

Chapter 5.



Sustainable woodfuel management in East and Southern Africa

Jolien Schure,¹ Tuyeni Heita Mwampamba,² Kaala Moombe,³ Arturo Gianvenuti,⁴ Phosiso Sola⁵ and Thierry Lusenge⁶

1 CIFOR-ICRAF, Kisangani

2 The Nature Conservancy, Arusha

3 CIFOR-ICRAF, Lusaka

4 The Food and Agriculture Organization (FAO), Rome

5 CIFOR-ICRAF, Nairobi

6 Central African Forest Initiative (CAFI), Kinshasa

Abstract

This chapter provides a comprehensive compendium of woodfuel (comprising charcoal and fuelwood/firewood) in East and Southern Africa, describing trends, options and practices for sustainable management and incentive mechanisms. It shares examples of 'what works', including practices of improved community-based forest management, woodlots, agroforestry and assisted natural regeneration methods with potential for sustainable wood production for energy. It looks at key components for success such as community involvement, secure land and forest tenure, transfer of capacity and ownership, and engagement of various stakeholders. It also reviews how incentive mechanisms for replication and upscaling can come from climate financing, private sector restoration obligations, and well-integrated national government policies that consider the inextricable links between rural development and household energy portfolios. Throughout the region, a change in thinking is needed to place woodfuel higher on the reforestation, climate change, energy and sustainable development agendas to enhance the potential of sustainable woodfuel practices and incentive mechanisms.

Introduction

Woodfuel (comprising charcoal and fuelwood/firewood) plays a significant role in the African energy mix and the economy but also has implications for both human health and the natural environment. Depending on the sustainability of their production and consumption, fuelwood and charcoal can be a source of renewable energy or a driver of local forest degradation, deforestation and greenhouse gas (GHG) emissions. To highlight these challenges and opportunities, this chapter presents cases of sustainable woodfuel management from the East and Southern Africa (ESAf) region, including incentives that hold promise for success.

Wood is widely used as an energy source for cooking and heating at the household level and for commercial activities, particularly in areas with limited access to electricity and modern cooking solutions. Charcoal is made by heating wood under controlled oxygen (carbonization), while fuelwood or firewood is the result of burning wood directly to provide energy. Whereas firewood is often collected for use in rural areas, charcoal is mostly produced in rural areas, and traded and used by urban citizens. Even in regions where alternative energy sources such as electricity and liquefied petroleum gas are available, charcoal is often a key component of the household energy mix.

Statistics on the production of woodfuel and industrial roundwood indicate the magnitude and scale of forest and wood resources needed to help formulate effective policies for the forestry sector. In 2018, woodfuel accounted for more than 40% of total primary energy supply on the continent (FAO 2022a), with ESAf countriesⁱ among the largest consumers of woodfuel. Based on FAOSTAT data (Figure 5.1), most roundwood production in ESAf is used as woodfuel, representing an average of 94% and 52%, respectively, in East and Southern Africa; the remainder is for industrial roundwood production. Woodfuel production increased

by 9% from 2013 to 2023 in the region, while industrial roundwood production increased by 10% over the same period (FAO 2025). The world continues to advance towards sustainable energy targets; however, the pace of progress is insufficient to achieve Sustainable Development Goal (SDG) 7 on access to affordable, reliable and modern energy services by 2030. If trends continue, about 1 billion people living in sub-Saharan Africa will still be without access to clean cooking solutions in 2030 (IEA et al. 2022). Hence, improved renewable energy solutions are needed, including upgrading of woodfuel production and use.

