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CLIMATE TECHNOLOGY CENTRE & NETWORK

World Agroforestry Centre
CGIAR
RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security
CCAFS

September 2018

The case for investment in industrial charcoal production in the Republic of Congo

Results of a technical and economic feasibility assessment of Congo Carbo Industrie

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Key messages

People in sub-Saharan Africa (SSA) generally and in the Republic of Congo specifically rely heavily on biomass—fuelwood and charcoal—for household energy.

Demand is likely to increase in the near term as the population increases and becomes more urbanized. Few alternative fuels are available.

Congo Carbo Industrie (CCI) proposes to develop the first industrial-scale supply chain for charcoal and associated products in SSA.

An initial assessment suggests that CCI could produce charcoal in ways that increase efficiency, return a profit (estimated 10.7% ROI), provide incomes for rural people and help the Congo meet its climate goals.

However, strong environmental and social safeguards must be established to ensure the environmental sustainability and benefit sharing of the project.

Figure 1. *Charcoal production in tropical forests of Central Africa. Photo credit: Fassio/CIFOR*

Situation analysis

The number of people who rely on wood as a source of fuel is large (1.3 billion people worldwide) and growing, especially in lesser developed parts of the world. In sub-Saharan Africa, more than 80% of households rely on wood or charcoal for cooking. Cooking with wood is more common in rural areas, while charcoal is more prevalent in urban areas, largely because it is a more compact fuel that is easier to transport. As Africa's population continues to grow and to become more urbanized, demand for charcoal is likely to increase, at least in the near term, because alternatives are unlikely to be accessible.

Fuelwood and charcoal production and use has negative impacts on human health and the environment. Traditional wood stoves emit smoke and gases that cause long-term respiratory health problems and deaths, killing at least 1.5 million people worldwide per year, more than tuberculosis and malaria combined. In Africa, woodfuel use account for 10% of disease-related deaths. Much of the harm of woodfuel use disproportionately affects women because they are primarily responsible for cooking and wood collection.

Production of woodfuel and charcoal furthermore causes localized deforestation, endangers biodiversity and contributes to climate change. More than 300 million tonnes of wood are consumed annually across Africa. Though no longer believed to be a primary driver of large-scale deforestation, wood collection does create hotspots of localized deforestation and forest degradation. This changes habitats and affects species that depend on forest resources. Moreover, woodfuel production and use releases carbon into the atmosphere, contributing to climate change.

Charcoal production, however, also can offer clear economic benefits. In most SSA countries, the wood-based biomass sector employs a significant workforce. In Ghana, for example, the charcoal sector employs about 3 million people, of whom 65% are women. In many cases, production of charcoal is the only available economic activity in rural areas. Charcoal production is typically an informal economic sector with tens of thousands of actors across the value chain, starting

with producers in rural areas and ending with vendors in cities.

There is significant interest in formalizing and modernizing the charcoal sector to increase efficiency, stabilize supply and reduce environmental externalities. Here we assess the feasibility of an industrial-scale charcoal project in the Republic of Congo (hereafter 'Congo'). The country offers the ideal location for this study because it is in the forefront of regional trends: Congo has the highest rate of urbanization (65.7%) of any country in SSA, and roughly 85% of people in the Congo burn wood or charcoal to satisfy basic energy needs, with demand for charcoal especially high in cities. Charcoal demand is currently approximately 150,000 tonnes per year, sold at 160–250 FCFC (about 0.29–0.45 USD) per kg depending on location. Given that the Congo has significant forest cover (figure 2) and relatively low population relative to its land mass, an industrial charcoal sector could help the Congo (and other countries) attain sustainable development goals regarding economic opportunities for rural households, access to sustainable energy, management of natural resources and addressing climate change.

