

Agroforestry and sustainable woodfuel: Experiences from the Yangambi landscape in DRC



*Mumbere Kiwanza G,
Schure J, Cerutti P O, and
Kasereka-Muwatsi L*

SUSTAINABLE WOODFUEL BRIEF #8

Agroforestry and sustainable woodfuel: Experiences from the Yangambi landscape in DRC

*Mumbere Kiwanza G, Schure J,
Cerutti P O, and Kasereka-Muvatsi L*

This publication is part of a series of briefs describing findings from the EU-funded Governing Multifunctional Landscapes Sustainable Woodfuel project, which aims to contribute to knowledge, options and engagement for more sustainable woodfuel value chains across Sub-Saharan Africa.

cifer.org/gml/sustainable-woodfuel

Key messages

- This brief describes the first efforts to integrate agroforestry with charcoal production in the Yangambi tropical forest landscape.
- Activities resulted in both increased food crop production and reforestation, as well as the establishment of producer-led local associations and greater collaboration between communities and local authorities.
- Demonstrating the benefits of agroforestry systems as a source of woodfuel, along with capacity-strengthening activities, are critical to the successful adoption of activities by communities, as is ensuring that all activities are participatory and inclusive in nature.
- Local land tenure and rights must be well understood, as well as how gender dynamics and cultural norms may impact uptake.
- Finally, understanding local governance systems and social norms is fundamental to ensuring sustainable results.

Introduction

Woodfuel harvesting and deforestation in the Yangambi landscape

In the Democratic Republic of the Congo (DRC), shifting cultivation (slash-and-burn) agriculture and the production of woodfuel are the main income-generating activities for peri-urban populations – yet these are also the main causes of deforestation and forest degradation (Péroches A. et al. 2019). In the Yangambi landscape, which extends over 220,000 hectares of tropical forest landscape in Tshopo Province, the area of intact (undisturbed) forest fell from 1,452,666 ha to 1,105,204 ha between 2001 and 2020; that is, a decrease of nearly 24% over 20 years. The main drivers are population growth and activities such as shifting cultivation, charcoal production and logging (Cerutti and Vancutsem 2022). Charcoal producers in this landscape often work under uncertain institutional conditions and lack the skills to sustainably manage woodfuel resources and produce charcoal in an efficient way (Schure et al. 2021).

Before this project, no producer had ever planted a tree for the purpose of exploiting woodfuel in the intervention sites of this landscape. However, 80% of the producers noted the increasing difficulty in accessing woodfuel, as people are having to travel farther and farther from their villages to find wood for charcoal production.