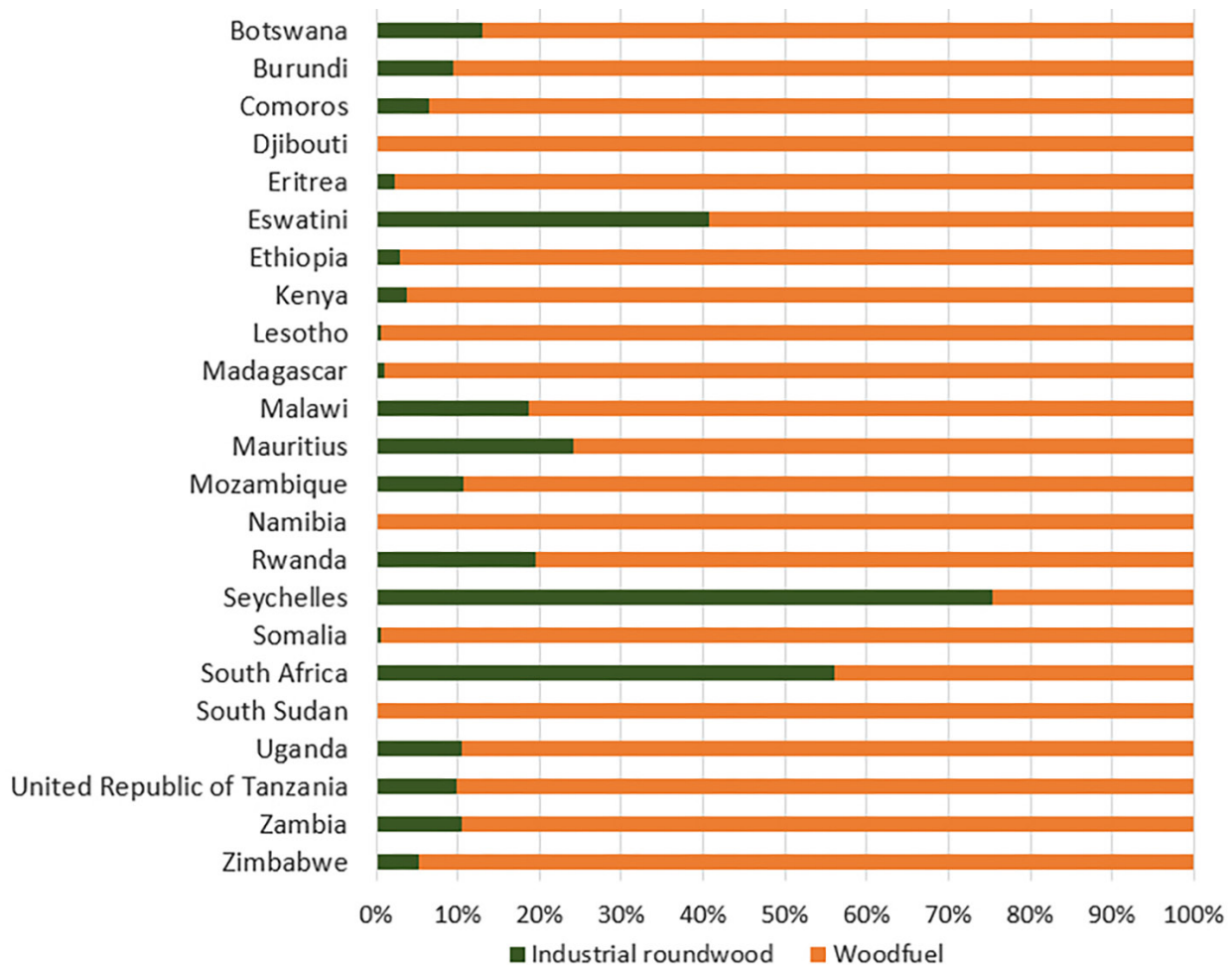


Figure 5.1. Proportions of industrial roundwood and woodfuel, by country, 2023

Source: FAO (2025).

5.1 The multifaceted implications of woodfuel

The use of woodfuel has significant and complex implications for the economy, environment and human health.

Income generation: Woodfuel is an important source of income for rural and urban citizens. Activities include wood chopping, drying, carbonization, packing, transportation and sales, offering much-needed cash income to poor people. Activities that add value are carbonizing wood into charcoal, packaging and transportation; however, profit margins are modest and depend on inputs that are often wrongly perceived as 'free resources' and 'free labour' (Luoga et al. 2000; Schure et al. 2014).

Charcoal trade: Trade patterns follow local demand patterns and available resource basins. Despite their informal status, charcoal supply chains are often well organized and provide an essential service to urban citizens (Agyei et al. 2018). Although trade is usually local and domestic, cross-border trade of charcoal is rampant in the region. Zambia exports to neighbouring countries; Cameroon exports to Nigeria and Chad and imports from the Central African Republic; and Kenya imports charcoal from Uganda (Sola et al. 2021). Much of the cross-border flows tend to be illicit. This is also true for the charcoal trade among the East African nations of South Sudan, Uganda, Kenya and Tanzania (Haysom et al. 2021).

Forest degradation: Combustion in open fires, basic cookstoves and charcoal kilns is usually characterized by low energy conversion efficiency. This results in inefficient use of a limited resource, contributing to forest degradation due to unsustainable harvesting (Schure et al. 2021).

Health impacts: The exposure to indoor air pollution from the inefficient burning of wood with basic cooking systems poses serious health and safety risks, as well as premature death. This is especially the case for women and children, who spend the most time in poorly ventilated kitchens (Agbo et al. 2021).

Resource depletion: High demand for woodfuel, in combination with unsustainable sourcing, can cause forest degradation and deforestation. At national levels, net biomass is often sufficient to meet demand (Openshaw 2011). However, pressures are reported at subnational levels, especially around urban centres or in areas with sudden surges in demand, such as refugee-hosting areas. In rural areas, this forces women and children to spend more time travelling over greater distances to find fuelwood. In urban areas, consumers are confronted with rising market prices that can put households into energy poverty or limit cooking time. The environmental costs of woodfuel production are often not internalized in the product price. This, in turn, contributes to resource depletion of peri-urban tree sources, especially in the case of charcoal and in the absence of management of the sector (Chidumayo and Gumbo 2013).

