

Zambia Buy-in

THE ROLE OF POLICY AND INSTITUTIONS IN GREENING THE CHARCOAL VALUE CHAIN IN ZAMBIA

By

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EXECUTIVE SUMMARY

In Zambia, agricultural land expansion is responsible for 90 percent of forest cover loss (Mabeta, Mweemba, and Mwitwa 2018), followed by settlement expansion and infrastructure development; its annual deforestation estimated between 167,000 and 300,000 hectares is among the highest worldwide. Charcoal is becoming an increasingly important driver of deforestation and forest degradation due to its increasing role as a cooking and space-heating energy source, predominantly among urban households. The erratic and limited supply of electricity in recent times, coupled with increased electricity tariffs, limited access, acceptability, and prohibitive costs of alternative energy sources has increased urban demand for charcoal—a situation likely to continue in the foreseeable future. The heightened demand for charcoal, which will continue to increase, has far-reaching environmental consequences.

This study sought to find ways in which the charcoal value chain (CVC) can be made more sustainable in Zambia, with a view of reducing charcoal-induced deforestation and global warming. It meant to answer the questions of how charcoal production and trade is governed, lessons learned from constraints experienced in making charcoal production sustainable, and the opportunities for “greening” the charcoal value chain¹. This was done through extensive review of relevant literature, both grey and published, the 2015 Living Conditions Monitoring Survey (LCMS) data, and key informant interviews (KII).

Zambia has a comprehensive policy framework on sustainable management of forestry resources, which recognizes that increased charcoal use is driven by the desire to meet household energy needs and is a livelihood option for many of the poor. The main challenges in sustainably managing resources and greening the CVC include the unorganised nature of production making it difficult to organise and monitor production, limited financing, and weak enforcement and compliance with regulations. There are also cultural myths associated with the use of charcoal to cook food, with some having a clear preference for using it to cook traditional food because it gives the food good taste and/or texture (Tembo, Mulenga, and Sitko 2015; Chidumayo 2002). There are many opportunities to implement sustainable charcoal production for the short- and medium term including financing sustainable charcoal production interventions to facilitate: 1) forming charcoal associations that can be the eyes on the ground for the Forestry Department; 2) sensitization campaigns on sustainably produced charcoal and its importance; 3) providing support to producers by setting up woodlots and nurseries for fast growing species with irrigation support for biomass; 4) support for the development of improved kilns; 5) forestry extension to raise awareness on sustainable production practices and the rules and regulations on licensing; 6) promotion of efficient cookstoves for the general public; and 7) investigating the seepage of charcoal into the region—an area that is still overlooked as a driver of production.

In the long term, there is a need to provide alternative livelihoods appropriate for the agro-ecological zones to help producers transition from charcoal production, because poverty and lack of employment are some of the main drivers for charcoal production.

¹ Greening the CVC refers to one that: has multiple initiatives to reduce GHG emissions along the entire value chain; increases financial viability; and legal access to land and biomass resources for charcoal production along the chain (FAO 2017)

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ACRONYMS

CVC	Charcoal Value Chain
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse Gases
Ha	Hectares
KII	Key Informant Interview
LCMS	Living Conditions Monitoring Survey
ZMW	Zambian Kwacha

1. BACKGROUND

In Zambia, the main drivers of deforestation are agricultural land expansion, infrastructure development, wood extraction, and fires, with charcoal production identified as one of the main drivers of deforestation and forest degradation (Day et al. 2014; Vinya et al. 2011; Mabetwa, Mweemba, and Mwitwa 2018; Seano et al. 2016).² Deforestation contributes to climate change and other environmental degradation outcomes such as soil erosion, river siltation, and reduced ecosystem functions of forests such as water filtration, and in Zambia, it is responsible for 75 percent of the GHG emissions (GRZ 2017). In terms of carbon dioxide (CO₂) emissions, FAO (2017a) estimates that production and combustion of charcoal and other woodfuels contributes between 1 to 2.4 Gigatonnes (Gt) CO₂ emissions annually, representing 2 to 7 percent of total anthropogenic (human-induced) emissions. Thus, reducing charcoal-induced deforestation could aid climate change mitigation and other negative environmental outcomes.

Annual deforestation estimated between 167,000 and 300,000 hectares (Ha) in Zambia is among the highest worldwide (Kalinda et al. 2013; FAO 2015). Charcoal is becoming an increasingly important driver of deforestation and forest degradation due to its increasing role as a cooking and space-heating energy source, predominantly among urban households (Mulenga, Tembo, and Richardson 2018). Erratic and limited supply of electricity in recent times, coupled with increased electricity tariffs, taste preferences for traditional foods cooked using charcoal, and limited access, acceptability, and prohibitive costs of alternative energy sources has increased urban demand for charcoal, a situation likely to continue in the foreseeable future (Tembo, Mulenga, and Sitko 2015). Charcoal constitutes about 76 to 90 percent of household energy expenditure in southern African countries (Syampungani 2008; Hibajene and Kalumiana 2003; Brigham, Chihongo, and Chidumayo 1996). The heightened demand for charcoal has and will continue to worsen charcoal-driven deforestation in most southern African countries, including Zambia (Dlamini et al. 2016), with far-reaching environmental consequences.

With over 80 percent of the urban population in Sub-Saharan African depending on charcoal as a source of cooking fuel (Tembo, Mulenga, and Sitko 2015; Zulu and Richardson 2013), charcoal remains important in meeting household energy needs. In addition to helping meet these needs, charcoal is also a source of income mainly for rural and urban households participating in the trade. Given the important role charcoal plays both as a source of energy and livelihoods, production and use are more likely to increase over time, further exacerbating the environmental and health hazards stemming from charcoal. Thus, it is important that the CVC is structured in a way that helps mitigate the negative effects resulting from its production, transportation, distribution and use, and actively promotes use of alternatives. Therefore, it is important to green the CVC.

A CVC is green if it is efficient and promotes sustainable sourcing, production, transportation, distribution, and use of charcoal (FAO 2017b). Green CVCs ultimately improve the well-being of people; promote social equity; and reduce environmental risks. Greening entails transforming entire CVCs from production, carbonisation (charcoal making techniques), and marketing, to charcoal utilization (Ackermann et al. 2014).

Several national policies provide for sustainable forestry management in Zambia, yet implementation of coherent policy remains a challenge. The major problem facing efforts to curb deforestation include: the lack of capacity of mandated institutions to regulate forest use and promote reforestation, high demand for charcoal from urban areas, and weak participation in community-

² However, some studies (e.g., Chidumayo and Gumbo 2013) contend that charcoal only causes localized deforestation and forest degradation.

based forest management. If left unaddressed, further global warming could result, undermining agricultural production and food security. As charcoal is one of the key drivers of forest cover loss in Zambia, addressing deforestation will require policy options that identify ways of greening or making the CVCs more sustainable.

