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## EVALUATION OF CHARCOAL PRODUCTION IN MAKURDI AND GUMA LOCAL GOVERNMENT AREAS OF BENUE STATE, NIGERIA.

## EXAMEN DE PRODUCCIÓN DE CARBÓN VEGETAL EN GOBIERNOS LOCALES DE MAKURDI Y GUMA ÁREAS DEL ESTADO DE BENUE, NIGERIA.

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### ABSTRACT

Economic adversity, scarcity, joblessness and upsurge in the price of oil have dictated the need for people to find alternative means of making a living in respect of domestic cooking energy in Nigeria. Therefore, this work examined charcoal production in both Makurdi and Guma Local Government Areas (LGAs) of Benue state to ascertain its impacts, contributions to rural livelihood and efforts in replanting trees felled for charcoal production. Villages involved in charcoal production were identified using snowball sampling techniques. A Multi-stage Sampling Technique was employed to select respondents for data collection as personal interview and semi-structured questionnaire were used. Twelve villages were selected purposively from four Council Wards out of eleven in Makurdi LGA, while six villages were selected from two Council Wards out of ten in Guma LGA. Three charcoal producers and marketers were selected in each village for administration of questionnaire. Results revealed that males (85.4%, 83.7%) were higher than females (14.6%, 16.3%) in charcoal production in both Makurdi and Guma LGAs, respectively. Youths between ages of 21-30 years (27.1% and 32.6%) in Makurdi and Guma with highest level of secondary education were foremost in the business. *Prosopis africana* was the most preferred tree species for charcoal production in the area. Despite fewer number of Council Wards chosen in Guma LGA, respondents felled as much as 132 trees per week for charcoal production against 109 trees felled in Makurdi LGA. The results also revealed that on weekly bases, 22 charcoal producers in Makurdi earned ₦25,000, while 18 in Guma LGA earned between ₦11, 000 - ₦15, 000 from charcoal business. The result further revealed that, respondents met family needs as feeding family members, paying school fees and purchase of motorcycles. The major health hazard encountered by respondents

in Makurdi and Guma LGAs was fire burn (50% and 25%), respectively. Efforts in replanting felled trees in the study area was minimal through plantation forestry and agroforestry. In conclusion, charcoal production was observed to improve socio-economic benefits to people. However, it was recommended that alternative sources of livelihood should be provided for the people to mitigate the adverse effects of deforestation in the State.

Key words: Charcoal, deforestation, livelihood, *Prosopis africana*, wood species.

## RESUMEN

La adversidad económica, la escasez, el desempleo y el aumento en el precio del petróleo han dictado la necesidad de que las personas encuentren medios alternativos para ganarse la vida con respecto a la energía doméstica para cocinar en Nigeria. Por lo tanto, este trabajo examinó la producción de carbón vegetal tanto en Makurdi como en el estado de Guma LGAs de Benue para determinar su impacto, sus contribuciones al sustento rural y los esfuerzos para replantar árboles talados para la producción de carbón vegetal. Las aldeas involucradas en la producción de carbón vegetal fueron identificadas utilizando técnicas de muestreo de bolas de nieve. Se empleó una técnica de muestreo en varias etapas para seleccionar a los encuestados para la recolección de datos, ya que se utilizaron entrevistas personales y cuestionarios semiestructurados. Doce aldeas fueron seleccionadas a propósito de cuatro salas del Consejo de cada once en Makurdi LGA, mientras que seis aldeas fueron seleccionadas de dos salas del Consejo de cada diez fueron diez en Guma LGA. Se seleccionaron tres productores y comercializadores de carbón vegetal en cada aldea para la administración del cuestionario. Los resultados revelaron que los hombres (85.4%, 83.7%) fueron más altos que las mujeres (14.6%, 16.3%) en LGAs de Makurdi y Guma, respectivamente. Los jóvenes entre las edades de 21-30 años (27.1% y 32.6%) en Makurdi y Guma con el nivel más alto de educación secundaria fueron los principales en el negocio. *Prosopis africana* fue la especie de árbol más preferida para la producción de carbón vegetal en el área. Sin embargo, a pesar de la menor cantidad de salas del Consejo elegidas en Guma LGA, los encuestados talaron 132 árboles por semana para la producción de carbón vegetal contra 109 árboles derribados en Makurdi LGA, que suman 241 árboles por semana. Los resultados también revelan que en las bases semanales, 22 productores de carbón en Makurdi ganaron N25,000, mientras que 18 en Guma LGA ganaron entre N11, 000 - N15, 000 del negocio del carbón. El resultado reveló además que, los encuestados satisfacían las necesidades de la familia como alimentación, pago de cuotas escolares y compra de motocicletas. El principal peligro para la salud encontrado por los encuestados en LGAs de Makurdi y Guma fue la quema por incendio (50% y 25%), respectivamente. Los esfuerzos para replantar árboles en el área de estudio fueron mínimos a través de la plantación forestal y la agrosilvicultura. En conclusión, se observó que la producción de carbón vegetal mejora los beneficios socioeconómicos para las personas. Sin embargo, se debe proporcionar una fuente alternativa de sustento para que las personas mitiguen el efecto adverso de la deforestación.

Palabras clave: carbón vegetal, deforestación, medios de vida, *Prosopis africana*, especies de madera.

## INTRODUCTION

Household energy for rural and urban centers in Nigeria has become paramount importance on daily bases because of its use for various purposes. Zaku *et al.*, (2013) revealed that in rural areas of developing countries are reliant on biomass fuels such like wood fuel, charcoal and dried dung for their energy consumption. Wood fuel as a source of energy function remarkably in household energy demands. As a result of growing economic difficulties in Nigeria, many people are finding it continuously hard to afford conventional fuels (Zaku *et al.*, 2013). Kammen and Lew, (2005) indicated that charcoal was the primary energy source for cooking, major source of revenue generation and environmental degradation in rural areas of most African countries including Nigeria.

