

Critical evaluation of locally controlled forest enterprise subsectors likely to contribute to more integrated, intensive and climate-friendly land use in the Democratic Republic of the Congo

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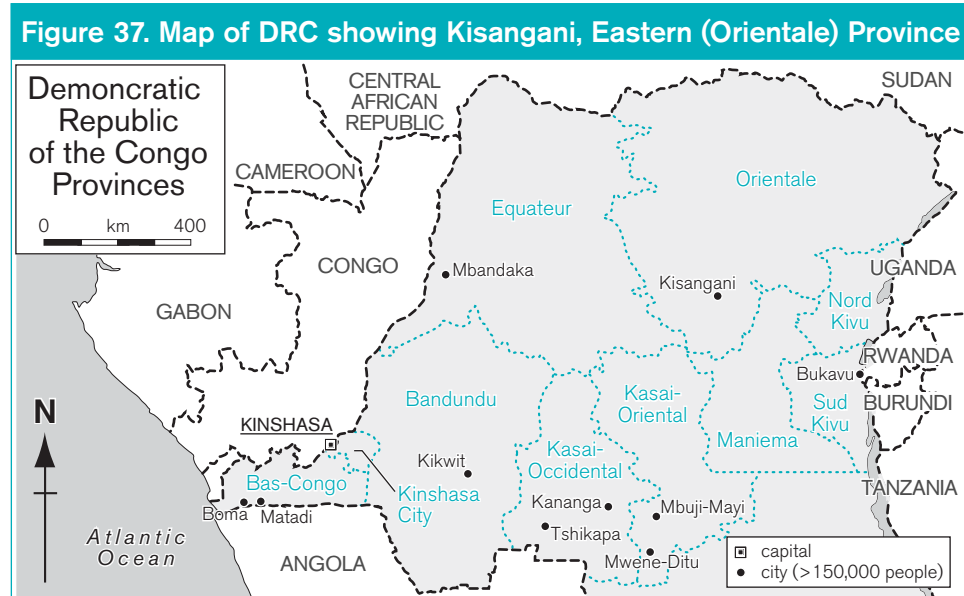
9.1 Introduction

The Democratic Republic of the Congo (DRC) has 154 million hectares of forest, which is the second-largest area of tropical forest globally after Brazil. Since the post-conflict reform agenda was launched in 2002, pressure on forestland for economic development has grown, both from external sources and from the 70 per cent of DRC's total population of 60 million people who live in rural areas.

Forests are the main source of subsistence for many rural people in DRC. It is estimated that locally controlled forest enterprises in many low- and middle-income countries account for 80-90 per cent of forestry activities in the forest sector (Macqueen, 2008). Locally controlled enterprises generate local wealth, secure community rights to resources, help create social capital through professional associations, encourage greater local environmental responsibility, help preserve cultural identity, and play an important role in poverty reduction. Yet in countries like DRC – and in Kisangani in the east of the country, the focus of this chapter – such SMFEs also face complex problems.

Kisangani was selected for the study because growing demand in the local market there has led to an upsurge in artisanal logging. When political activities returned to normal and functional road networks helped revive the local economy after the official end of the war, city-dwellers responded to the lack of state support by starting up numerous income-generating and self-help initiatives. Kisangani has been opened up by six main roads serving the agricultural areas of Bafwasende, Banalia, Lubutu, Ubundu, Isangi and Opala, making it easier to transport forest products into urban areas and encouraging artisanal operators and local communities to intensify production to satisfy the growing demands of the urban market. The race to build new houses with durable materials has direct implications for the forests in which timber, woodfuel and rattan are produced, increasing pressure on them from artisanal operators and local communities.

Kisangani is the main city in Eastern Province (Figure 37). It is made up of six administrative communes: Lubunga, Makiso, Tshopo, Kabondo, Mangobo and Kisangani. The city has 1,186,479 inhabitants, of which 600,998 (50.7 per cent) are men and 585,481 (49.3 per cent) are women, according to the Institut National des Statistiques. The city has an area of 1,910km² and is located in the eastern part of the central Congolese basin, at 0°31' latitude North and 25°11' longitude East, some 396m above sea level.



Congolese legislation characterises SMFEs as economic initiatives that aim to make a profit through forest-related activities, employ 10-100 full-time staff, have an annual turnover between US\$10,000 and US\$30 million, or consume 3,000-20,000m³ of roundwood per year (Mayers, 2006).⁴ For the purposes of this chapter, any activity undertaken by a natural or legal person in order to produce and market forest products and generate an income is regarded as an SMFE.

Articles 7 and 9 of the Forest Code stipulate that forests are the property of the state. The provisions of this law and its implementing measures regulate the private and public exploitation and use of forests by natural or legal persons. Natural or planted forests on land ordinarily granted under land legislation belong to the party to whom they are assigned. For example, trees located in a village or its immediate surroundings or in a collective or individual field are the collective property of the village or the person to whom the field belongs.⁵ Article 112 of the Forestry Code specifies that, in addition to rights of

4. Ministerial Decree No. 020/CAB/MIN/FINANCES/2010 of 25 March 2010, modifying certain provisions of Ministerial Decree No. 015/CAB/MIN-FINANCES/2008 of 21 August 2008 regarding the implementing measure for Law No. 06/004 of 27 February 2006 on the tax regime applicable to small and medium-sized enterprises (income and turnover taxes).
 5. Law No. 011/2002 of 29 August 2002 regarding the Forestry Code, articles 7, 8 and 9.

use, local communities have the right to exploit their forests themselves or through the intermediary of private artisanal operators working under a written agreement. Private artisanal operators may only operate in local community forests if they are authorised to do so by the governor of the province, as proposed by the local forest administration.

Artisanal operations in Congolese forests are also regulated by Decree 035 regarding forest use. Article 8 of this decree states that artisanal logging permits are issued to authorised natural persons operating pit saws or chainsaws. Permit-holders are only authorised to cut wood in one local community forest. Artisanal logging permits may not cover an area exceeding 50 hectares.⁶ They are valid for a period of one year, running from 1 January to 31 December, and are issued by the governor of the province in which the forest is located, at the proposal of the provincial administration responsible for forests. Artisanal loggers must be Congolese nationals and may not hold more than two permits in the same year, meaning that they cannot work more than 100 hectares in a single year.

Various researchers have studied forest use by locally controlled enterprises, including timber and other products, in the Kisangani region to determine the activities involved, how such activities are carried out, and what effect they have on the environment and local communities. Tshimpanga (2011) looked at the woodfuel subsector and its implications for forest management in the region. Talinabopato (2011) studied the strategies used by brickmakers to reduce the distance between the points of production and end use, which has a significant effect on the price of baked bricks in Kisangani. Kahindo (2011) analysed the rattan supply chain from production to transport, marketing and consumption. Manirakiza *et al.* (2009) concentrated on the *fumbwa* (*Gnetum spp.*) supply chain in DRC, especially in Equateur and Eastern Province through to Kinshasa. Finally, a study by Benneker *et al.* (2012) centred on forest use and its consequences for all the actors concerned and the interaction between economic and political interests and forest governance policies.

This aim of this chapter is to determine the possible correlation between locally controlled forest enterprises and community development and environmental issues in the Kisangani region. Locally controlled forest enterprises there can be divided into several subsectors. Given constraints on time and space and our desire to produce an accurate and succinct analysis, we restrict our research to six subsectors: timber, oil palm, baked bricks, biomass energy, rubber, and NTFPs such as *fumbwa* and rattan.

Most of the timber produced by industrial logging in the Kisangani region is exported but almost all the timber consumed in the region comes from artisanal logging. It seemed logical to study this subsector, given the large number of operators in the chain, its structure and impacts on local livelihoods, the scale of local demand and the attention it receives in forest governance mechanisms.

Oil palm merited inclusion in the study because of the wide variety of products derived from this type of tree. Palm oil is the most widely consumed oil in the region, and palm

6. Decree No. 035/CAB/MIN/ ECN-EF/006 of 5 October 2006 regarding forest use.

kernels provide feed for livestock, especially pigs. Additionally, palm oil is used to make artisanal soap and fuel. Finally, large quantities of palm wine are consumed in makeshift bars across Kisangani.

Although baked bricks are not a forest product in the strict sense of the term, we wanted to look at the role that locally controlled enterprises play in the structure of the baked-brick supply chain, its impact on local livelihoods, and the environmental effects of brick baking, especially through woodfuel consumption.

The people in the region mainly rely on biomass energy (charcoal and firewood) to meet basic energy needs because of the scarcity or lack of alternative sources of energy, such as electricity and fossil fuels. This subsector was selected because we wanted to investigate the systematic use of both charcoal and firewood, and the pressure this places on the forest.

Rubber production helps households in and around production sites balance their budgets, and it slightly reduces the pressure on forests by providing an alternative to crop production. Old rubber plantations are essentially artificial forests, however, and burning them to produce charcoal and firewood or to clear the land for cultivation could threaten certain ecosystems.

We decided to include the NTFPs *fumbwa* and rattan in the study because of their contributions to household incomes in the Kisangani region, the ways in which their supply chains are organised by artisanal producers, and the scale of demand for these products in local markets.

Information in this chapter has been derived from extensive interviews with: (i) various state services in the province responsible for locally controlled enterprises, environment, nature conservation, energy and agriculture, as well as the Eastern Province Directorate of Revenue and the National Forestry Fund; (ii) NGOs (Organisation Concertée des Ecologistes et Amis de la Nature – OCEAN; SOS Nature; the Association for the Promotion of Local Initiatives in the Forested Areas of Africa – APILAF; and Action for the Integral Development of Kisangani and the Congolese Central Basin – ADIKIS); (iii) bilateral cooperation agencies (the Belgian Technical Cooperation Support Program for Community Development Initiatives); and (iv) artisanal operators themselves. Most of the interviews with state actors and NGOs were held in their offices with the people responsible for the sector concerned; the artisanal operators interviewed came from every part of the production chain (producers, hauliers, vendors, traders and consumers).

A total of 74 surveys were conducted for the study, including with each of the eight state services concerned (environment and nature conservation, energy, locally controlled enterprises, agriculture, the National Forestry Fund, the Eastern Province Directorate of Revenue, the General Directorate of Taxes and the National Institute for Social Security). We interviewed one staff member each in ADIKIS, APILAF and SOS Nature and two staff members at OCEAN, making a total of five respondents from the NGOs operating in Kisangani region. We also interviewed five people in higher-education establishments and universities: two from the University of Kisangani (UNIKIS), two from the Yangambi

Institute of Agricultural Sciences (Institut Facultaire des Sciences Agronomique de Yangambi – IFA), and one from the Bengamisa Advanced Institute of Agricultural Studies (Institut Supérieur d'Etudes Agronomiques de Bengamisa). A total of 56 artisanal operators from across the production chains were interviewed: eight from the timber subsector, nine from the oil-palm subsector, eight from the baked-brick subsector, ten from the charcoal and firewood subsector, six from the rubber subsector and 15 from the *fumbwa* and rattan subsector.