The investment

The project, Congo Carbo Industrie (CCI), would be the first industrial-scale supply chain for charcoal and associated products in SSA. CCI aims to boost the efficiency of charcoal production and stabilize supply by adopting improved production technologies (kilns), developing a plantation to supply wood and formalizing parts of the supply chain. Improved production technologies will include brick kilns, a carbonization plant and charcoal briquetting capability, all of which will improve the efficiency of carbonization and the scale of production. Production activities will then be integrated with transport and, potentially, exports. The result would transform a non-trivial proportion of the Congolese charcoal supply chain (~10%).

Our assessment updated a feasibility study conducted in 2009. The new analysis is based on a technical review of documents and interviews with government, donors and civil society undertaken in December 2017. Data for the economic model are derived from secondary sources, including the earlier assessment and information from the project promoter. Whenever possible, values were cross-checked with key informants.

CCI plans to stabilize and increase efficiency of production by producing its own raw materials (wood) and introducing improved kiln technologies. The project would source wood from existing and newly planted Eucalyptus plantations. CCI is in negotiations with the government of the Congo about the location and size

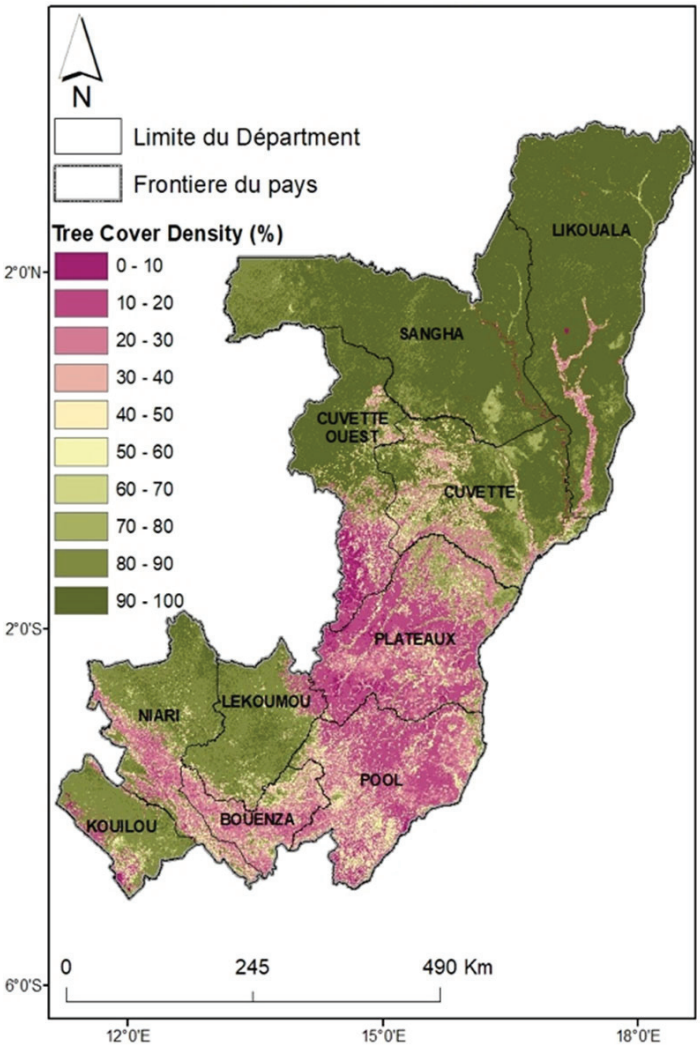

Figure 2. *Tree cover in the Republic of Congo. Map: Mboi/ICRAF.*

of these plantation, but it is expected that they will be near Pointe-Noire. Use of planted forests will reduce pressure on natural forests, thereby helping to conserve biodiversity. Plantations will be self-managed by CCI, and reforestation will be in collaboration with the National Service of Reforestation.

CCI will rely on advanced technology to increase the efficiency of carbonization (i.e., the process of turning wood into charcoal), doubling it by comparison to the traditional mound kilns and unimproved kilns commonly used in the Congo today (table 1). Specifically, CCI will implement 200 Green Mad Retort Kilns (GMDR) and one industrial plant relying on the CML process.

