

# CHARCOAL SUPPLY NEAR LUBUMBASHI, ZAIRE: TECHNIQUES OF PRODUCTION, TRANSPORTATION AND CONSUMPTION OF CHARCOAL AND THEIR IMPACT ON THE ENVIRONMENT

Renaud De Plaen  
Concordia University

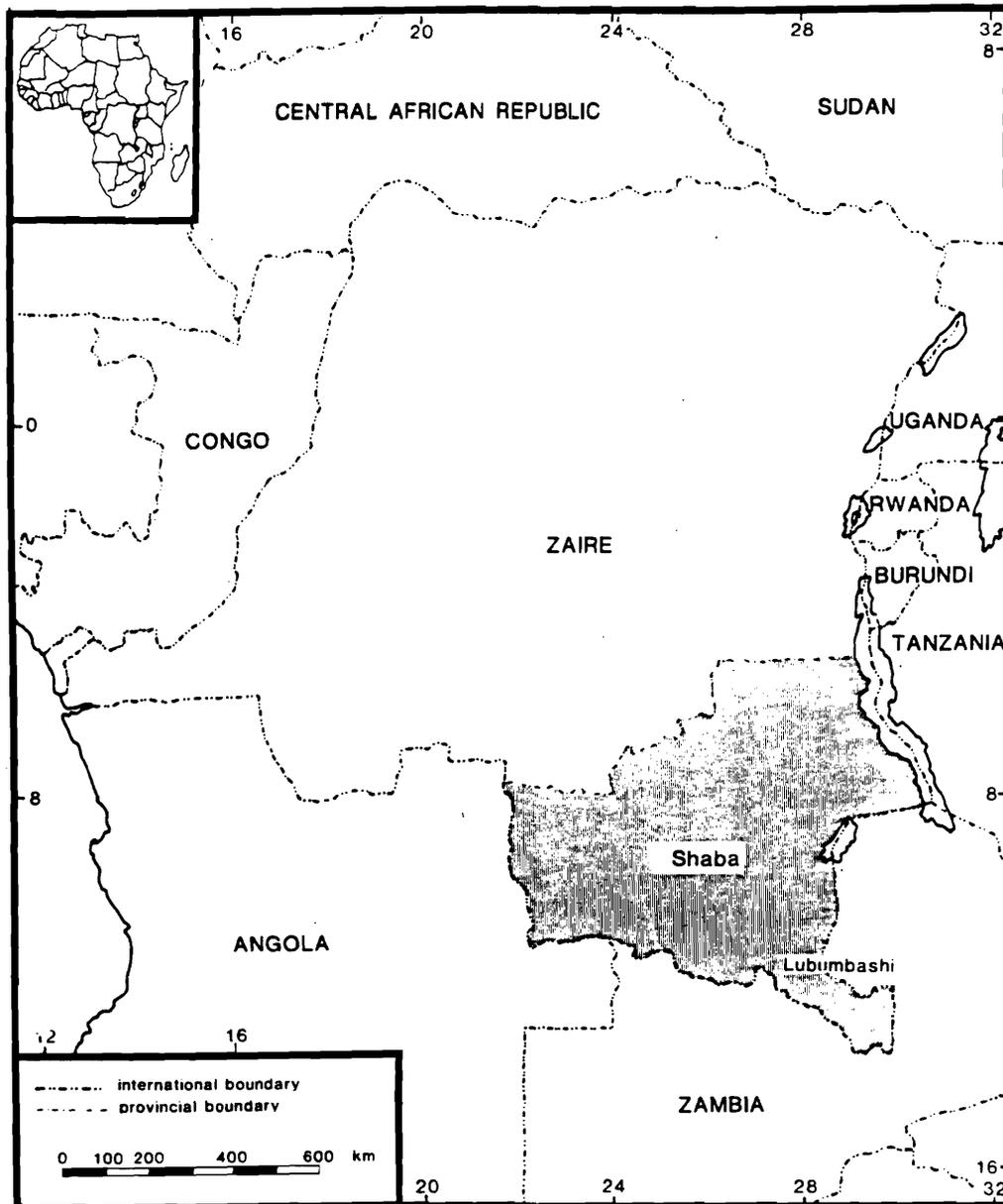
*ABSTRACT. Charcoal production has been identified in the literature as a leading factor in deforestation and associated environmental degradation in Africa. This study identifies methods of production, transportation, and consumption of charcoal in Shaba, Zaire. It assesses the efficiency of harvesting methods and the furnaces and stoves used in charcoal production and consumption. It also defines some of the more salient environmental impacts of these methods and technologies. Ultimately a number of recommendations are made, which aim to increase the efficiency of production and consumption. The study concludes that charcoal production is secondary to agricultural practices in its impact on the woodland reserves of Shaba.*

