

# Sale of Charcoal in the City of Bunia, Ituri Province, DRC

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## Abstract

An environmental study using surveys was done on 60 sellers in six markets in Bunia city in order to assess the sale of charcoal. The Komanda forest is the main supply route with *Cynometra alexandri* as the tree species of choice. The average monthly supply is 5 891,69 kg (5,89 T) and the average monthly sale is 3 632,36 kg (3,63 T) per seller. Charcoal sellers in Bunia make sales with an average monthly expenditure of CDF 2 307,710 (approx. USD 1 153,85) per seller, giving an average monthly profit of CDF 257,876 (around USD 128,93), or an average commercial profitability of 10%. Thus, it is important to organize and supervise these sellers for a sustainable management of this type of wood-energy.

**Keywords:** Sale; Charcoal; Bunia.

## 1. Introduction

Globally, wood energy does not seem to play its important energy role and has been replaced by other energy sources including gas, oil, solar energy, hydroelectric power and nuclear energy. In developing countries, wood energy continues to play an important role, as these countries consume more than three quarters of the world's wood energy [1]. In Congo Basin countries, wood energy has long been considered abundant and a by-product of timber or agricultural exploitation, leaving the informal sector. As a result, wood energy covers nearly 92% of the population's energy consumption [2].

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The exploitation of wood energy is often done in an artisanal manner, and is increasingly concentrated in peri-urban areas and along the main communication routes. This exploitation is accompanied by overexploitation and deterioration of the surrounding forests [3].

The issues of the fuelwood and charcoal sector can be analyzed in two ways: on the one hand, wood fuel as a cause of deforestation and forest degradation, and on the other hand, as a promising source of non-exhaustible energy [2]. Despite its social and economic importance, the usefulness of this sector appears little in public policy in DRC [4]. In Ituri Province, a region dominated by growing insecurity, access to a reliable source of energy remains limited or non-existent as in many other provinces and cities in the country. The rural exodus, as well as the collective (or uncontrolled) migrations observed, are leading to an increase in energy demand for both urban and rural populations. In Bunia city, the capital of Ituri Province, there is remarkable demographic and spatial growth with a low proportion of electrification. As a result, the population start to use charcoal for cooking, as result; there is an activity of selling this wood fuel.

Thus, our study focuses on the sale of charcoal in the markets of Bunia city. It therefore seeks to take stock of the sale of charcoal in the markets of Bunia.

## **2. Material and methods**

This study focused on Bunia city, the capital 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 Ituri forest. Bunia is located north of the Equator at 1°35' north latitude and 30°15' east longitude. In accordance with the Provincial Order N°01/JAPM/056/CAB/PROGOU/P.I/2017 of July 18, 2017 on the creation, naming and delimitation of quarters in the communes of Bunia city in Ituri Province. The city is currently made up of 24 quarters divided into three communes. With an area of 57,6 km<sup>2</sup>, its population is estimated at one million inhabitants. It should be noted that the name of the city, Bunia, comes from the word "*Mbunya*", a customary chief of the Bira people, indigenous to the area.

Given the low proportion of electrification of the ELECTROKIMO/SOKIMO Company (Kilo Moto Electricity Company), there are a large number of wood energy sellers, including charcoal, in the various markets of Bunia.

For this study, apart from the vendors surveyed, we used a survey questionnaire developed with the help of Kobocollect software set on a Camon 19 brand Android phone, which was submitted to the vendors operating in the target markets. The same phone was also used to take photos of field findings. The field data was analyzed and processed using Excel (version 2016) and SPSS (version 25) Software. Analysis of variance and Tukey tests were therefore carried out to determine the existence of data differences in these markets. The data collection for this study involved surveys of charcoal vendors in Bunia market; for 10 consecutive days, from december 11 to 21, 2022. Following a stratified and random sampling, a sample of 60 vendors out of a total of 113 vendors (wholesalers and retailers) was selected for this study in the six main markets including: Cinquantenaire (Cinq.), Hoho, Central, Kindia, Saio and Yambi-Yaya. It should be noted that a random sample of 30 vendors in the six markets was selected to weigh the quantities of charcoal by sales unit using a 100kg scale.