The GMDR is a brick retort kiln, first developed in Madagascar, that requires only modest investment and produces up to 35% charcoal yields by mass. An advantage of these kilns is that they can be distributed throughout the area to minimize the transport of wood. Because they are made with locally available materials (bricks) and rely on a network of production locations, the overall system is very resilient to disruptions from the

loss of any individual unit, which can be easily replaced. The primary disadvantages are that the kilns are of fixed capacity and that installation requires skilled craftsmen. CCI intends to have a wide network of traditional charcoal makers using the GMDR kilns.

The project also plans to use an advanced technology known as the CML process with industrial retort kiln. Designed by a French company, the CML process produces a high-quality charcoal (20–30% yields, depending on fuel source conditions) and is a flexible system that allows installation of from 4 to 12 kilns to match needs and capacity. These kilns not only burn the methane produced but also capture the heat generated to dry wood or to produce electricity. A drawback is the high investment cost. Establishment, kiln manufacture and operations require skilled labor and significant logistical considerations.

Table 1. *Comparison of kiln technologies: traditional kilns (such as mounds and pits currently in use) and the technologies to be used by CCI. Colors: yellow = no, green = yes; grey shading represents costs, with lighter being cheaper and darker more expensive.*

Kiln	Efficiency (%)	Distributed network	CH_4 recycling	Costs
Traditional	8–12			
GMDR	Up to 35			
CML	20–30			

Lastly, CCI also plans to produce charcoal briquettes ('charbriquettes'), which are created by combining charcoal dust—a waste product of charcoal production—with a binding agent, usually starch from maize, manioc or rice. Charbriquettes behave and burn very similarly to charcoal and thus have the advantage that they do not require a major change in use by consumers. However, because they compete with charcoal in the market, charbriquettes must be offered at a competitive price if they are to gain market share.

In short, CCI believes that a stable raw material supply, consistently high quality, market diversification, adaptive management and a cooperative approach will support the business model for industrial charcoal production.

Performance and risks

Although many uncertainties remain, the CCI project holds significant promise. The economic analysis evaluated the project's benefits and costs over an eight-year period. It estimates an investment cost of approximately 4.6 million euros and operations costs of between 0.5 and 3.3 million euros per year, depending on the level of activities. The resulting return on the total investment of 25.3 m euros is about 2.5 million euros, or 10.7%. This is based on a projection of producing more than 51,000 t of charcoal and charbriquettes. The analysis suggests the enterprise could begin to turn a profit after the fourth year, assuming a selling price of 300 FCFA per kg charcoal and a purchasing price of wood of 26,5000 FCFA (40 euros) per tonne. It is important to note that financial outcomes do not include any annual interest to financial partners, because the source of financing for the project has not been established. Therefore, estimates presented here can be considered an upper bound on potential profits.

The assessment is based on a series of assumptions about the source of raw material, operational efficiency and market size. Wood would be sourced from the requested 30,000 ha forest concession, which includes 3,000 ha of three-year-old Eucalyptus plantations, providing immediately available feedstock. If this concession does not materialize, alternate feedstocks would be required and revenue projections would be reduced. In addition, there are significant fiduciary risks for CCI that are unquantifiable because the company is only emerging.

These financial uncertainties are compounded by a broad range of other risks. After years of civil unrest, the Congo is experiencing a period of relative political stability, but new risks have emerged, including a military rebellion in the Department of Pool. In addition, there is limited in-country capacity in kiln, charbriquette and tree-plantation activities at the scale envisaged, and technology transfer in developing countries requires considerable time and resources. CCI has proposed a rapid timetable that will require sufficient capital and the availability of technical expertise at appropriate times.

The largest challenges, however, lie in evaluating the social and environmental impacts. CCI represents a transformative change to the charcoal industry and will almost certainly have both positive and negative impacts for the environment around the plantation and factory, for participants in the supply chain and for customers of the product. Whether these impacts are positive or negative will depend on the management practices implemented during production. Of the many rural people who currently work in charcoal production, some may be hired to work on the plantation or in production, either for daily wages or on a contract basis. With the support of the government, CCI is negotiating with charcoal producers about possible work arrangements. Whatever is decided, a new supply chain relying on industrial procedures will have cascading impacts on rural employment, and the impacts must be monitored closely.