The information obtained from these surveys was supplemented by existing documentation on forest use in the Kisangani region and elsewhere, provided by research institutions such as UNIKIS, IFA and the National Institute of Agricultural Studies and Research (Institut National Pour l'Etude et la Recherche Agronomiques – INERA). Statistical analysis methods were used to process the quantitative data, and the information generated by the surveys and interviews was subjected to a qualitative analysis.

9.2 Assessment of market prospects of shortlisted subsectors

The city of Kisangani is situated in rainforest, and its citizens still depend on forest products to meet many of their daily needs. The artisanal exploitation of forest products is not well structured or well regulated in DRC. The Forestry Code is geared more to industrial logging and forest use, while artisanal forest operations tend to be informal activities by individuals who negotiate directly with the communities living in or around the sites concerned. The public services are mainly involved in taxing forest products when they come into public markets, predominantly by collecting business tax.

The Small and Medium Enterprise (SME) Division in Kisangani uses a 1990 law⁷ to determine which forest products should be taxed. Article 5 of this law stipulates that small-scale farmers and herders who occasionally – on days determined by the local authority – go to public markets to sell produce from their food crops, fishing, livestock rearing or wild harvesting are exempt from business tax. All forest products not cited in this law are subject to business tax, which is collected by urban SME Division inspectors, who monitor sites where products are usually sold or may be displayed for sale.

We now analyse each of the six subsectors, describing their characteristics and production chains. The subsequent section assesses the impacts of the subsectors on poverty reduction, household well-being, gender equity, food and energy security, climate change mitigation and adaptation, biodiversity, and soil fertility without nitrogen-based inputs.

1. Timber

Authorisation from the relevant public administration, in the form of logging permits, is normally required to cut timber, although some operators run clandestine operations without logging permits, and artisanal operators tend to negotiate directly with local communities to obtain rights to access forest resources. Timber is used for domestic roof frames and numerous other products needed to construct and renovate houses. To make

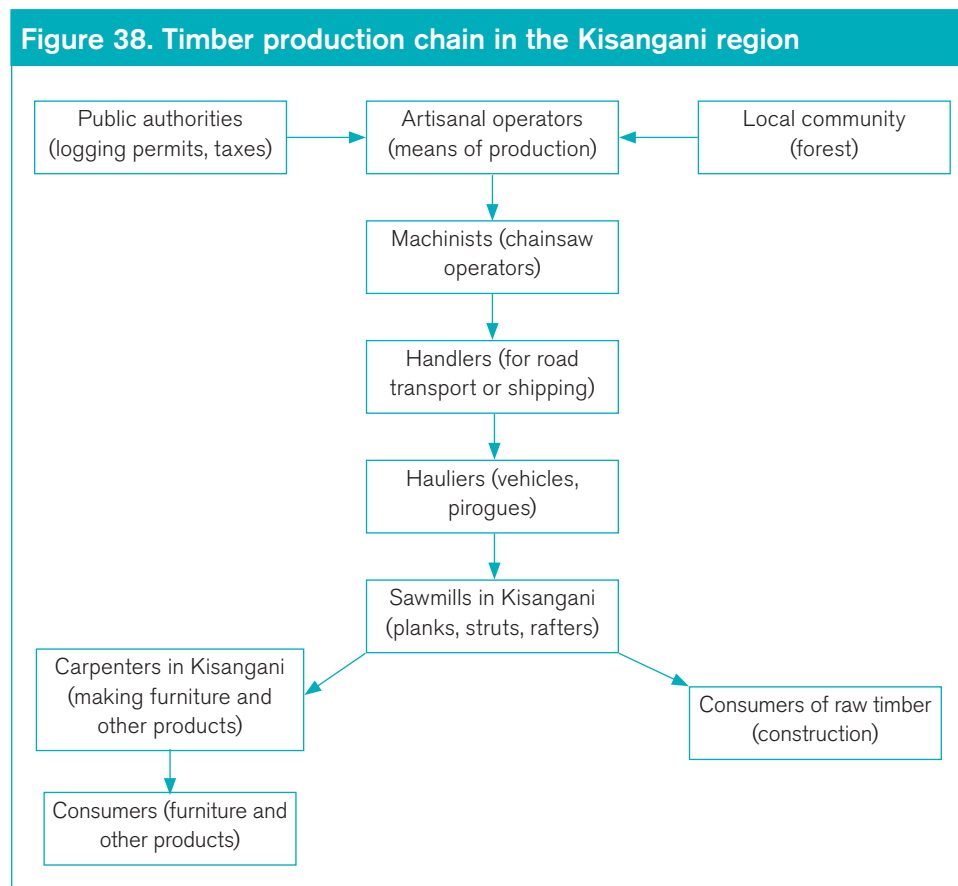
7. Ordinance-Law No. 90-046 of 8 August 1990 regarding the regulation of small business in the Republic of Zaire.

them easier to transport, logs are sawn and cut into planks and struts before they are removed from the forest.⁸

The term 'timber' applies to wood that is used for purposes other than heating and cooking (domestic or otherwise). Timber can be divided into two categories: timber for building, which is used in civil construction and shipbuilding; and timber for carpentry, which is used for joinery, furniture-making and the manufacture of wheels, barrels, and so on. (Ngoy, 2012).

Illegal logging and the trade in illegally sourced timber are complex problems that have wide-ranging environmental, social and economic repercussions (FAO *et al.*, 2006). Forestry could be an important economic sector in DRC but it only accounts for 0.7 per cent of GDP (Greenpeace, 2007).

Various actors are involved in the timber production chain⁹ in the Kisangani region (Figure 38): public authorities, artisanal operators (owners of the means of production), local communities, machinists, handlers, hauliers, dealers, carpenters and consumers.



8. www.cecobois.com/les-produits-du-bois/bois-oeuvre/classe-visuelle, accessed 18 December 2012.

9. http://fr.wikipedia.org/wiki/Cha%C3%A9ne_de_production, accessed 27 January 2013.

Artisanal operators use their financial capital to acquire the means of production, for example, chainsaws, fuel, lubricants and money. Two or more people can do this by pooling their resources in the production process. They need to obtain logging permits and licences from the environment and nature conservation service, negotiate with the local community, pay for the trees they fell, and get the timber transported to Kisangani to be sawn up and sold. The local communities that live in and around the sites where logging operations take place, sell trees to loggers. Artisanal loggers may buy directly from individual villagers selling trees near their homes or in their fields, or from representatives of the community (village chiefs), who sell trees in community forests 5km or more from the village.

Chainsaws are usually operated by two people, a machinist and an assistant, who fell and saw trees bought from the community by artisanal loggers into boards that can be taken to their point of use. Artisanal loggers pay the sawyers piece rates. Depending on the amount of work involved, teams of six to eight local handlers move the timber from the logging site to road or river depots so that hauliers can transport it to Kisangani. Handlers and hauliers are paid by the operator, who then has the timber cut to the desired shapes and sizes and sells it in the Kisangani market, where furniture-makers and housebuilders buy it.

This production process is shaped by two factors: the artisanal operators' preferred species and the diameter of the trees that are felled. Artisanal loggers in the Kisangani region mainly use afrormosia (known as *mogoya* in the local language) and other hardwoods such as sipo, kossipo, essia, tola, iroko and sapelli. The highest-quality wood is afrormosia, which is also the most popular timber on national and international markets: 51 per cent of the operators we interviewed said it is their preferred timber. It is attractive, very strong and hardwearing, and it is suitable for furniture, marquetry and joinery because it does not shrink much. It makes excellent timber frames and can be used for pit props, in shipbuilding and as railway sleepers (Assumani, 2009). Sipo, kossipo, essia, tola, iroko and sapelli are mainly used in general construction, for example, planks, ties, rafters, and external and internal coverings, and water works, such as bridges. They were the species of choice for 35 per cent of the artisanal operators interviewed for this study.

Forestry regulations in DRC stipulate that no trees of any species should be felled if their diameter is less than 60cm but this rule is widely ignored because the state services rarely monitor logging sites. The environment and nature conservation service intervenes upstream of the logging process, issuing 'logging permits and licences' that cost artisanal operators US\$250 per quarter; the Eastern Province Revenue Department and National Forestry Fund intervene downstream, collecting 'business taxes and receipts' when the timber comes onto the public market.¹⁰

2. Oil palm

The oil palm (*Elaeis guineensis*) originated in Africa, probably along the Gulf of Guinea, where it still grows in natural groves. The other main species of *Elaeis* is *E. oleifera*, which is found in South America, often in the wild. The fruit and kernels of the oil palm provide oil with a high fat content that is a key ingredient in Congolese cuisine in general and in dishes in the Kisangani region in particular.

10. Interviews with individuals at the Eastern Province Revenue services office in Kisangani, and the National Forest Fund office in Kisangani.

Various actors are involved in oil-palm production (Figure 39). Men are responsible for cutting the fruit and maintaining plantations, while women and children collect the fruit and take it to be stored and processed. On mixing days, women carry the fruit to the presses and usually take the extracted oil to market. Tools used in the plantations before mixing include machetes, axes, files and baskets to transport the fruit. Local presses known as *loko*, which are hand-operated by men, are used to extract the oil, which is stored in cans and barrels.

The city of Kisangani consumes large quantities of palm oil produced by traditional artisanal methods that use *loko* or pound fruit cooked in a barrel or pot. After the palm oil has been extracted, the nuts are crushed to free the kernels and a special press (which requires electricity) is used to produce palm kernel oil. Another sub-product of the oil palm is 'palm wine'.¹¹ Although the sap from which this is made can be obtained from living trees, it is becoming increasingly common to simply cut down the trees to obtain the wine. The palm-wine supply chain involves producers who extract the sap and make the wine, usually from trees growing in the wild, the dealers who own drinking establishments, and their customers, the end consumers, who are often regular patrons. Over time, some of these drinking dens have become public meeting places that people visit to discuss current affairs and daily life as well as to drink palm wine.

3. Baked bricks

Baked bricks are solid blocks of clayey earth that are formed into regular geometric shapes and baked in an oven at 600-1,200 °C. They are used in construction and are classified as a durable building material. As people in Kisangani strive to meet the basic human need for shelter and protection, they want to improve their housing by constructing their homes out of durable materials. The fact that baked bricks are cheaper than concrete blocks has helped revive an activity that was common during the colonial period.