The exclusion of greening the CVC in national policies further delays opportunities. Such a value chain must be supported by available policies and legal frameworks. In Zambia, the current National Forest Policy provides for promotion of sustainable forestry management practices, while the Forest Act No. 4 of 2015 provides for regulation of the charcoal industry. However, enforcing the legal framework has been a challenge due to limited allocation and disbursement of funds, and capacities of the Forestry Department that is grappling with levels of understaffing, lacking appropriate modes of transport, and limited research facilities (Mwitwa, Mwila, and Mweemba 2018).

This trend is similar at a regional level as most countries have been unable to raise adequate domestic funds for forestry management because of the low priority forestry has in national policy—a situation borne from the inability of national accounting systems to fully document the contribution of forestry resources to the national economy because the activities are largely informal—hence undervaluing the sector and its priority (Gondo 2012). To some extent, the forest policy alleviates this challenge by providing for community participation in forest resources management through the promotion of Community Forest Management agreements that are well structured for mutual cost and benefit sharing opportunities. However, adoption of such initiatives by communities is at its lowest level for a country facing increased forest loss that is far ahead of the slow rate of forest regeneration.

To address some of the challenges observed, the Forestry Department is in the process of developing the charcoal regulations that will address some issues of low community participation by promoting a well-coordinated member-based charcoal industry that will ensure controls are put in place to allow for the manufacture of charcoal in designated areas under prescribed conditions. If well implemented, this will transform the charcoal industry by increasing opportunities for the department to monitor charcoal production areas, manage harvested areas, and collect forest revenue. These actions will ultimately contribute towards greening the CVC.

The exclusion of greening the CVC in national policies further delays the opportunity to modernise the value chain and harness its potential in generating government revenue and slowing down charcoal's contribution to deforestation and climate change. The modernization process requires consensus from all government bodies that govern charcoal production and utilization.

Against this backdrop, this research seeks to identify ways in which the CVC can be made more sustainable in Zambia, with a view to reduce charcoal-induced deforestation and global warming.

The paper seeks to address three main questions:

1. How is charcoal production and trade governed in Zambia?
2. What lessons have been learned from the constraints to greening the value chain?
3. What opportunities are there for greening the CVC in Zambia?

Results of this study will contribute towards a better understanding of how a green CVC can contribute to reducing charcoal-induced deforestation and global warming, and how such value chains can be incorporated in the national legislative and regulatory frameworks concerned with climate change mitigation.

2. METHODOLOGY

This study is based on an extensive review of relevant literature, both grey and published, the 2015 Living Conditions Monitoring Survey (LCMS) data, and key informant interviews (KII). The literature review sought to assess the extent to which current policy frameworks support sustainable charcoal production and draws best practice lessons from countries where charcoal production is properly regulated. LCMS data are used to generate descriptive statistics on urban household access to electricity and the different cooking energy sources used by urban households. The KIIs covered actors involved in sustainable forestry management and promotion of sustainable charcoal production. A focus group discussion was held with 15 members of the Choma Charcoal Association in Choma District who were organized under the FAO funded Forest and Farm Facility program.

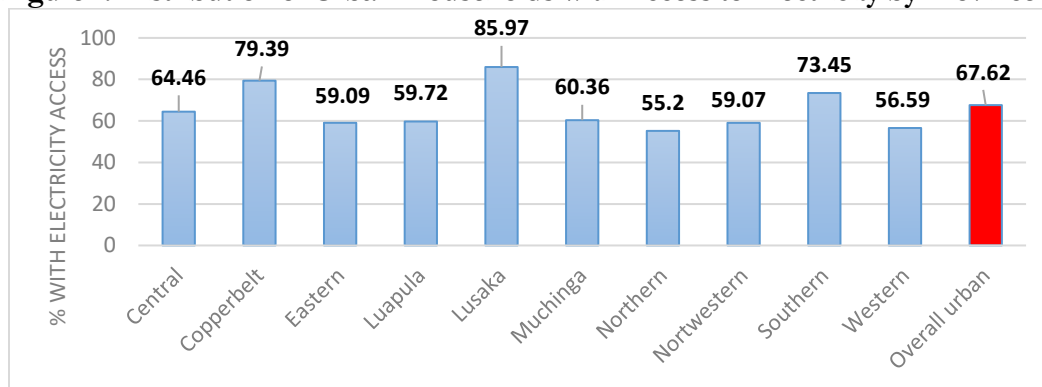
3. MAIN COOKING ENERGY SOURCES AMONG URBAN HOUSEHOLDS

In Zambia’s urban areas, the two most commonly used energy sources for cooking are electricity and charcoal (Mulenga, Tembo, and Richardson 2018; Richardson et al. 2015; Zulu and Richardson 2013). Figure 1 shows the distribution of urban households with access to electricity by province. As expected, access rate is highest in Lusaka (85 percent), followed by the Copperbelt (79 percent), and in third place is Southern Province at 73.5 percent; while Northern is the least at 55 percent, as compared to an urban average access rate of 68 percent, countrywide (LCMS 2015).

Despite the fact that over half of urban households have access to electricity, charcoal remains the most commonly used source of cooking energy compared to electricity. Some underlying factors for this phenomenon include preference for food cooked using charcoal (certain food types are believed to taste better and more flavourful when prepared on charcoal cookstoves³; charcoal is more affordable relative to electricity or other energy sources; and the increased electricity rationing (load shedding) resulting in unreliable supply; and unavailability of affordable and compatible alternative energy sources. These and other factors have been the driving forces behind increasing charcoal demand.

Figure 2 (following) shows the distribution of urban households by main cooking energy source. The figure clearly illustrates the dominance of charcoal as the main cooking energy source, in particular purchased charcoal, accounting for 57 percent of the total sample of urban households; whereas own-produced charcoal accounts for only 2.3 percent. Taken together, charcoal is used as the main source of cooking energy by about 59 percent of urban households. In second place is electricity, accounting for 34 percent of urban households, while in a distant third place is own-collected firewood at 3.2 percent. Purchased firewood accounts for another 2.8 percent, thus when combined, firewood accounts for about 6 percent of urban households main cooking energy source, which is surprisingly high considering that firewood is predominantly a rural energy source. However, further analysis revealed that firewood is mostly used in peri-urban areas (areas associated low income households), perhaps because of its affordability compared to charcoal. The other energy sources account for less than 1 percent, an indication of limited use of alternative energy sources among urban households.