The woodfuel crisis of developing countries only became an issue in the early to mid-1970s when much of the world was in the grip of the oil crisis. Prior to this time, though deforestation was an acknowledged problem, researchers were yet to become aware that enormous and growing demand for woodfuel in the developing world was an important contributing factor to deforestation. At the same time, research demonstrated that millions of people were finding it increasingly difficult to get enough fuel, as tree stocks declined throughout the developing countries. The woodfuel crisis is a typical case of rising energy demand outstripping supply. Although forests are renewable, they are being used at an unsustainable rate.

In Africa, during the last 20 years, there has been a transition from wood to charcoal as the dominant source of energy. Two reasons induce this transition: 1) the energy content of charcoal is about twice that of fuelwood, which makes its transport more profitable, and 2) as the forest became less accessible, thanks to urban growth, the source of fuelwood production became further removed from these centers of consumption, giving charcoal a clear price advantage over fuelwood. The rise in the importance of charcoal in Africa is likely to continue into the future. On the surface this transition would appear to be a positive one in terms of reducing the threat of deforestation. However, currently used methods of charcoal production waste a very substantial volume of wood. As a consequence, unless more efficient charcoal-making techniques are introduced, the transition from wood to charcoal will not go far toward reducing the threat of deforestation.

At the beginning of my study I assumed that the increase in charcoal production was the major contributor to deforestation in Africa. The aim of my research was to study the processes of charcoal production, transportation, and consumption in the context of underdevelopment and to identify possible improvements in techniques and organization that could reduce the negative impact on the forest of charcoal production while enhancing its accessibility to the African population.

The objectives of my research are: 1) to describe traditional processes of charcoal production, transportation, and consumption in one small district of southeastern Zaire, 2) to examine briefly some of their environmental impacts, and 3) to identify methods of charcoal production that could both increase the efficiency and minimize environmental costs. It is, however, impossible to examine the impact of charcoal production on the environment without looking at the relationship of charcoal production to logging and agriculture, because they are intimately related.



**fig. 1 : The study area- Shaba province**

I conducted my research in Shaba (Figure 1). The fast pace and scale of forest exploitation taking place in Shaba typifies the acute crisis common to much of Africa. The margins of the forest have been drawn back further and further from areas of settlement and the price that urban dwellers have to pay for charcoal has been rising rapidly as a result of increasing transportation costs. "Savannization", erosion, and laterization are occurring at a fast pace around the cities.

The vegetation of Shaba (where the savanna woodland predominates), is the product of a long evolution of soil development, bioclimatic conditions, and human activities. The savanna woodland consists of ligneous and herbaceous strata coexisting in a precarious equilibrium. If for any reason this equilibrium is upset in favor of one of the strata, that strata readily supplants the other and dominates or even destroys it. Around

Shaba's main city of Lubumbashi, the imbalance favors the grass coverage. Other than by brush fires started late each year, the pace of this development is accelerated by other human activities, such as lumbering for industrial purposes, and clear-cutting for charcoal production and agriculture.

Charcoal is the main source of energy for domestic consumption in Lubumbashi. The population of the city has been increasing rapidly over the last 20 years. The most recent estimate places it at 551,000 people. Due to the increasing population density and very low wages, the demand for ligneous and agricultural products has increased dramatically, putting inordinate pressure on the surrounding vegetation. The magnitude of charcoal consumption in the city can be estimated by observing the number of charcoal bags entering Lubumbashi every day. This is estimated at 2476 bags.