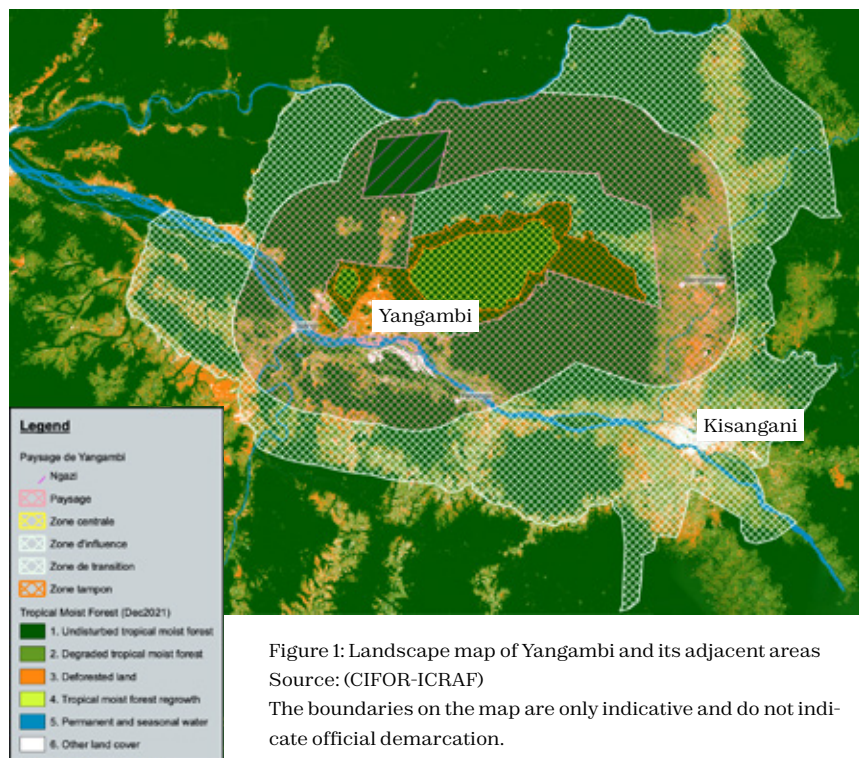


Figure 1: Landscape map of Yangambi and its adjacent areas
 Source: (CIFOR-ICRAF)
 The boundaries on the map are only indicative and do not indicate official demarcation.

To address the overexploitation of woodfuel resources and ecosystem disturbance in the Yangambi landscape, the Governing Multifunctional Landscapes Sustainable Woodfuel project adopted a participatory approach, working with charcoal producers to establish agroforestry systems. On customary lands – which are often left fallow – *Acacia auriculiformis* trees were intercropped with food crops such as maize, cassava, peanuts, cowpeas and rice in rotational agroforestry plantations. In a rotation system of 6–7 years, the tree plantations will contribute to two main objectives: first, to create a reliable source of woodfuel that can be harvested annually (starting in 2026) to meet increasing urban demand; and second, to reduce pressure on surrounding intact forests.



Base Vie in Yangambi - DRC.
 (Axel Fassio/CIFOR-ICRAF)

Development of a woodfuel agroforestry system in a tropical forest landscape

Participatory approach to establishing a sustainable timber source

The identification of appropriate and relevant stakeholders helps to take into account the equitable distribution of resources (Prell et al. 2009). These are individuals or groups who influence and/or are affected by woodfuel activities in the Yangambi landscape.

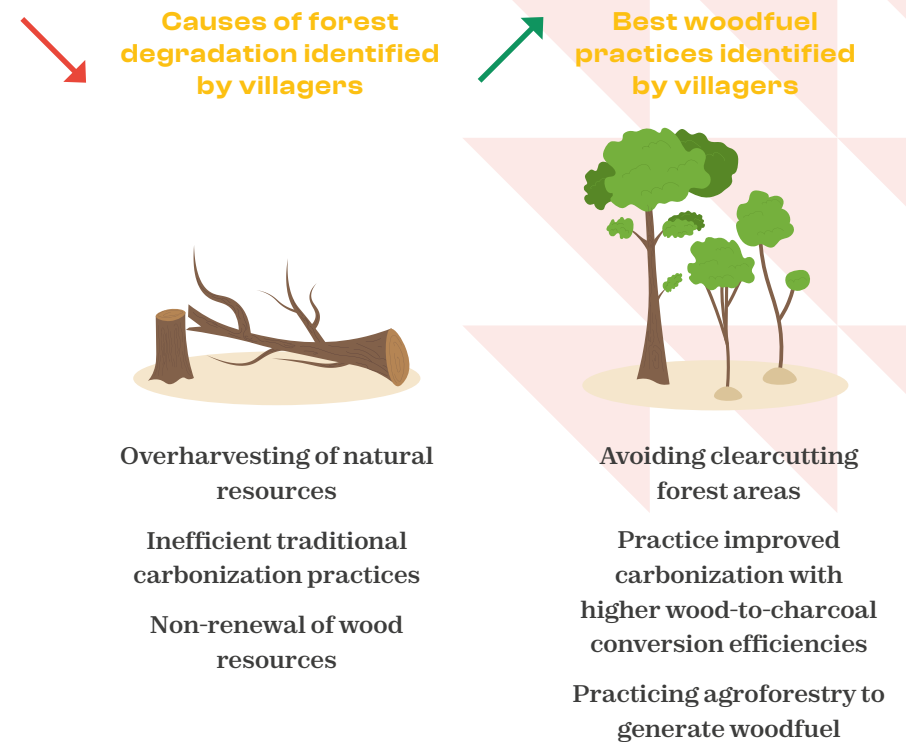
Villages with established charcoal production activities and which were experiencing an advanced level of degradation were selected. Stakeholders were identified through a participatory process that involved workshops featuring discussions on the disappearance of woodfuel resources from the vicinity of the villages. This step was followed by awareness-raising activities on agroforestry options through community screenings of films depicting experiences in other areas.