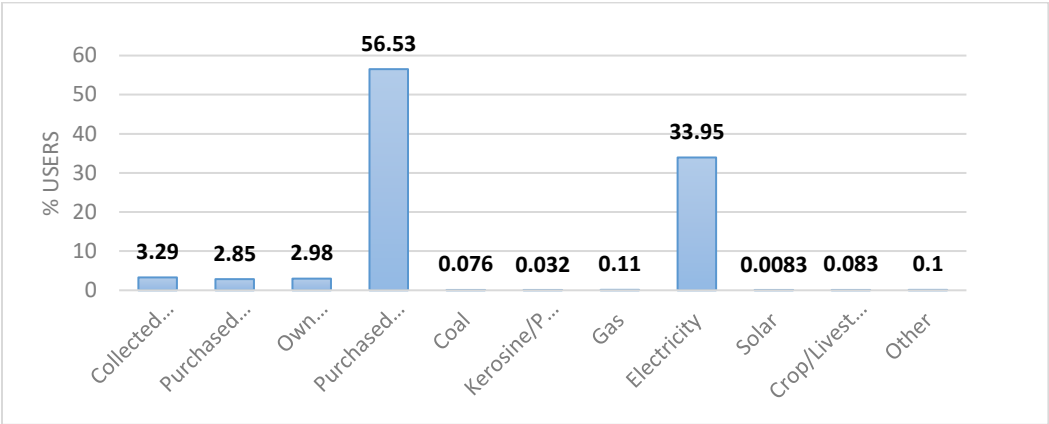
Figure 1. Distribution of Urban Households with Access to Electricity by Province



Source. LCMS (2015).

³ Locally known as mbaula.

Figure 2. Main Cooking Energy Sources among Urban Households in Zambia



Source. LCMS (2015).

As charcoal continues to be the dominant energy source even in areas with relatively high levels of electricity access, it becomes critical that the CVC is transformed to be green in order to reduce its carbon footprint.

4. THE POLICY AND LEGAL FRAMEWORK IN SUPPORT OF A GREEN CHARCOAL VALUE CHAIN IN ZAMBIA

This section reviews the legal framework in Zambia that governs the management of natural resources in relation to charcoal production. The focus is on proposals within the documents that promote actions towards greening the CVC. It also touches on the issues of financing for resource management, which is a critical element in making charcoal production more sustainable.

Zambia has the National Forestry Policy that provides a comprehensive policy framework on sustainable management of forestry resources, which recognizes that increased charcoal use is driven by the desire to meet household energy needs and as a livelihood option for many of the poor (GRZ 2017). This policy is supported by the Forest act No. 4 of 2015 under which the charcoal industry is regulated. However, there are also other related policies and legal documents that cut across the land, agriculture, forestry, natural resources, climate change, and other associated sectors. The legal framework takes into account the importance of forest resources and proposes measures that are useful for shaping how to green the CVC, with particular focus on investing in alternative energy sources that meet the energy and livelihood needs of the various sectors, mitigate climate change, and promote sustainable forest resource use.⁴

4.1 Policy Documents and Legal Framework

The more broadly proposed actions within the legal framework governing forestry management and sustainable charcoal production have the common goal of ensuring that resources are sustainably managed to provide products and services for current and future generations. These policies are located or established in specific institutions that are individually funded to implement activities that are in line with their mandates; this affects the extent to which they are able to address the challenges observed along the value chain and contribute to the attainment of the common goal. Provisions of the policy and legal framework including proposed actions on the charcoal industry are highlighted in Table 1 following).

4.2 Budgetary Allocation

Unfortunately for Zambia, financing for sustainable natural resource management and environmental protection has remained very low. This is despite the fact that a grand total of Zambian Kwacha (ZMW) 60,993,748 was realized from the forestry sector from 2010-2017 (Mwitwa, Mwila, and Mweemba 2018). This figure does not even account for the informal contributions that are not documented by the national accounting system. About 73 percent of funding towards biodiversity and natural resources management has been from donor funding (Mweemba 2018).

⁴ *Forest produce* as defined by the Forest Act of 2015 includes algae, bamboos, bark, bedding, bees, honey, beeswax, boards, branch wood, carbon, canes, charcoal, chips, climbers, cones, coppice, creepers, fibres, flowers, fruits, fuelwood, fungi, gills, grass, gums, hives, lichens, litter, logs, moss, nursery plants, peat, planks, plant, poles, reeds, resin, roots, rubber, rushes, sand, sap, sawdust, scantlings, seeds, seedlings, slabs, soil, stumps, timber, thatch, thinnings, trees, vegetable-derived oils, vegetable-derived tar and wood spirits.

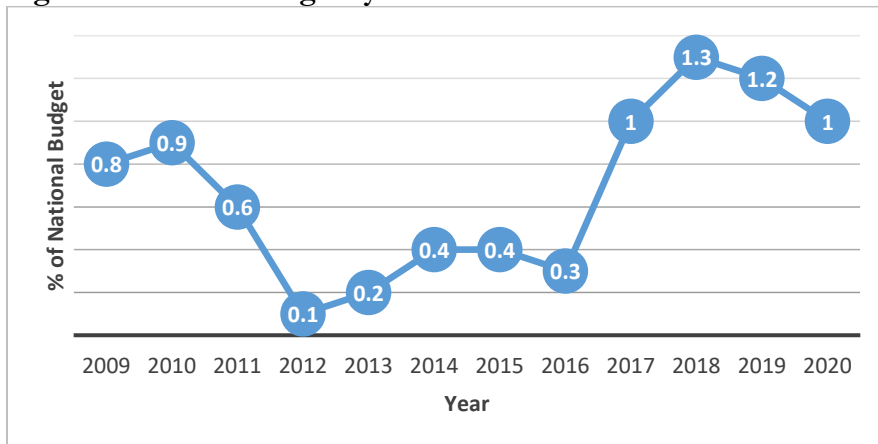
Table 1. Policy Documents and Legal Framework on Charcoal and Their Proposed Actions

DOCUMENT	PROPOSED ACTIONS ON CHARCOAL PRODUCTION
Zambia’s Nationally Appropriate Mitigation Actions (NAMA):	Sustainable forestry management identified as sustainable charcoal production that includes the use of improved kilns as a co-benefit that can result in improved livelihoods, reduced GHG emissions, and improved air quality.
Zambia’s Nationally Determined Contributions:	Promotion of natural regeneration, afforestation/ reforestation, sustainable charcoal production and utilization practices, and generation of electricity from forest waste and residues.
Seventh National Development Plan:	Subsidy reforms in energy and agriculture – with a focus on testing charcoal taxation while reducing the cost of and promoting the use of alternative clean or improved cooking energy. Development of a comprehensive national energy strategy that contains or includes a master plan for sustainable energy alternatives to charcoal and other household energy needs.
National Policy on Climate Change:	Promote and implement sustainable land-use management practices to contribute to reducing GHG emissions from land use and land use change and forestry Promote sustainable production of charcoal.
The Forest Act of 2015	Provides guidance for the protection of forests and trees, and restrictions on charcoal production coupled with the relevant permits that are required for production and sale.
National Energy Policy of 2008	Promotes the use of improved technology of charcoal production and utilization through improved kilns, effective and efficient production methods, and development of stoves that are efficient and convenient.
Second National Agricultural Policy (SNAP)	The 8 th objective – Sustainable resource management through promotion of community woodlots, agroforestry, afforestation, and the promotion of the use of alternative sources of energy such as solar and gas.
Environmental Management Act of 2011	Emphasizes that all management of forests is in relation to the Forestry Act.
National Water Policy of 2010	Recognises the need for integrated planning and development of energy infrastructure, and for private and public investment in the energy sector to cut back on overexploitation of wood fuel. Highlights the need to develop and promote alternative energy sources to fuel-wood and technologies in order to reduce the use of fuel-wood and woodlands, forests and wetlands in order to mitigate GHG emissions.
Community Forest Management Regulations of 2018	Gives the structure and regulations for community forest management groups and their user rights in the community forest
National Biodiversity Strategic Action Plan II (NBSAP-2)	Strategic Goal B - Reduce the direct pressures on biodiversity and promoting sustainable use to reduce the deforestation rate in Zambia to 25 percent by 2020 Strategic Goal D – Enhance the benefits to all from biodiversity and ecosystem services by defining and enforcing a generic benefit sharing mechanism to genetic resources.