Charcoal consumption vs. deforestation: The assumed direct link between charcoal consumption and deforestation is often false (Openshaw 2011). Charcoal production is more likely to degrade forests, with the impact on deforestation in sub-Saharan Africa estimated at $14.07 \pm 5.27\%$ of total deforestation (Chidumayo and Gumbo 2013). The reality of woodfuel impacts on forests is quite diverse, as woodfuel production is location-specific. East Africa has the highest concentration of 'hot spots' (areas where over half of the woodfuel harvested is considered non-renewable), whereas for most of the continent this figure remains below 20% (Bailis et al. 2015).

Renewable fuel scenarios: Woodfuel does offer a sustainable scenario when it replaces fossil fuels and is managed as a 'renewable fuel'. A fuel is considered renewable when the tree stock is derived from sustainable production practices. These can include agroforestry (where trees

are integrated on farms); rotation growth and forest plantations; farmer-managed/assisted natural regeneration (FMNR/ANR); and use of technologies that optimize energy efficiency at production and consumption levels coupled with recovery of by-products for energy (Bailis 2009; Belward et al. 2011; Njenga et al. 2023).

5.2 Sustainable management of woodfuel: Cases from across the region

Experiences from across the region show various woodfuel management practices that hold promise for success. The following cases show how agroforestry; management and use of an invasive shrub; community-based forest management; and assisted natural regeneration can contribute to sustainable woodfuel supply while benefitting communities.

5.2.1 Democratic Republic of the Congo: Towards a sustainable woodfuel value chain in the Yangambi landscape

In the Democratic Republic of the Congo (DRC), shifting cultivation agriculture and the production of woodfuel are the main income-generating activities for peri-urban populations. However, these are also the main causes of deforestation and forest degradation. In the Yangambi landscape, which covers 220,000 hectares (ha) of tropical forest landscape in DRC's Tshopo Province, supplying charcoal to the big urban centre of Kisangani has led to forest degradation, with no sustainable practices in sourcing wood and inefficient carbonization.

The Governing Multifunctional Landscapes in Sub-Saharan Africa project adopted a participatory approach to address the overexploitation of woodfuel resources and ecosystem disturbance in the Yangambi landscape. The project, funded by the European Union and implemented by the Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF), worked 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 six to seven years, the tree plantations will contribute to two main objectives. First, they will help create a reliable source of woodfuel that can be harvested annually (starting in 2026) to meet increasing urban demand. Second, they will help reduce pressure on surrounding intact forests.

The participatory agroforestry model introduced by the project empowered communities at all levels of implementation. As agroforestry is new to the region, it required intensive exchanges and coaching during the first phase. This was followed by transfer of skills to community members and consultations with stakeholders. Finally, the project made efforts to improve governance of natural resources in the landscape to ensure the sustainability of achievements.

Promoting and demonstrating the benefits of establishing agroforestry systems as a source of woodfuel is essential. In the Yangambi landscape, and 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. They are engaged in learning silvicultural techniques, including the revival of local species and crop rotation in agroforestry systems.



Community nursery in the Yangambi landscape

Photo by Axel Fassio/CIFOR-ICRAF.

The success of these efforts is evidenced by the 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). The experience of first-of-a-kind activity in the region generated several lessons:

- Local land tenure and rights and local governance systems must be well understood, as should social norms and the potential impact of gender dynamics and cultural norms on uptake.
- Ensuring activities are participatory and inclusive can increase adoption of proposed activities. In project areas, all segments of the population participated in project activities, including men, women, youth and elders.
- Training, follow-up activities and focus groups in the field need to be applied and adapted in a flexible manner to assure appropriate guidance; understanding local governance systems and social norms is fundamental (excerpt from Mumbere et al. 2023).

5.2.2 Kenya: Options for sustainable charcoal for Baringo charcoal value chains

In Kenya, charcoal has been one of the most important cooking and heating energy sources for urban and rural households, as well as an essential source of income for many people for decades (MoE and CCAK 2019). Over 80% of the wood used for charcoal production is sourced from private farms in the drylands (Ndegwa et al. 2021). However, about 40% of wood used for charcoal is sourced unsustainably, and most producers use traditional, low-efficient kilns (Drigo et al. 2015).

Making charcoal value chains sustainable requires interventions that address the inefficiencies at all the stages – from production to consumption. For instance, sourcing wood from invasive tree species such as the *Prosopis juliflora*, commonly known as mathenge, has implications for both wood and livestock. On the one hand, it provides wood for charcoal production. On the other, it opens land for cultivation and managing thickets to allow for the growth of grass for livestock production (Koech et al. 2020, 2021). Kenya introduced *Prosopis juliflora* in the late 1970s from Latin America to curb desertification and the resulting sandstorms, and to provide firewood. The species has spread aggressively, invading 500–1,300 ha annually, threatening farm and grazing lands (Mbaabu et al. 2019). Yet it provides a utilizable biomass of 37 tonnes per hectare that can produce a high-quality charcoal (Choge and Kyuma 2011). A survey of charcoal producers in Baringo in 2018 indicated that more than 80% used *Prosopis juliflora*. However, a considerable proportion (67%) preferred the indigenous tree species *Acacia tortilis* (Ndegwa et al. 2021).