### 3. Results and Discussion

This section is devoted to presentation, interpretation and discussion of the results of the opinions of the vendors surveyed concerning the preferred tree species and the quantity received and sold in the markets. 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. KsH: Kenyan shilling.

**Table 1:** Tree species preferred by charcoal sellers in Bunia.

| N <sup>o</sup> | Species                          |            |             |                          |                    |      |         |
|----------------|----------------------------------|------------|-------------|--------------------------|--------------------|------|---------|
|                | Scientific name                  | Local name | French name | Family                   | Environment        | %    | p-value |
| 1              | <i>Cynometra alexandri</i>       | Butina     |             | Caesalpiniaceae/Fabaceae | Primary forest     | 90   | p<0,05  |
| 2              | <i>Acacia hockii</i>             | Ngando     |             | Fabaceae                 | Savane             | 3,33 |         |
| 3              | <i>Mangifera indica</i>          | Manga      | Manguier    | Anacardiaceae            | Agricultural field | 3,33 |         |
| 4              | <i>Persea americana</i>          |            | Avocatier   | Lauraceae                | Agricultural field | 3,33 |         |
| 5              | <i>Gilbertiodendron dewevrei</i> | Limballi   | Limballi    | Caesalpiniaceae/Fabaceae | Primary forest     | 1,71 |         |
| 6              | <i>Musanga cecropioides</i>      | Kombokombo |             | Urticaceae               | Secondary forest   | 1,71 |         |
| 7              | Other species                    | Popolo     |             |                          | Secondary forest   | 1,71 |         |

Table 1 shows that the vast majority of vendors surveyed, 90%, have a strong preference for using the species *Cynometra alexandri* for charcoal production. This is followed by *Acacia hockii* De Wild, then fruit trees such as *Mangifera indica* and *Persea americana*, each accounting for 3,3% of vendors' choices. Species such as *Gilbertiodendron dewevrei* and *Musanga cecropioides* are also cited for carbonization. However, 1,71% of vendors mentioned selling charcoal made from species that they themselves did not know. This charcoal is often light and of poor quality, hence the nickname "Popolo" in the region. The statistical variance test revealed a significant difference between the tree species used for charcoal-making, with a p-value of less than 0,05. These results underline the importance of the tree species used for charcoal production, a criterion taken into account by sellers in their choice of raw material. To facilitate the sale of charcoal, sellers are interested in customer preference, tree species and accessibility of the charcoal production site. This explains the fact that Komanda axis is more solicited to supply the city with charcoal. This is because the area is accessible and the species of first choice for urban consumers is found there, including *Cynometra alexandri* (Butina).

This difference could be due to the species' phytogeographical position and ecology, which make it more exposed to exploitation by coal miners in the east of the Republic. Several authors have observed that *Cynometra alexandri* is widely used for charcoal making in the east of the country. For example, in Butembo, around 2 401 tons of charcoal are sold each year, of which almost 2000 tons are made from *Cynometra alexandri*, followed by *Acacia mearnsii* and *Eucalyptus maidenii* [5]. It is also present in Kisangani and absent

from Kinshasa [2] and Boma [6].

Apart from primary and secondary forests [7], charcoal also (Bunia) comes from agricultural fields and part of the savannah, especially in Irumu Territory. Forest plantations are not included, unlike in Butembo [5]. It should be noted that the Ituri forest remains one of the most favorable forest ecosystems for this species of *Cynometra alexandri*.