The different stakeholder groups were as follows:

- 223 charcoal producers (mostly farmers) in 19 villages in the Yangambi landscape who are direct beneficiaries of this income-generating activity. With support from the project, they set up agroforestry plantations as sustainable sources of woodfuel, and were trained on improved carbonization techniques.
- 98 clan leaders from across the 19 villages who are the customary landowners and who have the power to accept or refuse tree-planting initiatives (at the village level, planting a tree is a symbol of claiming land).
- 19 local chiefs, who were approached to facilitate awareness-raising around the need to restore severely degraded areas or unproductive fallows, and to transform these into areas that could profitably produce woodfuel.

- 3 sector heads (Yalikandja-Yanonge, Turumbu, Yaokandja) and 2 chiefdom heads (Yalihila and Kombe), who held administrative powers. They were approached to include forest restoration activities under the project in their daily management programmes, thereby contributing to a change of mentality through sustainable practices in the management of forest resources (awareness, recognition, and supervision of associations).

During participatory discussions on the drivers of forest degradation, stakeholders proposed best practices to be followed by farmers, as well as best practices for woodfuel production.





Pilot farm of the ITM (Institut Technique Medical) Association in Yangambi - DRC.
(Axel Fassio/CIFOR-ICRAF)

Series of training sessions for the establishment of a sustainable woodfuel agroforestry system

Following the first phase, the project launched a series of training sessions to improve knowledge and develop the technical capacities needed to implement the project activities.

To establish a sustainable wood production system, certain categories or ‘professions’ are needed within the community. Roles and responsibilities within groups must be clarified to guarantee the proper implementation of agroforestry systems, as well as the management of future woodfuel supplies. As the process progresses, this community structuring is guided by rules of governance that manage the new roles, starting with incentives and sanctions that different groups can use to guide their members. For example, villagers through kinship lineages have the customary rights to access forest land, exploit its resources and to plant trees. People originating from outside the village who want to set up similar activities within the village territory must first negotiate with the village chief to use a certain area of forest. After this, they must follow the same steps at the sector level to obtain the required administrative documents.

Each village, community and group typically has its own social rules that must be understood and adapted, if necessary, to ensure that innovations can be properly integrated into community activities. This is a long-term process that is almost never resolved during initial meetings but rather needs constant monitoring in the field.

Establishment of village nurseries

To demonstrate to local communities the value of tree nurseries for generating useful species for land restoration and woodfuel production, the project trained a total of 223 households in 19 villages in the establishment and operation of a nursery.

Trainings focused on the technical requirements for an agroforestry system with different species for woodfuel and fruit production. Three focus groups were organized at the village level: one comprising youth (18–30 years old), another comprising people aged 30 and over, and a third comprising only women. Discussions centred around species that are useful but which have become rare.

It should be added that in the nursery, some native species (*Ricinodendron heudelotii*, *pentacleth*, *Alstonia boone*) were combined with the non-native *Acacia auriculiformis* following experiments in Mampu and Ntsio that demonstrated acacia’s ecological elasticity (i.e., the ability of a species to adapt to several types of ecosystem), its rapid growth of biomass, and its capacity to restore soil fertility by absorbing nitrogen from the air and transferring it to the soil via its roots and leaf litter (World Bank 2013).

The choice of sites for the nursery was defined in a participatory manner based on the following criteria: proximity to a watercourse, non-shady location, land not subject to periodic flooding, little slope and level surface. The nurseries were then established in 19 villages and managed by two people per village, selected on the basis of their strong involvement in the community and their ability to transmit the concepts learned during training. In order to ensure the harmonious application of the technical specifications, these local managers were trained to support communities in the construction and management of their village nurseries. In the field, these technical specifications were applied according to the model described by Fabienne and Francois in 1995.