Wood carbonization remains wasteful, adding to the inefficiencies that make the charcoal value chain unsustainable. In Baringo County, most charcoal makers use traditional earth mound charcoal kilns that have low wood-to-charcoal conversion rates. According to an action research with charcoal producers in the county, using *Prosopis* wood improved traditional earth mound kilns, increased charcoal yield by 50% per mass of wood, reduced emissions by over 40% and the small stems and branches of 5 centimetres in diameter produced good quality charcoal with 28 kilojoules per gram (Njenga et al. 2023).ⁱⁱ The simple improvements included improving air circulation by fixing breathers at a cost of USD 50, drying wood before combusting and stacking wood tightly in the kiln (Schure et al. 2021). Thus, improved carbonization practices and technologies could reduce unnecessary cutting of trees and associated GHG emissions. Ultimately, then, use of improved charcoal stoves reduces charcoal consumption and thus emissions. Cooking with the Jikokoa – an industrial charcoal stove – reduced charcoal consumption by 6% to 26% compared with Kenya Ceramic Jiko, a small and medium-sized artisanal charcoal-burning stove (Kirimi et al. 2023).



Measuring emissions from an improved earth mound kiln in Baringo, Kenya

Photo by Mary Njenga/CIFOR-ICRAF.

5.2.3 Tanzania: Community-based management of natural forests for charcoal, firewood and timber

Devolving rights to rural communities to manage forest for conservation and extractive purposes can lead to better-preserved natural forests that also provide subsistence and commercial sources of firewood, charcoal and timber. In Tanzania, where different forms of forest ownership are possible under the Forest Act and the National Forest Policy, several non-governmental organizations (NGOs) have helped communities secure forest tenure and subsequently develop forest management plans for extracting timber and wood for charcoal and firewood. In the case of charcoal production, one of the most successful initiatives in the country began as a Swiss government-funded project (Transitioning Tanzania's Charcoal Sector, or TTCS). It was implemented by the Tanzanian Forest Conservation Group (TFCG) and the Community Forest Conservation Network of Tanzania (known by its Swahili acronym MJUMITA). The National Forest Act (2002) grants communities the rights to form village land forest reserves and appoints village councils as the authority over such lands. Building on these provisions, TFCG and MJUMITA pioneered a model for sustainable charcoal production in village forest reserves.

The TFCG–MJUMITA model secures full devolution of access and use of forests to communities and the rights of communities to generate revenue from their forests through sustainable extraction (Doggart et al. 2019). The model must meet four conditions:

- Villages must gain full security of tenure over forests. This requires assisting communities to develop and register village land-use plans that designate a proportion of the total land as village forest reserves.
- Forest management plans that guarantee sustainable biomass extraction from selective logging of natural forests must be developed, and charcoal producers must improve their practices. Additionally, paid community patrol units must regularly monitor the reserve to ensure correct implementation of management plans, adherence to bylaws and respect for the conditions for natural regeneration (i.e., agriculture encroachment into reserves is stopped, and grazing and fires are controlled).
- Village natural resources committees must be trained and empowered to issue biomass extraction permits, collect revenue from producers and buyers, and manage funds generated from forest resources. These committees must also be linked directly with charcoal buyers, enabling them to plan biomass extraction according to expressed demand and the limitations imposed by their management plans.
- Capacity building in good governance must be extended to village councils so they can develop inclusive social development plans and responsibly manage funds to realize their communities' visions and aspirations.

The TFCG–MJUMITA model has been replicated in 30 villages in Morogoro, Tanzania and 'copied' by other villages in the country. By permitting regulated selective logging, the model builds on key lessons learned in Tanzania. Earlier initiatives in community forestry in Tanzania had been hesitant to consider extractive use of forests. As such, they could not generate direct economic benefits to communities entrusted with conserving them.

5.2.4 Assisted natural regeneration: Experiences from Uganda and Zambia

ANR combines active planting of seedlings with activities that nurture the conditions for tree stumps to re-sprout naturally and pre-existing seedlings to grow free of the common threats

to seedling survival: grazing, fires and farming. ANR is particularly successful in degraded landscapes that have recently been deforested and where the roots under stumps are still alive and functional (Chazdon et al. 2022). As the stumps regenerate, pruning promotes growth and reduces competition among sprouts. This generates woody biomass that can be used as woodfuel without the need to fell trees.

In northern Uganda, where large tracts of forest are being felled to extract timber, produce charcoal and make space for large-scale agriculture (Branch and Martiniello 2018), a private company – Kijani Forestry Ltd. – works with farmers to restore forests and produce charcoal sustainably. The Kijani Forestry model follows the three main principles of FMNR originally developed for restoring drylands:

- Involve the landowner or user to systematically prune and manage existing indigenous trees and shrubs.
- Increase tree and shrub coverage over the managed landscape.
- Improve ecological function of the landscape and its ability to improve human well-being (Rinaudo 2007; Francis et al. 2015).