Unfortunately, selective carbonization in the region most centered on this species will make it vulnerable if nothing is done to protect it from wood-energy exploitation. It is a pity that it remains the most sought-after species for carbonization in Ituri, when it should be protected and exempt from all exploitation. Komanda is an area located more than 70 km south of Bunia city. This leads us to say that most of the charcoal used in Bunia comes from the forest more than 70 km away. This observation from Bunia is in line with that of [5], who confirm that the charcoal supply basins of Butembo city go beyond the peri-urban limits, since a large proportion of the dealers obtain their supplies in the neighboring province of Ituri, more than 150 km from Butembo. It should be noted that most of the charcoal consumed in both Bunia (Ituri) and Butembo (North Kivu) comes from the same Komanda-Idohu-Mambasa forest. This observation in Bunia consistent with observations made by [8] that deforestation increases progressively as one moves away from urbanized areas. We share the view of [5, 9] that the exploitation of wood energy, in particular charcoal, locally known as "makala", is threatening the forest south of Bunia. This region is home to the largest forest in Ituri Province, where the two Okapi Wildlife Reserves of Epulu (to the south-west) and Mont Hoyo (to the southeast of Bunia) are located, both UNESCO World Heritage Sites. In the same vein, Luchois charcoal makers nowadays travel more than 30 km to make charcoal [1]. In Kinshasa [2], in a space of less than ten years, charcoal is increasingly coming from areas located between 50 and 300 km for an average supply radius of 135 km. As in Bunia, charcoal is supplied by road; in Kisangani there are four road supply routes (Buta, Ituri-Lubutu, Ubundu and Opala) and two river routes (Yangambi and Ile Mbiye). This observation made in Bunia shows the environmental extent of the supply points where carbonization is carried out daily. In addition, the city of Butembo has the same Komanda-Idou-Mambasa forest in the south of Ituri Province as a charcoal supply basin. So what will happen to the inhabitants of Bunia, a town in the middle of the savannah, if the forest continues to retreat? This fact alone demonstrates the need for initiatives to limit charcoal-related deforestation in this savannah region (Bunia city).

**Table 2:** Quantities supplied and sold in kg/month.

| Markets        | Quantity received in kg/month   | Quantity sold in kg/month       | Number of bags supplied  | Number of bags sold       |
|----------------|---------------------------------|---------------------------------|--------------------------|---------------------------|
| Kindia         | 3 409,20±1 726,91 <sup>b</sup>  | 1 538,93±1 328,27 <sup>b</sup>  | 44,51±21,19 <sup>b</sup> | 19,81±17,18 <sup>b</sup>  |
| Hoho           | 4 477,29±1 674,61 <sup>b</sup>  | 2 764,09±533,49 <sup>b</sup>    | 55,53±20,77 <sup>b</sup> | 34,28±6,61 <sup>b</sup>   |
| Yambi-Yaya     | 2 539,53±2 775,83 <sup>b</sup>  | 902,7±548,75 <sup>b</sup>       | 31,5±34,43 <sup>b</sup>  | 11,19±6,80 <sup>b</sup>   |
| Saio           | 5 635,95±2 109,05 <sup>ab</sup> | 3 983,02±1 585,78 <sup>ab</sup> | 69,9±26,16 <sup>ab</sup> | 49,4±19,66 <sup>ab</sup>  |
| Central        | 9 742,37±6 438,38 <sup>a</sup>  | 6 168,76±4 078,14 <sup>a</sup>  | 120,8±79,86 <sup>a</sup> | 76,51±50,58 <sup>a</sup>  |
| Cinquantenaire | 5 225,76±1 748,43 <sup>ab</sup> | 3 445,82±1 526,02 <sup>ab</sup> | 64,8±21,64 <sup>ab</sup> | 42,74±18,92 <sup>ab</sup> |
| p-value        | 0,0004 <sup>***</sup>           | 0,0000 <sup>***</sup>           | 0,0007 <sup>***</sup>    | 0,0001 <sup>***</sup>     |
| General mean   | 5 891,69±4 547,03               | 3 632,36±3 018,56               | 73,97±56,44              | 45,61±37,5                |

**Legend:** means with equal letters, no significant differences for  $p > 0.05$  according to Tukey test.

*p*: probability

\*\*\*: highly significant differences

An analysis comparing the quantities of charcoal procured and sold in the six markets in Bunia was conducted, using the Tukey test. The results showed a highly significant difference between markets for the quantities (kg) of charcoal procured, with a p-value of 0,0004. Similarly, for the quantities (kg) of charcoal sold, the difference was highly significant with a p-value of 0,0000. For the number of bags of charcoal procured and sold, the differences between markets were also highly significant, with p-values of 0,0007 and 0,0001 respectively.

However, this analysis reports that the quantities of charcoal procured and sold do not differ between the Kindia, Hoho, Yambi-Yaya, Saio and Cinquantenaire markets. The same case is observed between the Saio, Central and Cinquantenaire markets. In the Bunia markets, the average quantity of charcoal supplied was  $5\,891,69 \pm 4\,547,03$  kg (equivalent to 5,89 T), or  $73,97 \pm 56,44$  bags per seller per month. The average quantity of charcoal sold was  $3\,632,36 \pm 3\,018,56$  kg (equivalent to 3,63 T), or  $45,61 \pm 37,5$  bags per vendor per month.

