Working Paper

Lessons from eastern Africa's unsustainable charcoal trade

Fridah Mugo and Chin Ong

East Africa

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

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Abstract

Although charcoal meets 80% of urban households' energy needs in eastern Africa, it hardly attracts the attention of policy makers. Yet charcoal will remain the main cooking fuel for most people in the region's towns for the foreseeable future because it is affordable. As demand for charcoal increases with rapid urbanisation, so does pressure on forests and woodlands, most of which are poorly managed and prone to degradation. Matters are made worse because there are no incentives for investment in planned charcoal production. Consequently, the current charcoal business is unsustainable and has a negative image. Banning the making and transportation of charcoal in some countries has largely been unsuccessful in regulating its production and trade. There is need to look for alternative ways of dealing with charcoal issues.

Over the past few years, the Regional Land Management Unit (RELMA) has conducted a series of workshops to discuss charcoal trade in the region. From the discussions, it was clear that contradictory directives and weak laws are to blame for the confusion in the charcoal business in eastern Africa. Apart from Sudan and Kenya, the other countries are yet to formulate policies or enact laws to promote sustainable charcoal production and use.

While Sudan has a regulatory system of planting and harvesting trees for charcoal production, the other countries neither plant trees nor give land owners incentives to do so. Instead, they are preoccupied with policing exploitation of existing stocks of wood. Other obstacles to streamlining charcoal trade include inefficient production methods, poor marketing and its semi-illegal status. What must be done? It is vital to create the right climate for profitable and sustainable charcoal production. This can be done by formulating sound policies and enacting appropriate laws. Regulation of charcoal production, distribution and marketing should be assigned to a single authority that would be accountable for all issues relating to the industry. Finally, there should be short- and long-term plans for tree planting by smallholders and the private sector. With the right climate, charcoal trade can be turned round to provide employment and protect the environment it now threatens.

Key words: woodfuel, charcoal policy, deforestation, eastern Africa.

Table of contents

Introduction

The choice of charcoal as a source of energy

Studies from around the world indicate that the more affluent households prefer cleaner, more convenient cooking fuels to wood. The well-off see changes from fuelwood to charcoal, kerosene, gas or electricity as steps in the improvement of the quality of their lives (Reddy, 1982). But among the poor, the reverse occurs. As woodfuel becomes scarce and prices increase, people turn to twigs, dung, roots, vegetable residue and leaves, as they slide lower and lower the energy scale.

In the absence of or lack of access to cleaner and more convenient forms of energy such as electricity, gas or kerosene, as is the case in many African towns, charcoal is the next best alternative for many. For example, a recent survey of households in towns in the northern region of Mahajanga, Madagascar, showed that charcoal was the main domestic fuel (CIRAD, 1999). The figures revealed increasing charcoal use when compared with a 1992 survey for the World Bank by the Household Energy Unit of the Ministry of Energy and Mines.

While electricity and gas may be considered the most desired cooking fuels, most households cannot afford both the energy resource and the devices required to use these forms of energy. Many, therefore, turn to using kerosene or charcoal. Since most countries in the region import kerosene, it is not always available or it is too costly for many. This leaves charcoal as the most readily available fuel in urban areas.

In addition, charcoal has unique cooking properties that make households to go for it even when other fuels are also available. This has been demonstrated in Sudan, where the price of gas (LPG) fell to a third that of charcoal but many homes still went for charcoal (Ibrahim, 2003). Most hotels and restaurants also prefer charcoal for roasting meat.

In terms of quality and energy value, charcoal compares well with other sources of energy.

Trends in charcoal use and reasons for its negative image

Reliable information and estimates of charcoal production, trade and use or its impact on forest and woodland cover in most African countries are not available. However, recent case studies — for example, in Tanzania (Malimbwi, et. al., 2001), Mozambique (Pereira et. al., 2001), Madagascar (CIRAD, 1999) and Kenya (ESDA, 2005) — show increasing use. This is as a result of a combination of many factors that include increasing population, rapid urbanization and a shift to charcoal use by urban dwellers.

High profits from charcoal have also contributed to the shift, spawning new businesses far away from the markets and leading to exploitation of distant forests and woodlands. These are often those areas where there is less control and which lack institutional support by the public authorities responsible, such as forest and energy departments (Trossero, 2003).

Charcoal production is a big threat because it targets specific preferred species found in natural forests and woodlands, most of which are poorly managed. The result is unsustainable harvesting. In drier areas, where the regenerative capacity is lower, unplanned and unmanaged charcoal production accelerates the processes that lead to desertification. In addition, in most countries of the region, regulation of charcoal production is uncoordinated and there is little investment to make business more efficient and cost-effective. This makes charcoal extraction unsustainable and contributes to its negative image.

The charcoal industry has been viewed negatively because it is associated, rightly, with deforestation and land degradation, slow and unsustainable growth of trees, wasteful use of wood, environmental pollution and poor working conditions of those involved in production.

Importance of charcoal as a fuel in the region

Despite its negative image, there is no doubt that charcoal trade will not stop. Instead, it will remain the main and, in some cases, the only source of energy for millions of people in the region for a long time to come.