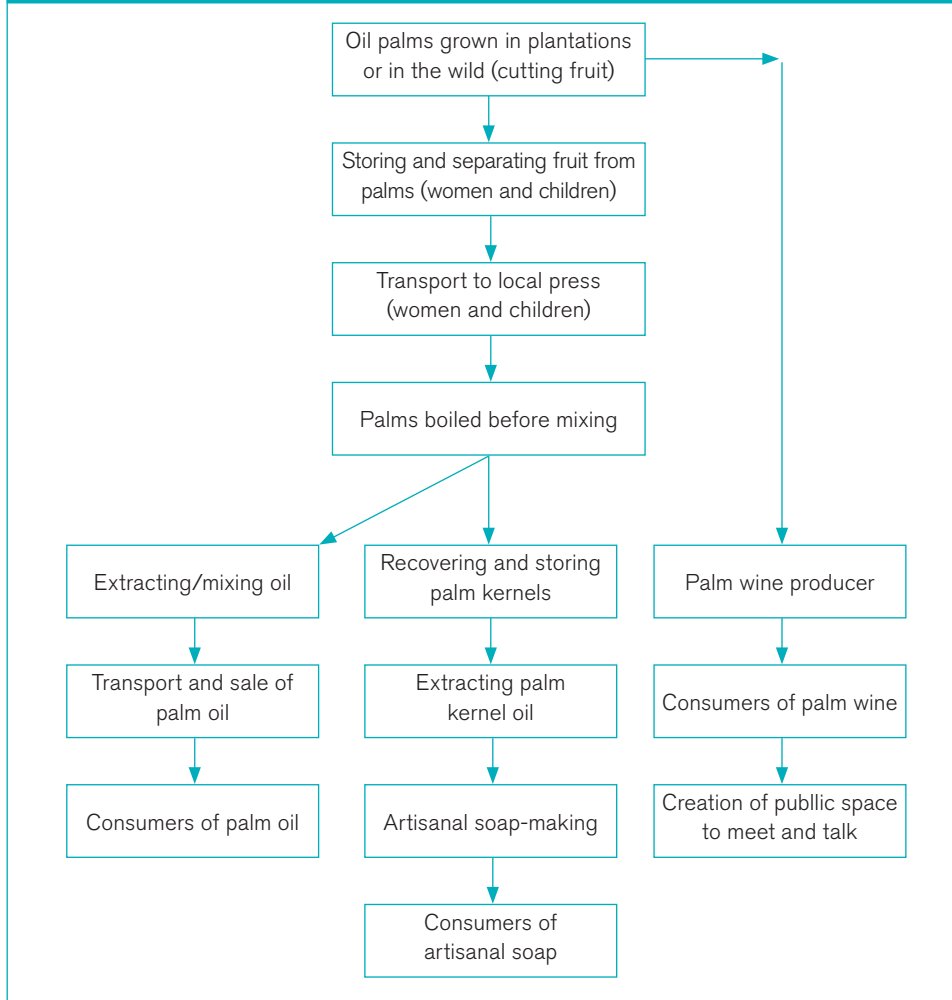
The resurgence of artisanal baked-brick making began in the 1990s, when the socio-economic effects of the country's growing political instability started to bite. As the economic crisis gathered momentum, the price of cement soared in Kisangani, and unemployment in various sectors rose across the nation. People had to find new ways to earn a living, and brick making gradually emerged as an important income-generating activity for households.

Various actors are involved in the production of baked bricks: the entrepreneurs who set up one or two brickmaking machines on pre-selected sites; the small teams of one or two people who use these machines to make the bricks; the suppliers and hauliers who provide the woodfuel to bake the bricks; and the end users who buy the bricks to build durable housing. The baked-brick production chain has several stages:

- The producer chooses a site with good-quality soil that meets a number of criteria.
- A shed is built near the brickmaking site.

11. 'Palm wine' is a traditional drink derived from standing or felled oil palms. It is popular among people with limited purchasing power on the outskirts of the city of Kisangani. It is not wine in the usual sense of the word because no grapes are used in its production.

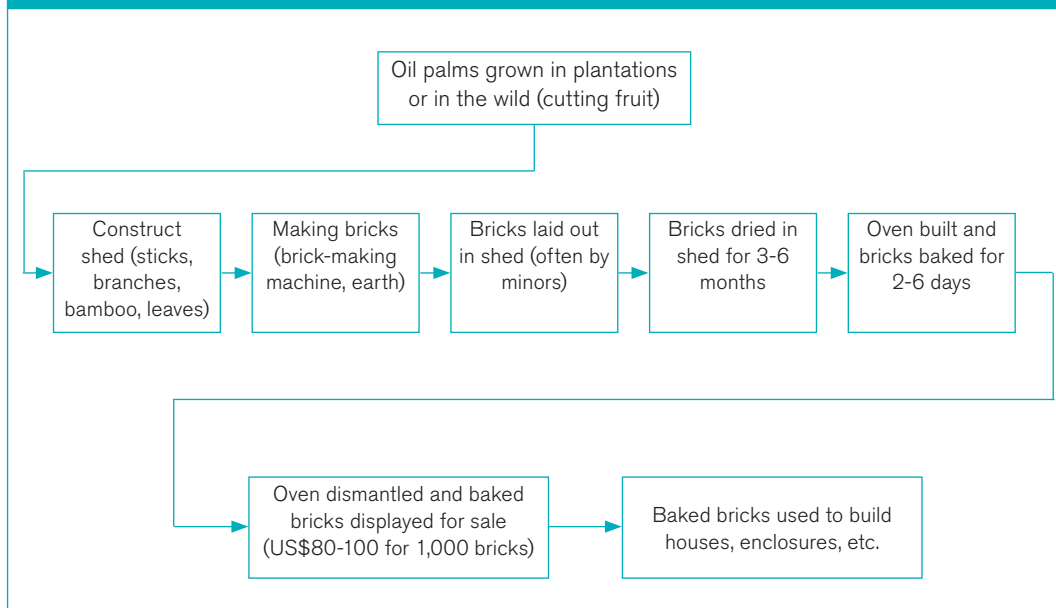
Figure 39. Production chain for oil palm and its sub-products in the Kisangani region



- The brick mixture is prepared using sand and clay if the soil on the site requires it.
- The mixture is pressed into hollow moulds that give the bricks their final shape.
- The bricks are laid out on dry ground in a purpose-built shed (to avoid overdrying), arranged so that air can circulate between the bricks.
- Bricks can be used for construction once they have dried out, although they will be more durable if they are baked for four to six days at 600-1,200 °C.
- When the baking is finished, the oven is dismantled and the bricks are displayed for sale to end-users. They sell for US\$80-US\$100 per 1,000 units, depending on the location and accessibility of the production site.

Figure 40 illustrates the production and marketing chain.

Figure 40. Baked-brick supply chain in the Kisangani region



4. Biomass energy (charcoal and firewood)

Firewood is procured by gathering dead wood or cutting dead or green wood. It does not involve any particular technical processes, and it can be obtained from all wood-producing plant species whatever their value, height or diameter. Large-diameter timber is difficult to cut and transport and is either split or burned on site. Although the forest service frowns on the removal of green wood to meet energy needs, this practice is common in the Kisangani region.

A number of actors are involved in charcoal production (Figure 41). Small-scale producers tend to be individuals who live in the vicinity of Kisangani and make small charcoal stacks or pits that produce two or three sacks of charcoal to cover their basic needs. These producers often take sacks of charcoal to sell in Kisangani on bicycles. At this level, the supply chain includes charcoal burners, buyers-hauliers-dealers and consumers.

Private entrepreneurs work with local communities to produce charcoal on a slightly larger scale (20 sacks or more). They negotiate with village chiefs and buy the trees to be felled, recruit charcoal-burners to produce the charcoal, and find someone to take the sacks of charcoal to the city by vehicle, pirogue or raft. The two main methods that individuals and entrepreneurs in Kisangani region use to produce charcoal are covered stacks and traditional pits.

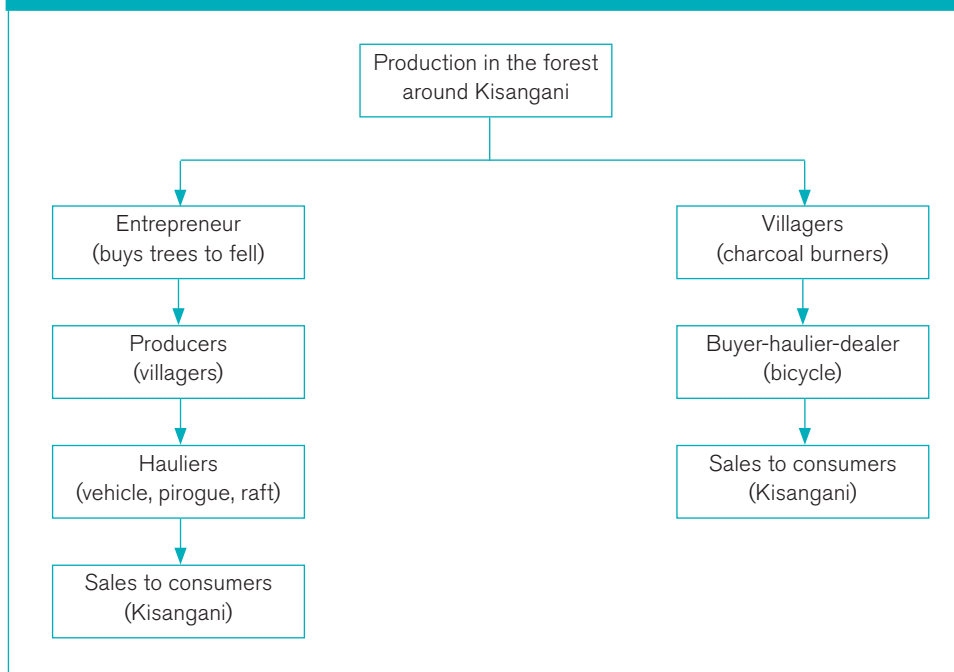
- **Covered stacks** consist of a pile of one to seven steres of wood, whose shape and size vary according to the charcoal-burner. The wood is covered with fresh leaves and earth, with vents left at the base of the stack to allow and control the entry of air. It can take three or more days to produce charcoal in this way, depending on the size of the stack.

- **Traditional pits** are usually rectangular, measuring about 3m long, 1.5m wide and 2m deep. They can accommodate one to four steres of wood, which are covered with fresh leaves and earth. It can take between several hours and several days to produce charcoal in this way. Pits are more stable than stacks because they do not collapse, but they are rarely used in the rainy season because of the risk of flooding.

Whichever technology is used – stacks or pits – traditional charcoal-making can be seen as a wasteful use of resources because it takes 5-7kg of wood to produce 1kg of charcoal. It can take one stere of wood to produce 33kg of charcoal in a covered stack (a 14 per cent yield) and 52kg of charcoal in a traditional pit (21 per cent yield) (Tshimpanga, 2011).

