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Analysis of the Wood Energy Market (Charcoal and Firewood) in the City of Kindu, Maniema Province in DR Congo

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ABSTRACT

This study was conducted in the city of Kindu in 2023 to examine the marketing of wood energy (charcoal / and or firewood). The issue of domestic energy remains a major concern globally, particularly in developing countries, where the majority of the population primarily relies on wood. This situation is common in DR Congo, especially in the Province of Maniema. The main objective was to analyze the wood energy market (charcoal and firewood) sold in the city of Kindu. The methodology used was a survey supported by interviews, site visits, and direct observation for data collection, using pre-established survey forms.

Following these surveys, it was observed that the market circuit for the sale of wood energy is poorly structured and minimally organized by the population involved. Of the 389 individuals engaged in the wood energy trade, 365 (93.84%) work independently for personal profit, while only 24 (6.16%) operate within an association or working group. The proportion of women in the sector is significantly higher: 70.95% (276 women) compared to 29.05% (113 men).

Daily sales volumes, based on buyers' preferred measurement units, are distributed as follows. For charcoal, the small bag (200g to 300g) and the large bag (1kg) are the most common, accounting for 52.87% and 7.32% respectively, followed by 56kg sacks at 31.93%. For firewood, sellers typically offer 10-20 packages of 1kg (46.11%), 5-10 packages of 2kg (38.35%), and 10-50 packages of 3kg (15.52%) per day. The distances traveled by sellers to obtain wood energy range between 1 to 10 km, 5 to 10 km and 1 to 5 km.

Keywords: wood energy, sellers, market, city of Kindu

INTRODUCTION

The issue of domestic energy remains a major concern in the world and in particular in developing countries where the majority of the population mainly uses firewood, charcoal and agricultural residues to meet their energy needs related to cooking food (Boulier & Simon, 2009; Aruna, 2011; Bararwandika et al., 2012).

In the Economic Community of the Great Lakes Countries sub-region, wood and lignocellulosic products account for over 97% of the energy balance. Over 90% of the

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population in cities and secondary urban centres use charcoal as their main source of domestic energy, especially for cooking (MEM, 2005; MEM, 2011ab; Dusabe, 2013).

The province of Maniema is subject to strong anthropogenic pressures linked to the deforestation of forest species intended for carbonization and firewood, due to the non-permanence of electricity and the high price of bills which does not allow the poor population to use it on a daily basis (Anonymous, 2022; Lucungu et al., 2022).

The extensively degraded road infrastructure, the lack of appropriate means of transport that could allow the transfer of firewood and charcoal, the total absence of storage facilities (depots) that could facilitate the supply of firewood and charcoal to sellers, and the absence of appropriate pavilions for the sale of charcoal and firewood remain a major challenge to be met (Schure & Hunhyet, 2014).

Throughout the study, wood energy is, and will continue to be, an important issue for the population of Kindu city, although alternatives can be tested. The use of wood for domestic energy purposes requires special attention if we are to ensure sustainable management of the forest ecosystems that produce it. As Viers (1970) and Choma (2019) stated, "forest and development do not go well together so far, except for a few exceptions, the progress of one is accompanied by the destruction of the other."

This study was initiated to analyze the market of wood energy (charcoal and firewood) sold in the city of Kindu. Specifically, the study made it possible to:

(i) determine the number of men and women who carry out the activity of selling wood energy in the city of Kindu;
(ii) show the quantity of charcoal and firewood sold per day;
(iii) determine the distances traveled by wood energy sellers and;
(iv) identify the means of transport used by wood energy sellers in the city of Kindu.

The main objective that we have set ourselves is to carry out an analysis of the wood energy market (charcoal and firewood) sold in the city of Kindu, Maniema province in the DR Congo.

MATERIALS AND METHODS

Study Environment

The study environment is the city of Kindu, a decentralized administrative entity composed of three urban communes (Latitude: 2°56.37' South and Longitude 25°55.20' East with an altitude of 464m) namely: Kasuku, Mikelenge and Alunguli. The surveys were carried out in three neighborhoods for each commune; for the Kasuku Commune (Kassuku, Basoko and Lwama Neighborhood); Mikelenge Commune (Tokolote, Mukunda and Mikelenge Neighborhood) and finally, for the Alunguli Commune (km 2 Neighborhood, Mangobo and Kabondo).

Materials

The biological materials of this study are of two types and were made up of 389 individuals (surveyed sellers of embers and firewood) and charcoal and firewood.