Considering the increasing distance from market to source, Fuwape (1993) found that on the basis of physical and combustion-related properties of charcoal and fuelwood, charcoal is considered better. Another woodfuel study in Niger concluded that charcoal is a technically and financially feasible energy option, but should be produced under a long-term scheme (Kjell, et. al., 1988) to ensure a sustainable supply.

Generally, the demand for charcoal is on the increase, especially in urban areas of developing countries due to lower transport and handling costs compared to firewood (Earl, 1975).

While information on charcoal use in the region is sparse, available estimates indicate that the fuel provides energy for a majority of urban households. In Kenya, it provides for 80% of urban households and 34 per cent of those in the rural areas (Republic of Kenya, 2002). The situation is similar in Tanzania, where 80% of the charcoal produced is used by urban households (Ngerageza, 2003).

In Ethiopia, a wood energy survey of 1996/97 indicates that 230,000 tonnes of charcoal are used every year. Seventy per cent of the total production is used in towns, supplying 97% of household energy needs.

In Uganda, biomass constitutes 90% of the total energy consumption (Republic of Uganda, 2002). Like in the other countries in the region, charcoal is mainly used in urban areas and its use, estimated to increase at 6% a year, is proportional to the rate of urbanization (Tumuhimbise, 2003).

In Zambia, woodfuel supplies 68% of national energy requirements. A total of 0.7 million tonnes of charcoal is consumed annually and 85% of urban households are reported to use it. Charcoal use is reported to have increased by 4% between 1990 and 2000 (Chidumayo, et. al., 2002).

Charcoal production and trade contributes to the economy by providing rural incomes, tax revenue and employment. It also saves foreign exchange that would otherwise be used to import fuel. In the Licuati region of Mozambique, for example, 65.4% of rural incomes are derived from charcoal. In Kenya, the annual consumption of charcoal has been estimated at 2.4 million tonnes (Republic of Kenya, 2002) valued at Ksh 36 billion. The most recent estimates reported a figure of 1.6 million tonnes worth Ksh 32 billion (ESDA, 2005). At the 16% Value Added Tax charged by the Kenyan Government, this should contribute Ksh 5.12 billion in taxes every year.

The World Bank/ESMAP employment estimates per TJ Energy consumed in person days indicate that charcoal creates between 200 and 350 jobs per TJ *Woodfuel policy and legislation in eastern and southern Africa.* Proceedings of a Regional Workshop held at the World Agroforestry Centre, Nairobi, Kenya, March 4-6, 2002. RELMA, ICRAF. p9., electricity 80-110, LPG 10-20 and kerosene only 10. The figures suggest that promoting charcoal can create more jobs than the other forms of energy. In addition, planting trees for charcoal can be a profitable enterprise as shown in the case of Kakuzi (2003), where it

costs Ksh 159 (60%) to produce a bag of charcoal that is sold at Ksh 260, earning a net revenue of Ksh 101 or 40% of the retail price.

The charcoal industry in Kenya employs about 200,000 in production alone. In Uganda, production provides 20,000 jobs and generates more than Ush 36 billion (US$20 million) a year for rural people. The pattern is similar in the other countries in the region.

However, despite its significant contribution, charcoal has been kept out of the formal economies of these countries, mainly because its importance is not well understood and appreciated.

Trends in the charcoal industry and its changing image

Contrary to popular belief, charcoal production and use is increasing worldwide rather than decreasing (Rosillo-Calle et al., 1996) as some believe. Brazil is the world's largest producer and user of industrial charcoal, consuming more than 7.3 million tonnes (1992 level) a year. Various studies, for example (Emrich, 1985), have shown that because of the synergistic effect of improved charcoal technology and advanced silvicultural practices, the use of charcoal and its by-products will continue to increase.

Johansson et al. (1993) has estimated that by the middle of this century, renewable sources of energy could account for 60% of the world's electricity and 66% of the market for fuels used directly, of which biomass makes up 38 per cent. A 1994/5 study by Shell International Petroleum also predicts a significant role for modernized biomass energy in this century. This calls for adequate investment in developing renewable sources of energy, including charcoal.

As living standards rise and urban areas expand, households and cottage industries in many developing countries, especially in Africa, are turning to charcoal for cooking, increasing its demand even further. In a bid to produce charcoal sustainably to meet rising demand, countries such as Brazil (Rosillo-Calle et al, 1996) and Sudan (Ibrahim, 2003) have set up large plantations in low-population areas and under-used land. Many developing countries are also promoting the making of charcoal briquettes from biomass waste.

The role of charcoal in land degradation and deforestation

In Kenya, about 40% of the charcoal comes from rangelands, an equal share from farmlands and 20% from government forests (Republic of Kenya, 2002). Most of the charcoal from rangelands and government forests is harvested unsustainably. In Uganda,

charcoal is generally produced on non-state land (Republic of Uganda, 2002) and its production has been associated with deforestation and degradation of large areas of rangeland and forest.