In the Kisangani region, the entire charcoal production process – from cutting the timber to the finished product – takes about 16 days and involves around seven people. Workers sometimes specialise in one stage or another, such as felling trees or weaving sack extensions from branches and leaves. They are paid daily rates or given food and drink, working in a rotation system known as a *tontine*.¹²

Figure 41. Charcoal supply chain in the Kisangani region

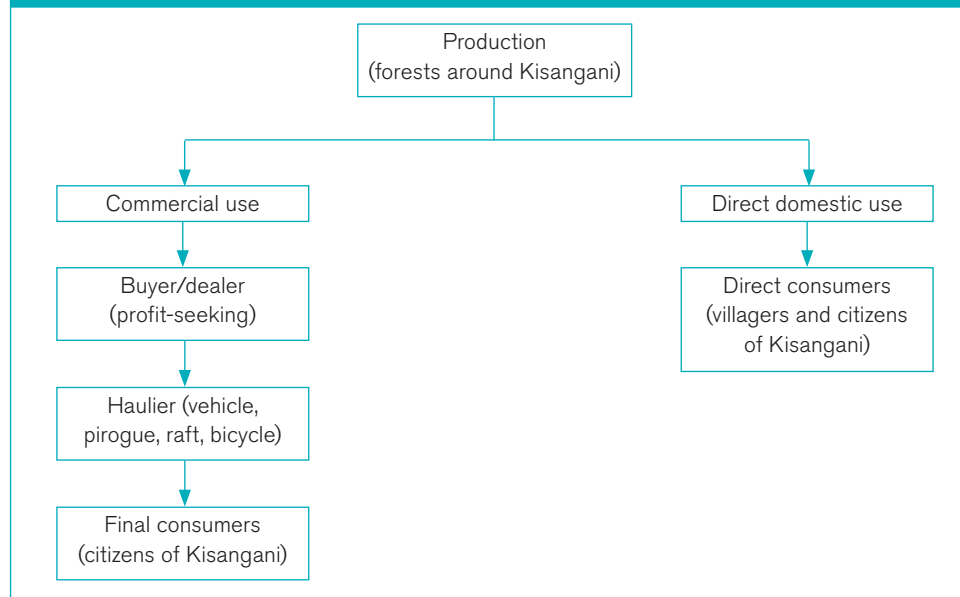


12. In the *tontine* system, each member of the group takes it in turn to provide food and drink for other members. Many producers do not take the unpaid elements of the production process – such as family labour and the rations given to members of the group – into account when estimating their production costs.

Woodfuel provides over 80 per cent of DRC's energy needs and is particularly important in the Kisangani region because of the under-development of the industrial sector, a lack of transport and the high cost of electricity and fossil fuel. Wood is one of the main sources of energy for most rural families and for about 70 per cent of urban families (Tshimpanga, 2011). Woodfuel in the Kisangani region mainly comes from natural vegetation and trees felled to clear land for crops.

Numerous actors are involved in the firewood supply chain: producers, buyers/dealers, hauliers and consumers (Figure 42). Producers are usually rural people who obtain and sell the wood from medium-sized trees in various sites in secondary forests within 80km of Kisangani. Buyers/dealers are men and women who travel to surrounding villages to buy firewood for resale in Kisangani. They pay hauliers to transport it from the production site to the city by vehicle, bicycle, pirogue or raft. Rural people who produce firewood for domestic consumption often carry it home on their heads or backs. Firewood is used for domestic and semi-industrial purposes, such as cooking food, producing alcoholic beverages and baking bricks. Firewood is also used by industries that operate in Kisangani, such as the Société Textile de Kisangani (SOTEXKI). SOTEXKI is not directly involved in logging activities, however; it buys firewood from villagers, who fell the trees and sell it in steres on roadsides. At the time of writing, a stere of firewood was selling for 2,000 Congolese francs in villages near Kisangani.

Figure 42. Firewood supply chain in the Kisangani region



5. Rubber

In its natural setting, the rubber tree (*Hevea brasiliensis*) can grow up to 30m high, with trunks measuring up to 1m in circumference. It has greeny-grey bark and alternate, palmate leaves with three leaflets at the end of a petiole. Lactiferous tissue occurs all over the tree, from the roots to the leaves and the bark of the trunk, where latex is extracted. Latex vessels spiral up the tree in a continuous network within each axial duct. They contain living cells with all the organelles (nucleus, mitochondria and plastids) they need to function.

Latex is different from sap, because sap carries water, minerals and sugar around the tree, while latex is more involved in the tree's natural defence mechanisms and circulates in a distinct network of vessels, or latex canals. Like resin, it oozes from wounds and forms a protective barrier as it dries. The latex that is harvested by tapping is the cytoplasm, or liquid content of the latex cells, composed of a suspension of rubber particles and organelles such as luteoids. Because the nuclei and mitochondria remain attached to the cell walls, the latex is replenished after harvesting, making it a renewable resource. Rubber particles represent about 25-45 per cent of the volume of latex and 90 per cent of the dry matter. Trees can start producing latex when they are five years old and remain productive for about 30 years, after which time they are cut down and replaced.

Latex is harvested by cutting the bark on the trunk of the tree and collecting the liquid that drains from these cuts. Harvesting usually starts when the circumference of the trunk 1m above the ground measures 50cm. Rubber-tappers use special knives to make a light spiral incision downwards on one-third to one-half of the trunk, starting about 1.5m above the ground. Incisions are usually made every two days but may be made as little as once a week, depending on the intensity of harvesting. When the incision (known as the panel) has yielded all its latex, another one is made on the other side of the tree. The liquid gathered just after the incision is known as the latex harvest, while latex that has been allowed to coagulate in the collecting cup is known as the cup lump.¹³

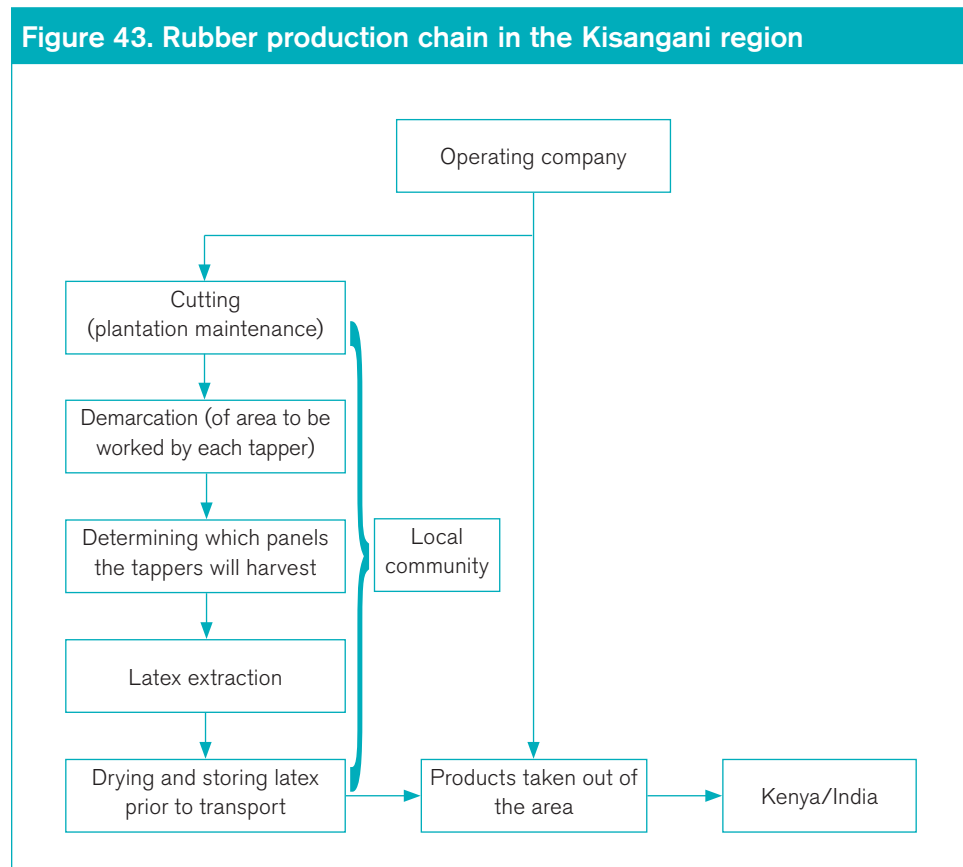
The different stages in latex production and marketing are:

- cutting in order to maintain the plantation;
- marking out the land parcels or area to be allocated to each rubber-tapper;
- determining which panels will be harvested;
- placing the cup carrier and the cup; and
- cutting the preparatory groove using a special rubber-tapping knife. A 15-day pre-tapping period is factored in to establish a good flow of latex for harvesting.

Each operator has to sign a contract with the rightsholders of existing plantations in the area and another contract regarding use rights. These two contracts are not the same for all operators, although the Ministry of Environment, Nature Conservation and Tourism has introduced standard contracts, as for industrial logging (see the cases of the company Congo Relai d'Exploitation et d'Exportation – COREX – and the Tanzanian company

13. Information provided by the supervisor of the Lobby Congo plantation in Pk 36 on the Kisangani–Banalia road. When we visited the site we followed the latex production process from the plantation to the packaging factory.

Lobby Congo).¹⁴ The actors involved in rubber production include national and foreign owners who fund operations, such as COREX, Lobby Congo and Indian-owned companies, and local labourers, who are predominantly male due to the physically demanding nature of the work. Women who are involved in the production process mainly work on the administrative side. None of the latex produced in the Kisangani region is consumed locally (there are no processing companies); it is all taken to the city or exported. Lobby Congo trucks its products to Nairobi, Kenya, via Uganda, while COREX takes its latex products to the port of Dar-es-Salam, where they are processed before being exported to India. Figure 43 depicts the rubber production chain.



14. COREX has not signed a contract with local communities because it uses old rubber plantations and INERA's buildings and factory and pays INERA a percentage after the latex has been produced. Unlike COREX, Lobby Congo has signed a contract with local people (agreeing to build two schools, a hospital and several houses and provide childcare for rightsholders at the university). However, at the time of writing, Lobby Congo was yet to fulfil its side of the contract, leading to tensions between the company and local community members.

6. Non-timber forest products: fumbwa and rattan

The most commonly used NTFPs in the Kisangani region are rattan, *fumbwa*, caterpillars, game, tree bark, honey, cola nuts, the leaves of *Leucosperma species* (for wrapping) and mushrooms. This study examines the scale and impacts of the use of rattan and *fumbwa* on local sites and markets.

Rattan is one of the main NTFPs used by local people in the Kisangani region. It is a major source of income and the basis of a very active informal sector that supplies the city of Kisangani with untreated and processed rattan. Countries in Central Africa are now waking up to the economic potential of the rattan sub-sector, some three decades after it took off in Asia (Kahindo, 2011).