This low investment from the government is reflected in the annual budgetary allocation for sustainable forest resources management and environment that averaged about 0.68 percent of the annual budget between 2009 and 2020 (Figure 3). This allocation is much lower than many other sectors particularly because sustainable resource use and the environment are mentioned as high priority areas in national dialogue because of their far reaching effects across all the sectors, yet they receive very little funding. Allocation trends towards environmental protection show a drop from 1.3 percent in 2018 to 1 percent in 2020. Not only that, allocation to environmental protection in the 2020 budget had the most significant reduction at 17 percent from the 2019 allocation, a move that contradicts national rhetoric on the need to mitigate and adapt to climate change. Further, these allocations only meet approximately 30 percent of the budgetary requirements (Mwitwa, Mwila, and Mweemba 2018) and worse still, current disbursement of the allocated budgetary funds averages around 40 percent (Mweemba 2018).

The repercussions are seen in the financial and administrative systems of agencies governing natural resources having inadequate funding to implement planned activities and acquiring more human resources (Mwitwa, Mwila, and Mweemba 2018). This results in the weak extension services and enforcement prevalent in the forestry sector—despite the country facing the ravages of more frequent, extreme climatic events. Adapting and mitigating these changes requires robust financing to sustain the livelihoods of people who rely on these resources and deal with the shocks.

Figure 3. National Budgetary Allocation to Environmental Protection - 2009 to 2020



Source: Compiled by authors (2019) from Zambia National Budget Speeches 2008 to 2019.

5. GREEN CHARCOAL VALUE CHAINS

This section discusses the global and local evidence on experiences with efforts to mainstream efficiency in CVCs and highlights the key challenges and successes.

Modernizing and making the CVC green through policy and institutions will require consensus by all actors in the CVC. The approach will require an adaptable framework that takes into consideration the technological developments within the value chain, and the procedural and organizational aspects (World Bank 2012). Ensuring the success of the greening of the CVC requires deliberate efforts to address the issues that are found in sustainable forestry management, as well as the inefficiencies prevalent in production, transportation, legislation, and marketing of charcoal.

5.1 Challenges in Mainstreaming Sustainable Charcoal Production

On a national and regional scale, several challenges exist in mainstreaming sustainable charcoal production. The challenges can be summarised below.

5.1.1 *Unorganised Production*

The fact that most charcoal producers do so at an individual level makes it difficult to monitor their activities and provide support as a collective package on the sustainable methods of production. This lack of an association to work towards formalising the activities makes their activities illegal and, hence, production remains concealed. The lack of organisation observed at producer level, coupled with the lack of explicit charcoal producer groups—who adhere to particular rules and regulations, carry out enforcement and can leverage access to training on sustainable production from relevant public and private agencies—means that they cannot exclude outside producers under the present law. Charcoal producers also seldom organise themselves to take advantage of support offered by the government. This is because there is little incentive to organise themselves, as there is an on-going narrative that charcoal production is illegal and contributes very little to Zambia's development needs (Gumbo et al. 2013). It is also because there are no clear incentives as to why a producer should join such a group, particularly because being in such a group would entail paying membership fees and complying with the law by paying for permits and licenses—a cost an illegal charcoal producer does not have to incur.

5.1.2 *Limited Financing*

Access to finance for effective forestry management interventions and development of improved technologies—such as kilns and cookstoves—poses a challenge in making charcoal production sustainable. Efficient technologies are expensive and the fact that the producers are mostly low-income rural households implies that they have no incentive to invest in these technologies when they can use old methods—though harmful to the environment—to produce charcoal. On the consumer side, access to consistently good quality and quantity of cookstoves continues to be a challenge. Traditional braziers are more widely available as opposed to the more energy efficient cookstoves. Even when they are accessible, they are quite expensive. A spot check in some of the markets and leading retail stores in Zambia shows that some of the efficient cookstoves can be bought from the range of ZMW 150 in the markets made by the local artisans up to ZMW 1,200 for

those that are made by larger companies. In comparison, the price of traditional mbaulas (braziers) begins at about ZMW 20 up to ZMW 300 depending on its size. This difference in price disincentivises end users from seeking out efficient cookstoves.

5.1.3 Weak Enforcement of Licenses and Permits

There is weak legal enforcement in regulation of charcoal production and trade. Few efforts have been taken to discourage the use, transportation, and production of charcoal from unsustainable sources. Sustainable production of charcoal functions on a financial model different from traditional charcoal production and law enforcement is not always clear on what these regulations are, more so in situations where regulation is focused on national laws rather than agreed upon local level rules and regulations. The enforcement of license and permits that are issued for charcoal production and conveyance also offers very little personal economic incentives, further making it an unpopular model as opposed to the traditional illegal system that thrives on bribes—at the expense of environmental sustainability. For example, currently, the production license for charcoal is valid for 14 days and it costs ZMW 270 for every ten 50kg bags of charcoal produced. The conveyance license, which allows for movement of charcoal to any other part of the country, is valid for 14 days and costs ZMW 135 for every ten 50kg bags.

Some of the challenges associated with licensing and conveyance are: there are few, if any, forestry vehicles at the provincial and/or district level to help with monitoring and enforcement; there are too few staff in the forestry offices to man the large areas under their jurisdiction; and extension assistance is minimal at the district level to reach out to producers concerning the production, licensing, and conveyance regulations due to limited funds and manpower. This calls for the need to establish a collaborative framework with other law enforcement to help in monitoring and enforcement. This includes working with the council at the checkpoints and with the council police, as well as revenue collectors. It also calls for the need to increase funding to the Forestry Department to hire more people and fund extension to help disseminate information on sustainable production and the legal requirements for production and trade.

In addition, the role of traditional forest governance has not been fully appreciated in the country and not been actively used to leverage local-level institutional arrangements that can help in the regulation and enforcement in charcoal production (Dlamini et al. 2016).