Kijani Forestry trains farmers to manage stumps for faster regeneration. Once the right amount of biomass has been achieved, farmers are trained on sustainable harvesting and use of the Casamance kilns to produce charcoal from cuttings. To catalyse regeneration and survival of planted seedlings (active restoration is also practised), farmers are encouraged to include annual crops into their restoration areas. Intercropping with annual crops such as soy and sunflower generates short-term income while waiting for trees to grow. At the same time, it ensures that farmers visit the regenerating sites often and are vigilant about keeping livestock and fires at bay.

In Zambia, CIFOR-ICRAF piloted participatory forestry action plans and ANR activities in degraded woodfuel production sites on both state and community lands in Mushindamo, Mufulira and Nchelenge districts. The activities were conducted under the Governing Multifunctional Landscapes in Sub-Saharan Africa project. Both the government (the Zambia Forestry Department, local government or district councils) and local participating communities have been actively engaged in developing and implementing the action plans. These stakeholders managed the ANR demonstration activities by protecting trees against fires through creation, maintaining fire breaks and spot weeding, and raising indigenous tree seedlings for enrichment planting.

Forest landscape restoration using the ANR option within the participatory action planning framework can motivate a change in mindset towards forest landscape governance and management among stakeholders, including at the local community level. In Mufulira, for example, Ngala community members established and managed their ANR sites alongside the project demonstration sites, replicating project activities in their own sites. They also applied their local and/or indigenous plant propagation technology and knowledge on regeneration mechanisms. To that end, they planted stem or branch cuttings of the local species to support restoration of the site.

A decentralized model offers options for sustaining these activities. Decentralization offers a chance to mainstream participatory forest action planning and management into subnational integrated development plans, especially in districts (Moombe 2022; Moombe et al. 2022; Mwaanga et al. 2023). The legal option for community forest management groups (CFMGs) enables these groups to apply to the Forest Development Fund (under the Forests Act of No. 4 of 2015) to support their activities. Another opportunity could come from the private sector, such as mining operations that are obliged to restore lands after exploitation (GRZ 2015, 2018).



Assisted natural regeneration demonstration plot

Photo by Gabriel Mulenga/CIFOR-ICRAF.

5.3 Woodfuel governance: Incentives for sustainable practices

An enabling environment is needed for woodfuel management practices to be sustained, replicated and upscaled. The region provides some valuable examples of incentive mechanisms to 'mainstream' sustainable woodfuel.

5.3.1 Malawi: A stick-and-carrot approach for shifting the charcoal sector onto a sustainability pathway

A simple (yet difficult) mechanism for making woodfuel systems more sustainable is to transform some illegal activities related to production, transportation and trade into the legal domain through formalization of the sector (FAO 2017b). Such a transition requires a careful balance between improving laws, strengthening law enforcement and providing accessible procedures for actors to formalize their activities (Branch et al. 2022). In recent years, Malawi has experienced a significant decrease in the contribution of charcoal to deforestation through such a 'stick-and-carrot' approach at the scale of the forestry and juridical sectors.

In 2020, an amendment to Malawi's Forestry Act (1993) clarified charcoal as a "forest product", giving charcoal similar status to timber. Doing so dissolved a legal deadlock that had previously made it difficult to penalize, fine or imprison charcoal producers, transporters and traders. A UKAid- and USAID-funded project has supported the Government of Malawi to strengthen the legal and regulatory framework of the forestry sector and to investigate and prosecute forest crimes more effectively (Tetra Tech and Winrock International 2021). Additionally, it has supported development of the National Charcoal Strategy (2017–2027), which provides clear and accessible pathways in pursuit of a diversity of options for developing a regulated household

energy sector. The Charcoal Strategy discusses charcoal as a viable and necessary source of cooking energy at a time when alternative sources of cleaner energy are unreliable and unaffordable to most Malawians (Republic of Malawi 2017).

Malawi's National Charcoal Strategy is a progressive and pragmatic approach to develop a sustainable and regulated household energy sector. At the same time, it recognizes the strong interdependencies between biomass energy, rural livelihoods and the national economy (Mwampamba et al. 2022). It identifies seven strategic 'pillars' for promoting sustainable charcoal production and use of alternative cooking fuels (Republic of Malawi 2017):

- Pillar 1: Promote alternative household cooking fuels
- Pillar 2: Promote adoption of fuel-efficient cookstove technologies
- Pillar 3: Promote sustainable wood production
- Pillar 4: Strengthen law enforcement
- Pillar 5: Regulate sustainable charcoal production
- Pillar 6: Enhance livelihoods
- Pillar 7: Adopt information, awareness and behaviour-change communications

Malawi's approach for reigning in its charcoal sector remains in its early stages of implementation. The ease and accessibility for acquiring charcoal production licences for rural producers need to be monitored and assessed; it is common for such regulations to favour medium- and large-scale producers with medium to high literacy and the capital to cover upfront costs (Branch et al. 2022).