In a bid to curb the damage caused by unplanned charcoal production, most countries in the region have imposed restrictions on production and transportation of charcoal. However, charcoal trade in urban areas is legal.

Unless modern techniques are used, charcoal is a wasteful use of natural resources that leads to massive land degradation and deforestation. A study on deforestation along the Morogoro-Dar es Salaam highway in Tanzania confirmed that unemployment and demand for charcoal by urban consumers were reducing the Miombo woodlands at the rate of 4354 ha a year, which would be equal to 1524 km^2 in 35 years (Monela et al, 1993). It was estimated that restoring the Miombo woodlands to their original state would as many years.

Another study, also in Tanzania, examined the reasons for changes in natural woodland in a 10,000 sq km area supplying Dar es Salaam city with charcoal. The four-year study found that harvesting of wood for charcoal had degraded 25% of closed woodland and deforested 20% of the same. It had also degraded 51% of open woodland (Malimbwi, et. al., 2001).

This was confirmed by a socio-economic survey in which 75% of respondents in Mbewe, Bana and Kitulangalo areas of Tanzania identified charcoal as the main cause of woodland degradation and deforestation. The study found that in most of the areas trees were cut and left to regenerate as opposed to land being cultivated for agriculture.

Other studies in Tanzania (Misana, 2001), southern Africa (Chidumayo, 2001), Kenya (Mugo and Poulstrup, 2003) and Zambia (Chidumayo, 2001) observed that conversion of woodland to agricultural use is the leading cause of land cover change.

Although agricultural expansion is a major cause of woodland change and deforestation in many parts of eastern and southern Africa (Dewees, 1994), in the study of Dar es salaam and its catchment, Malimbwi et al (2001) found the role of cultivation negligible compared to charcoal production. Between 1991 and 1998, for instance, only 5% of closed woodland, 8.9% of open woodland and 6.5% of bushland was converted to mixed cultivation. In Ethopia, 150,000 – 200,000 ha of forest cover is lost annually to charcoal (Yigard, 2003).

The actual causes of forest cover loss vary according to location. A study in Makueni and Kitui districts, Kenya, revealed that the trees used to produce charcoal are cleared under different arrangements. When new land is opened up, vegetation is cleared to give way to crop production. The trees felled are used to make charcoal (Mugo and Poulstrup, 2003). The same has been observed in Narok, also in Kenya, (Robert: Personal communication, 2003), Sudan (Ibrahim, 2003), and the Amazon (Fearnside et al, 2001). Generally, new land is usually opened up after older farmland is are exhausted and no longer gives adequate yields.

In the case of Narok, land was cleared for large-scale wheat farms. This happened as group ranches were sub-divided and allocated to individuals, who then cleared the wood and bushes to grow wheat. In this case, it is actually land clearing for agriculture that produced wood for charcoal. Charcoal was just a by-product. A similar process is followed in the freehold land tenure system when land is sub-divided among sons and each son clears his share for farming.

In Taita Taveta and Kitui Districts of Kenya where land is managed for livestock production in ranches, squatters are asked to clear trees, shrubs and bushes to give way for pasture. They are then allowed to make charcoal from the wood they cut down. Usually, the charcoal burners pay very little for it, Ksh 20-50 (US cents 25 - 40) a 35kg bag. Again, as in the Narok case, charcoal is a by-product, this time of land management for livestock production.

However, there are cases when wood is sought specifically for charcoal. During famine when people cut down trees to make and sell charcoal to get money for food. This is common in the arid and semi-arid areas of the country.

Trees are also cut for charcoal where people are employed for longer periods in charcoal production. Some people, especially the landless, are employed full-time in production. In such cases, the people buy wood or are allowed to produce charcoal for free on land owned by the government or county councils (Mugo and Poulstrup, 2003).

The studies concluded that both charcoal production and agriculture contribute to woodland degradation and deforestation. However, the contribution of each varies from one country to the next and between different areas of the same country. Rural and urban population growth, unemployment and land tenure are key drivers of degradation and deforestation.

As witnessed in Tanzania (Malimbwi, et al, 2001), if natural woodlands are harvested and not cultivated for agriculture, they can regenerate. This suggests that population control,

change in the land tenure to discourage uneconomical land sub-division, increased agricultural productivity, increased employment, and appropriate woodland management strategies can reduce woodland degradation and deforestation. In addition, planned commercial growing of trees for charcoal production can supply the much-desired energy, create employment and provide additional by-products.

Provided a market for charcoal exists, governments in the region will continue to have problems regulating its production and transportation to urban areas. Instead, these governments should encourage commercial growing of trees for sustainable production of charcoal. In Kenya, for example, it is estimated that commercially grown trees can produce 18 tonnes of charcoal from one hectare. About 135,000 ha of fast-maturing tree species will be required every year to meet the current demand of .4 million tonnes. In order to produce the volume of wood needed, 270,000 jobs would have to be created, at the rate of two jobs for each hectare. This is in addition to the environmental benefits to be gained from the forests or woodlots established.