Rattan is a climbing palm that is used in the manufacture of furniture and wickerwork. Wild rattan plants can grow up to 200m in length, attaching their grey thorny stems to trees. Varieties of rattan are named according to their provenance, giving us malacca (pale yellow), manila (brown), tohiti, sarawak, sampit and pasir rattans. Manila and malacca rattans are solid enough to be used to make chair frames and furniture, while more flexible varieties such as tohiti are used for wickerwork.¹⁵

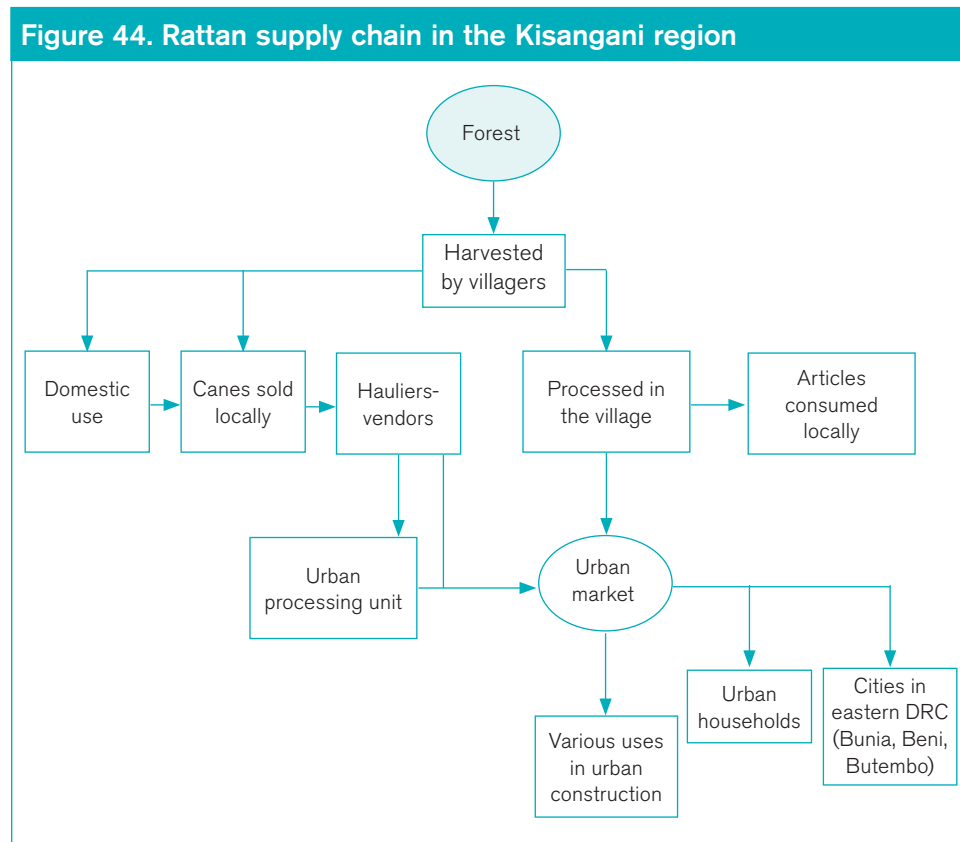
Fumbwa (*Gnetum spp.*) is found mainly in the tropical regions of Asia, South America and Central Africa. It includes about 30 species, mainly lianas but also a few shrubs and trees. In Africa, and especially in DRC, two species of *fumbwa* are harvested: *G. africanum* and *G. buchholzianum* (Lomba, 1997). Both of these species are dioecious climbing vines with branching stems, which are often full of nodes, and broad-bladed, opposing leaves of oval or elliptical shape. They have no resin ducts (Flore du Congo Belge et du Ruanda-Urundi, 1948).

It is not easy to distinguish between the two species without looking closely at their flowers and anatomical structure (Manirakiza *et al.*, 2009). The male flowers of *G. africanum* are closely and evenly spaced along a straight narrow spike, while those of *G. buchholzianum* are more widely spaced along a tapering spike. While the efficacy of treatment is unknown, the literature shows that the leaves are mainly used for food and to treat medical conditions such as enlarged spleens and sore throats, to alleviate labour pains, and as an antidote to various types of poison and snake bite. The seeds are used as a fungicide on fresh or infected wounds and are traditionally chewed raw to manage excessive urination in diabetic children (Mialoundama, 1993).

The traditional rules and modes of regulating NTFPs in DRC focus on the legal conditions for their exploitation (harvesting, gathering and marketing). The exploitation of plant-based NTFPs is based on use rights that allow forest communities to meet their individual domestic and collective needs, although permits are needed to remove some products. The Forest Code is unclear on the exploitation of NTFPs in general and *fumbwa* in particular, which seems to be one of the most profitable forest products. The Forest Code places certain limits on use rights relating to local customs, agricultural use and the protection of classified forests and requires several types of authorisation for the harvest of NTFPs – regular harvesting permits when the product is covered by a particular measure, and special permits for protected products. Such permits give holders the right to harvest and sell products such as rattan and the bark, roots and branches of trees (Mpoyi, 2006).

15. en.wikipedia.org/wiki/Rattan.

Figure 44 shows the rattan supply chain in Kisangani and the surrounding area, from the forest to the end-user. It shows that the chain functions at three levels – the forest, village and city – and involves the following actors: rural people (primary collectors), hauliers-vendors, rural and urban artisans, travelling salespersons and traders, and households (consumers of raw and processed rattan).¹⁶ Our interviews and field studies showed that rattan goods in the Kisangani region normally go through six stages of production: soaking, cleaning, splitting (for basketwork), dividing or sizing canes, making frames and, finally, assembling the finished items.



Producers use some of the rattan they remove from the forest for domestic purposes, making it into mats, trays, baskets, furniture, beds, shelves and other goods that are sold locally or sent to the market in Kisangani. Raw rattan is also taken to Kisangani, where it is sold for construction (houses, fencing), and small amounts of raw and processed rattan are sent to meet consumer demand in cities in the east of the country (mainly Bunia, Beni and Butembo).

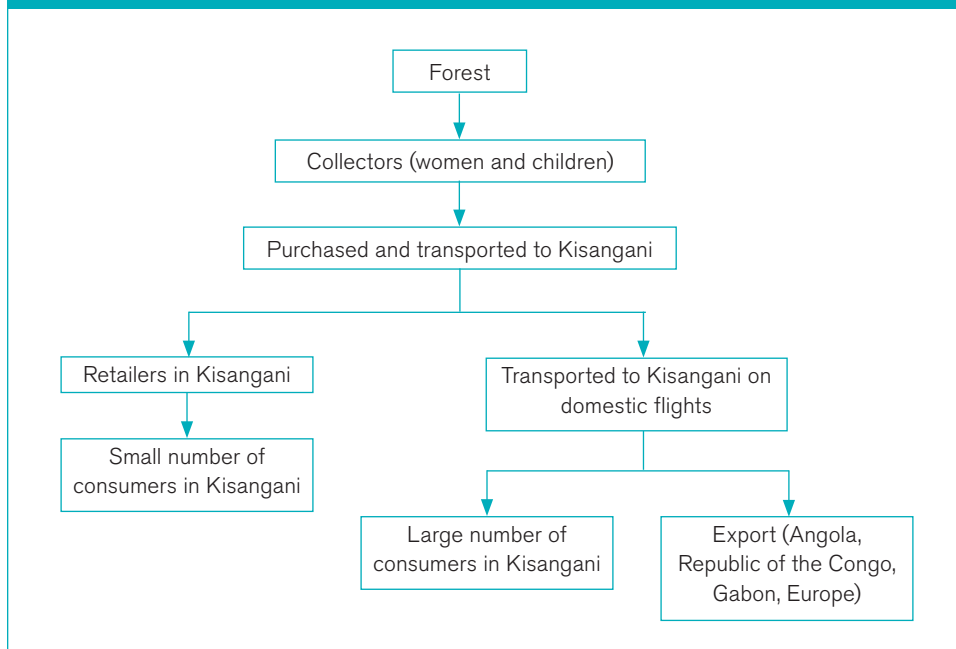
Large quantities of *fumbwa* are sent from Kisangani to traders in Kinshasa and the interior. The two main *fumbwa* trade routes in DRC are the Kisangani–Kinshasa and

16. Interviews with rattan producers on the Kisangani–Yangambi axis, who take their goods to Kisangani market by pirogue.

Mbandaka–Kinshasa runs used by the airlines that operate in the region. All the *fumbwa* from Kisangani comes from the forest and is mainly gathered by children and women, who tend to know more about where and how to harvest it. As people in Eastern Province do not tend to eat much *fumbwa*, villagers harvest it to order and pack it into bags or baskets to be transported to Kisangani.

In Kisangani, *fumbwa* is sold to retailers, who cut it up before offering it for sale. Wholesalers also buy large quantities and on-sell it to traders in Kinshasa. These wholesalers rarely transport the goods themselves, and few have contracts with their associates. Most transactions are based on trust and family links between traders in Kisangani and the villages.¹⁷ One wholesaler in Kisangani told us, 'I've never met my business partner in Kinshasa. I send her my package; she confirms that it has arrived and transfers the money to me when it has been sold. Everything is done on the basis of mutual trust'.¹⁸ *Fumbwa* is harvested the day before the flights leave and taken to Kisangani by bicycle, motorbike or pirogue. The collectors buy on credit and pay when the goods reach their final destination in Kinshasa. If there are no freight planes, the consignment is thrown away and the harvesters receive no money. Figure 45 shows the *fumbwa* supply chain in the Kisangani region.

Figure 45. The *fumbwa* supply chain in the Kisangani region



17. Wholesalers in Kisangani told us that they do not have sufficient capital to fly to Kinshasa and sell their goods there themselves. Therefore, they have to rely on someone in Kinshasa who is prepared to receive the merchandise, sell it and send them the money via one of the financial messaging systems in Kisangani (such as Soficom, Semence or Western).

18. Conversation with *fumbwa* wholesaler in Kisangani, who collects merchandise on the Kisangani–Banalia road.

9.3 Assessment of integrated impacts of subsector options

In the following section we assess, for each of the six identified subsectors, the main impacts associated with production and processing. For each subsector, we comment on their income-generation potential, their impacts on gender equity and food and energy security, and their contributions to mitigating climate change, protecting biodiversity and improving soil fertility without nitrogen-based inputs.

1. Timber

Artisanal timber production has various impacts in the Kisangani region. It helps meet local demand because most of the output from industrial logging is exported, and it contributes to the creation of jobs in sawmills and joineries. This employment has a knock-on effect on living standards and, to a certain extent, poverty reduction, at a time when the government is increasingly shedding its primary responsibilities. Operators use their profits to cover their basic needs and provide a degree of food security for their families. Because the early stages of timber production involve heavy labour and require a certain level of physical strength, the role of women in the production process is limited to that of employers or vendors. Table 30 shows the number of jobs created by sawmills and joineries in the city of Kisangani, by commune. Each sawmill employs eight to twelve people, with an average of ten people per outfit; joineries employ three to five people, with an average of four employees.