5.1.4 Compliance with Regulations

One of the key areas that is overlooked in the discussion on charcoal production is the assumption that the owners and users of land and those who produce charcoal are aware of why it is wrong to produce charcoal and are aware of what the regulations are. Therefore, there is limited capacity by members of producer associations, when in existence, to make production guidelines and constitutions that members are agreeable to without support, and to enforce these formal regulations. Also, provision for extension to educate producers on how to sustainably produce charcoal is weak, and this mostly stems from inadequate number of staff in the responsible agencies and limited financing for these activities.

Another challenge in compliance towards sustainable charcoal production has to do with the low levels of literacy typical of charcoal producers. This implies that they may not be aware of what regulations are there for how to properly cut trees and the licensing required. A way to ensure that they are able to fully participate in these exercises is to ensure communication is in the local language so that these techniques are well understood by the producers.

5.1.5 Limited Information about the Licencing System

Issuance of felling and conveyance permits in the Forestry Department is decentralised and up to the district, and sometimes to the sub-district level. However, these licencing centres are sometimes located in places too far off from the charcoal production areas, thereby, making it difficult for the charcoal producers to travel and obtain the legal documents. In addition, information on the type of

permits offered by the department and where they can be obtained is lacking at community level. In some cases, some communities only have access to very little sensitization by the charcoal producers and traders on what the regulations are. This coupled with the lack of established producer groups with locally defined production guidelines in the communities, and who can provide the platform for sensitization and monitoring, limits the extent to which charcoal producers can access useful information for decision support.

These constraints provide opportunities in the short- and medium term by making production more sustainable, and the long term to successfully transition away from this inefficient energy source.

5.2 Building Blocks for Success in Sustainable Charcoal Production

The main requirements for a successful transition into a low-carbon future for economies dependent on wood fuel can be summarised in Table 2 following, which highlights the main structural and legal requirements in greening the CVC.

This transition will require realigning of human and financial resources towards natural resource management in order to combat the primary issue of indiscriminate harvesting of trees. It will also require strong support towards the development of alternative livelihoods as the issue is clear—charcoal is produced in order to meet the energy and economic needs of people. Providing them with viable and sustainable alternatives to meet this need is the only long term solution towards addressing greening the CVC.

Table 2. Legal and Institutional Support for Sustainable Charcoal Production

REQUIREMENT	STEPS
Governance	Forward looking policies
Subsidiarity	Trained institutions to bridge the gap between the charcoal producers/value chain actors and authorities enforcing management
Decentralization	Management functions given to those directly affected including traditional authorities
Tenure Security	Access to title through identification, documentation and reconciliation of claims to forest areas, rather than community property and management alone
Technology Efficiency	Increase output along the value chain with the same local raw materials and utilize improved carbonization/kiln technologies
Simplicity	Simple community institutions/regulations and administrative procedures
Formalization	Legalizing the representative user group bodies
Economic Returns	Quick and tangible economic returns
Devolution/Empowerment	Transfer of user rights and duties to associations/user groups
Capacity Building	Facilitation of capacity in terms of efficiency of technologies and sustainable drafting and implementation of rules/guidelines at a local level
Utilization	Increasing the efficiency of cooking devices for the end users

Source: Adapted from Ackermann et al (2014) and World Bank (2012).

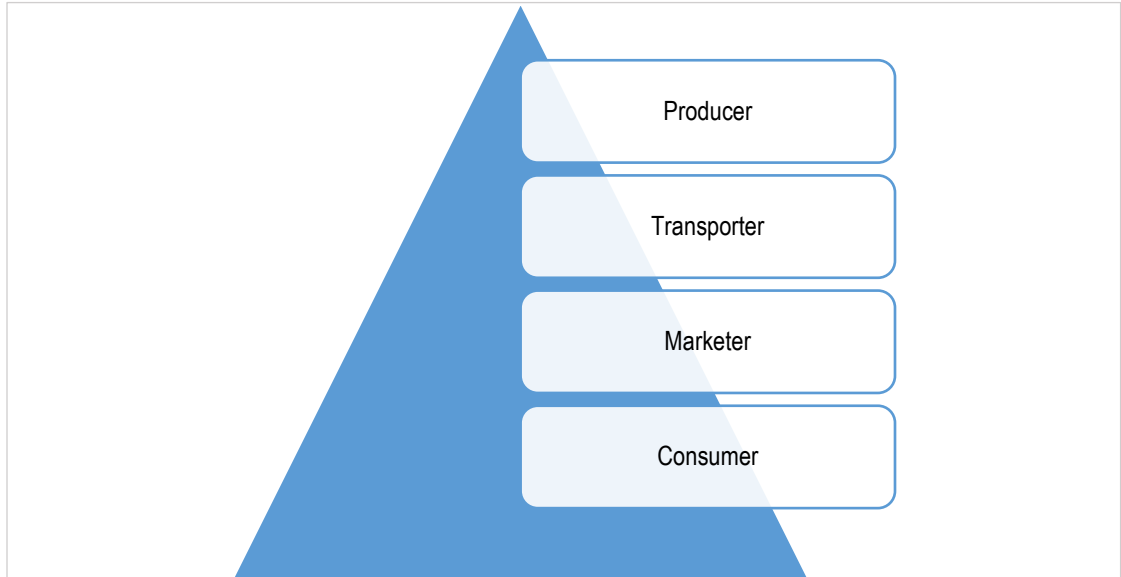
6. OPPORTUNITIES FOR SUSTAINABLE CHARCOAL PRODUCTION IN ZAMBIA

This section is guided by the trends in charcoal production in the country and opportunities that exist in making the CVC sustainable based on the experiences and literature of practitioners on the ground.

Charcoal production in Zambia is similar to that of many African countries in that it is mostly undertaken by informal and unorganised groups that use the typical *slash and burn* method, and principally done by those in rural areas for peri-urban and urban consumers (Basu, Blavy, and Yulek 2004; Hibajene and Kalumiana 2003). The sector also typically receives little reporting in national economics despite its contribution to the livelihoods of many because of its largely illegal nature of production (Johnson et al. 2018), and is driven by poverty, unemployment, and limited livelihood options—making charcoal production a lucrative livelihood option that requires minimal investment (Gumbo et al. 2013). The onset of load shedding in the country has triggered increased demand for charcoal—ultimately driving up production and accompanied by a subsequent forest loss (Dlamini et al. 2016). The effects of increased load shedding countrywide in 2019, often over 15 hours per day, is already being seen and is yet to be quantified. The fact that not all charcoal producers do it full time (Hibajene and Kalumiana 2003), makes it a lucrative additional income stream and leads to the number of producers being quite substantial. The CVC in Zambia can be summarised in Figure 4 below.

Two of the main constraints in the regulation—inadequate awareness and unorganised production—provide opportunities in the short- and medium term for making production more sustainable, and the long term to successfully transition away from this inefficient energy source.

Figure 4. Actors in Zambia's Charcoal Value Chain



Source: Authors (2019).