The demand for charcoal resulting from its continuous production is on the increase in developing countries as well as international market respectively (Adeniji *et al.*, 2015). Charcoal has become one of the major products or portions of fuel wood. Wood charcoal is produced from wood while wood materials are derived from trunk, branches and other parts of trees and shrubs. These parts are processed by burning to lease energy. Charcoal is reported to be a significant domestic product for decades and has extensive market acceptance. Charcoal is found to be the primary urban fuel in most of Africa and around developed countries and is a major source of income (Jamala *et al.*, 2013). Anozie *et al.*, (2006) claimed that the desire to substitute energy sources due to the effects of global warming has put charcoal in the forefront of the global market.

Olori (2009) reported that charcoal production was regarded as one of the activities leading to uncontrolled clearing of forest cover in Nigeria. This condition is worsened by unlawful commercial logging. Nigeria has the world highest deforestation rate of primary forests according to revised deforestation figures according to (FAO, 2005). From the report, between 2000 and 2005 the country lost 55.7% of its primary forests which is defined as forests with no visible signs of past or present human activities. Logging, subsistence agriculture, and the collection of fuelwood are cited as leading causes of forest clearing in the West African country (FAO, 2005). Charcoal is normally produced in the rural areas and transported to the urban areas for consumption (Tunde *et al.*, 2013).

FAO, 2017 also reported that in Nigeria, from the north to west and all across the country charcoal production and sales were the order of the day. The report also has it that many trees were felled for the production of charcoal in commercial quantity and unfortunately, no replacement planting is being done. FAO, 2017 further stated that, visit to some of the villages revealed that danger was impending as forests are becoming bare and vegetation were getting thinner. Olagunju (2006) reported that, as a result of problems associated with gas and kerosene in the recent years in Nigeria, substitution of charcoal as alternative fuels by different categories of people has increased, and this will further worsen deforestation challenges in the country.

Tunde *et al.*, (2013) reported that recently, economic adversity, scarcity, joblessness and upsurge in the price of oil have dictated the need for people to find alternative means of making a living in respect of domestic cooking energy in Nigeria. High demand for charcoal in the urban areas of the country motivated a lot of people especially men both young and old in the rural areas into the business

of charcoal production. This study was therefore undertaken to assess charcoal production in both Makurdi and Guma LGAs of Benue state to ascertain its impacts, contributions to rural livelihood and efforts in replanting trees felled for charcoal production.

## MATERIALS AND METHODS

**Study Areas:** The study was conducted in Makurdi and Guma LGAs of Benue State. Makurdi is located on latitude  $6^{\circ} 22'$  and  $7^{\circ} 56'$  North and longitude  $7^{\circ} 37'$  and  $9^{\circ} 5'$  East. It lies within the Guinea savannah region. There are eleven (11) Council Wards in Makurdi L.G.A. They include: Agan, Ankpa/wadata, Bar, Central/south Mission, Clerks/market., Fildi, Mbalagh, Modern Market, North Bank I, North Bank II and Wailomayo Council Wards. The annual rainfall is between 100 and 150 cm which extent between April to October while dry season is from November to March. The trees and grasses are very green during the rainy season and shed their leaves in the dry season while grasses turn brown. The plants have a way of adapting themselves to the dry season.

Guma LGAs is situated between latitude  $7^{\circ} 56'$  and  $0.01''$  North and longitude  $8^{\circ} 46' 0.01''$  East of Greenwich Meridian. The LGA is bounded to the east by Logo LGA, to the south by Makurdi and Tarka LGAs and to the west by Doma LGA of Nasarawa State. Guma LGA has the land mass of 240.000 square km, the LGA had a total population of 191,599 people. There are 10 Council Wards Guma LGA. They include: Kaambe, Abinsi, Uvir, Saghev, Ndzorov, Nyiev, Mbabai, Mbayer or Ymanadev Mbawa, and Mbasombo. The vegetation of the study area is guinea savanna characterizes by dense grass cover consisting of dominant species of trees like, *Daniellia oliveri*, *Azadirachta indica*, *Khaya senegalensis*, *Prosopis africana*, *Parkia biglobosa*, *Vitellaria paradoxa*, *Tamarindus indica* and a host of others.

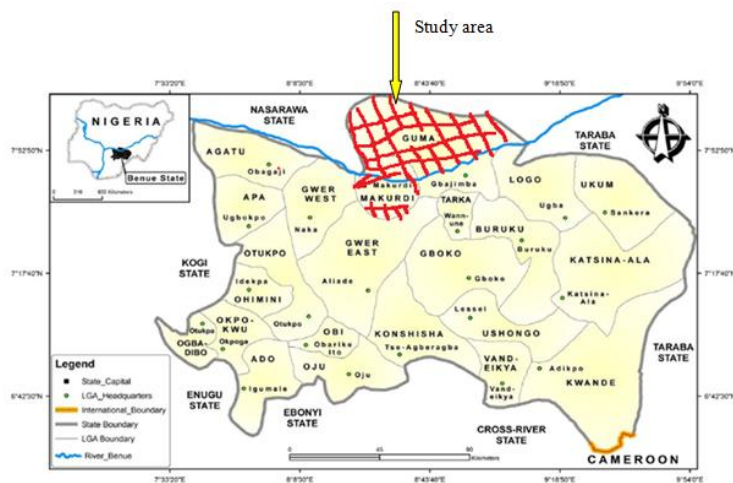


Figure 2. Map of Benue State showing Makurdi and Guma LGAs

Source: Ministry of land and survey (2006).

## MATERIAL AND METHODS

**Experimental Design:** The villages involved charcoal production were identified using snowball sampling techniques (by inquiring from selected target group) according to Ekhuemelo *et al.*, (2017).