A woodlot for commercial production of charcoal in Bondo District, Kenya. Estimates from the country indicate that commercially grown trees can produce 18 tonnes of charcoal from one hectare.

Charcoal production and the tree production cycle

Low growth rates, 0.1 to 1.8 cubic metres per ha a year, of native forests mean that vast areas under proper management and control are needed to produce the amount of wood required to supply the urban areas (Pereira et. al., 2001). A regeneration period of 35 years has been reported for the Miombo woodlands of Tanzania, and 26 years for indigenous species of the semi-arid areas of Kenya (Mugo, 1999).

As shown in Table 1, generally, all species of wood can be carbonized to produce charcoal. The quality of charcoal, however, varies from species to species and depending on the method of carbonization. The species that have been reported to produce high quality charcoal include *Casuarina equisetifolia, Acacia mearnsii, Acacia polyacantha, and Acacia xanthophloea,* and other acacia and combretum species.

Table 1 Examples of emerging tree species for charcoal and respective processing technologies

Species	Cycle - Rotation (Years)	Company – Country	Type of kiln used
Casuarina equisetifolia	5-7	Baobab Farm, Mombasa	Metal Jumbo kilns
Acacia mearnsii	7-8 (4)	Former Eatec - Kenya	Beehive kilns (Brazilian design)
Eucalyptus camaldulensis	6-20	Various in Brazil and Kakuzi in Kenya	Beehive kilns (Brazilian design)
Acacia nilotica, Acacia seyal	15-20	Forest National Corporation – Sudan	Conical earth mound kilns
Leuceana leucocephala	3	CEPAC – Congo and Baobab, Mombasa	Earth mound kilns
Acacia polyacantha, Acacia xanthophloea	4-6	Thuiya Enterprises Ltd. – Kenya	Masonary kilos (Half orange Argentinian and Brazilian design
Leuceana leucocephala and Tectonia grandis	5	Federal University of Technology, Agure, Nigeria	Pyrolytic drum technique

Other tree species that have been cultivated for charcoal in short rotations are *Eucalyptus camaldulensis, Leuceana leucocephala, Tectona grandis, Acacia spectabilis and Sesbania sesban.* Studies in India, for example (Ahuja, 1993) have shown that Eucalyptus

and *Acacia nilotica* can be cultivated in short rotations for charcoal. It was also found that although large sizes of wood produce comparatively more charcoal, the quality of charcoal from smaller diameter wood (2.5 –7 cm) does significantly differ from than that of larger wood. Hence, even smaller sizes of wood could be harvested and used to produce charcoal.

Growing trees for charcoal is viewed negatively because many people believe that the trees will take too long to mature. However, experience has shown that trees can be harvested in as short a period as three years. Many people have not internalised this knowledge. Furthermore, Sudan is growing trees for charcoal in rotations of 15 years, meaning that with proper planning, the growing period need not be an issue.

Wasteful conversion of wood to charcoal

Charcoal making is considered wasteful because only 30-40% of the wood is actually converted to charcoal. The rest is released into the atmosphere as gases. Recovery of by-products from charcoal production could contribute significantly to profitability.

There are many techniques for making charcoal. In the simplest method, wood is burned in an open fire and the charred remains recovered as charcoal. A more controlled process is by restricting the supply of air during carbonization. Two main methods are traditionally used. In one, the wood is stacked on the ground and covered with soil, forming what is often referred to as an earth mound kiln. The other method involves digging a hole in the ground into which the wood is placed and then covered with soil. This one is commonly referred to as a pit-kiln.

Efficiencies in charcoal production vary considerably, but generally, the process is characterised by low efficiency (on weight-by-weight basis) and low productivity. Efficiency varies considerably because it depends not only on the type of kiln used, but also on the type of wood, its moisture content, density and diameter as well as the experience of the operator and even climatic conditions. This is the case in many other parts of the world.