Table 30. Number of jobs in sawmills and joineries, by commune, in the city of Kisangani

Commune	No. of sawmills	No. of jobs in sawmills	No. of joineries	No. of jobs in joineries
Mangobo	12	120	102	408
Makiso	19	190	68	272
Tshopo	9	90	49	196
Kabondo	7	70	39	156
Kisangani	5	50	36	144
Total	52	520	294	1,176

Source: Field data collected by the authors in 2012.

Table 30 shows that the sawmills and joineries in the communes of Mangobo and Makiso provide the most jobs, followed by those in Tshopo, Kabondo and Kisangani. Mangobo employs more workers than any of the other communes (12 sawmills and 102 joineries), so it can be considered most active in the emergence and development of this type of locally controlled enterprise in the city. Two factors – location and taxation – explain why this commune has the most joineries. The River Tshopo, which is used to transport large quantities of timber, is the main entry point to the commune. This makes it a good location for sawmills and joineries that want to cut the cost of transporting timber from the docks to their premises and also have easy access to the market. SMEs in the centre of Kisangani, and especially in Makiso, have to pay higher rates of tax than those in other communes; certain operators prefer to run their businesses in outlying communes to avoid the exorbitant taxes or, if possible, not pay any tax at all.

Despite its high taxes, some entrepreneurs prefer Makiso because it provides important enabling conditions – such as reliable electricity supplies, as well as good accessibility and proximity to clientele. Makiso therefore has the most sawmills and the second highest number of joineries in the city. These workshops provide employment and thus contribute to the domestic well-being of sawyers, vendors, agents, handlers, hauliers, carpenters, joiners and security guards. Sawyers use varying types of machinery and are paid piece rates by sawmill owners. Vendors are usually family members who are recruited to take care of the daily sales of goods (for example, rafters, struts and planks); they are paid a flat rate in cash or in kind.

Agents work on behalf of the timber merchants or joiners, finding clients and helping gain access to the market. They are well-known in the supply chain, arranging transactions and business deals on behalf of their employers. They do not have their own capital and are paid a percentage, which is agreed in verbal contracts. Handlers in sawmills arrange for the timber to be moved from the point of sale to the point of transport and oversee its loading; they are paid by the purchaser. Timber that is transported by cart or bicycle is handled by the transporter. Hauliers move timber from sawmills to the point of consumption (carpenters' workshops) or processing (joineries). This is usually done by vehicle, cart or bicycle. Carpenters use rafters, struts and planks for domestic construction and roofing, and joiners process the timber bought from sawmills into furniture, such as tables, chairs, wardrobes and closets or into doors, windows, shop windows, coffins, and so on. Watchmen keep guard over the sawmills and workshops to ensure that goods are kept secure until they are sold.

The jobs created in Kisangani sawmills and joineries do not necessarily improve domestic well-being directly because the money does not always reach the households concerned to help balance their budgets. According to one artisanal timber operator, 'some agents, handlers and carters are not organised and their situation does not improve, even though they earn money here every day'.¹⁹

Our surveys show that very little is being done to mitigate climate change in the Kisangani region. Although artisanal operators pay business taxes,²⁰ the authorities that are supposed to use this money for reforestation do not seem to be in a hurry to do so. In addition to the business tax, artisanal operators must pay numerous other taxes for which no official proof of payment is given.²¹ Consequently, many prefer to work clandestinely because they are fed up with seeing their money used for purposes other than the

19. Interview with an artisanal timber operator in the sawmill opposite the municipal offices in Mongobo.

20. The operators we interviewed reported that they paid two kinds of tax: official taxes (for which they receive a signed document), and unofficial taxes (for which no papers are issued). Unofficial taxes include taxes on information (charged by the National Intelligence Agency), migration (charged by the immigration office), customs (charged by the General Directorate of Administrative and State Revenue), local taxes (charged by decentralised local government bodies), and docking fees (charged by the commune). Taxes are also levied by the provincial environment and nature conservation service, such as the SME business tax, the forest tax and the loading and service tax. Listed official taxes include taxes on statistics, surface area and licences levied by the governorate; and charges, felling and forest use permits, reforestation, volume, income, clearance for crops, rights of access to resources, licences to buy and sell levied by the provincial environment and nature conservation service.

21. Interview with an artisanal operator whose wood is sold in a sawmill in the commune of Makiso.

intended reforestation. Because they cannot be sure that their taxes will reach their rightful destination, many give wine to the tax agents instead. The State technical service responsible for reforestation is eagerly awaiting the National Forestry Fund, the objective of which is to 'contribute, by funding conservation operations, to the reconstitution of forest capital as part of the national effort for sustainable forest resource management and poverty reduction and the global effort to combat climate change resulting from deforestation and the degradation of forested lands'.²²

The lack of reforestation means that the Kisangani region is gradually losing its forest cover, which will reduce its capacity to capture carbon and mitigate climate change in areas where logging takes place. Although the forest is extremely resilient, there is reason to fear that the rate of deforestation in the Kisangani region is exceeding the pace of reforestation in areas damaged by artisanal logging. Biodiversity in the region is also affected by artisanal forestry operations. Selective woodcutting (skimming) that targets valuable timbers creates a risk that certain species and NTFPs that depend on these trees could disappear. The consumer preference for afrormosia and other hardwoods is contributing to an upsurge in selective logging.²³

While felling old trees creates space in the canopy for recruits, it takes many years for the new trees to reach maturity, reconstitute the forest and enable it to fulfil its environmental role. Unregulated logging also displaces certain animal and plant species. Nowadays, for example, people have to travel 50-100km to find plant and animal species that used to be common within a 15-20km radius of the city. Some organisations in the region, such as OCEAN, APILAF and ADIKIS, have run awareness-raising and training sessions for state actors, artisanal operators and local communities, but selective logging continues, with no regard for the mechanisms that are supposed to protect biodiversity in Kisangani.

Given that it is difficult – if not impossible – to stop artisanal logging in the region without creating social imbalances and depriving households of their main source of income, the state services and national and international environmental organisations need to do more to regulate the sector and to educate the actors concerned in order to safeguard the region's forest capital, which constitutes a crucial element of global forest reserves.

Reforestation projects could be established in logging zones, and local communities could be educated on the need to replace trees that they fell or sell to artisanal operators to ensure the long-term protection of the forests. National and international organisations could sensitise the state services, which are the principal protectors of national forests, to ensure that existing forestry regulations are respected and to formulate other regulations that are adapted to national realities, and which encourage and develop reforestation activities in logging zones. Artisanal operators should be monitored and controlled by the state services and local communities to prevent the unauthorised logging of old and young trees and to clamp down on the clandestine operations that are rife in the timber-supply chain. Priority should be given to setting up training and awareness-raising projects for all actors involved in the timber production chain so that they understand the ecological roles played by the forest.

22. Kisangani provincial service information on the National Forestry Fund.

23. Interview with a researcher for OCEAN, conducted in the Kisangani office on 22 November 2012.

2. Oil palm

Palm oil is widely used for cooking, such as for frying, margarine and vegetable oils, and its sub-products of stalks, pulp fibres, liquid and solid waste, cakes, and so on, provide various forms of bioenergy, fertilisers and livestock feed. In 2010, palm oil was regarded as the most widely consumed vegetable oil in the world (25 per cent of the world market).²⁴ The palm nuts are crushed and the kernels extracted, and the waste products are used as an alternative source of energy for cooking; kernels that are not used for oil are fed to livestock, especially pigs. Palm oil is only produced in low- and middle-income countries, where it is the primary vegetable oil in terms of production and trade. It is also the least expensive of all the vegetable oils available on the market in Kisangani (in late 2012, a 20-litre can of palm oil cost US\$20 in Kisangani, while five litres of olive oil and other types of oil cost US\$15). The labour-intensive production of palm oil involves few mechanised processes and generates 30 times more jobs per unit area than other major agricultural outputs such as soya (Thomas *et al.*, 2009).

To a certain extent, the production and marketing of palm oil and palm kernel oil contributes to household well-being and gender equity in the Kisangani region because women participate in the supply chain – collecting the fruit and taking it from the plantation to the storage site, drawing water when the oil is extracted, and selling the oil and other products. In the production of palm kernel oil, women buy the palm nuts, crush them in local presses, take them to have the kernel oil extracted, and sell the oil on the market. To improve the quality of palm oil, PAIDECO (Projet d'Appui aux Initiatives de Développement Communautaire dans la Tshopo) intends to run a palm-oil training and support project in and around Kisangani.²⁵

Small artisanal soap manufacturers use much of the palm kernel oil produced in the Kisangani region; these manufacturers are officially recognised by the public administration (the SME Division). Various types of artisanal soap, such as Tembo, Peto, Benita and Tembe, are available on the local market. These soaps helped fill the gap created by the absence of brands such as Le Coq, Monganga and Give when Kisangani was occupied by rebel forces and cut off from the rest of the country between 1998 and 2003. The popularity of locally produced soaps has waned since the old favourites reappeared on the market after the official end of the war and reunification of the country, but they are still bought by poorer people who cannot afford to purchase imported soap on a regular basis.

Most of the 22 ordinary oil-palm plantations in the region lie between Kisangani and Yangambi. Oil palms also grow in the wild, providing easily accessible fruit that local people use to produce palm oil for their own consumption or to generate additional income. However, many of these trees are being felled for palm wine made from their fermented sap, which is sweet when newly harvested but which soon sours during the rapid fermentation process. Local demand for both bitter and sweet palm wine is partly driven by the lack of purchasing power among certain sectors of the population. So many palm-wine outlets have sprung up in the outskirts of the city that there is a risk that the region

24. Mattea Battaglia, 'Noyé dans l'huile de palme. L'explosion de la demande mondiale', *Le Monde Magazine*, No. 39, supplement to *Monde* 20336, 12 June 2010, p. 14.

25. Interview with a communications officer for PAIDECO (Tshopo), held in Kisangani.

will lose its wild oil palms and have to rely on more expensive oil produced elsewhere. Surveys show that many palm-wine producers fell trees without obtaining logging permits, or they apply for authorisation to fell trees to clear land for cultivation and then use these documents to cut down oil palms to make palm wine. The state services have much to do in order to combat this practice.

3. Baked bricks

Baked-brick making meets a real and urgent need for better housing in Kisangani, helping to alleviate the soaring cost of cement used in concrete blocks. Brick making is also a profitable activity that contributes to the household well-being of the makers and of other operators involved in the production process. Because it involves hard labour, the role of women in brick making is usually limited to that of entrepreneurs or cooks preparing food for labourers.