5.3.2 Tanzania: Community management of natural forests for charcoal production

Sustainable practices are reinforced when communities can link their overall well-being to the quantity and quality of their forests (Loveridge et al. 2021). This is particularly obvious when communities are empowered to make decisions on how funds generated from their forests are used. As such, full devolution of forest management to villages comprises (i) building capacity in forest management and good governance; (ii) entrusting communities with the rights and responsibility to issue licences and permits for access to forests and extraction of forest-derived products; and (iii) 'allowing' communities to retain the funds generated from their forests to finance their development programmes.

Focusing on these three mechanisms for successful community forest management has enabled the Transitioning Tanzania's Charcoal Sector project to reverse deforestation and degradation trends in 30 villages in Morogoro, Tanzania (Doggart et. 2019). The project, funded by the Swiss Agency for Development and Cooperation, has built the capacity of village councils in good governance, financial management and development planning. This approach was as important as building capacity in forestry, charcoal production and forest management. However, decentralizing revenue collection to village governments can retract important sources of funding for district forestry and natural resources departments. In so doing, it can generate a competitive rather than a collaborative environment between villages and districts.

Governments can retract components of full devolution to mend revenue losses attributable to the successful implementation of community-based forest management (Meshack et al. 2022). In May 2019, for example, Tanzania issued Government Notice 417 (GN417) – the Forest (Sustainable Utilization of Logs, Timber, Withies, Poles or Charcoal) Regulations. This reassigns responsibilities

for the preparation of harvesting plans and issuance of harvesting permits from village councils to the director of forestry. In so doing, it contracts the Village Land Act (1999) and Forest Act (2002), which grant decision-making power over village land and forest reserves to village councils. More importantly, however, GN417 requires village councils to match their licensing fees to government royalties, removing their leverage to provide lower fees and thus attract traders. Consequently, sustainably produced charcoal has become too expensive, pushing traders towards riskier but cheaper alternatives (Meshack et al. 2022).

Lobbying has been a key mechanism of the TTCS project to bring awareness of the value of charcoal in Tanzania to both the public and decision makers, as well as the need to support communities to sustainably produce charcoal in their forests (Doggart et al. 2019). To be successful, NGOs and civil society must unite around common issues, synthesize the key challenges and strategize on the best way to reach the public and decision makers. TTCS, for example, has fully incorporated an advocacy department into the organization. Through the MJUMITA network, charcoal-producing communities can build their case and use their voices to raise awareness of their struggles and successes – and to demand justice where it is due.

The public attention gained by communities from lobbying and advocacy has helped them better articulate their rights. For example, they are better equipped to explain to journalists what they are doing and why. They also take more pride in their activities; are better able to reinforce the value of their stance; and they are invited more frequently to speak about their activities in different forums. Although not measured in any systematic way, the positive public attention on communities' work has undoubtedly incentivized communities to continue with their sustainable practices.

5.3.3 Carbon finance for sustainable woodfuel value chains: The case of Ecomakala in DRC

Household energy demand is substantial in North Kivu Province, DRC, where charcoal and fuelwood account for approximately 80% of total energy consumption. Forests are the primary source of charcoal, often exploited unsustainably and even illegally. For instance, significant deforestation has occurred in and around the Virunga National Park due to charcoal production. In 2019, 56% of the charcoal sold in Goma originated from Virunga National Park, amounting to 135,000 metric tons – a figure projected to rise to around 188,000 metric tons by 2028 (ONFi 2019).

For over two decades, the World Wildlife Fund (WWF) has supported various initiatives in North Kivu to protect the Virunga National Park and improve the livelihoods of surrounding communities. Through the Ecomakala project, funded by multiple donors, WWF implements three key activities:

- reforestation with fast-growing species
- sustainable charcoal production
- production and dissemination of improved cookstoves (ICS) for households

The reforestation initiative involves planting fast-growing tree species on deforested land. By the end of 2024, approximately 15,000 ha had been reforested, with the involvement of over 17,000 farmers.

The sustainable charcoal component supports the production of renewable charcoal using biomass from dedicated plantations located outside the national park, across the territories of Masisi, Rutshuru, Nyiragongo, Lubero and Beni. To date, over 36,500 metric tons of sustainably produced charcoal have been sold.

The ICS initiative has introduced improved cookstoves to reduce household fuel consumption. Since 2009, more than 140,000 of these cookstoves have been produced and distributed in North and South Kivu provinces.

To ensure long-term financial sustainability, the Ecomakala project is built on three pillars:

Carbon finance

Under the Kyoto Protocol, carbon trading and the Clean Development Mechanism are tools to reduce GHG emissions (Gorain et al. 2021). On the voluntary carbon market – potentially fully supplied by nature-based solutions by 2030 – annual demand is around 95 MtCO_{2e}, about 0.2% of global GHG emissions (MSCI 2021).