Methods

To select the districts in the study area, a preliminary survey was carried out to locate the different points of sale where the trade of wood energy (charcoal and firewood) takes place in the city of Kindu. This pre-survey was organized with the target group of this study, and we proceeded with an exploratory visit to each site through the different municipalities and 9 districts which were selected.

The criteria used for the selection of points of sale and sellers were as follows:

For the points of sale (market), in order for it to be selected, it should have at least 15 sellers of embers or firewood; while for the sellers, they should have spent at least 2 years in the exercise of the sale of wood energy, have a residence in the district / and or Municipality where the survey is being carried out and be at least 18 years old.

The method used was that of a survey supported by interview techniques based on interviews and visits to different sites and direct observation for data collection using pre-established survey forms which facilitated exchanges with the target groups (Investigators).

RESULTS

Number of Wood Energy Sellers in the City of Kindu

The analysis of the wood energy market sold in the city of Kindu is co-signed in Table 1 below, for the entire city of Kindu.

Table 1. Number of respondents grouped by municipality

Commune	Frequency	Percentage
Mikelenge	153.00	39.33
Kasuku	133.00	34.19
Alunguli	103.00	26.48
Total	389.00	100.00

Table 1 opposite provides information on the number of respondents per Commune. Mikelenge comes first with 39.3%, or 153 sellers of wood energy (charcoal / and or firewood) out of a total of 389; followed by Kasuku 34.1% and at the bottom of the scale, is Alunguli which has only 103 sellers of this commodity highly prized by the population of Kindu.

Gender of Respondents

Table 2 below shows the distribution of surveyed by gender.

Table 2. Distribution of respondents by gender

Gender investigated	Frequency	Percentage
Women	276	70.95
Man	113	29.05
Total	389	98.8 (100)

Table 2 above shows that the proportion of female sellers of wood energy (charcoal and firewood) is significantly higher than that of male sellers, i.e. 70.95% against 29.05; or 276 women against 113 men for a total of 389 individuals.

Number of Charcoal (Embers) and Firewood Sellers in the Town of Kindu

Table 3 gives the distribution of respondents selling charcoal, firewood or both at the same time.

Table 3. Distribution of sellers of charcoal, firewood or both

Nature of Wood	Frequency	Percentage
Charcoal	205	52.7
Firewood	175	44.99
Coal and Firewood	09	2.31
Total	389	100

Reading Table 3 above shows that, in terms of the sale of wood energy in the city of Kindu, sellers of embers are more numerous than those who sell firewood or both at the same time, that is to say 205 respondents sell embers, or 52.7% against 175 who deal in firewood, or 44.99%; and only 9 respondents who combine the two products at the same time (embers and firewood), or 2.31%; this would be justified by the fact that most of the population who use embers are concentrated in the Kasuku and Mikelenge communes.

Working Method of Wood Energy Operators in the City of Kindu

Table 4 below shows the distribution of respondents working, either in an association or privately.

Table 4. Distribution of respondents working, either in association or privately

Work mode	Frequency	Percentage
Private	365	93.83
Association	24	6.16
Total	369	100

Of the total study population of 389 individuals recorded as active in the sale of wood energy, 365 or 93.83%, work as free electrons, that is to say in private for a personal interest, 24 are in an association or working group of 6.16%; and this would be justified by the fact that it is an informal activity for most households, which leads to self-support for survival and it is only for firewood that sellers make associations, but not in an orderly manner.

Main Activity on the Sale of Wood Energy

Table 5 shows the frequency of respondents' main activity of selling wood energy.

Table 5. Frequency of respondents on the main activity of selling wood energy

Sale of wood energy	Frequency	Percentage
Wood energy	356.00	91.51
Other activities	33.00	8.48
Total	389.00	100.00

From the examination of this Table 5, most of the operators who only sell wood energy (charcoal and/or firewood) as their main activity have a workforce of 356 respondents, or 91.51% against 33, or 8.48% who combine with other income-generating activities.

Distance Traveled by Sellers from the Supply Site to the Distribution Site

Table 6 provides information on the distances travelled by respondents in search of their goods.

Table 6. Distances traveled by respondents to search for their goods

Distance traveled	Frequency	Percentage
>10 km	142.00	36.50
1 km	125.00	32.10
1 to 5 km	69.00	17.70
5 to 10 km	53.00	13.60
Total	389.00	100.00

In relation to the distances travelled in search of wood energy by the population studied, the long distances are greater than 10 km, 5 to 10 km and 1 to 5 km respectively with a number of 142 individuals, or 36.5, 69 respondents or 17.7% and 53 individuals, or 13.6% against 1 km with a number of 125 respondents in all the municipalities under study.