6.1 Biomass Source for Charcoal Production

EXPERIENCES IN MARKETING SUSTAINABLE CHARCOAL

Sourcing stock: The small land sizes that producers have makes it difficult for them to sustainably source wood.

Establishment of a coupe system is a good option. Community forests must be identified and managed sustainably to benefit a larger scale of production. This will require traditional authorities to be on board and need to clarify how they will play through national charcoal regulations.

Target market: The target market of sustainable charcoal is mostly the supermarkets and establishments such as lodges and hotels. The general public remains a big market pool that is yet to be explored. This is mostly because illegal charcoal is cheaper than sustainable charcoal coupled with an inadequate awareness of the benefits of using sustainable charcoal and the need for market research on the appropriate charcoal packages with the best economic gains.

Behavior change: Changing from the traditional way of doing things has not been easy'. People are used to doing things the old way.

The wood in Zambia required for charcoal production is mostly sourced from communal and forested areas. A key challenge in the sourcing of biomass for charcoal production is the excessive harvesting and inefficient processing driving the need for more wood. This is coupled with inadequate clarity on land and tenure rights for resources that includes the trees—presently vested under the hands of the president and requires licensing—introducing a problem of who should manage and monitor its production; with the reality of the government agents having little capacity to monitor and manage the utilization of these resources as production typically takes place in rural areas on communal customary land (FAO 2017b).

Several interventions are being done in the country that are focused on forest regeneration, afforestation, and the use of coupe system to make charcoal production more sustainable.⁵ Feedstock alternatives for charcoal production are also being explored by institutes such as the Mwekera Forestry College, the University of Zambia's School of Engineering Technology Development and Advisory Unit, agricultural cooperatives, and several other organisations.⁶

Experiences in working towards greening the CVC have identified the following opportunities:

- *Afforestation Programs:* Water is a major requirement for reforestation and afforestation efforts, as well as to provide livelihood diversification. Water shortages for the setting up of nurseries and woodlots for sustainable forestry management and charcoal production is a big challenge. This has been a critical challenge in successfully implementing these efforts. Water access for nurseries and afforestation must be high on the agenda, with efforts towards the drilling of boreholes and harvesting of water resources as key activities to support establishment of nurseries and woodlots. The focus on the nurseries and woodlots needs to be on indigenous trees as well as fast-growing exotic trees such as Pines, Bamboo, and Eucalyptus etc.
- *Research and Development:* Miombo woodlands are predominantly used for charcoal production in Zambia, with species such as *Brachystegia*, *Julbernardia* and *Isoberlinia*

⁵ A *coupe* as defined by the Forest Act of 2015 means any site or area for the cutting, felling or taking of forest produce, whether the boundaries of the area are demarcated on the ground or not.

⁶ A feedstock is any unprocessed material used to supply a manufacturing process – in this case, supply for charcoal production (Helmenstine M. A. 2019)

being commonly used and when absent, other indigenous tree species are used (Hibajene and Kalumiana 2003). Considering the fast rate at which the Miombo woodland is being depleted, there is need to explore locally appropriate feedstock. For example, the stocks from cotton can be used and the law requiring all stocks to be cut and burnt each year can be used as a comparative advantage. There is need to fund research towards biomass that has high calorific/energy values. Some potential areas of research include off-cuts from the timber industry. This will require consistent support to research. A first step would be to fund research laboratories that are present in forestry departments country-wide, as many require laboratory rehabilitation and have outdated equipment.

- *Regeneration Programs:* Fire is one of the biggest challenges in implementing regeneration activities as it is used to cut down the trees and clear land; ensuring no possibility of natural regeneration. Tackling it will require putting animals back into the areas so that they can eat the foliage that the people are trying to get rid of through planned grazing. This can be done through strategic grazing after the rains to reduce biomass. These activities can only be done with community commitment. Another opportunity that can be looked at is focusing production of charcoal in areas that have forested areas that have high regenerative potential using the coupe system.
- *Traditional Leadership:* The role of traditional leadership in the governance of resources that include trees for charcoal production is not very clear. The strides towards the establishment of charcoal production guidelines is a step towards clearly defining the role of traditional leadership, especially in light of how current legislation functions. This will have to be accompanied with clear demarcations/designated areas for the communities and must be tied to a holistic landscape management style that takes into account all interested parties such as councils, water management groups, forest user groups, etc.
- *Compliance:* The main challenges in compliance towards sustainable charcoal production have to do with the low levels of literacy typical of charcoal producers. This implies that they may not be aware of what regulations are there for how to properly cut trees and the licensing required. A way to ensure that they are able to fully participate in these exercises is to ensure communication is in local languages so that these techniques are well understood by the producers.
- *Biomass Substitution:* Substitution of feedstock for wood in charcoal production remains very low. This is because the wood used is *free*, in comparison to feedstock that may require some financial input. The biomass resource potential can be explored by integrating waste from industries such as timber, agriculture, and food processing as feedstock for charcoal briquettes. Potential sources of biomass for charcoal production includes twigs and saw dust from the timber industry, husks from rice and maize from food processing industries, and cotton stalks after harvest. This will require strong research, development and training support from both the public and private sector to narrow down the most appropriate feedstocks in the high charcoal production zones that can be a viable replacement for wood at low cost.

Forestry management will need to be a whole management strategy rather than one act to take advantage of the opportunities existing in the country.

6.2 Carbonization

Almost all production of charcoal utilizes the earth clamp method that involves cutting down trees, making them into short logs, piling the logs, covering the logs with soil, lighting the logs in the kiln, carbonizing the wood into charcoal, harvesting, and then packaging it (Hibajene and Kalumiana 2003). The biggest issue with carbonization is the inefficiency of traditional kilns, which is at about

10 percent only (Kapiyo 1996). Some of the opportunities in overcoming the issues of inefficiencies are as follows:

- *Co-production of Kilns:* Efforts in co-production of efficient production techniques with producers that have been using the old methods for a long time can help them change from the outdated means of production, and facilitate awareness, understanding and compliance of the regulations. An adaptive style of technology development is critical. This can be done with fact finding missions that take into mind local materials and environmental conditions for kiln development.
- *Cost of Improved Kilns:* Improved kilns are stated to be the more efficient as carbonisation can be done in as little as 12 hours, produce good quality charcoal, and are less labour intensive. Some of the improved kilns are permanent structures and provide the opportunity to have year-long production because they are enclosed e.g., drum kilns. The biggest need in the development and promotion of the use of improved kilns is capital investment to develop prototypes that are appropriate for various agro-ecological regions. These must take into consideration the need for local materials that are cheap. Apart from cheap materials, establishment and use of formalised associations of charcoal producers can work as a way to offset the high costs. The modalities can be similar to those used by many organised groups like agricultural cooperatives in aggregating funds through cooperative membership fees, and purchasing equipment. However, the challenge remains with how to incentivise producers to join, as currently they incur little cost when they produce illegally in comparison to those in associations.
- *Capacity Building:* The biggest knowledge requirements for the construction of these kilns is basic bricklaying knowledge. This has the advantage of being a skill that women can learn, allowing them to participate in more efficient production. The typical training period is 14 days: with 5-6 days for construction training and 4-5 days for charcoal production itself, and a two-day recap session.⁷ There is a need to fund the Forestry Department to train producers in sustainable production through the establishment of demonstration sites with improved production technology. This action needs to be tied to woodlot establishment using fast growing varieties to provide feedstock for certified charcoal at premium prices.