In one day, this supply is estimated at around 196,38 kg (0,19 T) and the sale at around 121,07 kg (0,12 T) for one seller. In one year, the supply is approximately 70 700,28 kg (70,70 T) and a sale of approximately 43 588,32 kg (43,58 T) for one seller. For 60 sellers surveyed, a supply of around 4 242 016,8 kg (4 243,01 T) of charcoal is needed for a one-year period. This figure shows that the need for wood energy, mainly charcoal, is very real for Bunia city. It should be noted that in Bunia's markets, a pile of charcoal of CDF 1000 weighs on average 1,062kg, a basin of CDF 10 000 weighs on average 10,62 kg and a bag weighs on average 80,62kg. Charcoal sold in Bunia weighs far more than that sold in the towns of Butembo in North Kivu [5] and Boma in Kongo-Central [10] in the DRC, where a bag weighs around 60 and 40 kg respectively. This difference in product weight is linked to various factors such as tree species, the size of the bag used...

The monthly supply of charcoal per seller (around 74 bags) in Bunia exceeds that of the town of Boma (around 40 bags) [10]. This means that charcoal consumption by the inhabitants of Bunia (Ituri) is far higher than that of Boma in Kongo-Central.

**Table 3:** Average monthly expenditure, profit and commercial profitability.

| Markets        | Expenses (CDF)                  | Profit (CDF)                  | Commercial profitability (%) |
|----------------|---------------------------------|-------------------------------|------------------------------|
| Kindia         | $1\,358\,680 \pm 677\,640^b$    | $-271\,709 \pm 526\,101^a$    | $-24,65 \pm 38,13^b$         |
| Hoho           | $1\,756\,990 \pm 633\,247^b$    | $195\,326 \pm 457\,235^a$     | $20,21 \pm 33,24^{ab}$       |
| Yambi-Yaya     | $998\,741 \pm 1\,061\,560^b$    | $-361\,152 \pm 1\,209\,350^a$ | $10,88 \pm 72,79^{ab}$       |
| Saio           | $2\,213\,430 \pm 803\,476^{ab}$ | $599\,824 \pm 566\,707^a$     | $28,19 \pm 23,49^a$          |
| Central        | $3\,790\,560 \pm 2\,463\,560^a$ | $566\,505 \pm 1\,177\,290^a$  | $15,93 \pm 25,91^{ab}$       |
| Cinquantenaire | $2\,054\,780 \pm 659\,666^{ab}$ | $379\,046 \pm 592\,771^a$     | $13,86 \pm 30,15^{ab}$       |
| p-value        | 0,0004***                       | 0,0552 <sup>NS</sup>          | 0,0251 <sup>NS</sup>         |
| General mean   | $2\,307\,710 \pm 1\,744\,440$   | $257\,876 \pm 898\,368$       | $10,46 \pm 38,75$            |

**Legend:** means with equal letters, no significant differences for  $p > 0.05$  according to Tukey test.

$p$ : probability

\*\*\* : highly significant differences

<sup>NS</sup> : no significant difference

According to the results of the Tukey test, there are no significant differences between the markets taken in pairs in terms of realized profit ( $p$ -value = 0,0552) and commercial profitability ( $p$ -value = 0,0251). However, there were significant differences between markets in Bunia in terms of realized expenditure ( $p$  = 0,0004). The Kindia, Hoho, Yambi-Yaya, Saio and Cinquantenaire markets showed no significant differences in terms of expenditure. The same applies to the Saio, Central and Cinquantenaire markets. These results suggest that markets in Bunia city differ in terms of expenditure, but not in terms of profit and commercial profitability. The Kindia and Saio markets therefore differ in terms of commercial profitability.

Their average monthly expenditure is estimated at CDF 2 307 710 $\pm$ 1 744 440 (approx. USD 1 153,85) per vendor. The average monthly profit made by salespeople is CDF 257 876 $\pm$ 898 368 (approx. USD 128,93 on average) per salesperson. Considering these figures, the commercial profitability of charcoal sellers in Bunia is average, with an average monthly estimate of 10%.