Next, community participants began sifting the soil, packing the soil into bags, placing the bags of soil in the flowerbeds, and puncturing the bottom of the bags to prevent the young seedlings from rotting.

Good quality seeds (mature and dry) were selected, with seed packages differentiated according to species. As the process of preparing seeds varies from one species to another, some were soaked in hot water for 6 hours, then in room temperature water for another 5 days; others required the hulls to be broken and the integument to be scarified. For acacia, water was heated to 100°C in a pot, then the seeds were added and the pot was removed from heat and covered, then left to cool for 12 hours before sowing.

In areas where shifting cultivation remains the norm and seeds are burned away with crop residues, nurseries are critical to ensuring the continued availability of seedlings. Efforts were led by teams to raise awareness around bushfire management (e.g., the adoption and implementation of rules prohibiting burning during certain periods), and firefighter teams were established and trained to fight bushfires.

The success of these efforts is demonstrated by the total of 562,500 acacia seedlings (planted across 703 ha) and 22,000 native seedlings planted (110 ha) in 19 villages between early 2020 and 2022 (over five planting seasons). Difficulties encountered included the slow pace of bagging potting soil, as it was a new practice for woodfuel-producing households. In addition, differentiating weeds from young seedlings proved to be a challenge when seeds first germinated, until participants learned to distinguish them.

Training in tree planting and maintenance of agroforestry woodfuel plantations

Farmers were trained on the technical specifications for planting acacia mixed with food crops, taking into account the following:

- The distance between acacia saplings is 4 by 3 metres. This represents a planting density of 830 plants per hectare in an agroforestry system associated mainly with cassava, corn or groundnut.
- Native species were planted at 10 meters distance all around the plantations, as additional tree resources and to indicate the planting area.
- In terms of food crop rotation, after the harvesting of legumes, grass species can be planted on the same land. For example, after groundnut harvesting, corn or manioc is planted.
- While the trees are growing, farmers can grow crops in between the lines of trees for about two years' time. This means four crop rotations in the Tshopo Province that has two growing seasons in a year.
- The management plan was detailed in local community management plans to prevent conflicts related to land allocation and the distribution of benefits related to agroforestry plantations and woodfuel production. (These plans will determine land allocation and use, as well as the terms of benefit sharing.)

Training in improved carbonization

Activities related to nurseries, agroforestry plantations and firefighting were less familiar to participating community members, whereas charcoal production has been practised in the region since 1980. Due to poorly applied and inefficient carbonization techniques in traditional kilns (around 11% on a dry-wood basis) these practices contribute to overexploitation of wood as producers need to use more wood to yield a set amount of charcoal (Forest Project 2018, Schure et al. 2019). Enhanced carbonization seeks to increase the charcoal yield for the same amount of biomass.

A total of 75 charcoal makers were selected (15 per association) to participate in the training of trainers, based on the following criteria: knowing how to read and write, having a well-maintained agroforestry plot, and having extensive experience in charcoal production. The training focused on different practices to improve traditional carbonization methods (see Schure et al. 2021). During the training sessions, improved kilns demonstrated a strong increase in yield (doubling to around 22% on dry-wood basis) with a reduced carbonization time (from 17 days to 5 days) compared to traditional kilns.

Establishment of producer associations

To properly carry out the above-mentioned activities, the project facilitated the organization of producers into associations to allow the appropriation and dissemination of best practices.

In the Yangambi landscape, several forms of associations exist, and these are often linked to agricultural activities. Although informal, these associations can be considered a useful foundation on which to build more formal organizations capable of managing more complex activities such as agroforestry schemes, management of nurseries, and fire management.

Organizing farmers into groups involved consultation with a group of woodfuel producers to inform and train them on best practices for the sustainable management of natural resources. This made it possible to properly channel the project's efforts to improve the woodfuel value chain.

Seven associations were formed according to their customary affinities, geographical proximity and availability of resources: APBEYA (Association des producteurs de bois énergie de Yanonge), OPPBEYA (Organisation Paysanne des producteurs du bois énergie de Yawenda), APAMY (Association des planteurs des acacias pour la production de makala de Yelongo), AFEVADES (Association des femmes valorisatrices des déchets des scieries), APTBEYA (Association des producteurs et transformateurs du bois énergie de Yafira), APTBE (Association des producteurs et transformateurs du bois énergie) and APBEYAYA (Association des producteurs du bois énergie de Yalihila-Yaokandja).