Thereafter, the identified charcoal producing villages were visited as stated below. The target groups include charcoal marketers, farmers, villagers and village head in the study areas.

A multi-stage sampling technique was employed to select respondents for data collection as personal interview and semi-structured questionnaire were used. Twelve villages were selected purposively from four Council Wards out of eleven in Makurdi LGA, while six villages selected from two Council Wards out of ten were ten in Guma LGA. The reason for selecting fewer Council Wards in Guma LGA was because the incessant herdsman attacks in the area. Three charcoal producers/production sites were selected in each village among the identified ones. Three copies of questionnaire were administered in each village as shown in table 1.

Table 1: administration of questionnaire in the study area.

S/No.	LGA	Council Wards	No of villages	Target of respondent in each village	No. of questionnaires	Total no. questionnaires
1	Makurdi	4	12	charcoal producers	3	72
				charcoal marketers	3	
2	Guma	2	6	charcoal producers	3	36
				charcoal marketers	3	
				Total		108

The administered questionnaire was divided into section A, B, C, D and E respectively. Section A, was on demography of respondents. Section B, centered on charcoal production process. Section C, addressed issues of socio-economics of charcoal production. Section D, focused on environmental impacts of charcoal production while Section E, assessed safety measures in the charcoal production

Data Collection Techniques: A total number of 108 copies of semi-structured questionnaire were used in the two LGAs. That is, 72 in Makurdi and 36 in Guma LGAs. Three copies of the semi-structured questionnaire were administered to charcoal producers and charcoal marketers respectively to elicit information in the study areas. In addition to questionnaire, personal interview with charcoal producers and charcoal marketers was done and visit was made to charcoal production sites

Data Analysis: Data collected from this study were analyzed with descriptive statistics.

## RESULTS

Demographic Data of Respondents in the Study Areas: Table 2 shows the demographic information of respondents in the various Council Wards in Makurdi and Guma LGAs of Benue State. In Makurdi, LGA 85.4% of the respondents were male while 14.6% were female. In Guma LGA, 83.7% of the total respondents were male while 16.3% were female.

In Makurdi LGA, 8.3% of the respondents were within age class of 0-20, while 27.1% of the respondents were within the age class of 21-30. Whereas 25% respondent was within aged 31-40, majority of respondents 35.4% were within age class of 41-50. However 4.2% of respondents were age class 51 and above. In Guma LGA, 20.9% of the respondents were within age class of 0-20, while majority (32.6%) was in the age class of 21-30. The result also shows that 16.3% respondent was in the age class of 31-40, 14.0% in the age class of 41-50, and 16.3% of them were aged 51 and above.

In Makurdi LGA, educational level of the respondents shows that 35.4% had primary education, 45.8% secondary education and 18.8% tertiary education. In Guma LGA, 30.2% of the respondents had primary education, 41.9% secondary education and 21.9% tertiary education. In Makurdi LGA, majorities (58.3%) of respondents were farmers, 12.5% respondents were civil servants, 22.9% traders and 6.2% had other occupations. In Guma LGA, most respondents (58.1%) were farmers, 18.6% of the respondents were civil servants, 18.6% were traders and 4.7% had other occupation.

In Makurdi LGA, 54.2% of respondents were married 22.9% were unmarried, 10.4% were divorced, and 2.1% were widows while 10.4% were widowers. In Guma LGA, majority of respondent (51.2%) were married, 37.2% were unmarried, 7% were divorced while 4.7% were widowers.

Species of Wood Mostly Used for Charcoal Production Makurdi and Guma LGAs: Table 3 shows lists of wood species, family, common and local names (Tiv) mostly used for charcoal production in Makurdi and Guma LGAs. In Makurdi LGA, twelve different wood species were commonly used for charcoal production while in Guma LGA, eight were used. Wood species common to both LGAs were *Vitex doniana*, *Vitellaria paradoxa*, *Prosopis Africana*, *Khaya Africana*, *Anogeisus leiocarpus* and *Manifera indica*.

Table 2: Demographic information of the respondent in Makurdi and Guma LGAs of Benue State

Variables	Makurdi LGA		Guma LGA	
	F	%	F	%
<b>Gender</b>				
Male	41	85.4	36	83.7
Female	7	14.6	7	16.3
Total	48	100.0	43	100.0
<b>Age</b>				
0-20	4	8.3	9	20.9
21-30	13	27.1	14	32.6
31-40	12	25.0	7	16.3
41-50	17	35.4	6	14.0
51 and above	2	4.2	7	16.3
Total	48	100.0	43	100.0
<b>Level of Education</b>				
Primary	17	35.4	13	30.2
Secondary	22	45.8	18	41.9
Tertiary	9	18.8	12	27.9
Post Tertiary	0	0	0	0
Total	48	100.0	43	100.0
<b>Occupation</b>				
Civil Servant	6	12.5	8	18.6
Farmer	28	58.3	25	58.1
Trading	11	22.9	8	18.6
Others	3	6.2	2	4.7
Total	48	100.0	43	100.0
<b>Marital Status</b>				
Married	26	54.2	22	51.2
Unmarried	11	22.9	16	37.2
Divorced	5	10.4	3	7.0
Widow	1	2.1	0	0
Widower	5	10.4	2	4.7
Total	48	100.0	43	100.0

