Guinea Savannah, Sudan and Sahel Savannah. The LGAs selected were Toro and Dass from Northern Guinea Savannah, Kirfi and warji from Sudan Savannah, and Jama'are and Dambam from Sahel Savannah. A total of eighteen copies

questionnaire were administered each to the selected LGAs. Therefore, one hundred and eight copies of questionnaire were used to extract the needed information from the respondents, out of which there are hundred responses. The collected information were coded and subjected to descriptive statistic in order to classify the responses based on proportion.

### **Procedure for Data Collection**

Structural questionnaire were used in data collection. Information on charcoal producers was sought. Verbal interview was also held with the targeted respondents. The questionnaire was design such that the needed information can be extracted from the target respondents. The important item of the questionnaires cover identification of charcoal trees. Other aspects include the level of commitment of the respondents in the areas of planting charcoal tree species in the fast and their intention to take part in future for environmental conservation. Completed copies of questionnaire were retrieved back from the respondents after three weeks. The of the target respondents was made possible with the intervention of forestry units of the directorate of Agriculture and Natural Resources of the affected LGAs.

### **Data Analysis**

Data collected were coded and subjected to descriptive statistic to pave way for classifying the responses based on proportion.

## **Results and Discussion**

### **Demographic Information of Respondents**

The respondents of this survey were male, married and aged from 41-50 years, which earned 15,001-20,000 naira per month and none have attended formal education (table 1). Their main occupation is forest base as majority of them (>70%) were engaged in charcoal business (table 1), this indicates that felling of trees for charcoal making and the like may likely persist considering their age class and educational background, and following the lean income of the respondents, rapid population growth, coupled with difficulties involved in the acquisition of the alternative sources of domestic energy for household utilization. The collective approach of these trend is the rampant removal of vegetation at the rate beyond the regeneration capacity of the forest and its attendant environmental degradation as a result of desertification and soil

erosion as reported by many researchers (Sanda *et al.*, FAO, 1990; kilahama, 1998; Akpan *et al.*, 2005).

Table 1: Demographic Information of respondents

Variable	Frequency	Percentage
<b>Marital status</b>		
<b>Married</b>	95	95
<b>Single</b>	05	05
<b>Total</b>	<b>100</b>	<b>100</b>
<b>Sex</b>		
<b>Male</b>	100	100
<b>Female</b>	00	00
<b>Total</b>	<b>100</b>	<b>100</b>
<b>Age group</b>		
<b>21-30</b>	18	18
<b>31-40</b>	32	32
<b>41-50</b>	36	36
<b>51-60</b>	10	10
<b>Total</b>	<b>100</b>	<b>100</b>
<b>Monthly income (N)</b>		
	23	23
<b>Below 5,000</b>		
<b>5001-10,000</b>	25	25
<b>10,001 -15,000</b>	45	45
<b>15,001 -20,000</b>	07	07
<b>Above 20,000</b>	00	00
<b>Total</b>	<b>100</b>	<b>100</b>
<b>Occupation</b>		
<b>Charcoal vendor</b>	30	30
<b>Farming</b>	25	25
<b>Charcoal making</b>	45	45
<b>Total</b>	100	100
<b>Educational background</b>		
<b>Non-formal education</b>	100	100

<b>Primary education</b>	00	00
<b>Secondary education</b>	00	00
<b>Tertiary education</b>	00	00
<b>Total</b>	<b>100</b>	<b>100</b>

### Charcoal Tree Species

During the present investigative survey, a total of twenty-nine (29) tree species were found to be used as charcoal tree species in Bauchi State and voucher specimens of the same were collected and deposited in the herbarium of Federal Polytechnic, Bauchi. The Identification of these species was done using local names and later their scientific names were sought from Biological Science Programme of Abu-Bakr Tafawa Balewa University, Bauchi. The species were found to be from eighteen botanical families with *Fabaceae* and *Combretaceae* been most frequent by having four species each, *Mor-asaceae* represented by three species and, *Caesalpinaceae*, *Verbanaceae* and *Anarcadiaceae* were represented by two species each. The families of *melaceae*, *Sapotaceae*, *Myrtaceae*, *papilionaceae*, *leguminaceae*, *balanitaceae*, *Bambacaceae*, *Rhamnaceae*, *Euphobiaceae*, *Boraginaceae*, *Ebonaceae* and *Burseraceae* were represented by a species each; *Khaya senegalensis*, *vitellaria paradoxa*, *syzyguim guinense*, *pterocarpus erinaceus*, *Tamaridus indica*, *Balanites aegyptiaca*, *Bombax ostatum*, *ziziphus spina-christi*, *Hymenocordia acida*, *Cordia Africana*, *Diospyros mesphiliformis* and *Bosweillia dalziellii* respectively (table 2). The most frequently used species are preferred because of the quality of their charcoal. Others are used just because of their availability. The choice of the resource is not only related to the energy quality but also to the availability.