Means of Transport Used

Table 7 shows the means of transport used by sellers to evacuate products from the supply site to the point of sale.

Table 7. Means of transport used by sellers for the evacuation of products, from the supply site to the point of sale

Means used	Frequency	Percentage
Bike	221.00	56.80
Canoe	68.00	17.40
Head	56.00	14.30
Motorcycle	35.00	8.90
Others	9.00	2.30
Total	389.00	100.00

The means of transport most used by the respondents is the bicycle, with a proportion of 221 individuals, or 56.8%, followed by canoes and transport on the head with each, a respective proportion of 68 people and 56, or 17.4 and 14.3%; the other means of transport have lower values.

Firewood and Charcoal Depots

Table 8 provides information on the provision of wood depots by respondents in the town of Kindu.

Table 8. Wood deposits by respondents in the town of Kindu

Deposit in the city	Frequency	Percentage
No	382	98.2
Yes	7	1.7
Total	389	100

From reading Table 8 above it is clear that, out of a total of 389 sellers of charcoal and firewood combined (or 100%); 98.2% do not have wood depots compared to 1.7% who do and this proportion is not significant for the city as a whole.

Price of Charcoal by Different Units of Measurement in the City of Kindu

Table 9 provides information on the different selling prices, per unit of measurement of charcoal in the city of Kindu.

Table 9. Different selling prices, per unit of measurement of charcoal in the city of Kindu

Unit of measurement	Price in FC	Frequency	Percentage
Small bag of 250 to 300g of wood	200	141	60.25
56kg bag	20000 to 30000	64	27.35
Large bag from 500g to 1kg	500 to 1500	19	8.11
7kg basin	2500 to 5000	10	4.27
Total		234	100

The analysis of Table 9, shows the sale of charcoal by the respondents; the most requested unit of measurement of sale (price) is the small bag of 200-300g of embers which comes first with 60.25% of 200fc, followed by a bag weighing 56kg of charcoal, with 27.35% at a cost which varies between 20,000 to 30,000 Fc, while the large bag of 500g to 1kg and the basin of 7kg, are less requested and their prices fluctuate around 500 to 1500 FC and 2500 to 5000 FC respectively. This could be explained by the fact that the majority of the population buys embers on a daily basis, due to the lack of sufficient means to obtain the bag which is expensive and which is accessible to only a minority of the population.

Quantity of Charcoal Sold per Day

Table 10 shows the different quantities of charcoal sold per day in the city of Kindu.

Table 10. Different quantities of charcoal sold per day in the city of Kindu

Unit of measurement	Quantity	Frequency	Percentage
Bag (56kg)	2 to 10	61.00	31.93
Bag (56kg) >	11 to 50	4.00	2.09
Basin (7kg)	2 to 10	11.00	5.75
Bag of 250 to 300g of wood	10 to 20	101.00	52.87
Bag of 500g to 1kg	More than 20	14.00	7.32
Total		191.00	100.00

Table 10 above gives the daily quantities sold by the respondents according to the units of measurement preferred by the buyers. From the examination of this table, the bag comes out on top with 52.87% and 7.32% respectively followed by bags of embers with bags weighing 56Kg with 31.93% and 2.09% of respondents involved in the circuit and the basin takes last place.

Unit Price of Firewood

Table 11 below records the different prices of firewood in the town of Kindu in packages.

Table 11. Different prices of firewood in the city of Kindu

Unit of Measure	Price in FC	Frequency	Percentage
1kg package	500	135	61.64
2kg package	700 to 1000	36	16.43
Packages over 3kg	1500 and more	48	21.91
Total		219	100.00

The price of firewood in the city of Kindu is presented as follows: the most accessible price for the majority of the population is 500Fc per package which comes first with 61.64%, followed by 1500Fc and more (21.91%); and finally, that of 700 to 1000Fc which covers 16.43% of our respondents.

Quantity of Firewood Sold per Day

Table 12 shows the quantity of firewood sold daily in the town of Kindu.

Table 12. Quantity of firewood sold daily in the city of Kindu

Unit of measurement	Quantity	Frequency	Percentage
Package of 1kg	10 to 20	101.00	46.11
2kg package	5 to 10	84.00	38.35
3kg package	10 to 50	34.00	15.52
Total		219.00	100.00

In light of reading Table 12 above, sellers sell around 10 to 20 packages of 1kg of firewood, or 46.11% per day, for some respondents, compared to 5 to 10 packages, or 38.35% and 10 to 50 packages, or 15.52% respectively for quantities of 2kg and over 3kg of wood.