We analysed various aspects of the production process, starting with the main raw material for bricks: earth. When this activity first started, baked-brick makers in Kisangani often used earth from hills in their own plots or on neighbours' land, and people were happy for them to do so because it is easier to cultivate flat surfaces. Over time, however, the baked-brick makers started digging more deeply to increase their output or find better earth so they could produce higher-quality bricks. Baked-brick making is now well established in almost every commune in the city and has completely changed the landscape in and around Kisangani. Brick-making sites and many public places and housing plots are pitted with large open holes that pose a danger to residents (especially children), who are at risk of falling into them. The excavations also cause serious soil degradation, rendering brick-making sites unfit for productive use, long after the activity has ceased.²⁶ The state services should ban the production of baked bricks on housing plots and in residential areas and oblige brick makers to move to the outskirts of the city in order to protect the urban environment from damage caused by their activities.

Baked-brick making also comes at a high cost to forests, the edges of which are retreating from the city as a result of felling to supply firewood to bake the bricks. The distance between sites where the wood is cut and where it is consumed is increasing by the day; it varies from 12km to 50km, depending on the road network.²⁷ Kisangani is losing its natural greenery because the secondary forests that should form a windbreak around the city are heavily exploited for firewood for artisanal brick making. While these forests still have great potential and capacity for resilience, the current rate of exploitation makes it imperative that the state services implement reforestation strategies and develop alternative energy sources if forests are to be retained for the benefit of future generations and the environment and biodiversity are to be protected.

26. Field observations made during data collection in communes in Kisangani. The commune of Kisangani is particularly badly affected, between PK 4 and 7 in neighbourhoods along the road to Bangboka airport.

27. Interviews with a baked-brick maker in the commune of Mangobo, and a baked-brick maker in the commune of Kisangani.

Baked-brick makers consume large quantities of firewood because few alternative sources of energy, such as electricity or fossil fuels, are available to them. Demand for bricks is increasing as the government encourages citizens and state services to contribute to the national reconstruction process by constructing solid buildings. Even supposedly environmentally aware institutions are encouraging and helping local organisations to increase their productivity, with little consideration of the effects that their activities are having on the environment. In 2001, for example, PAIDECO supported brick makers in the district of Tshopo in Kisangani.²⁸ This assistance mainly consisted of advising the managers of selected organisations, providing work tools, such as brick-making machines, hoes and shovels, and legalising and structuring selected organisations.

Another disturbing observation made during the collection of data in the field was that many of the labourers making bricks are school-age minors, even though the child protection law in DRC formally forbids the abusive use of children in informal income-generating activities. According to the International Catholic Child Bureau *et al.* (2004), 'The employment code regulates child labour (duration and conditions of work), but has not been adapted to the economic crisis (dominated by the informal and opportunistic economic sector). This leaves the way open for child labour violations. [...] the Labour Code has been reformed; it forbids the worst forms of child labour and has raised the minimum age for employment to 16'. The reality is that children aged between 10 and 17 years are involved in brick production in the Kisangani region. The different services responsible for child protection need to look into this issue.

The majority of baked-brick makers in Kisangani prefer to work at night. Survey respondents said they do so because it is cooler and less tiring and consequently they are more productive (producing more bricks per shift).

4. Biomass energy

DRC is classified as one of the African nations with the greatest potential for 'clean' energy, mainly hydropower. Although DRC has the potential to meet its own electricity needs and those of all its neighbours, only about five per cent of households in DRC have access to electricity, one of the lowest domestic rates of access in the world (Aveling *et al.*, 2004). The most commonly used sources of energy are charcoal and firewood in urban centres, and wood, crop residues and animal dung in rural areas.

The population in Eastern Province grew from 4.3 million in 1984, when the first scientific population census was conducted, to 8.5 million in 2008 (INES, 2008). This rapid demographic growth poses a serious environmental threat because of the increased consumption of charcoal and firewood it implies and the lack of renewable energy and electricity. Cleaver and Scheiber (1994) argued that rapid demographic growth has exacerbated the high dependence on ligneous fuels and increased pressure on natural resources, including forests.

28. PAIDECO (Tshopo), technical report on the identification of baked-brick producers' and makers' associations and the management of storage structures, May 2012.

There is no standard price for firewood in Kisangani due to the liberalisation of the market. All actors seek to maximise their profits by setting their own prices without reference to what others are charging, although prices vary according to the quality of the wood and the rate at which it burns. Charcoal and firewood are the main sources of domestic energy for most people living in and around the city of Kisangani, small semi-industrial operations, for example, bakeries, soap manufacturers and baked-brick makers, and even industrial outfits such as SOTEXKI. Unlike firewood, the price of charcoal is fairly uniform in Kisangani – US\$10 per sack when bought from producers/vendors and US\$12-US\$20 per sack in the city, where the cost of transport is included in the sale price.²⁹

The main points of sale for charcoal and firewood in Kisangani city are the markets of Litoi, IAT and the Association of Pirogue Fishermen (ASPIRO) in the commune of Makiso; the Djubudjubu/Tshopo and 11th Avenue markets in the commune of Tshopo; the Djubudjubu/Mangobo and Balese markets in the commune of Mangobo; the Kikongo market in the commune of Kabondo; and the Cimestan market in the commune of Kisangani. Prices vary according to the quality of the merchandise, which is determined by the type of wood. Surprisingly, producers use high-value timber such as afrormosia and other hardwoods because they burn more slowly than other types of wood. According to one charcoal producer and vendor, 'Consumers prefer hardwood products, and we want to meet their demand'.³⁰

This means that high-value species that could be used to produce value-added timber products are sought-after for charcoal and firewood. This seems to be largely due to a lack of knowledge among producers and a lack of training and advice from the state services that raise taxes at various stages of the charcoal and firewood supply chain. The state needs to regulate the sector more effectively to protect threatened species, especially hardwoods, which are most at risk. Public authorities, research centres and national and international organisations involved in forest protection should provide training on alternative sources of domestic energy.

Despite these concerns, the charcoal and firewood supply chain does have positive impacts on people's lives and on financial stability in the Kisangani region. The income it generates enables households to meet their daily needs for food, education, clothing and modern medicine, and it enables women, who are very active in marketing, to become more autonomous and to take control of their lives. One female charcoal seller told us that, 'Selling charcoal enables me to feed my family without constantly having to ask my husband, who has been unemployed for ten years, for money'.³¹

Reliance on charcoal and firewood for domestic energy is so high in the region that stopping production would deprive the population of its main source of energy. Locally controlled enterprises in this supply chain need to be better organised so they can

29. Source: Conversations with charcoal sellers and dealers in Litoi market (commune of Makiso), ASPIRO market (commune of Makiso) and Cimestan market (commune of Kisangani).

30. Source: Conversation with a charcoal producer and vendor in the 11th Avenue market in the commune of Tshopo, Kisangani.

31. Source: Interview with a charcoal seller at the Cimestan market in the commune of Kisangani.

continue production without harming the forest. Local communities and entrepreneurial producers need to be made more aware of how to protect the forest, use its resources more carefully and manage it sustainably – for example by replacing trees that are felled for charcoal or firewood. State interventions should include working with national and international partners to disseminate relevant legislation and ensure that every actor in the supply chain obeys the law. This is a key subsector in the provision of domestic energy in the region and merits special attention in order to safeguard people's energy supplies and protect the forest.

The estimated annual consumption of woodfuel in DRC in 2005 was 81.6 million m³ (FAO, 2010b). This level of consumption is causing deforestation and creating a threat to the environment that affects every link in the charcoal and firewood supply chain. Researchers, politicians, NGOs and donors should ensure that their environmental and biodiversity protection programmes take into account the role that each actor plays in this chain in the Kisangani region. Studies have shown that local people often fell trees for charcoal in primary forests because such forests seem to produce better-quality charcoal than secondary forests and fallow land, and there is strong consumer demand for a good-quality product.³² Along with legislation, training and guidance for all the actors concerned, the public authorities urgently need to diversify energy resources to reduce the pressure on forests caused by the population's high dependence on charcoal and firewood.

Large amounts of material are also removed from the forest for housing. Almost all villages in the region and the surrounding area are built from non-durable materials – mainly sticks, which are used to construct walls and roofs, fence off plots, enclose livestock, display goods in the market, and make scaffolding and shuttering for cement works.

The prevalence of stick-built houses in the region reflects a lack of purchasing power that prevents local people from constructing and living in solidly built homes. A lack of employment and low salaries mean that a large proportion of the population cannot build their homes from durable materials. If they want to provide their families with a roof over their heads and provide some kind of domestic stability, the only option is to use sticks to build makeshift homes.

It has been shown that stick-built houses can last for 20-30 years, depending on the type of wood used. Some valuable species, such as afrormosia and other hardwoods, are felled as saplings because they provide long-lasting, termite-resistant sticks for housebuilding; an important consideration in an area where termites do a lot of damage. These sticks sell for 300-2,500 Congolese francs, depending on length (40-200cm), type and quality. The main points of sale in Kisangani are the Litoi, ASPIRO, Kikongo and Djubudjubu markets. The real problem here is that the youngest plants are systematically cut with no regard for the vital role they would otherwise play in mitigating climate change by capturing CO₂ and regenerating the forest.

32. A typical example is the consumer preference for charcoal made from *Gibertiodendron dewevrei* (limbali), which is only found in primary forests.

5. Rubber

To a certain extent, rubber production in the Kisangani region contributes to economic growth by creating jobs for men and women. The companies that farm rubber (Lobby Congo and COREX) operate in the interior of the province and use local labour to harvest the latex. Local people tend to use rubber production to supplement what they earn from their fields. They alternate between the two cropping systems, tapping rubber while they wait for their crops to ripen and selling the latex to the rubber company that operates in the locality. The money they earn slightly increases household income, enabling them to cover various household expenses, such as food, medical care and schooling, thus helping reduce poverty.³³

Unlike rural areas where the population is almost entirely reliant on the forest and its resources, rubber-growing provides work for young people and reduces their dependence on natural forests. Because the rubber trees in this region grow in old, virtually abandoned plantations, local people use their dead wood for charcoal and firewood and as materials for housing, fencing and livestock enclosures.³⁴ This helps mitigate climate change by reducing pressure on natural forests as a source of these products and by enabling forest regeneration. Rubber production in the region also helps maintain biodiversity because producers only extract latex (in plantations) and do not cause serious degradation to the natural forest.

Nevertheless, researchers working on forest protection are concerned about the use of rubber trees to produce charcoal in Yangambi and Bengamisa (Kisangani PK 52 on the Buta road) because of its possible contribution to greenhouse gas emissions and the potential to cause deforestation unless practical and effective control mechanisms are put in place. Rubber plantation managers should ensure that rubber trees are protected, and they should raise awareness of the environmental role of rubber trees among staff, possibly with assistance from the authorities. They also need to better remunerate their staff, because field information indicates that employees are selling rubber trees to subsidise their salaries.