Table 3: Wood Species used for charcoal production in Makurdi and Guma LGAs

No	LGA	Scientific name	Family	Common Name	Tiv Name
1	Makurdi	1 <i>Mangifera indica</i>	Anacardiaceae	Mango	Mango
	LGA	2 <i>Azelia africana</i>	Caesal pinoideae	Cotton wood	Yiase
		3 <i>Burkea africana</i>	Caesalpiniaceae	Wild syrnga	Gbaghbongom
		4 <i>Terminelia avicenniodes</i>	Combretaceae	-	Kuegh
		5 <i>Anogeissus leiocarpus</i>	Annonaceae	Chewing stick tree	Maaki
		6 <i>Tectona grandis</i>	Lamiaceae	Teak	Kpar
		7 <i>Khaya senegalensis</i>	Miliaceae	Mahogany	Haa
		8 <i>Prosopis africana</i>	Mimosoideae	Iron wood	Gbaaye
		9 <i>Vitellaria paradoxa</i>	Sapotaceae	Shea butter tree	Ichamegh
		10 <i>Vitex doniana</i>	Verbenaceae	Black plum	Hulu
		11 <i>Cassia siemea</i>	Verbenaceae	-	
		12 <i>Gmeliana arborea</i>	Verbenaceae	Melina	
2	Guma	1 <i>Mangifera indica</i>	Anacardiaceae	Mango	Mango
	LGA	2 <i>Anogeissus leiocarpus</i>	Combretaceae	Chewing stick tree	Maaki
		3 <i>Tectona grandis</i>	Lamiaceae	Teak	Kpar
		4 <i>Khaya senegalensis</i>	Miliaceae	Mahogany	Haa
		5 <i>Prosopis africana</i>	Mimosoideae	Iron wood	Gbaaye
		6 <i>Vitellaria paradoxa</i>	Sapotaceae	Shea butter tree	Ichamegh
		7 <i>Gmelina arborea</i>	Verbenaceae	Gmelia	Melina
		8 <i>Vitex doniana</i>	Verbenaceae	Black plum	Hulu

Ranking of most Preferred Wood species for Charcoal Production in Makurdi and Guma LGAs: Table 4 shows the ranking of most preferred wood species used for charcoal production in the study areas. In Makurdi LGA, *Prosopis africana* was most preferred at 24.3%. This was followed by *Khaya Senegalensis* (19.9%), *Tectona grandis* (12.7%), *Angoeissus leiocarpus* (9.9%), *Gmelina arborea* (9.4%), *Vitellaria paradoxa* (8.3%), *Burkea africana* (5.5%), *Mangifera indica* and *Vitex doniana* (2.8%) respectively *Azelia africana* (2.2%), *Cassia siemea* and *Terminelia avicenniodes* (1.1%) respectively. In Guma LGA, *Prosopis africana* was mostly preferred at 24.2%. This was followed by *Khaya senegalensis* at 18.8%, *Tectona grandis* (18.2%), *Angoeissus leiocarpus* (13.3%), *Gmelina arborea* (10.3%), *Vitellaria paradoxa* (7.3%), *Vitex doniana* (4.2%) and *Mangifera indica* (3.6%). Number of logs felled per production/duration of charcoal production process: table 4 shows number of villages, logs felled and duration of charcoal production process in the study area. In Makurdi LGA, total number of logs felled per production was 109 trees with Tse Taki having the highest number (14.9%) and Tse Uperegh with the least number of 3.7% per production

In Guma LGA, the total number of logs felled per production was 132 trees with Umerge village having the highest number (37%) and Nyiev with the least number of 6% per production. Duration of



the charcoal processing was one week and the season of production varied between the raining and dry season in both LGAs.

Table 4: Ranking of most preferred wood species mostly used for charcoal production in Makurdi and Guma LGAs.

LGA	Scientific Name	F	%	Ranking	Other uses of preferred tree species
MAKURDI	<i>Prosopis africana</i>	44	24.3	1	Local bridge construction, Fire wood Medicinal purpose, Fruit for soap making
	<i>Khaya senegalensis</i>	36	19.9	2	Roofing of houses, Fire wood, Medicinal purpose, Local bridge construction
	<i>Tectona grandis</i>	23	12.7	3	Fire wood, Medicinal purpose, Roofing of house
	<i>Anogeissus leiocarpus</i>	18	9.9	4	Roofing of houses, Fire wood
	<i>Gmelina arborea</i>	17	9.4	5	Fire wood, Roofing of house Medicinal purpose
	<i>Vitellaria paradoxa</i>	15	8.3	6	Oil for wound clotting, Fire wood
	<i>Burkea africana</i>	10	5.5	7	Local bridge construction, Medicinal purpose Fire wood
	<i>Mangifera indica</i>	5	2.8	8	Medicinal purpose, Roofing of houses Fire wood
	<i>Vitex doniana</i>	5	2.8	8	Fire wood, Medicinal purpose Roofing of houses
	<i>Azelia africana</i>	4	2.2	9	Soap making, Local medicine
	<i>Cassia siemea</i>	2	1.1	10	Medicinal purpose, Fire wood
	<i>Terminelia avicenniodes</i>	2	1.1	10	Fire wood, Medicinal purpose
	Total		181	100	
GUMA	<i>Prosopis africana</i>	40	24.2	1	Fruit for soap making, Local bridge construction Medicinal purpose, Fire wood
	<i>Khaya senegalensis</i>	31	18.8	2	Local bridge construction, Medicinal purpose Roofing of houses, Fire wood
	<i>Tectona grandis</i>	30	18.2	3	Medicinal purpose, Fire wood, Roofing of house
	<i>Anogeissus leiocarpus</i>	22	13.3	4	Fire wood, Roofing of house
	<i>Gmelina arborea</i>	17	10.3	5	Roofing of house, Fire wood, Medicinal purpose
	<i>Vitellaria paradoxa</i>	12	7.3	6	Soap making (fruit), Medicinal purposes
	<i>Vitex doniana</i>	7	4.2	7	Roofing of houses, Medicinal purpose, Fire wood
	<i>Mangifera indica</i>	6	3.6	8	Produces edible fruits, Medicinal purpose Fire wood
Total		165	100		

Respondents' Efforts in Tree Planting in the Study Area: Table 5 shows the respondents' efforts in tree planting exercise. In Makurdi LGA, there was high percentages of forest plantation in Tse Agbee, Tse Ati, Tse Madugu, Tse Uperegh, Tse Mkir and Tse Agbede, with 21.4%, 14.3%, 14.3%, 14.3%,

14.3%, 14.3%, respectively, mainly through forest plantation. Whereas in Guma LGA, there was high percentage of forest plantation in Ukpam, Umenger, Ukohol, Udeh (29.2%, 25.0%, 16.7%, 16.7%) respectively. The result indicates high level of forest plantation practiced by respondents in the study area.