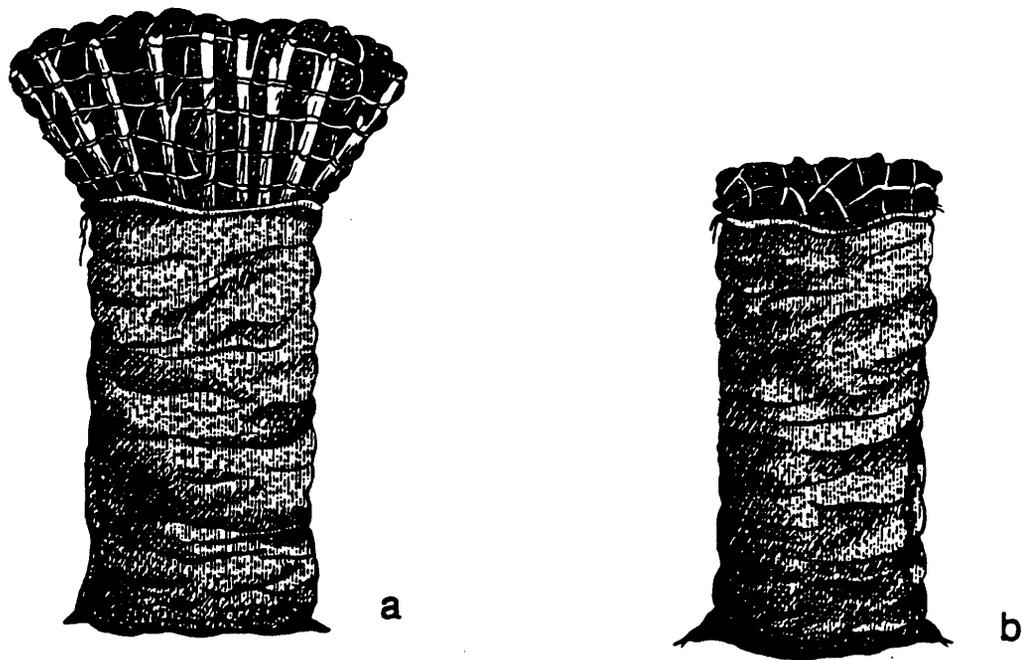
I identified modes of charcoal transportation and estimated the volume being transported along the main access road to Lubumbashi to assess the extent to which road and trail conditions influenced the mode of transportation. I classified vehicles into six categories according to their capacity to carry bags: trucks and vans with capacities between 80 and 150 bags; jeeps and pick-ups, between 30 and 50 bags; trolleys between 10 and 15 bags; cars between 1 and 10 bags; bikes between 1 and 2 bags, and finally pedestrians who can carry 1 bag at a time. The average weight of a charcoal bag is about 48 kg (Figure 2).

In Shaba, the harvesting of ligneous products is generally done by one of three parties: the housewife, who collects the fuelwood for the household, charcoal producers, who are usually small contractors, and independant laborers, and logging companies. The first to invade a region are usually the logging companies. Wood produced by these large scale forestry operations goes through the following procedures: 1) felling, 2) lopping and pollarding, 3) sawing, 4) bark stripping (for mine timbers), and 5) transport toward an exit trail. All these activities depend on the construction of roads or the clearing of trails. Forest roads and trails handle seasonal and limited traffic and are often poorly constructed. The road network is typically dendritic (Figure 3): leading from a public road or the railway line, an access road to the felling area is cut, which then branches out to collection trails. During the rainy season, sites more than 20 km from these lines of communication pose a maintenance and access problem. Thus, only a small portion of the available forest is exploited beyond 15 or 20 km on each side of a public road. The only part of the cut tree used to produce mine timbers and poles for cooper refining is the trunk. The rest of the tree, namely branches and foliage, is left on the ground and burned. The volume of ligneous material that is wasted in this type of operation is tremendous.

Such forest operations do not directly destroy the forest. As large logging companies practice selective cutting (they cut only certain trees corresponding to certain standards of production), the vegetation would be able to recover easily after the logging if it were left to regenerate. This is not the case.

The roads built by the forestry operation provide ready access to charcoal producers, who arrive after the departure of loggers and radically transform the landscape by clear-cutting. Since the first days of the colony, Shaba has produced charcoal (called makala in Kiswahili) commercially using earthen furnaces (kibiri in Kiswahili). The kibiri's structure and form has undergone many modifications, from the "feux de camps" and "compas", to the current version, the "tchatchatcha". The present day kibiri is a pile of logs stacked horizontally on 2 or 4 supports, covered with lumps of earth (mashinde in Kiswahili) on the sides and with earth and grass on the top (Figure 4).