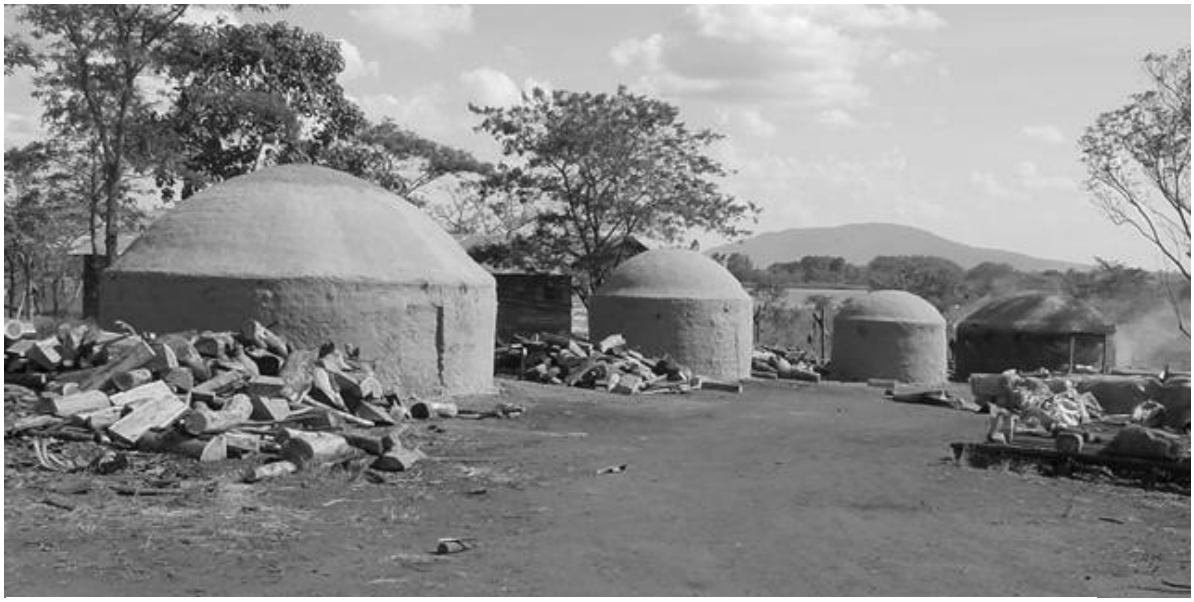
For example, using the earth mound kiln, about 12% efficiency is normal in Zambia (Kalumiana and Shakachite, 2003), 11-15% in Tanzania (Ngerageza, 2003), 8-12% in Ethiopia (Yigard, 2003) and 9-12% in Kenya (Theuri, 2003). In the most efficient kilns, like those used on plantations, an efficiency of 28% (Kakuzi, 2003) has been achieved. In Laikipia, Kenya, the retort kilns have attained 35-45%. In Mozambique, efficiency was found to range from 14 to 20% (Pereira, et. al., 2001).

Charcoal production from natural woodlands is dispersed, with small amounts made at different sites. Charcoal from forest plantations can, however, is produced on a much larger scale, making it feasible to use more advanced and efficient equipment like retorts in order to recover the by-products. Investment costs are high and if there is no ready market for the by-products, the option may not be attractive to the large-scale charcoal producer.

It is estimated that with modern carbonization techniques, for each tonne of charcoal produced, about 0.6 tonnes of dehydrated chemical products and 7×10^6 J of energy in the form of poor quality gas is partially burned in the kiln or released into the atmosphere. These gases could be recovered (Rivelli and Rezende, 1989; Rezende et al., 1993).

Only 42% of the energy represented by the crop in the field is retained in the final product (Moreira et al, 1992). If plantations are excluded, charcoal from natural woodlands is still produced with primitive technology, little operational control of kilns, manual loading and unloading, and without quantitative and qualitative control. It operates in an empirical and craftsman-like way with a labour force that is poorly educated if not illiterate, which makes it more difficult to modernize the sector (Brito, 1990; Brito, 1991; Rivelli and Rezende, 1989). Injecting professionalism in the charcoal industry can help eliminate waste and improve the negative image of the industry.

Earth mound kilns: Efficiency has been reported to range from 8-15 per cent.



A battery of masonry kilns in Kenya

Charcoal production and environmental pollution

There are two levels of environmental concerns in charcoal production: Tree planting for wood production, and processing. Generally, charcoal production in Africa tends to be small-scale and dispersed, mainly in rural areas. This causes less environmental damage than would otherwise have been expected, but, at the same time, makes it difficult to enforce environmental control.

It is estimated that carbon is accumulating in the atmosphere at a rate of 3.5 billion metric tonnes a year as a result of tropical deforestation, related land use changes and fossil fuel combustion. Estimates by Woomer (2003) indicate that one hectare of trees can offset between 200-160 tonnes of carbon a year. The environmental effects of sustainable charcoal production therefore include reduction of greenhouse gas accumulation in the atmosphere and runoff. Trees also reduce soil erosion and increase nutrient recycling. This helps to improve soil fertility, resulting in higher land productivity and reducing the need to clear forests and agricultural expansion.

Kilns and pits do not produce liquid effluent because the by-products are mostly dispersed into the air as vapours. In this case, contamination of the air is of greater importance. As the growing of trees for charcoal on individual farms and even plantations starts to take root, efforts should be made to ensure kilns are located appropriately. Kiln batteries should not be set up in residential areas because smoke would be a nuisance. Smoke would also be the limiting factor on the number of kilns assembled in a battery.

Kituyi (2006) estimates that when sing the beehive standard kiln, it should be located a minimum of 100 metres from residential housing and as much as possible of higher grounds. Despite this indicative distance, the kilns should also be fitted with chimneys to release the gases higher into the atmosphere.

There is need for research to provide an accurate estimate of the number of kilns a battery should hold and their minimum acceptable distance from residential areas to minimize environmental and health risks.

Alternative sources of raw materials for charcoal production

Developing countries have considerable biomass materials that could be used for energy but are wasted. In Kenya, research by the Chardust Briquetting Company has identified bagasse, coffee husks, sawdust, coconut husks and shells, and lump wood charcoal waste as materials that can be made into good quality charcoal. It is estimated that the country can produce 150,000 tonnes of charcoal briquettes valued at US$0.1-0.2 billion a year (ex-production facility) and save US$1.75 million that would otherwise be used for proper disposal of the biomass waste. The government should therefore encourage industries to invest in converting their biomass waste into charcoal briquettes for extra earnings. This would also reduce the demand for lump charcoal.