Since February 2022, the North Kivu Carbon Management Unit has overseen the ownership and management of Ecomakala. The reforestation component is undergoing certification as a Gold Standard Land Use & Forestry project (Gold Standard Impact Registry n.d1). Meanwhile, the energy component (charcoal production and ICS) is being certified as a Gold Standard Energy VER project (Gold Standard Impact Registry n.d2). Both components have completed performance verification in accordance with Gold Standard and national regulations. Over 1,500 ha of plantations have been established through carbon finance.

Farmer and women-led cookstove networks

The project supports five farmer cooperatives, one cookstove production company (Goma Stove), and two women-led platforms (JIKO Bora and COLOFA). With support from carbon credits, over 12,500 efficient cookstoves and 7,000 metric tons of sustainable charcoal have been produced and sold.

Revolving fund

A revolving fund provides financial support to local associations for establishing nurseries and expanding plantations. Farmers agree to reinvest 20% of profits after harvesting back into these associations, which in turn use the funds to grow more seedlings and support further planting. As of 2021, over 1,300 ha had been established through this mechanism.

This innovative financial model supports the sustainable management of forest plantations and wood energy supply in North Kivu. Further studies and projects are needed to assess its long-term impact and scalability.

5.3.4 The coupe system in Zambia

From the 1960s to the late 1990s, the Forestry Department in Zambia implemented sustainable charcoal production through the coupe system, which was later abandoned (Swennenhuis 2012). The coupe system identified charcoal production areas in which cycles of charcoal production followed the regeneration capacity of harvested areas. This approach sought to sustain both production and resource availability (Gumbo et al. 2013). Charcoal producers then had to follow the coupe system, which entailed using the forest for a given number of years in a sustainable manner under the supervision of the Forestry Department (Chama 2018).

Within forest reserves, clearing was confined to 'coupes'. This was any site or area allowing the cutting, felling or taking of forest produce, irrespective of whether the Forestry Department had demarcated boundaries of the area on the ground prior to allocation to harvesters of wood for charcoal manufacturing.

In coupes, clear-cutting of trees was often practised despite legal protection for some tree species (Serenje et al. 1994; Chama 2018). Usually, wider cleared coupes alternated with narrower 'shelterbelt' strips. The shelterbelt strips were intended to be seed sources for regeneration in cleared coupes through natural seed dispersal. Once adequate regrowth had occurred in the coupes, usually after 10 years, shelterbelts could also be cleared for charcoal production (Serenje et al. 1994).

This system worked well when the Forestry Department had adequate resources to govern and manage the system, especially at forest management unit level, and the government did not interfere politically with the governance of forests or reserves. However, in 1996, the department was restructured and abolished forest guards (Chama 2018). Changes in institutional structure and lack of policy support led to failure of research trials on controlled charcoal production (Gumbo et al. 2013).

The coupes were not legally protected areas, and hence the coupe system areas became de facto open-access areas. It was believed that traditional systems were well placed and strong enough to uphold the coupe system and manage forest resources (Sishekanu 2020). However, beginning in 2018, community forest management groups were legally required to formulate and implement a community forest management plan. It was therefore possible to adopt the coupe system under the governance of the local system. Plans had to be in accordance with sustainable forest management principles, include a set of community rules and measures for forest management, and be consistent with the traditional forest user rights of the local community (GRZ 2015, 2021).

Undoubtedly, the coupe/shelterbelt system encountered challenges driven by demographic and socioeconomic factors of landscape flux. In miombo landscapes, clearcutting in strips or coupes with shelterbelts would ensure sustainable tree regeneration (Chomba 2018). Since the collapse of the coupe system, there has been no sound system to manage sustainable charcoal production, despite some pilot efforts by different players in the forestry subsector. However, charcoal production can be sustainable if managed through the (re-)introduction of management systems, such as the coupe system, which are based on principles of joint government forest management and community forest management. Such principles are in line with the forestry legislation that supports such initiatives, such as proposed under the draft "The Forests (Charcoal Production and Trade) Regulations of 2021."

5.4 Sustainable woodfuel on the policy agenda: Uniting reforestation, climate change, energy and sustainable development

National woodfuel strategies are important for coordinating actions across government agencies and ensuring that interventions produce positive economic, social and environmental impacts. In some areas, demand for woodfuels exceeds the sustainable supply capacity of forests and trees, leading to forest degradation and loss. The gap between demand and sustainable supply can be bridged by the restoration of degraded forests, the establishment of fast-growing tree plantations, the use of residues from wood harvesting and processing, and the recovery of post-consumer wood within a more circular economic framework. Plantations can reduce pressure on natural forests and woodlands near major charcoal demand centres, such as urban areas in sub-Saharan Africa. Increasing biomass production to meet bioenergy production goals will require comprehensive policies, strategies, regulations, management measures and financial resources. This will ensure that such additional biomass production is sustainable and does not cause economic, social or environmental harm, including the loss of soil quality and biodiversity (FAO 2022a).