The production of charcoal by kibiri involves little capital expenditure. An axe, a hoe, forks and a shovel are all that is needed. The raw material, wood, comes from the prin-



**figure 2 : Charcoal bags: a. Mundule; b. Mufuko ya makala**

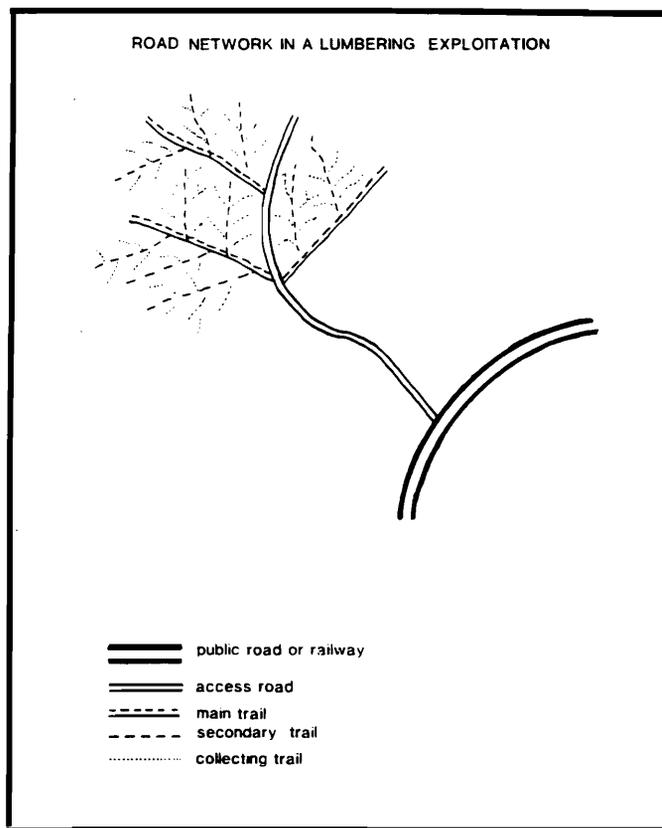
---

cipal tree varieties of the savanna woodland, as well as pine and eucalyptus, which were imported by European settlers around 1950.

It is possible to assess the environmental impact of charcoal production on a local scale (Figure 5). Three different zones can be identified on the production site. A sizeable area of the forest must first be felled to supply the wood which will be subsequently transformed into charcoal. Then, the surface of the soil surrounding the location of the kibiri must be dug to produce mashinde which are used for the coating of the kibiri. Finally, the soil directly underneath and covering the kibiri will be burned during the process of charring.

During the colonial period, steel furnaces appeared to be an economical alternative technology for the preparation of charcoal. Big industries such as GECAMINE (a mining concern) decided to import some of these furnaces to Shaba, to produce charcoal for miners' domestic use. The furnaces have a capacity of 20  $m^3$ , much larger than the kibiris I have seen, which have a maximum capacity of about 7  $m^3$ . Having exhausted the supply of ligneous material within a radius of 250 - 350 meters, steel furnaces were disassembled and reassembled elsewhere. The percentage of transformation of wood into charcoal by steel furnaces was almost double that of the kibiri (19% compared to 11%). In other words, whereas 2  $m^3$  of wood produce 3 bags of charcoal by the kibiri method, the same quantity of wood produces 5 bags of charcoal using a steel furnace.

The steel furnaces made the charring of wood profitable during colonial times, but they are no longer as lucrative. Due to maintenance problems, their productivity has decreased by 60%. Steel furnaces had just been abandoned by the time I arrived in Lubumbashi in August 1989. This raises questions about the viability of more efficient techniques of charcoal production. Often these techniques are not well adapted to



**figure 3 : The road network in a lumbering exploitation**

African conditions. The advantages of greater efficiency are diminished if these methods prove to be nonviable in the long run.

On a larger scale, we can say that charcoal production has a much greater impact on the forest than does the lumbering industry since it involves clearcutting as opposed to selective logging. However, its role in the environmental degradation of Shaba is much more difficult to quantify since deforestation is the result of the combined effect of a number of related activities, the most important of which is agriculture.

The growing population in the Lubumbashi area has also resulted in an increased demand for agricultural products. The principal agricultural technique in this area is swidden agriculture. The process involves clearing a section of land, and then setting fire to it, so as to cover and fertilize the clearing with ashes. The soil is then tilled and various crops are planted. On the plain surrounding Lubumbashi, the surface soil is first scraped in order to form arable mounds. The grass and branches are burned on these mounds to fertilize them. Traditionally, swidden agriculture in Shaba involved almost no crop rotation but consisted of planting a mixture of different cereals (corn and sorghum) or a combination of cereals and peanuts. The harvesting of cassava, which was introduced in Shaba around 1850 and which today constitutes an important part of the local diet, requires a large surface area. In the past, this crop was well adapted to Shaba's poor soil and low population density.