6.3 Licensing and Conveyance

There is weak legal enforcement in regulation of charcoal production and trade. This calls for the need to establish a collaborative framework with other law enforcement to help in monitoring and enforcement. This includes working with the council at the checkpoints and the council police, as well as revenue collectors. It also calls for the need to increase funding to the Forestry Department to have more people and fund extension to help disseminate information on sustainable production and the legal requirements for production and trade.

6.4 Transportation and Distribution

Dlamini et al. (2016) show that charcoal is mainly transported in trucks, followed by bicycles, wheelbarrows, and ox-carts. The fact that most transportation is by trucks from aggregation points suggests that charcoal is highly commercialised and is supplied in high quantities. The transportation business from the early 1990s to the early 2000s, employed over 3,500 people (Hibajene and Kalumiana 2003), a number that has likely risen substantially with the increased urbanisation and demand for charcoal. An opportunity this presents is the potential revenue that can be realised from

⁷ Personal Communication, October 1, 2019 with F, Banda - Research Engineer and Head of Training, Technology Development and Advisory Unit, University of Zambia.

these trucks if enforcement by various authorities is stepped up and channelling that money towards forestry management.

6.5 Charcoal Marketing and Trade

As things stand, the trees are free and license and conveyance payments are not paid, making illegally produced charcoal inherently cheaper than that which is done legally. There needs to be economic value that is gained from the forests in order for it to have more value than the trees. The following opportunities can be harnessed within the charcoal trade:

- A premium price for sustainably produced charcoal needs to be established in order to offset the costs associated with paying for licenses. This will require labelling, packaging, and providing a market for this charcoal. The buyers targeted for this charcoal should be the general urban public as they are the largest consumers.
- There is a need for mass sensitization to the general public on the regulations on charcoal production and the merits of using sustainably produced charcoal. This can help towards a cultural shift of the public developing
- A market for the sustainably produced charcoal needs to be provided that excludes those who do not have a license or producing unsustainably. This can be done through charcoal associations that monitor their members and have locally developed guidelines for production and certification procedures that are co-produced by traditional authorities and the Forestry Department.
- There is a need to facilitate the establishment of storage sheds for areas where sustainable charcoal is being produced to allow aggregation and have designated pick-up points. Again, this will require producers to be in a formalized group. The producers can agree on a day when the collections can be done and storage can be built if finances are available.
- Developing the forest product value chain and make it more resilient to allow yearlong production of non-timber forest products (NTFPs). If the forest is worth more to the communities and there is a sense of ownership, there will be incentive to use the forest resources sustainably.

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6.6 End Use – Efficient Cookstoves

Efficient cookstoves are a way in which charcoal use can efficiency be improved. One of the challenges associated with the use of efficient cookstoves is the expense associated with them (more expensive than the regular inefficient mbaula—traditionally called a brazier), limited awareness of the cookstoves and their potential benefits, hence, limited demand, and the difficulty in sourcing of materials for the ceramic pots used for these improved stoves. A study by Atteridge, Heneen, and Senyagwa (2013) shows that there is a high willingness to use the improved cookstoves if they can attain fuel savings from their efficiency and ultimately cover the cost difference between the stoves and a mbaula. An opportunity in up-scaling the use of efficient cookstoves is involving local tinsmiths who make mbaulas in green CVC interventions and providing them with support to make these improved stoves that look similar to traditional mbaulas. The co-production of cookstoves presents an opportunity that can help with greater acceptability of the technology. There is also a need to invest in after-sale extension to help the end-users use these stoves appropriately. Making the briquettes or pellets for some of these stoves more accessible will be a necessary aspect to consider, as currently few suppliers have them readily available. These wood energy substitutes still have not achieved significant market penetration in low developed countries (Sepp, Sepp, and Mundhenk 2014), and this includes Zambia. This will have to go hand in hand with a long term campaign on the benefits of their use, and potentially use-tax incentives to reduce their cost in the short term, as has been done for solar and alternative energy products in the past.

Suggestions have been made elsewhere to potentially incentivise end-users to use efficient cookstoves using carbon credits (Vos and Vis 2010) and other Clean Development Mechanisms in Zambia. As work on payment for ecosystem services is still underway in the country, this can be a potential avenue to look at in the future.

6.7 Formalising Producer Groups

Policies and institutional arrangements affecting charcoal production have not clearly mentioned charcoal producer groups and typically call them community groups or community forest management groups. The lack of explicit charcoal producer groups—who adhere to particular rules and regulations, carry out enforcement, and can leverage access to training on sustainable production from relevant public and private agencies—means that they cannot exclude outside producers under the present law.

Success has been witnessed in Choma District with the use of community radio programmes that allow question and answer sessions about group membership. The association reports that the number of community associations that are part of the Choma Charcoal Association has grown from ten to thirty four since the association establishment in 2017. Lessons from the implementation of the Forest and Farm Facility in Zambia also show that having charcoal producers that are organized through associations can act as a support for the weak extension in forestry management that currently exists and lay the groundwork for improved, sustainably-managed forests and revenue collection (FAO 2018).

This formalisation can be supported in other parts of the country by:

- Active community engagement in sustainable forestry management that takes into account their livelihood needs.
- Setting up a platform with a clear communication strategy among Forestry Department, the association, and traditional leaders to allow for larger stakeholder participation, particularly for individuals in far flung areas.
- Finalize the Participatory Guarantee System guidelines and strengthen them to enforce sustainable production— especially in far off areas—and using them as a basis to enhance support for transport, packaging, and pricing to complying producers.

6.8 Regional Trade

Suggestions from KIIs indicate that outside of domestic consumption, there is a network of regional trade going on with charcoal produced in Zambia. This could perhaps be due to the high regulations in many of the neighbouring countries that create a market for Zambian charcoal. Findings by Gumbo et al. (2013) and their reviews of other papers on regional trade with Zambia's neighbours suggests that there is significant cross-border charcoal trade with the neighbouring countries of Malawi and Tanzania and even the Democratic Republic of Congo (Minde and Nakhumwa 1998; Ackello-Ogutu and Eschessah 1998). This calls for the need to investigate how much charcoal being produced is supplying the region, therefore, driving production—outside of local demand.