Institutional arrangements for charcoal production, processing and marketing

Although tree planting has been actively promoted in arable areas across eastern Africa for more than two decades, shortages of wood for charcoal production persist. This is mainly due to lack of clear supply targets for wood needed by various consumers, and limited investment in forestry and related activities. Besides, no deliberate investment has been made in growing of trees to meet the rising demand for charcoal. Instead, unsustainable charcoal production has continued in natural woodlands, particularly in arid and semi-arid areas, leading to severe environmental degradation that now threatens the ecological stability of whole countries.

While many factors contribute to the current crisis in the charcoal industry, a key one is lack of coordination among different agencies trying to ensure a sustainable supply of wood energy. For example, in Kenya, the ministries of Energy, Environment, Natural Resources, Tourism and Wildlife, Water Resources, and that of Agriculture as well as various agroforestry programmes and numerous NGOs are involved in tree planting for

different purposes (Theuri, 2003). It would be expected that the Ministry of Energy or that of Environment would take full responsibility to coordinate production and distribution of charcoal but this is not the case.

Lack of coordination has been reported in Mozambique (Pereira, 2001), Tanzania (Malimbwi, 2001) and Ethiopia (Trossero, 2003). According to Tumuhimbise (2003), the Uganda charcoal industry is disorganized. The exception is Northern Sudan, where the Forest National Corporation (Ibrahim, 2003) implements charcoal production programmes and regulates the trade.

Status of charcoal policy in the region

None of the countries in the region has a specific policy on charcoal. Instead, charcoal is covered under energy, forestry, agriculture or all three. No particular institution has taken the responsibility to plan and implement charcoal production programmes.

Recent energy policies do not adequately address the problem. The energy policy for Zambia was approved in 1995 and Uganda's in 2002. Those for Kenya and Tanzania were passed in 2004. In Ethiopia and Eritrea, the documents are in draft form. Significantly, the four policies that have been officially adopted emphasize modern energy and pay little attention to charcoal.

The new Forest Act for Kenya addresses the issues concerning charcoal but implementation of the law tends to depend largely on the political goodwill of the officials in office.

Policies and laws relating to wood are scattered across different sectors, making it difficult for their provisions to be enforced. It is only Sudan and, recently, Kenya that have specific legislation to govern the charcoal industry.

Efforts to put charcoal on the agenda

In an effort to unravel the confusion in the charcoal industry, two regional workshops for eastern and southern Africa and a national one for Kenya were held to explore the potential for its sustainable and commercial production. The meetings brought together representatives of government departments, non-governmental organizations,

international and national research organizations, farmers as well as charcoal producers, transporters and traders.

Presentations confirmed that charcoal is a huge informal business that has the potential to develop into a large-scale formal industry. But it was also clear that its development is hampered by lack of appropriate policy, legislation and political will to support growing of trees for charcoal production or planned and sustainable harvesting of trees from natural woodlands for the purpose.

In addition, marketing is especially constrained by a situation where production of charcoal from natural forests is banned and yet certification of production from farms is not adequately supported by a suitable policy or legislation.

A number of measures would ensure a vibrant charcoal industry. These include identifying a key institution to take responsibility for charcoal development, formulation of a specific policy and legislation on charcoal. Short and long-term plans for charcoal production should be made and adequate resources allocated to support the business. Lessons from other countries such as Sudan and Brazil can contribute enormously to this process.

RELMA's role in charcoal policy

RELMA has supported a number of activities in the region to keep charcoal on the development agenda. They include the following:

1. First National Workshop on sustainable commercial production of charcoal in Kenya

In October 2001, RELMA funded the first workshop in Kenya to explore the possibility of growing trees for sustainable commercial production of charcoal. Some 50 representatives from government, non-governmental organizations and interest groups in charcoal production and trade took part. From the presentations, including case studies on the experience of Sudan and Namibia, the workshop concluded that with an appropriate policy and supportive laws, charcoal trade was profitable and could be developed to industrial status.

2. Regional Workshop for eastern and southern Africa

Encouraged by the outcome of the Kenya workshop, RELMA organised the first of two regional workshops on woodfuel policy and legislation for eastern and southern Africa in

March 2002. Twenty six delegates from Eritrea, Ethiopia, Kenya, Uganda, Tanzania and Zambia took part in the meetings.

The workshops discussed the supply and demand for woodfuel in the region and explored its potential for commercial production. It also looked at strategies to ensure a sustainable supply of woodfuel, appropriate institutional arrangements as well as policy and legal reforms needed in each country and the region.

Presentations showed that all the countries were dependent on woodfuel as their main source of energy, accounting for between 68% (Kenya) and 95% (Eritrea) of national energy requirements. Ethiopia reported 94% while Zambia and Uganda indicated 70% and 92%, respectively.