Today, the increased population density has led to an increased demand for agricultural products. The land surface cleared for agricultural purposes has had to increase



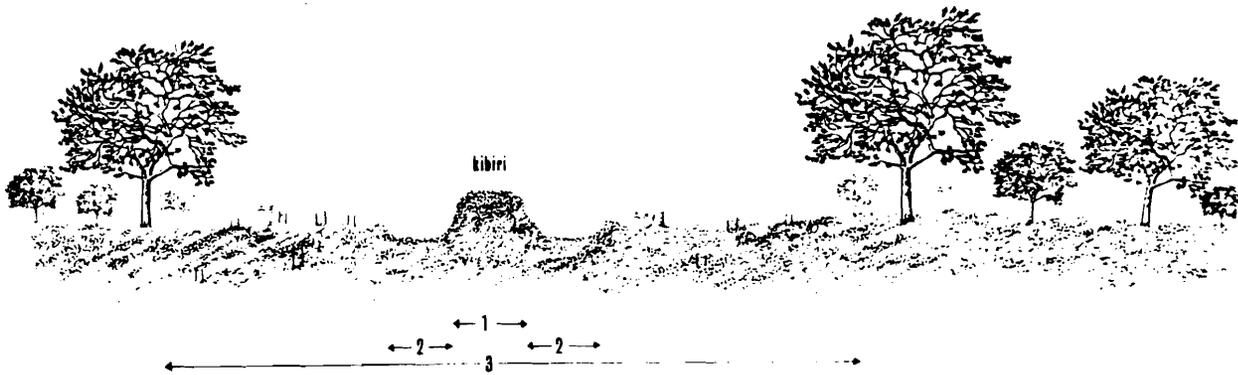
**figure 4 : the Kibiri furnaces: a. logs stack corresponding to tchatchatcha; b. Kibiri tchatchatcha**

---

significantly. As agriculture has been transformed from a subsistence activity to a market oriented activity, traditional mixed farming is no longer practiced. This results in the exhaustion of soil. When farmer leave their fields to clear a new patch, the nutrient content of the soil is too low to allow regeneration of vegetation. The regular burning of the brush is another factor that inhibits the recovery of the land. The bare and unprotected ground is quickly subjected to erosion due to wind and heavy rainfall during the rainy season. When the thin layer of arable land on the surface of the soil is removed, laterization takes place and soils become irremediably damaged.

As I said previously, deforestation and associated environmental degradation is the result of the combined effect of a variety of activities, primarily large scale logging operations, charcoal production and shifting cultivations. The first step toward the degradation of forest and land in Shaba is taken by large scale lumbering operations. The impact on the vegetation is minimal due to the application of selective felling. The forest may still recover easily following its exploitation by logging companies. The major negative impact of large scale logging activities on the forest is the result of path clearing and road construction which leaves the forest accessible to charcoal producers.

Charcoal producers take up where logging companies left off. They clearcut large strips of land on each side of the road. The impact of charcoal production on the forest is thus ultimately more devastating than that of the forest industry. Even so, the woodland could probably still regenerate if it were left untouched for a sufficient period of time. Unfortunately, this is usually not the case because, just as charcoal producers



**figure 5 : Local impact of charcoal production :**  
**1. burned topsoil; 2. dug ground; 3. clearcutted area**

follow logging operations, farmers follow charcoal producers. The farmers then cultivate the cleared land until its nutrient content is completely exhausted.

The initial hypothesis of this research was that charcoal production was the most important cause of deforestation and land degradation in Shaba. In fact, charcoal production is effectively only one of a number of contributing factors. It does not appear to be the most important one. Nonetheless, given that charcoal is likely to be the prime source of energy for a number of years to come, any improvement in the overall efficiency of energy production should be welcomed. To this end, my research has led to the following recommendations:

- 1) Cooperation between the forest industry and charcoal producers is necessary. The ligneous waste of the logging process should be left on the field to be used by charcoal producers, rather than be senselessly burned.
- 2) Designated tree farming areas should be established, in which charcoal may be produced using more efficient and modern charcoal making technology, such as the brick furnace.
- 3) The government should promote the use of more efficient domestic stoves which could be constructed by the local labour force and which would help to reduce the quantity of charcoal necessary for daily domestic consumption. One such stove, the Kimaki Jiko, is already used in Kenya for example.

The enforcement of these recommendations would slow the pace of land degradation and deforestation in Shaba. It would also provide a greater supply of charcoal at a lower cost, improving the standard of living for local residents. It is needless to say, however, that if these suggested changes were not made in conjunction with changes in agricultural practice, what would be gained by these efforts would be minimal.