6. Rattan and *fumbwa*

Rattan is one of the ten most widely sold NTFPs in Kisangani, and it has significant market value. Some canes are used to produce artisanal goods, and much of the raw rattan sold on the market is used for fencing and adobe houses, especially in the suburbs. Rural people make raw rattan into domestic items and take large quantities of it to Kisangani by bicycle, vehicle and pirogue. Bulk shipments from different parts of the region are also sent to the city by river.

Rattan canes make excellent bindings and are widely used in settings characterised by equatorial-type rainfall and urban development dominated by traditional housing, where roofs are regularly replaced and domestic fencing and livestock enclosures constantly need

33. Latex from the rubber trees is sold directly to the company in the area at US\$0.15 (150 Congolese francs) per litre.

34. In Yangambi (Kisangani PK 90), the trees from INERA's old rubber plantations are sold to local people for charcoal. Instead of having to travel long distances to find trees, local people negotiate directly with the managers of the local company.

to be reinforced. This requires large quantities of raw rattan, which cannot be recycled after use. Urban workshops that make rattan goods also have to respond to constant domestic demand from city-dwellers and commissions from various economic, health and cultural institutions. With the rehabilitation of the road network and national reconstruction efforts, markets for rattan goods are increasingly opening up in cities in the east.

Our field studies show that men produce nearly all the articles made of rattan in the Kisangani region. This activity is seen as hard, painful and dangerous because harvesters have to deal with ants, thorns and falling branches brought down by lianas, and sometimes they have to walk long distances with heavy loads. Rattan huts, beds, chairs, baskets and other products have always been made by men, while women have traditionally used rattan to make coffins and to weave items such as mats and baskets.

The harvesting and selling of rattan increase the incomes of villagers, giving them greater purchasing power and enabling them to meet basic needs. Rattan is the main source of income for some villagers and has a clear impact on household well-being. In terms of climate change, it seems that the exploitation of rattan as a forest product does not cause major harm to forest resources – although this may not always be the case, given the amount that is harvested and the high demand in local and urban markets. The various state services and national and international NGOs that work on environmental issues need to consider this issue and ensure that relevant legislation is properly enforced.

The *fumbwa* supply chain generates numerous jobs, particularly for women and children, who are the most vulnerable social groups. Women are mainly involved in marketing, which gives them a guaranteed daily income; harvesting tends to be done once or twice per week by children (and also women), providing them with weekly income. The money made from selling *fumbwa* helps stabilise household incomes and is also used to resolve periodic problems with food, health care and schooling.

Most dried *fumbwa* is exported to other African countries, such as Angola, the Republic of the Congo and Gabon, where it is bought by the Kongo, who are big consumers of *fumbwa*. Some product is exported to European countries like Belgium and France, which have quite large Congolese communities. Traders say that the leaves of *Gnetum* species can last up to two weeks after being harvested, but perishability is still an issue in getting the product to market, given the large distances often involved between the point of harvest and the main points of consumption. The *fumbwa* supply chain is poorly organised, and little attention seems to be given to conservation techniques.

Because *Gnetum* species can regenerate much more quickly than other NTFPs, *fumbwa* production does not seem to be causing serious harm to the forest or having any obvious visible impacts on climate change and biodiversity in the Kisangani region. Nevertheless, it has to be said that harvesting methods are very destructive and could eventually jeopardise the survival of this species.

9.4 Assessment of support priorities

A critical evaluation was made of the six surveyed forest subsectors – timber, oil palm, baked-brick making, charcoal and firewood production, rubber production, and NTFPs (*fumbwa* and rattan) – in the Kisangani region and their contributions to poverty reduction, household well-being, gender equity, food and fuel security, mitigating climate change, protecting biodiversity and improving soil fertility without nitrogen inputs. The six subsectors were selected among many because of their local importance. Table 31 summarises the results of the evaluation.

Subsector	Timber	Oil palm	Baked bricks	Charcoal and firewood	Rubber	NTFPs
Evaluation criterion						
Income-generating opportunities for women	4	5	4	5	4	5
Food security	5	5	5	5	5	5
Energy security	4	4	2	5	4	3
Mitigating climate change	2	4	2	2	4	4
Protecting biodiversity	2	4	2	2	4	4
Improving soil fertility	3	3	2	2	3	3
Total	20	25	17	21	24	24

Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

Table 31 shows that it is highly likely that the regional timber supply chain contributes to food security and household stability by providing numerous jobs in Kisangani city. Women are very active as employers and traders in this chain, which gives them a degree of financial autonomy and enables them to meet their daily household needs. Artisanal operators in the Kisangani region make a moderate contribution to energy security, insofar as local people collect the branches of trees that are felled to produce timber for use as charcoal and firewood. The artisanal exploitation of timber in the region has a slightly negative effect in mitigating climate change and on biodiversity, and few policies encourage reforestation or ensure that the forest is managed sustainably. Finally, artisanal exploitation has had little visible effect on improving soil fertility in the region.

It is highly likely that the oil-palm production chain contributes to household food security and provides good opportunities for women to earn money. As noted above, women are very active at almost every level of this chain, which gives them a degree of financial security and domestic stability. The exploitation of oil palm in the Kisangani region makes a moderate contribution to energy security because villagers use oil-palm waste products to help meet their energy needs, thereby helping reduce the systematic consumption of charcoal and firewood for cooking. With regard to mitigating climate change, our research shows that the multiple sub-products generated along the chain allow a certain part of the population to find alternative sources of income without having to rely on natural forests

for their survival. Similarly, oil-palm production helps maintain biodiversity by reducing pressure on forests arising from human activities. This activity has no visible effects in terms of improving soil fertility in the region without nitrogen-based inputs.

It is very likely that baked-brick production in the region contributes to the food security of actors in the supply chain by generating good income and probably helping to stabilise household finances. Women are less active in the production process, due to the hard labour involved, but they do play a small role in the business side of the chain and can achieve a reasonable degree of financial autonomy as entrepreneurs. Brick production has a slightly negative effect on energy security due to the large (even excessive) amount of firewood required in the baking process and the consequent impact on forests. The systematic use of firewood has a negative impact on climate change mitigation because material is removed from primary and secondary forests in the region and there are few reforestation initiatives and little training on this issue. The systematic removal of firewood is detrimental to biodiversity in the region for the same reason, and the production of baked bricks has a negative effect on soil fertility, sometimes rendering production sites infertile for long periods.

It seems very likely that the charcoal and firewood supply chain contributes to the financial autonomy of women, the food security of households involved in the chain, and the energy security of the majority of the population in the Kisangani region. Charcoal and firewood are the main source of domestic energy for local people, who have few, if any, other options. Women are very active at almost every point of the chain, which enables them to cover their basic needs. However, the supply chain has slightly negative effects on efforts to mitigate climate change, protect biodiversity and improve soil fertility without the use of nitrogen inputs. Selective woodcutting, the preference for high-value timber to meet consumer demand, and the lack of regulations, reforestation policies and training are all contributing to the progressive deterioration of forest resources in the region. Charcoal-burning sites are also used to grow crops at certain times, which affects the resilience of the area.

Rubber production in the Kisangani region involves hard physical labour and has a moderate positive impact on women's incomes. The income generated by selling latex to companies in the region is highly likely to contribute to food security in households that are involved in the supply chain, enabling them to cover the cost of food, medical treatment and school fees. Rubber production probably makes a moderate contribution to energy security in the region because people use the trimmings from branches and shrubs for their domestic energy needs, which also helps slightly to reduce pressure on forest resources. The rubber supply chain also makes a moderate contribution to efforts to mitigate climate change and protect biodiversity, insofar as rubber plantations reduce pressure on natural forests and also play a significant role in helping maintain ecosystems. Rubber production does not appear to help improve soil fertility in the region.

Women are closely involved in marketing NTFPs in the region, especially *fumbwa* and rattan, so it seems highly likely that NTFPs contribute to women's incomes and household food security by providing a level of financial autonomy and domestic stability. *Fumbwa* and rattan do not appear to contribute much to energy security because their raw materials and waste cannot be used as a source of energy. *Fumbwa* and rattan help mitigate climate

change and protect biodiversity in the region to the extent that their exploitation does not directly affect the forests in which they originate, and the income they generate helps reduce direct pressure on the forest. The harvesting of NTFPs does carry the risk, however, of endangering species by overharvesting. The exploitation of NTFPs in the region has no effect on improving soil fertility.

Interpretation and recommendations

These findings indicate that some subsectors may have particular value for sustainable development in the region; for example, oil palm, rubber and NTFP enterprises score highly on aggregate. Nevertheless, the subsectors were assessed for their current impacts, not their potential impacts. This is an important point, as the low aggregate scores for timber, charcoal and brick production really stem from deficiencies in the management of the natural resources from which wood is extracted. Were it possible to enforce sustainable management, these options might provide better alternatives than those that currently are ranked highest.

In part because of this poor enforcement environment, the study provides the basis for the following recommendations regarding sustainable forest management in the Kisangani region:

- All existing regulations on the exploitation of forest resources in DRC (the Forest Code, Order 035, etc.) should be properly disseminated to ensure that all resource users are aware of and understand them.
- Local communities' prior rights to forest resources should be safeguarded by the state services and respected by artisanal operators.
- The state services that issue logging permits and authorisations should oversee artisanal operators throughout the whole production chain to guard against abuses and breaches of contract between artisanal operators and local communities.
- The state services should restructure and limit taxes on artisanal operators, many of whom work clandestinely to avoid paying taxes that may in any case end up lining the pockets of officials.
- The state services should help diversify incomes as much as possible to reduce the pressure that local people place on the forest (their main natural resource). This may require the complete restructuring and retraining of forest service staff.
- State services and national and international NGOs should design and implement businesses in which reforestation and forest regeneration keep pace with the rate of exploitation – in other words, the harvest should not exceed the sustainable supply.
- All actors involved in the artisanal exploitation of the forest should receive training, awareness-raising and advice to ensure that forests in the Kisangani region are managed sustainably.
- Locally controlled forest enterprises in the Kisangani region need to be structured effectively; operate legally (with minimal bureaucracy in registration); and be supported to increase sustainable production, gain access to markets and simultaneously protect the forest.
- Authorities should promote, support and encourage projects that make sustainable energy available (including sustainable charcoal and firewood but also other renewables), with the aim of reducing the unsustainable use of charcoal and firewood as the only sources of domestic energy.
- Environmental research centres should mobilise funding to study the underlying causes of the serious threats to Congolese forests in general, and those in the Kisangani region in particular.