It was also revealed that the six countries represented had draft policies on woodfuel within their forest, energy and agriculture departments, but there were no legal frameworks to implement them. According to the information presented, none of the countries allocated adequate resources to turn policies into practice.

To advance the agenda of sustainable production and trade in charcoal, the workshop resolved, among other things, that countries should form woodfuel policy and legislation review forums that would bring together various institutions and interest groups. It was also agreed that policies and laws governing charcoal production and trade be reviewed and changes suggested. In addition, draft bills would be produced and publicised with a view to having them adopted and enacted into law by parliament in each of the countries.

It was also agreed that participating countries should:

- screen indigenous tree species used for charcoal production,
- draft and facilitate approval of standards for wood energy stoves,
- identify suitable wood energy substitutes and promote their use, and
- promote sustainable production and use of woodfuel.

3. Study tour to Sudan by regional policy makers

After learning of the favourable legal status of charcoal in Sudan, RELMA sponsored a team of 16 senior policy makers from eastern and southern Africa to visit the country to learn more about the policy and how charcoal production and marketing is managed. The leaders, drawn from the six countries in the regional initiative, were amazed at the way

the industry is organized. They found that Sudan has a long-term plan for charcoal production.

Every year, about 100,000 ha are planted with *Acacia seyal* and *Acacia nilotica* for charcoal. The wood is harvested after 15 years. Mature wood is sold to members of the Sudan Charcoal Association by tender. It then finds its way to users through a network of wholesalers and retailers. Charcoal traders pay taxes and other agreed fees to the government.

After clearing the forests and making charcoal, producers use the thorny branches left to fence off the land. The forest department provides certified acacia seed, which the charcoal makers plant to replace the harvested trees. The forest department then takes over and manages the woodlots until the trees mature again, ready for harvesting.

4. Round table discussions in Nairobi

Armed with the new knowledge from Sudan, the policy makers held roundtable discussions in Nairobi to plan the way forward for charcoal in the region. They noted that Sudan had shown that charcoal can be produced in a planned and sustainable manner and recommended that each country speeds up implementation of the steps agreed on at the Nairobi regional workshop of March 2002 (outlined in Section 2 above).

5. Draft woodfuel policy for Kenya

Acting on a request by the Ministry of Energy, in April 2003, RELMA supported a team of six charcoal stakeholders to formulate a draft woodfuel policy. The main elements of the policy included sustainable options of production, processing, marketing, standards, and institutional arrangements. The document advocates the creation of a Woodfuel Development Authority in the Ministry of Energy to coordinate production, processing and marketing of charcoal and fuelwood in Kenya.

6. Study of the potential in rural Kenya

In October 2004, with the policy document on hold, RELMA and Danida (the Danish Agency for International Development) funded a fact-finding study of the arid and semi-arid areas of Kenya to explore the potential for sustainable charcoal production as a source of income in rural areas. It was found that the areas had an enormous potential because large tracts of land are available and there is a need to diversity economic enterprises and provide employment.

However, the study team recommended that more accurate information be obtained. Consequently, a national study on charcoal spearheaded by Energy for Sustainable Development Africa (ESDA) and funded by Britain's Department for International Development (DfID) was completed in 2005. The results are being used to inform the charcoal policy in the making.

7. Policy brief on charcoal in eastern and southern Africa

RELMA is developing policy briefs to disseminate information on the importance of sustainable charcoal production in eastern and southern Africa. This is a way of keeping the countries informed of the progress in the region so that they can learn from one another and accelerate the development of appropriate charcoal policies and legislation.

Case study: Why the charcoal industry works in Sudan

Importance of woodfuel and institutional arrangements

Sudan derives 71% of its energy from woodfuel. The remaining 29% is from petroleum and electricity. Out of all the wood harvested, 88% is used for woodfuel and the remaining 12% for poles, posts and timber.

The government has recognized charcoal as an important source of energy and vested the power to regulate it in the Forest National Corporation. The agency is responsible for planning and organizing production from natural and planted forests. Natural forest in Sudan represents 68% of the total forested area, while plantations account for the remaining 32%.

The corporation has a management plan for natural forests. Forest land is first leased to farmers for five years. At the beginning, charcoal producers are contracted to clear the land for crop production and use the wood to make charcoal. The land is then farmed for five years after which it is left to regenerate for 14-20 years.

For planted forests, the department sets aside land and funds to plant and manage over 100,000 ha of trees a year. The species planted for charcoal are mainly *Acacia seyal*, *Acacia nilotica*, *Acacia melifera*, *Eucalyptus microtheca* and *Prosopis chilensis.* The trees take about 14-17 years to mature for harvesting. The government has recognized charcoal producers to whom it sells the trees by tender at officially set prices.

While most of the charcoal is produced by large-scale contractors with Sudan Charcoal Producers Association, individuals also produce limited amounts. The charcoal is sold to

merchants who transport it to wholesalers in urban centres for distribution to retailers and users.

Overall, production costs are about 41% of the retail price. Transportation accounts for 37% and service fees (royalties, taxes, duty) 22%.