The result further reveals that all the villages in Guma LGA were involved in plantation forestry (Table 6), home garden and agroforestry methods of tree planting exercise. However, in Makurdi LGA, out of 10 villages involved involved charcoal production, 2 (Tse Ati and Tse Taki) were not practicing home garden and agroforestry, while 1 village (Tse Bume) was also not involved on plantation forestry.

Table 5: Number of logs felled and duration of charcoal production process in Makurdi and Guma

LGA	Council Ward	Villages	No of log felled per production		No of log felled per week		Duration of production Process	Season for the production
			F	%	F	%		
Makurdi	Agan	Tse Ati	12	11.0	21	11.2	1-7 days	Raining season
		Tse Ancha	6	5.5	19	10.1	-	Dry season
	Mbalagh	Tse Taki	16	14.7	28	14.9	-	Dry season
		Tse Madugu	12	11.0	13	6.9	-	Raining season
		Tse Anula	12	11.0	19	10.1	-	Raining season
		Tse Bume	13	11.9	48	25.5	-	Raining season
	Modern Market	Tse Uperegh	4	3.7	4	2.1	-	Dry season
		Tse Mkir	7	6.4	7	3.7	-	Dry season
		Tse Agbee	14	12.8	14	7.4	-	Dry season
		Tse Agbede	9	8.3	9	4.8	-	Raining season
		Masenegen	4	3.7	6	3.2	-	Raining season
		Total	109	100	188	100		
Guma	Uvir	Torkula	29	22.0	32	21.0	1-7 days	Dry season
		Umenger	38	28.8	37	24.2	-	Dry season
	Nyiev	Ukpam	24	18.2	31	20.3	-	Dry season
		Ukohol	19	14.4	26	17.0	-	Dry season
		Udeh	14	10.6	16	10.5	-	Dry season
		Nyiev	8	6.0	11	7.0	-	Raining Season
		Total	132	100	153	100		

LGAs. Source: Field Survey, 2017

Earnings and number of employees in charcoal production in Makurdi and Guma LGAs: Table 7 presents the weekly earnings from charcoal production and the number of employees in the production process. The result shows that majority of charcoal producers (22) earned above ₦25,000 weekly in Makurdi LGA whereas in Guma LGA, majority (18) earned ₦11,000 - ₦15,000 weekly. The least earning was between ₦5,000 and ₦10,000 by 11 producers in Makurdi LGA and 10 in Guma LGA respectively. All respondents had employees in their charcoal business with Tse Ancha having the highest (22.7%) in Makurdi and 13% in Guma LGAs.

Benefits from Charcoal Production in the Study Area: Figure 1 shows the benefits of charcoal production in Makurdi and Guma LGA of Benue State. The result shows that in both LGAs, feeding and clothing family members was the highest achievement following by payment of school fees, and marrying of wives. Other achievements include building of houses, purchase of motorcycles and capital for other business.

Table 6: Respondents efforts in tree planting in Makurdi and Guma LGAs

LGA	Council Wards	Villages	Replanting Methods					
			Plantation Forestry		Home Gardens		Agroforestry	
			F	%	F	%	F	%
Makurdi	Agan	Tse Ati	2	14.3	0	0.0	0	0.0
	Mbalagh	Tse Taki	1	7.1	0	0.0	0	0.0
	"	Tse Madugu	2	14.3	2	16.7	1	7.1
	"	Tse Anula	0	0.0	2	16.7	2	14.3
	"	Tse Bume	0	0.0	0	0.0	1	7.1
	Modern Market	Tse Uperegh	2	14.3	2	16.7	1	7.1
	"	Tse Mkir	2	14.3	2	16.7	4	28.7
	"	Tse Agbee	3	21.4	3	25.0	3	21.4
	"	Tse Agbede	2	14.3	1	8.2	2	14.3
		Total	14	100	12	100	14	100
Guma	Uvir	Torkula	3	12.5	3	27.3	2	9.1
	"	Umenger	6	25.0	2	18.2	5	22.7
	"	Ukpam	7	29.2	1	9.1	8	36.4
	Nyiev	Ukohol	4	16.7	1	9.1	4	18.2
	"	Udeh	4	16.7	4	36.4	3	13.6
	"	Total	24	100	11	100	22	100

Table 7: Earnings from and number of employees in charcoal production in Makurdi and Guma LGAs