Gender impacts are also difficult to predict. Women play a relatively small role in the Congo's current charcoal sector (mostly vendors), and consolidation of production may lead to their further marginalization. On the other hand, CCI might create work opportunities for rural women, perhaps as part of charbriquette operations. Availability of charcoal may also positively affect women's workload, because they tend to spend a disproportionate amount of time on woodfuel-related tasks, including collection and cooking. The greater availability of charcoal may reduce the time dedicated to these tasks and allow women to devote time to other demands. Women are most vulnerable to the risks of burning poor-quality charcoal for cooking (such as bad indoor air quality and risk of fire); better availability of high-quality charcoal produced by CCI may improve this situation.

The development of industrial plantations over 30,000 ha may have a tremendous impact on the local populations. Impacts may include restricted access to lands used for grazing, hunting and foraging, and conflicts over water resources may emerge as well. At the moment, it is unknown what kinds of operations the Congolese legislation will authorize inside the boundaries of the concession. In an extreme case, establishment of the concession may lead to land tenure conflicts and to displacements of villages. At minimum, it may require radical shifts in livelihood strategies of local populations. Any plantation model of such size must be discussed and negotiated with local communities following the principle of free, informed and early consent.

Environmental impacts are likely to be both positive and negative. Large-scale Eucalyptus plantations are known to generate problems including soil acidification, loss of biodiversity and reductions in the level of water table. The precise location and size of the plantation, as well as how it is managed, will determine the extent of impacts. Gases released during carbonization have a threefold impact: carbon monoxide (CO) is toxic and therefore has a direct effect on human health; emissions of acid (acetic, formic, propionic, etc.) and polycyclic aromatic hydrocarbons have local effects such as acid deposition; and gases such as carbon dioxide (CO2) and methane (CH4) are greenhouse gases, and CH4 has a radiative forcing equivalent 25 times that of CO2. CCI's use of advanced kilns will greatly limit emissions of these greenhouse gases compared to current charcoal production methods. The benefits consist not only in limiting emissions in the combustion process but also in avoided consumption of non-sustainable biomass.

Conclusions

This assessment can best be thought of as a first step of appraising the CCI plans. More research is needed to validate the conclusions and design workable business plans and safeguards prior to investments. Specific analysis will be needed once the locations of the plantation and kilns are known, and close monitoring of impacts and financial performance will be required once operations begin. CCI intends to use a corporate social responsibility program to help mitigate and minimize the downside consequences to people and planet.

Despite the uncertainties, CCI presents an opportunity to improve livelihoods and environmental outcomes and to capture a unique market. In Africa, over 20 Mt of charcoal are consumed per year, and the growing demand for charcoal fuel is an important cause of continued GHG emissions and environmental and human health concerns. CCI could create a model that could improve the charcoal industry across the region, with substantial benefits in climate change mitigation, the health of forest and the well-being of those using charcoal.

Given rising urbanization across the continent, future markets for charcoal for much of Central Africa will resemble that of the Congo today. A sustainable, economically viable and modernized charcoal industry in the Congo could serve as a model for similar projects in other countries in the region and around the globe.

Further Reading

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This brief summarizes the assessment "Feasibility of industrial charcoal production in the Republic of Con-go," which was produced by the World Agroforestry Centre (ICRAF) and funded by the Climate Technology Centre & Network (CTCN). The authors thank the Re-public of Congo government officials, specifically those from the Minister of Forestry Economy, and partners who contributed information and opinions to this report. Views and perspectives provide herein are those of the authors and do not necessarily reflect those of CTCN, ICRAF or persons interviewed. Please contact Todd Rosenstock (t.rosenstock@cgiar.org) wlth any questions.