The Sudan Charcoal Producers Association

The Sudan Charcoal Producers Association was started to negotiate with the government on behalf of traders. Grouping producers, transporters and traders, the association has set up its own rules in addition to those laid down by the government. For example, the association expels members who fail to pay taxes or engage in corruption. The expulsion means one cannot trade in charcoal.

The organization has paid off, with some members producing between 2,000-5,000 bags of charcoal and earning up to US$50,000 a season. The association is not problem-free, however. Members complain of high taxes, unclear boundaries and conflicts due to animal routes through contracted land. They are pressing for the government to allocate them forest land to manage.

Charcoal processing in Sudan

Charcoal in Sudan is produced in earth kilns of up to 120 cubic metres. The unit of production and trade is a 40 kg bag. One cubic metre of wood produces three bags of charcoal. The country produces 1.2–1.6 million tonnes of charcoal a year from 7.8–12.3 million cubic metres of wood. On average, 7.7 cubic metres of wood produce one tonne of charcoal. Studies have shown that alternative charcoal-making technologies are neither more productive nor more economically attractive to the producer than the pit-kiln (Paddon, 1988).

Charcoal export in Sudan

Sudan banned export of charcoal in 1960 due to deforestation. However, the ban was lifted in 1995 to help eradicate *Prosopis chilensis*, an invasive species. Charcoal export is restricted to specific places and the Forest National Corporation sets the minimum price. Export of high quality charcoal, mainly acacia, is limited to 5,000 tonnes a year.

However, exports could rise as the government is promoting private investment in charcoal production for foreign markets. Private forest owners are also allowed to export their charcoal and many companies are coming in to exploit the opportunity. Under this

arrangement, investors meet the cost of establishing and maintaining the forests. The government is also encouraging farmers' to plant trees under the agroforestry land management system.

In 1998, consumption of charcoal was found to be 45% higher than the sustainable supply. The government then adopted policies to reduce consumption and increase the supply. One of the strategies was to promote the use of LPG by increasing the price of charcoal up to three times that of gas. However, this has not reduced the demand for charcoal, suggesting that gas is not a direct substitute for charcoal.

Lessons from Sudan

Considering what is happening in the countries of the region and the way the charcoal industry is run in Sudan, the following lessons can be drawn. In Sudan:

- Charcoal is recognized as a key source of energy.
- There is a specific institution, a government parastatal, to implement wood energy policies.
- Production of charcoal from plantations and natural woodlands is well planned.
- Resources are allocated yearly for establishment of plantations.
- There is strong public and private sector participation.
- Charcoal is a formal and lucrative industry.
- There are clear marketing arrangements and rules.
- Traders are organized into a formal association recognized by the government.
- The government is paid royalties and taxes, which are reinvested in establishing plantations.

Other countries in eastern and southern Africa should use some of these ingredients to establish dynamic charcoal industries of their own.

Recommendations and way forward

For the charcoal industry of the region to thrive, the following steps have to be undertaken:

- Governments should acknowledge the value of charcoal as a chief source of energy. A regional charcoal forum (task force) should be set up to sensitize governments and lobby them into action. The forum could include eastern and southern Africa, East and Central Africa, sub-Saharan Africa, or the entire continent.
- Charcoal should be given a suitable home in the government to coordinate its production, trade and use. This could be in the forestry department, ministries of energy or agriculture, or other appropriate government department. Alternatively, the coordinating agency could be a corporation -- as in Sudan -- commission or authority.
- Once a suitable agency is identified, governments should allocate adequate financial and human resources to develop an efficient and effective industry.
- A legal framework should also be put in place to regulate the charcoal industry, including setting and enforcing standards.
- Each country should create a Charcoal Development Fund to facilitate development of charcoal production, trade and use. For example, such a fund could impose levies on lump charcoal and use the revenue to replant trees. It could also provide money for research, development and promotion of technologies, such as that for briquettes, which makes use of biomass waste and reduces demand for lump charcoal.
- Each government should formulate long-term charcoal production plans, say for 20 years, and implement them consistently. Such plans should adopt a two-pronged tree-planting strategy that includes establishing government plantations of fast growing trees and shrubs, and a market focused strategy that encourages people to grow trees for money.

- ICRAF in collaboration with forestry and agroforestry research institutes and training institutions should start a scientific symposium to be held every two years to stimulate research on the charcoal industry. The initiative, which may also involve other developing countries, would stimulate interest and should lead to a scientific journal on charcoal.
- National, regional and continental charcoal stakeholder associations and cooperatives should be encouraged.
- Research should be undertaken in a wide range of areas, including species selection, genetic improvement; tree planting and management and harvesting techniques. Other key areas include carbonization, emissions, kilns and charcoal quality; indigenous species, which have received little attention from the private sector; wood density, disease and pest resistance, sprouting and root formation ability; and intercropping, nitrogen fixation and selection of better species to meet specific requirements of wood for charcoal making. Greater attention should be given to the effects of the charcoal trees on the environment, including on soil erosion control, water table and river levsls, natural regeneration management and the development of growth and yield models.

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