**Table 2: Charcoal tree species in Bauchi State**

Family	Scientific Names	Local names
<i>Fabaceae</i>	1. <i>Acacia albida</i> A. Chev	Gawo
	2. <i>Prosopis africana</i> (guii. & perr.)	Kiryra
	3. <i>Parkia biglobossa</i> (Jacq.) R.Br. ex G.Don	Dorawa Tawatsa
	4. <i>Entada afriana</i> Guill.and perr	

<b><i>Combretaceae</i></b>	5. <i>Anogeissus leiocarpus</i> (DC) Guill	Marke and per Tarauniya
	6. <i>Combretumhypopilinum</i> Diels	Wuyan Okafor damo
	7. <i>Combretummolle</i> R. Br	Baushe
	8. <i>Terminalia glaucescens</i> Planch	
<b><i>Caesalpinaceae</i></b>	9. <i>Daniella oliveri</i> (Rolfe) Hutch. & Dalz.	Maje Doka
	10. <i>Isobertiniadoka</i> Craib & Stapf	
<b><i>Bombacaceae</i></b>	11. <i>Bombax costatum</i> Pellgr. Et vuillet	Gurjiya
<b><i>Moraceae</i></b>	12. <i>Ficus bengalensis</i>	Yande
	13. <i>Ficusplatyphyla</i> Del. Holl	Gamji
	14. <i>Ficussycomorus</i> L	Baure
<b><i>Anarcadiaceae</i></b>	15. <i>Lannaecida</i> A. Rich	Faru
	16. <i>Sclerocaryabirrea</i> (A. Rich.) Hochst.	Danya
<b><i>Boraginaceae</i></b>	17. <i>Cordial Africana</i> Lam	Alilliba
<b><i>Ebonaceae</i></b>	18. <i>Diospyrus mesphiliformis</i> Hochtst. Ex A. DC	Kanya
<b><i>Euphorbaceae</i></b>	19. <i>Hymenocordia acida</i> Tul	Jan yaro
<b><i>Rhamnaceae</i></b>	20. <i>Ziziphus spina-christi</i> (L.) Desf.	Kurna
<b><i>Meliaceae</i></b>	21. <i>Khaya senegalensis</i> (Desr) A. Juss	Madaci
<b><i>Sapotaceae</i></b>	22. <i>Vitellaria paradoxa</i> Gaertner C F	Tabo
<b><i>Verbenaceae</i></b>	23. <i>Vitex doniana</i> L.	Dinya
	24. <i>Vitex simplicifolia</i> Oliv.	Dinyar biri
<b><i>Myrtaceae</i></b>	25. <i>Syzyguim guineese</i> (Wild) DC	Malmo
<b><i>Papilionaceae</i></b>	26. <i>Pterocarpus erinaceus</i> Poir.	Madpbiya
<b><i>Leguminoceae</i></b>	27. <i>Tamarindus indica</i> Linn	Tsamiya
<b><i>Balanitaceae</i></b>	28. <i>Balanites aegyptiaca</i> Del	Aduwa
<b><i>Burseraceae</i></b>	29. <i>Boswellia Roxb</i> ex. Co	Ararrabe

### Method of Charcoal Production

Depending on the season (Wet or Dry season), a piece of land measured 3m by 3m or 5m by 5m or 2m by 2m is cleared and dug 2m – 3m deep to form charcoal tank. The selected charcoal tree is cut down with an axe or power saw and the entire trunk alongside the branches are cut into log of 1m – 1.5m. The logs

are piled to the capacity of the charcoal tank with layers of dry combustible fuels (grasses and twigs) in between the layers of logs and any space between the wall of the tanks and the logs. Instead of floral fuels, fossil fuels may be used and such is sprayed on the logs (fossils used are kerosene and used/condemned engine oil). The charcoal tank is then covered with the fill-back soil leaving a small hole (plunger hole) through which logs will be ignited after which it is covered with mud. The charcoal tank remains covered for a period of 5 days in the dry season and 10 days during the rain/wet season. Any smoke leakage within the production period is blocked to guide against poor production (Ash and fragmentation into useless pieces).

Instead of using underground tank, the chopped wood can just be piled on the ground surface and the entire heap is covered with mud leaving a plunger hole through which the wood can be ignited using kerosene and a lighter/matches. To ease ignition, layers of combustible materials are placed between the layers of logs or the logs sprayed with fossil fuel (kerosene and or engine oil) before the logs' heap is covered with mud. The surface charcoal tank method is usually practices during wet season (May- October) when soil is moist and therefore easy to collect the needed mud for the production. The underground tank method is more practiced in dry season (November-April) so that it can serve s production oven throughout the entire season.