IEA et al. (2022) set out a roadmap for the global energy sector in which modern bioenergy, especially woodfuels, plays a key role in achieving net-zero emissions. Modern bioenergy use would increase by around 60% between 2020–2050 alongside a shift from the traditional use of biomass.

Achieving SDG 7 will require a transition from traditional uses of biomass for energy to modern systems of bioenergy production and use. Modern bioenergy can play a key role in supporting a safer, more resource-efficient and sustainable energy access, notably for cooking, heating and power generation. In so doing, it can contribute positively towards several SDGs, in particular SDGs 1–5, 13 and 15. African governments must prioritize significant investments to promote equitable and affordable access to energy in order to sustain economic transformation.

The supply of woodfuels from forests and trees must be adequate to secure basic energy services to ensure access to affordable and reliable energy services. Progress is needed towards modernizing woodfuel and enhancing access to a diverse range of renewable energy sources. Measures to enhance the sustainable supply capacity of woodfuel include the restoration of degraded forests; integration of trees into farms; plantation of rapid growth trees for energy use; natural and assisted regeneration; and effective recovery of energy of wood residues from wood harvesting and processing industries. By 2050, forest residues in Africa could generate an additional wood energy in the form of wood feedstock, valued at USD 621 million. The processing of this feedstock could also generate some 90,000 jobs (FAO 2022b). These innovations will enhance woodfuel demand–supply dynamics, and minimize adverse environmental impacts associated with traditional woodfuel use.

Improving woodfuel use by upgrading fuel properties, increasing woodfuel transformation efficiencies, enhancing stove performances and developing alternative energy sources can help reduce the demand for woodfuel, which is currently widely used for cooking and heating in households and small-scale agrifood industrial activities.

5.5 Conclusion: Ways forward for sustainable woodfuel in East and Southern Africa

Woodfuel provides a much-needed energy source for household cooking and heating, as well as for other commercial activities in sub-Saharan African countries. Over the past decade, woodfuel production increased by 9% throughout ESAf. This need for woody biomass resources creates dynamic markets and income resources for the people involved. If the biomass is unsustainably sourced, it exerts high pressure on forest resources, especially in areas of high demand and in absence of sustainable tree and forest management systems.

This chapter highlighted both success stories and obstacles to promoting sustainable woodfuel production. Experiences from across the region showcased successful application of improved community-based forest management, woodlots, agroforestry or ANR methods that hold the potential for sustainable woodfuel production. Some key components for success are participatory community involvement, secure land and forest tenure, transfer of capacity and ownership, and broader stakeholder engagement. At the same time, the chapter identified obstacles to widescale adoption of sustainable practices. These comprised the continuation of unsustainable cheaper extraction methods, as well as the lack of implementation of national rules and monitoring of the informal charcoal production and trade.

Mechanisms that can help upscale and replicate practices and 'mainstream' more sustainable woodfuel are urgently needed. The region provides some valuable examples of incentive mechanisms. Climate finance can provide much-needed additional income and investments to

reward carbon sequestration of reforestation and agroforestry initiatives or avoided emissions from more energy-efficient carbonization and improved cookstoves. Private sector contributions to restoration initiatives can also be directed to community initiatives that provide sustainable woodfuel options. At government level, policies related to woodfuel are often fragmented and do not promote sustainable practices.

- Malawi: The National Charcoal Strategy (2017–2027) shows a promising integrated approach to sustainable charcoal production and use and promotion of alternative cooking fuels.
- Tanzania: Community management shows that devolution of management practices is possible and provides incentives in the form of funds to finance community development programmes. Communities through networks and facilitating organizations were better able to voice their activities and concerns to the wider public and decision makers. This community mobilization is also a mechanism to raise sustainable community management practices for charcoal making and benefit sharing on political agendas.
- Zambia: The coupe system, once successfully practised as a rotation charcoal production system, collapsed when the monitoring system of forest guards disappeared in 1996. This system can be revised under current provisions for community forest management plans as proposed under the draft Forests (Charcoal Production and Trade) Regulations of 2021.

As seen through the cases described in this chapter, a shift in thinking that places woodfuel more at the centre of reforestation, climate change, energy and sustainable development agendas can enhance the potential of sustainable woodfuel practices. This should be in constructive interaction with targets for access to alternative affordable energy sources, rural development and development of forest sectors. A systemic shift is needed to reposition the role of government forestry departments relative to forest owners. In this way, they can serve as service providers (that facilitate forest owners to achieve national forest sector objectives) rather than natural resource police and forest revenue collectors. The importance of securing forest tenure for communities and the private sector to manage forests sustainably cannot be overemphasized.

End notes

ⁱ Regional and country groupings – East Africa: Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, South Sudan, Uganda, United Republic of Tanzania, Zambia and Zimbabwe. Southern Africa: Botswana, Eswatini, Lesotho, Namibia and South Africa.