The training focused on how associations are organized and run, the relationships between different organizations, and the procedure for obtaining legal status.

Lessons learned

Project activities revealed several key lessons. This section outlines areas for further consideration.

Gender dynamics

The participation of both women and men in agroforestry work demonstrates a real commitment to restoring the environment at the household level. However, the various project interventions also revealed distinct gender roles within the household, prompting the teams to focus more on gender considerations. Understanding gender dynamics is not only fundamental to optimizing efficiency in fieldwork but is also critical for land-use planning and plantation management activities over the long term.

Nursery

In nursery work, experience shows a gendered division of labour based on social norms.

Participation in various activities by gender

Men	Women	Men and/or women
Finding potting soil	Potting soil bags	Levelling the ground
Mixing black earth with sand	Nursery maintenance	Weeding
Sifting the soil		Cleaning
Transport of bags filled with soil		Construction of the nursery
Placing the filled bags in the flower bed		Assembly of the flower beds
		Water transport and irrigation
		Transportation of seedlings
		Finding native seeds

Plantations and land rights

Land is a key subject in establishing a plantation, as the situation differs according to gender, family ties and marital status. A married or single man who lives on community land has the right to use forest resources. This right gives him the opportunity to initiate other income-generating activities on the land, such as farming and tree planting.

A married woman who lives with her husband in his community can use the land and its resources only by virtue of being legally married. The activities she can undertake are often only of a short- to medium-term nature. She can cultivate the land but cannot plant trees on any land except that of her parents.

Regarding the use of forest resources, women, whether single or married, have the same rights as men without restriction.

In the context of tree plantation management, the age of the woman is a determining factor for the long-term sustainability of activities. A widowed woman over 50 years old will inherit her husband's plantation under the aegis of her adult children. However, a widow under 50 whose children are minors must return to her biological family, and the plantation is at the mercy of whoever buys the land.

The principle that the person who uses the land (and thus can obtain long-term benefits from it) also implies the reverse: that those who plant trees obtain the right to the land. Among the exchanges between communities and the project team, the subject of who can access benefits from trees was often raised, followed by the issue of insurance. The woodfuel producers supported are mostly villagers, who have the right of priority by virtue of custom, as well as some landholders who have the legal right to the land by virtue of their possession of a land title. These plantations belong exclusively to households. This implies that the management and operation is fully up to the nuclear family (parents and children).



Member of Akilimal women association at work, Yanonge - DRC. (CIFOR database)

Requirements for scaling up

The participatory agroforestry model introduced by the project has the advantage of empowering communities at all levels of implementation. During the initiation of activities, staff from the project team must visit the site on regular basis, because agroforestry is new to the area. Subsequently, the project team works on the transfer of skills to community members through different types of training, consultations with the various stakeholders at the local level, and efforts aimed at improving the governance of natural resources in the landscape. These elements are fundamental to ensuring the sustainability of achievements beyond the end of the project.

In terms of the materials needed to begin activities, these are not found in rural areas and thus financial support is needed to facilitate the import of equipment. It should also be noted that the lands on which the plantations are established are recognized as being areas that benefit from the right of use of the local community but without legal documentation.

These project activities have proven to be compatible with the sociocultural habits of this community as well as the technical requirements, and this facilitates scaling up.

Challenges and proposed solutions

Clearcutting – that is, the felling of any tree without regard for size or species – has been the traditional way of harvesting woodfuel and is clearly destructive to ecosystems. For this reason, the project proposed selective cutting as a more sustainable approach, while awaiting the first-grown acacia trees to be ready for harvesting (in 2026).

Only ‘original’ community members and private landowners hold the right to plant trees. This means that not all those who actually use the land, such as the many newcomers to the area, have the authorization to plant. To address this, communities recognized the need to add a benefit-sharing arrangement between these parties in their village management plans.