LGA	Council Ward	Villages	Weekly Earning in Naira (₦: k)					Weekly Earning		No. of Employees	
			5,000 - 10,000	11,000 15,000	16,000 - 20,000	21,000 25,000	Above 25,000	F	%	F	%
Makurdi	Agan	Tse Ati	2	1	0	0	3	6	12.5	7	7.2
	"	Tse Ancha	0	0	0	0	5	5	10.4	22	22.7
	Mbalagh	Tse Taki	0	0	0	1	5	6	12.5	19	19.6
	"	Tse Madugu	1	1	1	1	1	5	10.4	11	11.3
	"	Tse Anula	1	0	0	1	3	5	10.4	11	11.3
	"	Tse Bume								12	
	"			2	2	0	0	2	6	12.5	12.4
	Modern Market	Tse Uperegh	0	1	0	1	0	2	4.2	6	6.2
	"	Tse Mkir	2	0	2	0	0	4	8.3	0	0.0
	"	Tse Agbee	1	2	0	0	1	4	8.3	2	2.1
	"	Tse Agbede	2	1	0	0	0	3	6.3	0	0
		Total	11	8	3	4	22	48	100	97	100
Guma	Uvir	Torkula	1	3	3	1	0	8	18.6	13	35.1
	"	Umenger	7	4	0	0	1	12	27.9	7	18.9
	"	Ukpam	1	6	0	0	2	9	20.9	4	10.8
	Nyiev	Ukohol	0	4	0	1	1	6	14.0	5	13.5
	"	Udeh	0	1	2	1	1	5	11.6	4	10.8
	"	Nyiev	1	0	1	1	0	3	7.0	4	10.8
		Total	10	18	6	4	5	43	100	37	100

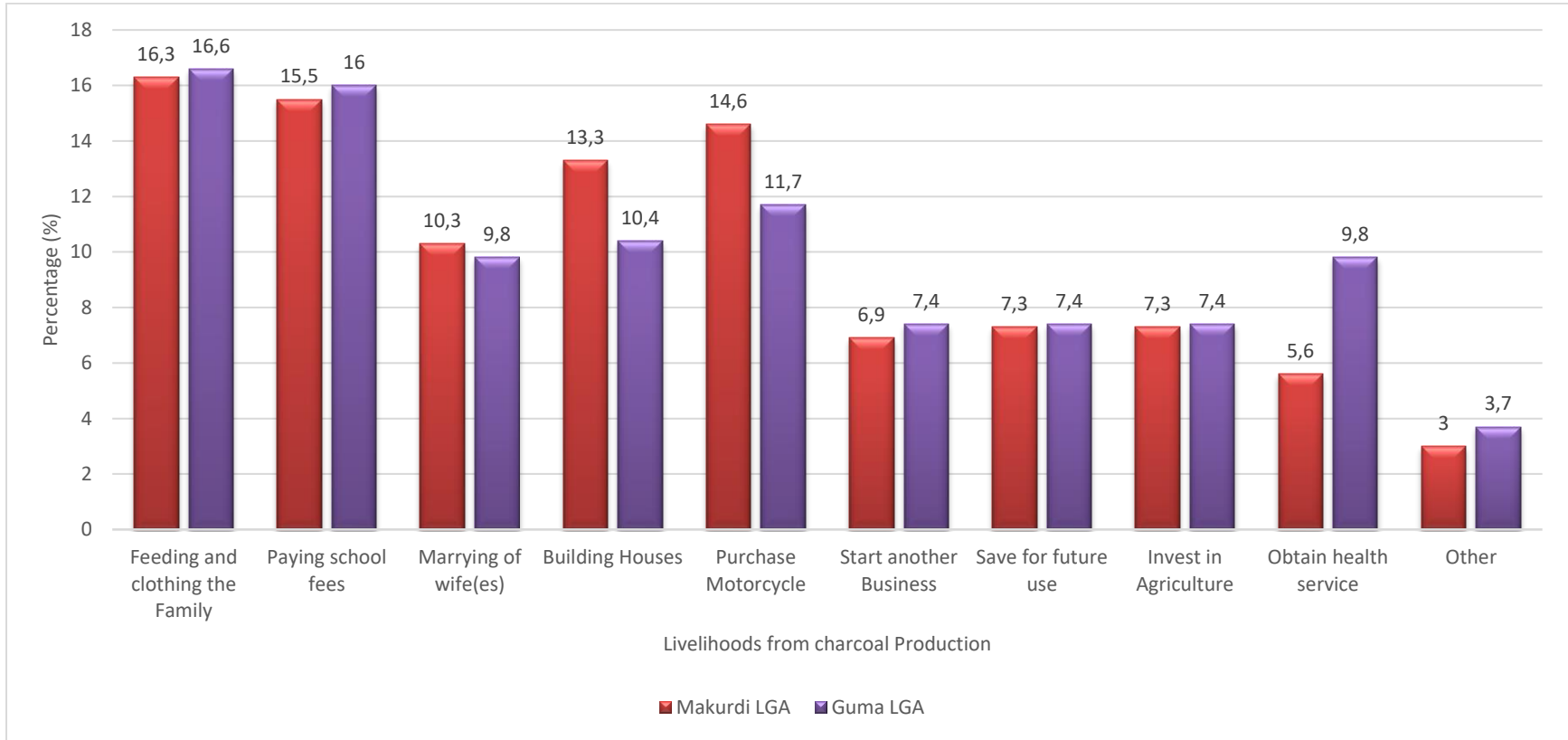


Figure 1: Achievements from charcoal production business in Makurdi and Guma LGA

Figure 2 shows market channels of charcoal production in Makurdi and Guma LGAs. In Makurdi LGA, 100% of respondents reported the presence of market for charcoal production business, while in Guma LGA, 51.7% agreed there was presence of market, while 48.3% respondents reported that there was no market for charcoal production business.