Charcoal prices vary greatly as in buying ( $\mu$ = CDF 30 883,3 (USD 15,44) $\pm$ 5 119,2) and selling ( $\mu$ = CDF 56 942,9 (USD 28,47) $\pm$ 3438) a bag, and this is true for retail sellers by basin ( $\mu$ = CDF 5 629,6 (USD 2,81) $\pm$ 1522,9) and by heap ( $\mu$ = CDF 1050 (USD 0,52) $\pm$ 236), which are the most commonly used modes among retailers. Market vendors sell an average of 18 bags per week, 5,8 basins per day and 16,6 piles per day (see Figure 1 below).



**Figure 1:** Charcoal sales units in Bunia, bag, basin and heap (from left to right).

We note that this variation in the purchase and sale prices of charcoal is linked to factors such as insecurity, taxes and harassment, the poor condition of the road and the season. It should be noted that the Komanda-road axis of Bunia is made of dirt and that during the rainy season; it becomes difficult to drive on. This means that the poor condition of the road is directly correlated with the rainy season to justify the variation in charcoal

prices. The subjects interviewed acknowledged that during the rainy season, the price of charcoal rises and falls during the dry season. Insecurity in Ituri is the primary factor in the variation of charcoal prices. There is more insecurity that increases the price of charcoal. This is because producers and sellers find it difficult to get to the production sites. As a result, the product becomes scarcer on the markets. Other reasons may be related to production factor is not developed in this research.

The results of this study show significantly lower profit figures (around USD 128) achieved when compared to vendors in the town of Lubumbashi and elsewhere in the DRC [11]. Hence, commercial profitability averages around 10%. As a result, average expenses reach USD 1 153,85. This is mainly linked to the security problem, where coal miners operating in Ituri (a province under a state of siege) generally have to deal with various taxes and other hassles.

It's worth noting that in Kenya, each kilogram of charcoal brings in around CDF 150, or USD 0,075 (equivalent to 10,5 KsH) for the charcoal-maker [12]. This amount is well below that earned by a vendor in the DRC in general, and in Bunia in particular, who can sell a heap (around 1 kg) for 1000 CDF (USD 0,52). There are two reasons why Bunia is more profitable than a Kenyan town. The first relates to customer choice, a choice linked to their habits [2, 4]. The second reason relates to the low level of competition from other energy sources compared with charcoal. Other energy sources, notably electric power, gas, oil, solar and firewood, remain less available, with a fairly high cost to obtain them. Consequently, they are not very competitive with charcoal in Bunia.

It should be noted that in Bunia, as in Kinshasa and Kisangani, charcoal is sold mainly to households, followed by aluminum smelters, restaurants and hotels [2].

Almost all households (rich or poor) to cook all dishes and not selective dishes as in the past use charcoal. For this reason, we say that charcoal will remain for a long time to come one of the main energy sources used daily by the inhabitants of Bunia, as proven by the results of this study. Because, being satisfied, the majority of charcoal sellers in Bunia wish to continue the same activity in the future. Hence, we conclude by stressing that investment in the promotion of renewable energies such as hydroelectricity and solar energy in Bunia would help to reduce urban pressure on wood energy.

#### **4. Conclusion**

A study on the sale of charcoal in the markets was carried out in Bunia, since little research has been published on wood energy in the region. A total of 60 sellers were randomly selected from the six markets in Bunia, namely: Central, Cinquantenaire, Hoho, Kindia, Saio and Yambi-Yaya.

The results revealed that:

- at least 80% of vendors prefer *Cynometra alexandri* as the tree species of choice, which is mainly sourced from Komanda area;



- the quantity supplied monthly is on average 5 891,69 kg (5,89 T) and the quantity sold monthly in the markets is on average 3 632,36 kg (3,63 T);
- Charcoal sellers in Bunia make sales with an average monthly expenditure of CDF 2 307,710 (approx. USD 1 153,85) per seller, giving an average monthly profit of CDF 257,876 (around USD 128,93), or an average commercial profitability of 10%.

In view of the above, we can say that charcoal is one of the most traded products in Bunia's markets, given its high demand among consumers. Hence the need to properly organize and supervise sellers for the sustainable management of wood energy resources in the region, while encouraging them to invest in other alternative activities such as sustainable agriculture.

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