Within communities, there are often two different camps: those who believe that forests are a limitless resource regardless of the activities carried out, and those who recognize that the forests will disappear due to unsustainable harvesting. For this reason, it is critical to invest in awareness-raising sessions and to maintain regular contact with communities to continue demonstrating the socioeconomic and ecological benefits of agroforestry plantations.

Due to a lack of land to carry out alternative activities and the relatively long time span before tree plantations can be harvested, planting activities needed to be adapted according to the land area available to different households. Alternative income-generating activities are being discussed and promoted with the producer associations as midterm solutions to pay for plantation maintenance and provide alternate income to charcoal production.

The low level of education in the villages does not facilitate balanced debate in community meetings and opens the door for community leaders to impose their views without being contradicted. Field days in pilot farms and farmer field schools have facilitated the sharing of experience with farmers and have led to better informed participation in agroforestry activities.

Stakeholder story

Norbert Kimbwaka Bin Badjoko



(Axel Fassio/CIFOR-ICRAF)

Norbert Kimbwaka Bin Badjoko has been a charcoal producer for 46 years. He claims to be the first charcoal producer in Yanonge, a town located about 60 kilometres away from the city of Kisangani.

Mr Kimbwaka learned how to produce charcoal from a member of the military, and then taught other community members the technique. At first, there were plenty of trees in the farmlands around the village; four decades later, preferred species such as bokele (*Hymenocardia ulmoides*), bosenge (*Uapaca guineensis*), and limbalu (*Gilbertiodendron dewevrei*) are now hard to find, and encroachment of nearby forests is worsening.

The charcoal producers, many of whom are also farmers, never thought about replanting trees. Through the GML project, farmers – who have long used a field rotation system – became aware of the potential of planting fast-growing tree species in their fallow lands.

“We realized that the trees that we have been cutting down won’t be there in the future,” said Kimbwaka. “But if we produce enough trees in our own land, we won’t have to cut down trees in the forest.”

Planting began in 2020, and with the support of CIFOR-ICRAF, Kimbakwa and other charcoal producers created an association called APBEYA (Association des Producteurs de Bois Énergie de Yanonge) with the goal of making their activities more sustainable and profitable.

“*If we produce enough trees in our own land, we won’t have to cut down trees in the forest.*”

Together, the producers set up a joint nursery where they grow two species with high calorific value: the fast-growing *Acacia auriculiformis*, which can be exploited in 6–7 years but is unknown to locals, and the slower-growing *Pentaclethra macrophylla*, a well-known species that can be used for charcoal production in about 10 years. Both species are nitrogen-fixing, which means they also improve soil fertility.

Twice a year following the rainy seasons, charcoal producers plant these trees in their fields in agroforestry systems. Both species can be combined with local crops such as maize, groundnuts and cassava. Depending on the spacing left between trees and the crop, they grow their crops for about a year and then they move from field to field until it is time to return to the first one to harvest the trees.

APBEYA’s members are expected to participate in caring for the trees in the nursery and planting them in the fields. The association is also training on improved carbonization techniques to increase yields and on commercial skills to improve their businesses.

Conclusions

The activities described in this brief represent the first time agroforestry was integrated with charcoal production in the Yangambi tropical forest landscape. Agroforestry plantations resulted in an increased production of food crops, as well as an increase in the area under reforestation. Establishment of local associations led by local producers – taking into account different gender roles within the household – has made it possible to revive community work through activities related to nurseries and tree planting. Agroforestry activities have also made it possible to maintain a collaboration between local communities and the customary and administrative authorities of their respective sectors.

Local customary practices for the acquisition and use of land have been respected, thanks to the collaboration between the woodfuel-producing households and customary authorities.

Recommendations

- Promoting and demonstrating the benefits of establishing agroforestry systems as a source of woodfuel is essential. In the Yangambi landscape, local communities are aware of the progressive reduction in the extent of surrounding forests. For them, tree nurseries represent a solution and an opportunity to replace the trees lost near their homes and reduce the time needed to search for and harvest woodfuel.
- Capacity building is a key component to ensuring buy-in. The proposed activities were very well received by the communities. They appreciated the opportunity to manage the process and to learn silvicultural techniques, particularly the revival of local species and crop rotation in agroforestry systems.