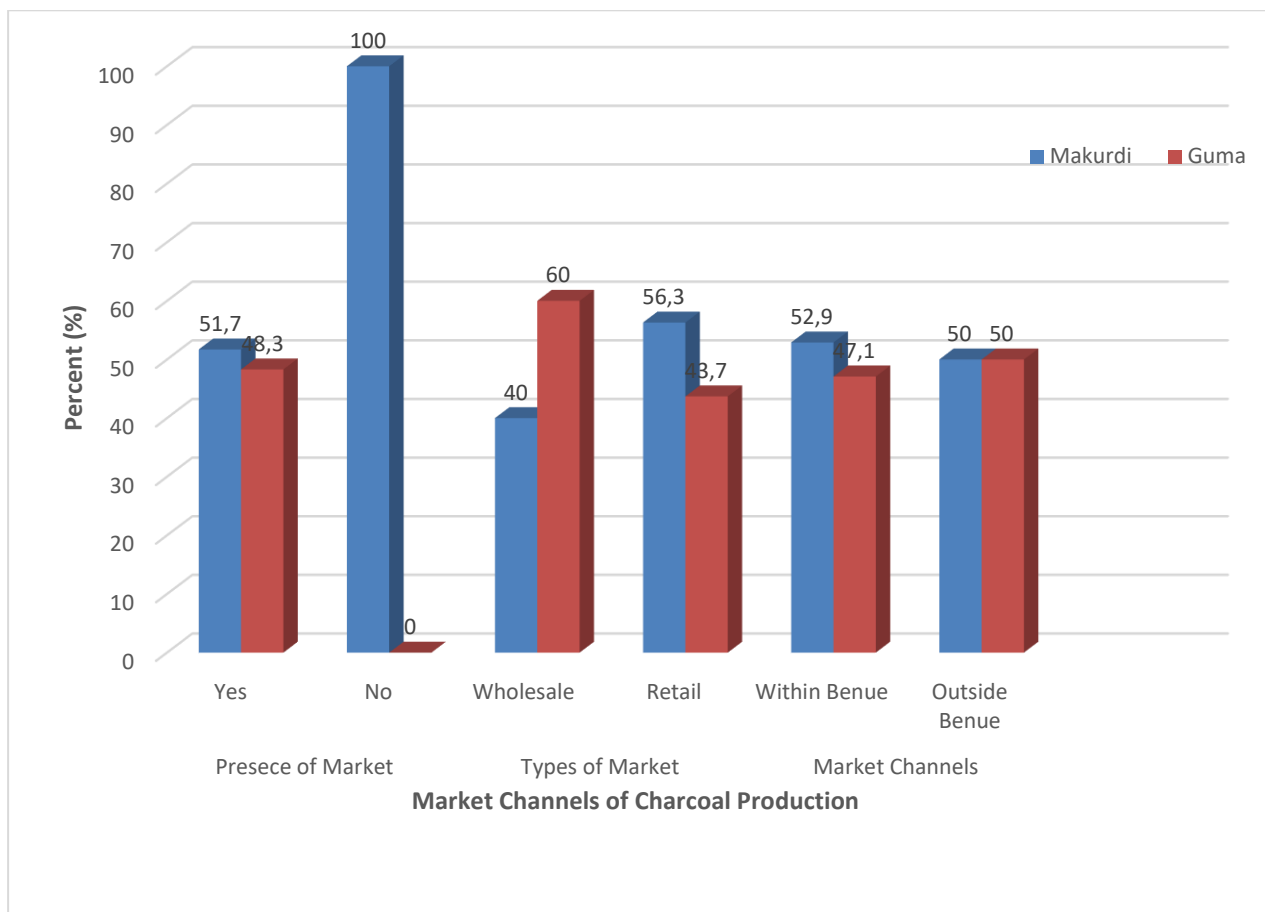


Figure 2: Market Channels of Charcoal Production in Makurdi and Guma LGAs.

Figure 3 shows injuries sustained by charcoal producers in Makurdi and Guma LGAs. The result reveals that fire burn was the highest (50%) recorded injuries followed by eye problem (20%), hand injury (10%) had leg injury and hand injury with 15%. In Guma LGA, injuries sustained by charcoal producers were fire burn (25%) followed by hand injury (20%). Eye problem and leg injuries (18%) were also sustained while respiratory problem (15%) was the least sustained problem.

Figure 4 shows Bags of charcoal in Tse Ancha in Makurdi LGA ready for sale. Figure 5 indicates Charcoal production site in Tse Taki, Makurdi LGA and sorting of charcoal from earth-mound kiln heap in Tse Umenger village in Guma LGA.

