

Charcoal Consumption by Households in Bunia City, Ituri Province, DRC

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Abstract

An environmental study using surveys was done on 599 households in three communes of Bunia city in order to assess charcoal consumption. At least, 90% of the households use charcoal primarily for cooking. The average household consumes 75,85 kg (0,075 T)/month, estimated at 2,52 kg (0,002 T)/day and 910,23 kg (0,91 T)/year. *Cynometra alexandri* species (Butina in the local language) produced in Komanda land (from Irumu forest and Mambasa) is the most used. Therefore the need to invest in the promotion of renewable energy such as hydroelectricity to reduce the consumption of charcoal in Bunia and thus combat deforestation.

Keywords: Consumption; Charcoal; Households; Bunia.

1. Introduction

Nowadays, more than 2 billion of the world's population depend exclusively on wood energy for cooking and heating, used as fuelwood and charcoal [1]. References[2, 3] have shown that in Africa, slash-and-burn agriculture is the primary cause of deforestation and that of forest degradation attribute to wood energy.

In Central Africa, mainly in Congo Basin, the wood-energy sector has more than 90% of the wood resources harvested from forests and wooded areas. This wood fuel has long been considered abundant and a product of timber derived on agricultural exploitation, leaving the informal sector with very little data available [4, 5, 6].

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In the Democratic Republic of Congo (DRC), the large consumption of wood fuel has direct impact on the region's forest stands, while at the same time, it providing employment to many people (producers, transporters, traders). Its timber production is estimated at 3 to 4 million m³/year, a minor figure compared to the extraction of wood for energy, which is around 80 million m³/year ; a local demand that will continue to increase in the coming decades due to demographic pressure [7].

In Ituri Province in northeastern DRC, there has been a recent phenomenon of rural exodus and collective or uncontrolled migrations that have increased the number of urban and rural populations. Throughout the province, only two hydroelectric power plants, Budana and Kpandroma, are operational and partially supply part of the population. It remains to be believed that in Bunia, a city that is experiencing considerable demographic and spatial growth, all households have a stock of charcoal or firewood for cooking.

It is in this context that this study seeks to determine the level of charcoal consumption in households in the city of Bunia in order to contribute to the sustainable management of wood energy in the region.

2. Material and methods

This study focused on Bunia city, the capital city of Ituri Province; located at an altitude of 1275 m, on a plateau about 55 km west of lake Albert, in the Rift Valley, and about 25 km east of the Ituri forest. Bunia is located north of the Equator at 1°35' north latitude and 30°15' east longitude.

Regarding energy, a small proportion of the urban population is supplied with hydroelectric power from Budana by ELECTROKIMO/SOKIMO (Kilo Moto Electricity Company). Because this power plant regularly experiences untimely power cuts due to technical breakdowns, urban consumers, particularly households, are increasingly using charcoal as their main energy source.

This study is focused on surveys (which took place in december 2022) based on households to estimate their level of charcoal consumption. The survey questionnaire used was developed using the Kobocollect software and was set in an Android phone (Camon 19 brand) to collect data from respondents responsible for charcoal-consuming households.

Using the purposive sampling techniques, the surveys were conducted in three communes of Bunia including: Mbunya, Nyakasanza and Shari. Two neighborhoods, one old and one new, were selected for each commune. These were: Mbunya commune: Bankoko (new) and Lumumba (old) neighborhoods; Nyakasanza commune: Kindia (new) and Saio (old) neighborhoods and Shari commune: Mudzi-Pela (new) and Lembabo (old) neighborhoods. The surveys reached a total of 599 households surveyed in the six selected neighborhoods in the three communes of Bunia city.

The results of this research collected on the field perceived performance of Kobocollect software downloaded from Excel spreadsheet (version 2016). After cleaning up the data in Excel, the data was transferred to SPSS (version 25) for statistical analysis (percentage, mean, standard deviation, coefficient of variation, correlation, etc.) and presentation of the results in frequency tables.

3. Results and Discussion

In this presentation section devoted on interpretation and discuss result from households survey opinions, it should be noted that each letter in the index in the tables (alphabets a, b, c, d, e, ...) indicates a subset of the residential neighborhood category whose column proportions do not differ significantly from one another at the 0,05 level. It should also be noted that during data collection, the monetary exchange rate in Bunia was CDF 2000 equivalent to US\$ 1.

Notices: CDF: Congolese franc, USD: American dollars, kg: Kilogram, km: Kilometer, T: Ton.

Table 1: Energy sources used according to neighborhood and household size.