- Ensuring activities are participatory and inclusive can increase the adoption of proposed activities. In project areas, all segments of the population participated in project activities, including men, women, youth and elders.
- Land tenure and rights must be well understood. For community plantations, the sustainability of activities depends on the local communities, because the forests and fallow land are allocated to them and they exercise the right of use. While nurseries are usually set up within or adjacent to the village and are thus on community lands, the planting itself, its planning and management cannot take place without first having a thorough understanding of land tenure and the rights and duties that apply to people (original inhabitants and newcomers), as well as gender considerations.
- Gender dynamics are an important factor. Understanding how cultural norms impact the division of gender roles is critical to ensuring the adoption of proposed activities.
- Finally, the presence of training sessions, follow-up activities and focus groups in the field need to be applied and adapted in a flexible manner to assure appropriate guidance. To ensure activities are well received, understanding local governance systems and social norms is fundamental.



Acacia plants being planted for future charcoal production in Yanonge - DRC. (Axel Fassio/CIFOR-ICRAF)

References

Cerutti P, Vancutsem C. 2022. Note sur les changements de couverture et d'utilisation des sols dans le Paysage de Yangambi. FORETS II, NPC, YPS, GML Projects, 6 p.

Fabienne M, Francoise B. 1995. Guide d'aide à la décision en agroforesterie. Volume 2. Paris: GRET.

Péroches A, Dubiez E, Peltier R, Procs P, Diowo S, Yamba-Yamba T, Vermeulen C. 2019. Les plans simples de gestion destinés à la production de bois-énergie en périphérie de Kinshasa : la participation et la restauration à l'épreuve du foncier. *Bois et Forêts des Tropiques* 340:71–90 <https://doi.org/10.19182/bft2019.340.a31698>

Prell C, Hubacek K, Reed, M. 2009. Stakeholder analysis and social network analysis in natural resource management. *Society & Natural Resources* 22(6):501–518. <https://doi.org/10.1080/08941920802199202>

Forest Project. 2018. Diagnosis of the woodfuel sector of the Yangambi Biosphere Reserve. Kisangani, DRC. Forest Project, 61 p.

Schure J, Pinta F, Cerutti PO, Kasereka-Muvatsi L. 2019. Efficiency of charcoal production in Sub-Saharan Africa: Solutions beyond the kiln. *Woods and Forests of the Tropics* 340:57–70. <https://doi.org/10.19182/bft2019.340.a31691>

Schure J, Hubert D, Ducenne H, Kirimi M, Awono A, Mpuruta-Ka-Tito R, Mumbere G, Njenga M. 2021. Carbonization 2.0: How to produce more charcoal with less wood and emissions. Brief #1. Sustainable Woodfuel Brief Series. Governing Multifunctional Landscapes Project. Bogor, Indonesia and Nairobi, Kenya: CIFOR-ICRAF.

World Bank. 2013. Des arbres fertilisants à l'assaut du changement climatique. <https://www.banquemondiale.org/fr/news/feature/2013/03/18/an-evergreen-revolution-cuts-fertilizer-costs-for-africa-s-farms>. Accessed 24 October 2022.

Suggested citation

Mumbere Kiwanza G, Schure J, Cerutti P O, and Kasereka-Muvatsi L. 2023. Agroforestry and sustainable woodfuel: Experiences from the Yangambi landscape in DRC. Brief #8. Sustainable Woodfuel Brief Series. Governing Multifunctional Landscapes Project. Bogor, Indonesia and Nairobi, Kenya: CIFOR-ICRAF.

Acknowledged contributors

Reviewers: Richard Atyi Eba'a, Neville Mapenzi
Project coordination: Jolien Schure
Editing: Erin O'Connell
Graphic design: Laurent Nyssen

Photo credits

Cover: Axel Fassio



This initiative is part of the projects Governing multifunctional landscapes in Sub-Saharan Africa: Managing trade-offs between social and ecological impacts (GML) and Training, Research, Environment in Tshopo (FORETS), both financed by the European Union.

cifor.org/gml