DISCUSSION OF RESULTS

In relation to the gender of the respondents in the activity of selling wood-energy (charcoal and firewood), after statistical analyses we have X-squared = 68.301, df = 1, p-value < 2.2e-16.

The null hypothesis is rejected because $p < 0.001$ and leads us to affirm that the proportion of women involved in the sale of wood energy is significantly high compared to men in the city of Kindu, X-squared = 68.301, df = 1, p-value < 2.2e-16. This would be due to the fact that men are moving towards other more revenue-generating activities.

Which confirms our first hypothesis of the study. This observation is supported by Tagirabo (2023) who conducted a similar study on the state of the sale of charcoal in the city of Bunia, the results of which show that 77.83% of women compared to 22.17% of men are engaged in the activity of trading in wood energy.

Paradoxically with Tshimpanga (op. cit), in his study on the charcoal industry and its socio-economic impact in Kisangani and its surroundings. He was able to find at the producer level that his sample contained more men than women, i.e. 94.1% against 5.9% respectively; This is justified by the fact that the number of men is high than that of women following the heavy work required for felling and making ovens.

Regarding the quantity sold in the city of Kindu for wood energy, Table 10 (coal) gives the daily quantities sold by the respondents according to the units of measurement preferred by the buyers; the small bag of 200g to 300g and the large bag of 1Kg come first, with 52.87% and 7.32% respectively in the range of quantities and the bag comes second with 31.93%. By comparing the results of Table 12 (firewood), we see that sellers have the possibility of selling per day 10 to 20 packages of 1Kg; from 5 to 10 packages of 2Kg of firewood represent respectively 46.11% and 38.35% and from 10 to 50 packages for 3Kg of wood with 15.52%

Comparing these two results with those of Choma (2019) who carried out an analysis on the eastern urban sector of Kindu and its impact on the forest ecosystems close to its environment; his results show that it is firewood that is most used by the population of the urban-rural commune of Alunguli, although not giving statistics on the quantified quantity, but was limited only to the opinions of the respondents on the use of firewood at 71.2% and 128.8% who use embers.

By doing the test of Qhi-square homogeneity to compare the different quantities of charcoal and firewood, the difference between the quantities is significant, X-squared = 182.17, df = 4, p-value < 2.2e-16; which confirms the second hypothesis according to which the quantity of charcoal and/or firewood is a function of the unit of measurement used by the sellers.

In relation to the distances traveled or covered for the search for wood energy by sellers, the most requested distances are: 1 to 10km, 5 to 10 km and 1 to 5 km respectively

with a number of 142 respondents, or 36.5%, 69 or 17.7% and 53 or 13.6% against 1 km, a short distance for the search for the commodity (wood energy) with a number of 125 respondents in all the municipalities under study, compared with the Schure and Hunhyet study (2014) on the development of a sustainable wood energy supply basin plan for the city of Kindu. The distance traveled by operators extends over a radius of 20 km from the city, this is all the more true because their study concerned all the players in the wood energy sector through the producer, transporter, seller and consumer links.

For the means of transport, the proportion of means of transport used by charcoal sellers differs significantly. The bicycle is the most used means of transport (chisq. test transport, p=prob 3) X-squared = 355.31, df = 4, p-value < 2.2e-16, which confirms the fourth hypothesis. This also corroborates the studies conducted by Schure, Huhnyet (2014) and de Choma (op. cit) who found the same reality on the ground for the transport of wood-energy.

CONCLUSION

A study on the Analysis of the Wood Energy Market; case of charcoal and firewood has just been conducted and had the objective of making a market analysis on the sale of this highly prized commodity in the city of Kindu, Maniema Province in DR Congo.

The methodology used is that of a survey supported by interview techniques based on the interview and visit of different sites and direct observation for the collection of data thanks to the pre-established survey forms which facilitated the exchanges with the target groups (Respondents).

The circuit on the market analysis for the sale of wood energy is poorly structured and less organized by the study population. Out of 389 individuals recorded in activity on the sale of wood energy, 365 or 93.83% work as free electrons, that is to say in private for a personal interest, against 24 who are in an association or working group, at a rate of 6.16%, but not in an orderly manner. Hence, it is imperative that this sector can be accompanied and supported in its organization to boost its harmonious development.

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