		Quarter							Value	p-value
		Bankoko	Kindia	Lembabo	Lumumba	Mudzi-Pela	Saio	Mean		
Energy used	Charcoal	86%	96%	95%	96%	86%	88,7%	91,3%	0,182	0,025
	Firewood	12%	4%	5%	3%	11%	11,3%	7,7%		
	Electricity SOKIMO	2%			1%	3%		1%		
		Household size							Value	p-value
		<= 3	4 – 7	8 - 11	12 – 15	16+	Mean			
Energy used	Charcoal	80%	91,9%	92,5%	91,4%	90%	91,3%	0,316	2,28E-11	
	Firewood	5,7%	7,7%	7,5%	8,6%	10%	7,7%			
	Electricity SOKIMO	14,3%	0,4%				1%			

From this table, more than 90% of households use charcoal as their primary fuel and less than 10% use firewood. This choice made on charcoal does not vary significantly on neighborhood and household size (p=0,025 and 2,28E-11), but there is a remarkable difference on energy type.

This is sufficient proof of the importance of charcoal in the daily lives of households in Bunia city. This finding in Bunia is consistent with the general reality of urban areas in the DRC, particularly Kinshasa and Kisangani, where 75% and 72% of households respectively use charcoal as an energy source [5]. Unlike Butembo city in North Kivu where only 47% of households use charcoal [8], the same case as Bunia is also observed in Lubumbashi where 72% of families consume this energy for cooking [9].

Table 2: Frequency (Freq.) of use per week according to neighborhood.

Freq.	Bankoko	Kindia	Lembabo	Lumumba	Mudzi-Pela	Saio	Mean	Value	p-value
1	3%		1%		1%	1%	1%	0,337	5,56E-06
2	5%	2%	1%	1%	5%	5,2%	3,2%		
3	3%		3%		6%	6,2%	3%		
4	3%	4%	2%	1%	1%	1%	2%		
5	7%	1%	7%	2%	1%	2,1%	3,3%		
6	8%	1%	13%	3%		1%	4,3%		
7	71%	92,1%	73%	93,1%	86%	83,5%	83,1%		

Charcoal is the most common source of energy used for food preparation in households in Bunia city. Hence,

more than 80% of households use charcoal every day for cooking and this frequency distribution is not the same ($p=5,56.10^{-6}$).

In general case different cities, it is noticed that household prefer charcoal, because it produces less smoke and dust, it does not alter the taste of food, and takes up less space for storage, making it easier to store and transport than firewood. Nowadays, the consumption of wood energy is only increasing, while oil and solar energy, as in the case of Bunia, are replacing electricity for lighting. Almost all households (rich or poor) to cook all dishes and not selective dishes as in the past use charcoal [5]. For this reason, the majority of households in Bunia use charcoal for cooking every day, with an average of two times per day.

Table 3: Quantities of charcoal consumed monthly (n=599).

Statistics	Quantity in kg
Mean	75,85
Standard deviation	49,35
Variation Coefficient (%)	65,06

In the household, the average amount of charcoal consumed per month is 75,85kg (0,075T) \pm 49,35kg. Thus, it is estimated that the average household in Bunia consumes 2,52kg (0,002T) per day and an annual average of 910,23kg (0,91T). The average purchase price of a bag is CDF 56 007,35 (USD 28), ranging from CDF 40 000 (USD 20) to CDF 650 000 (USD 32,5). Households buy charcoal in bags (45,40%), basins (16,69%) and piles (37,22%). This average daily consumption of charcoal in Bunia (2,5kg) is almost the same as in Kisangani where this average quantity varies from 2 kg to 16 kg [10].

Table 4: Choice of carbonization tree species in households.

Species	Bankoko	Kindia	Lembabo	Lumumba	Mudzi-Pela	Saio	Mean
<i>Cynometra</i> (Butina)	98% _a	99% _a	98% _a	89,1% _b	99% _a	95,9% _{a, b}	96,5%
Fruit trees	2% _{a, b, c}		2% _{a, b, c}	5% _b	1% _{a, b, c}		1,7%
<i>Acacia hockii</i> (Ngando)				1% _{a, b}		4,1% _b	0,8%
<i>Musanga cecropioides</i> (Kombokombo)		1% _a		1% _a			0,3%
Others				3% _a			0,5%
<i>Eucalyptus sp.</i>				1% _a			0,2%

In Bunia, the species used to make charcoal is a criterion of choice, apart from the weight and size of the product, and at least 90% of households prefer charcoal made from the species *Cynometra alexandri* (Tuna or Butina in the local language). This is confirmed by a study made in Mambasa Forest, which found that this species is most preferred by consumers as fuelwood because of its calorific value [11]. [8], reveal that the same species fuels the supply of charcoal in Butembo city from southern Ituri. Hence, we estimate that this part of massif forest of Ituri Province would be the most affected by the wood-energy sector in the region. Our research result and report concur with those of [8], indicating that charcoal consumption in the city contributes enormously to forest degradation and consequently to its impoverishment in biodiversity, especially in the case of selective exploitation of the specie *Cynometra alexandri*, which is more solicited for charcoal, characteristic of old-growth forests with generally slow growth [12].