### **Biological Status of charcoal Tree Species in Bauchi State.**

Table3 depicts the relative abundance scale of occurrence (Ecological status) of charcoal tree species in Bauchi State in which eleven (11) species were found rare, eight species occasional and four frequent.

Abundant has three species; *lenna acida*, *combretum molle* and *Tamarindus indica* and only two species were found to be in either Abundant; *Anogeissus leiocarpus* and *Diospyros mesphiliformis*. The few species which were found to be in either abundant or very abundant class were reported to be used for medicinal and forage purposes and therefore may soon lose their ecological ranking because whenever species selection for a particular purpose occurred, the species concerned stand the chance of an ecological threats and extinction (Wakili and Abdullahi, 2013, 2009).

The continues indiscriminate felling of these tree species irrespective of high or low caloric value of the same and with little or no effort in their generation by whatever means has rendered most of these important floral resources into a

state of an ecological rareness (table 4). Abdullahi *et al.*, 2010 reported that such species as *Acaci sieberiana*, *Acacia macristachya*, *Khaya senegalensis*, *Borassus aethiopium*, *Cieva penetendra*, *Bombax costatum*, *AcaBosweilla dalzilli*, *Daniella Cordia Africana*, *Ficus bengalensis*, *Ficus Sycomorus*, *Bosweilla dalzilli*, *Daniella Cordia Africana*, *Ficus bengalensis*, *Ficus Sycomorus*, *cia nilotica*, *Ficus ycormorus*, *ziziphus spina-christi* and *Syzygium guinene* were rare in Savannah region of Nigeria.

Table 3: Ecological Status of Charcoal tree Species in Bauchi State

Relative abundance scale	Species
Rare	Bosweilla dalzilli, Daniella Cordia Africana, Ficus bengalensis, Ficus Sycomorus, Vitellaria paradoxa, Boswellia dalziella, Pterocarpus erinaceus, Ficus sycomorus, Parkia biglobossa Syzyguim guinense and Acacia albida
Occasional	Balanite aegyptiaca, Tamarindus indica, Sclerocarya birrea, vitex doniana, Vitex simplilifolia, Hymenocordia acida, Prosopis Africana and Teerminalia glaucescens
Frequent	Khaya senegalensis, Entada Africana, Parkia biglobossa and Bombax costatum,
Abundant	Lenna acida, Cambretum molle and Tamarindus indica
Very abundant	Anogeissus leiocarpus and Diospyros mesphiliformis,

### Conservation efforts of respondents in the past and willingness to take part in future

Majority of respondents (98%) are aware of tree planting campaign going on with a view to awaken all and sundry on the need to embrace tree planting for environmental conversation and sustenance but ironically, only 4% had ever participated in tree planting even though all their businesses wholly depends on trees and related floral resources (table 1).

The non-participation of the respondents in environmental rejuvenation was attributed to non-availability of desired seedlings, the notion that forest is a gift of nature that will end and lack of planting ethics and etiquettes. The believe

that forest resources are endless formed the majority opinion of the respondents (60%), this was followed by lack of technical knowledge of tree planting (25%) and only 15% claimed unavailability of planting stock (table 4).

However, the respondents indicated their desire to take part in future tree for environmental rejuvenation and perpetuation that will ensure availability of tree resources for charcoal making and other wood base products.

Table 4. Conservation effort of respondents in the past and willingness to continue

Variable	Frequency	Percentage
Are you aware of tree planting campaign?		
<b>Yes</b>	98	98
<b>No</b>	02	2.0
<b>Total</b>	100	100
Ever Participated in tree planting?		
<b>Yes</b>	04	4.0
<b>No</b>	96	96
<b>Total</b>	<b>100</b>	<b>100</b>
Reasons for non-participation?		
<b>Non-availability of desired seedlings</b>	15	15
<b>Forests are inexhaustible resources</b>	60	60
<b>Lack of knowledge of planting</b>	25	25
<b>Total</b>	<b>100</b>	<b>100</b>
Willingness of respondents in future planting		
<b>Yes</b>	95	95
<b>No</b>	05	5.0
<b>Total</b>	<b>100</b>	<b>100</b>

### Recommendations

The following are here by recommended:

1. Effort should be intensified in the production and planting of multipurpose tree species by both government and non-governmental organizations.

2. The rural community should be oriented on the importance of sustainable collection of forest resources.
3. Government should take advantage of the interest shown by the respondents on environmental protection and perpetuation, and come up with integrated extension project that will teach rural people where, how and when to cut trees for charcoal making.
4. In order to lessen the use of fuel wood, improved stove be made available to rural areas at little or no cost.
5. That alternative to fuel wood be made available to respondents at very affordable rate and on perpetuity.
6. That woodlot plantation project should be installed in northern parts of Nigeria to provide the needed biofuel and combat desertification.

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