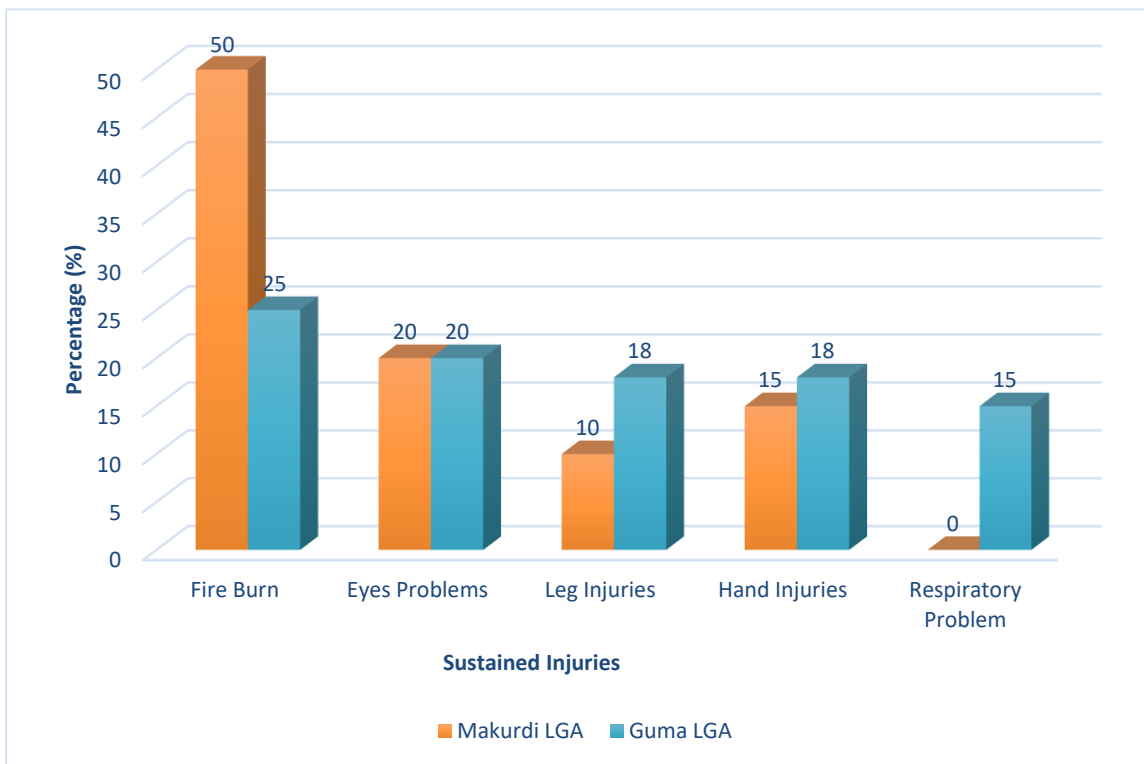


Figure 3: Injuries sustained during charcoal Production in Makurdi and Guma LGAs



Figure 4: Bags of charcoal in Tse Ancha in Makurdi LGA ready for sale



Figure 5: Earth-mound kiln Charcoal production site in Tse Taki Villge in Makurdi LGA (A)  
 Sorting of charcoal from earth-mound kiln in Tse Umenger village in Guma LGA (B)

## DISCUSSION

There were more males in charcoal production business compare females in both Makurdi and Guma LGAs. This could be that the job requires more physical energy found in males than females. This confirms the assertion of (MoPD&E, 2004; Adeniji, *et al.*, 2015) that the role of the women on charcoal production was very limited in their study on impact of charcoal production on environment and the socio-economy of pastoral communities in Somali. This they implied could be vindicated since charcoal production was a very tough work. Greater percentage of respondents in both LGAs was in age class of 21-30 years which were mainly youths. This again is similar to the finding of (MoPD&E, 2004; Adeniji, *et al.*, 2015) who reported ages of charcoal producers in their study as ranged between 17-30 and 20 – 39 years, respectively. This could be due to high rate of unemployment and energy in youths. This study also shows that the level of education of respondents in charcoal business was secondary school. This group was typically rural married farmers similar to the finding of Adeniji, *et al.*, (2015) on charcoal production and producers in Borgu LGA of Niger state, Nigeria.

Respondents in Guma LGA felled as much as 132 trees per week for charcoal production against 109 trees felled in Makurdi LGA which sum up to 241 trees felled per week. It was evident that the rate of harvest of trees was much higher than replanting. This massive deforestation without commensurate replanting would probably lead to extinction of preferred trees with associated environmental consequences. Out of a total of 20 wood species used for charcoal production in both Makurdi and Guma LGAs, the most preferred species was *Prosopis Africana*. This was closely followed by *Khaya senegalensis*, *Tectona grandis* and *Anogeissus leiocarpus*. This finding agrees with Bhattarai (1998); Essiet (2009), Salau and Keshinro (2015); Adeniji, *et al.*, (2015) and Ekhuemelo *et al.*, (2017) who in their respective studies found *Prosopis africana* to be most preferred in charcoal production. *Prosopis africana* is a multipurpose tree and is currently threatened which need to be conserved. Although twenty villages were involved in charcoal production in both Makurdi and Guma LGAs, the rate of replanting felled trees is very low. However, plantation forestry and agroforestry were being adopted as means of replanting exercise. The efforts of replanting by respondents may be could be they were aware of the impending hazards post to their business if tree cut were not replaced. Many villages were found to be involved in charcoal production in the study areas. The result indicates that there was higher rate of charcoal producers in Makurdi LGA than Guma LGA. This could due to higher vegetation cover with many tree species in the study area compared to Guma. Tse Taki accounted for the highest rate of charcoal production with 70 producers in Makurdi, while in Guma, Tse Umenger was the highest with 56 producers.

This study reveals that 22 charcoal producers in Makurdi earned ₦25,000 while 18 in Guma LGA earned between ₦11, 000 - ₦15, 000 from their business weekly and were able to meet family needs as feeding, paying school fees and purchase of motorcycle. This finding agrees with Tunde *et al.*, (2013) who reported that charcoal production has important aspect of the positive impact on the lives of the producers since income realized was always used to improve their wellbeing and hence reduce their poverty situation.

In this study, respondents had some health problems resulting from charcoal production which fire burn the most predominant. This agrees with the finding of Salau and Keshinro (2015)



who reported that challenges facing charcoal producers in Kwara State were health challenges that included irritation from smoke, fatigue and body ache, coughing, difficulty in breathing and tearing in the eye.

This result also indicates that respondents in the study area were making effort in growing trees of which forest plantation was highest practice of reforestation. The effort by the respondents may be because they were aware of the future danger post to their business if tree cut were not replaced.

#### CONCLUSION

There were more males than females in charcoal production business in the study area. The males were predominantly youth. High population rural people were involved in charcoal production in Makurdi and Guma LGAs. This has led to massive deforestation without corresponding efforts in replanting felled trees. The most preferred wood species was *Prosopis africana*. This species is seriously threatened because of its numerous uses. Charcoal production was observed to improve socio-economic benefits to the people of Makurdi and Guma LGAs mostly in feeding families, paying of school fees and as source of employment.

It suggests that, based on the findings from this study, the following recommendations are given: 1) As much as possible, all forest stakeholders in Benue state should ensure the conservation of *Prosopis africana* to avoid its extinction due to its massive exploitation. 2) Alternative means of livelihoods should be provided by Government for charcoal producers in Makurdi and Guma LGAs to discourage them from charcoal production because of its associated deforestation.

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