The study made by [11] in Mambasa Territory warns that due to uncontrolled exploitation, a secondary forest is replacing a primary forest where oil palms, papaya and cocoa trees are increasingly planted in the deforested area, which according to them favors the proliferation of many pathogens. However, another study made in Mambasa forest precisely in Banana area showed that in the absence of heliophilic species, *C. alexandri* characterized by barochory and shade tolerance, takes advantage of its aggregative dispersal mode to establish its monodominance in this part of the DRC [13]. This confirms the hypothesis that the ecological conditions of the southern Ituri forest are beneficial for the *C. alexandri* species, hence its uncontrolled exploitation as observed in our study for carbonization in the above-mentioned region, would therefore threaten its survival.

It should also be noted that in Bunia, a small portion of charcoal (less than 2%) comes from fruit trees (including *Mangifera indica* and *Persea americana*) and other unidentified species, giving charcoal of poor quality, such as *Musanga* (Kombokombo). It is for this reason that charcoal or "makala" in the local language from these tree species is often called "Popolo" a local nickname for a light type of charcoal with a low calorific value than *Cynometra alexandri*, the "Butina" in the local language.

In Kisangani, for example, apart from *Cynometra alexandri*, more than five other species have been inventoried for carbonization [4].

Table 5: Preferential axis supplying charcoal in Bunia city.

Origin	Bankoko	Kindia	Lembabo	Lumumba	Mudzi-Pela	Saio	Mean
Komanda	97% _a	95% _a	95% _a	73,3% _b	93% _{a, c}	86,6% _c	90%
Others		2% _{a, b}	5% _{b, c}	19,8% _d		11,3% _{c, d}	6,3%
Walu	2% _{a, b, c}	2% _{a, b, c}		6,9% _b	5% _{a, b}	1% _{a, c}	2,8%
Soleniama	1% _a				1% _a		0,3%
Mwanga					1% _a	1% _a	0,3%
On site in Bunia		1% _a					0,2%

After observation made through this chart, we noticed that charcoal consumed in Bunia city is produced in surrounding territories area. The result of our research shows that 70 km of the forest in southern of Bunia city belongs to Komanda toward Mambasa (Kisangani road) and Idohu (Beni road) remains the primary source of charcoal production consumed in Bunia city at 90%.

The observation made by [9] stipulate that: deforestation increases progressively as one moves away from urbanized areas, as sites closer to the city were already deforested in the past. Currently, one has to travel at least 35 km to find the nearest carbonization kilns to downtown Lubumbashi [14]. The same observation was made in Kinshasa city by [5], where charcoal comes from areas located between 50 and 300 km for an average supply radius of 135 km that has doubled in 10 years. In contrast to the case of Bunia city, which is supplied by road, the same author revealed that the main supply to Kisangani city is provided by four roads (Buta, Ituri-Lubutu, Ubundu and Opala) and two river routes (Yangambi and Ile Mbiye).

Our study is in line with the one conducted in Butembo by [8] confirming that the charcoal supply basins of Butembo city exceed the peri-urban limits due to the fact that a large part of the depositories get their supplies from the neighboring Province of Ituri more than 150 km from Butembo. According to him, the charcoal

warehouses of Butembo depend mainly on the south of Ituri (in Komanda-Mambasa-Idohu forest) because of the abundance of forest resources in this part of the DRC. Hence, this part of the forest located south of Bunia deserves special attention to avoid biological erosion in the region.

4. Conclusion and recommendations

A study on charcoal consumption in households was conducted in Bunia city, capital of Ituri Province, the purpose of this paper is contribute to the sustainable management of wood energy resources in the region. Surveys were conducted on a sample of 599 households surveyed and these were randomly selected in the three communes of Bunia city, namely Mbunya, Nyakasanza and Shari communes.

The results revealed that:

- more than 90% of households use charcoal as their main fuel;
- more than 80% of households use charcoal every day for cooking, with an average of two times per day;
- the average household consumes 75,85 kg (0,075 T)/month;
- more than 90% of households prefer charcoal made from *Cynometra alexandri* (Butina in the local language);
- the Komanda area located in the south in Komanda forest, toward Mambasa (Kisangani road) and Idohu (Beni road) remains the main supply axis of preference for more than 90% of consumers.

These results demonstrate that the primordial role of wood energy, particularly charcoal is, for cooking in Bunia households. On the other hand, this fact underlines the systematic exploitation of forests around Bunia city. Hence, the need to promote renewable energies such as hydroelectricity in households. Those urban consumers are increasingly using improved stoves to reduce the amount of charcoal used for cooking.

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