6.9 Financing

Financing is a major challenge in the enforcement of forestry regulations that plays a critical part in ensuring that charcoal is produced sustainable. There is also a need to ensure that revenue raised from forestry resources is spent on forestry management activities rather than going into the general national treasury that can utilise the resources for whatever developmental activities they choose.

This ring fencing has been done in countries such as Zimbabwe and Uganda where the forestry institutions are semi-autonomous commercial enterprises that are able to retain the revenue they collect and are then able to fund their operations (Gondo 2012). Modalities that are most appropriate for the Zambian context can be worked out to actualise this. The Forest Act provides ways in which finances can be generated but it does not explicitly state how revenue can be shared through co-management activities where the government partners with the private sector and local communities (Mwitwa, Mwila, and Mweemba 2018). This provides an opportunity to use this gap as a platform to advocate for increased benefit sharing in co-management actions, to incentivise the private sector and local communities to take part in sustainable charcoal production activities in forested areas—including alternative livelihoods for the producers. This can also be used as a platform to advocate for the autonomy in agencies managing the natural resources to be able to keep some of the revenue they make to provide more funding for sustainable resource management.

7. CONCLUSION AND RECOMMENDATIONS

In the long term, the future should look towards transitioning away from charcoal production and use, with alternative energy sources as the fore of these efforts. The short- and medium term need to focus on making charcoal production more sustainable, with investment in changing the source and type of feedstock for charcoal production, and improved technologies such as kilns and cookstoves to make use much more efficient.

Empirical evidence from Tembo, Mulenga, and Sitko (2015) suggests that even though electricity connection reduces charcoal use for medium- and high income households, it will not reduce charcoal demand, nor consequently, deforestation and degradation. Access to electricity has to be combined with measures such as having a reliable power supply and alternative power sources.

The following needs to be done to ensure there is a transition from charcoal in the long term:

- The need to identify the gaps in biodiversity and natural resource management to make a strategic plan for alternative livelihoods in the targeted communities. This should be followed by investment in value addition for non-timber forest products to help bring value to forested areas, which can act as a disincentive to tree cutting— because poverty and lack of employment are some of the main drivers for charcoal production. These activities should be something that can engage the whole family.
- Encourage long term fallow lands in heavily degraded areas to allow recovery of the forested areas.
- Provide alternative livelihoods such as bee keeping, particularly in the drought prone areas, and small livestock such as goats, which are drought resistant and have good marketing opportunities throughout the country. This can be further supported by investing in the use of alternative feeding practices to counteract droughts by planting fodder trees to help those hard hit by extreme weather events to not resort to charcoal production as a livelihood option.

What needs to be done in the short- and medium term is:

- Strengthening financing to the Forestry Department and associated resources and environmental management agencies by utilising policies such as the Forestry Policy to allow for financial and administrative autonomy from revenue that is collected, and establish a local system of benefit co-sharing.
- Raising and realigning funds to the forestry sector by utilising the current tax regime such as carbon tax to fund carbon sequestration activities (Mwitwa, Mwila, and Mweemba 2018).
- Forming charcoal associations that can be the eyes on the ground for the Forestry Department. The initial set up of the associations will require funding for capacity building.
- Facilitate a media campaign to sensitize the public on what a charcoal association is, what sustainably produced charcoal is, and why it is important that only sustainably produced charcoal is used.
- Having designated charcoal production areas i.e. coupes.
- Setting up woodlots and nurseries for fast growing plants such as eucalyptus, solid bamboo, regular bamboo, and pine. This should be coupled with consistent extension to enhance acceptability and facilitate a mind-set shift to move away from the indigenous varieties, and drilling boreholes where woodlots and nurseries are being developed.
- Improve and support forestry extension to counteract the low awareness on sustainable production practices and the rules and regulations on licensing.

- Invest in long term awareness campaigns on the use of efficient cookstoves and build capacity among local artisans to source materials and make these stoves at a cheaper price—with a focus on making stoves that are able to use charcoal efficiently and meet defined energy efficiency.
- Investigating the illegal supply of charcoal into the region—an area that is not discussed as frequently as it should. Areas to consider are at what level this seepage is happening and who is doing it. This can help determine what actions to take to halt illegal production.
- Resources in initiatives that deal with sustainable charcoal production need to also target the charcoal producers—specifically to help them transition to more sustainable livelihoods—and the use of an association is the best practice in implementing this.

REFERENCES

- Ackello-Ogutu, C. and P.N. Echessah. 1998. Unrecorded Cross-Border Trade between Tanzania and her Neighbors: Implications for Food Security. Regional Trade Agenda Series, Technical Paper No. 89. Washington, DC: USAID, Office of Sustainable Development, Bureau for Africa.
- Ackermann, K., L. Kirtz, C. Andriamanantseheno, and S. Sepp. 2014. The Green Charcoal Chain. *Rural 21* 48.1/2014: 36-38.
<https://www.rural21.com/english/current-issue/detail/article/the-green-charcoal-chain-00001053/>
- Atteridge, A., N. Heneen, and J. Senyagwa. 2013. Transforming Household Energy Practices among Charcoal Users in Lusaka, Zambia: A User-Centred Approach. Stockholm, Sweden: Stockholm Environment Institute.
- Basu, A., R. Blavy, and M. Yulek. 2004. *Microfinance in Africa: Experience and Lessons from Selected African Countries*. IMF Working Paper No. 04/174. Washington, DC: International Monetary Fund.
- Brigham, T., A. Chihongo, and E. Chidumayo. 1996. Trade in Woodland Products from Miombo Region. Rome, Italy: Food and Agriculture Organization of the United Nations.
- Chidumayo, E.N. 2002. Changes in Iombo Woodland Structure under Different Land Tenure and Use Systems in Central Zambia. *Journal of Biogeography* 29.12: 1619-1626.
- Chidumayo, E.N. and D.J. Gumbo. 2013. The Environmental Impacts of Charcoal Production in Tropical Ecosystems of the World: A Synthesis. *Energy for Sustainable Development* 17.2: 86-94.
- Day, M., D. Gumbo, K.B. Moombe, A. Wijaya, and T. Sunderland. 2014. Zambia Country Profile: Monitoring, Reporting and Verification for REDD+ (Vol. 113). Center for International Forestry Research. Bogor, Indonesia: CIFOR.
- Dlamini, C., B. Moombe, S. Syampungani, and P.C. Samboko. 2016. *Load Shedding and Charcoal Use in Zambia: What are the Implications on Forest Resources*. IAPRI Policy Brief No. 85. Lusaka, Zambia: Indaba Agricultural Policy Research Institute.
- FAO. 2015. *Agriculture-Charcoal Interactions as Determinants of Deforestation Rates: Implications for REDD+ Design in Zambia*. FAO Policy Brief No. 6. Rome, Italy: FAO Economics and Policy Innovations for Climate-Smart Agriculture.
- FAO. 2017a. *The Charcoal Transition: Greening the Charcoal Value Chain to Mitigate Climate Change and Improve Local Livelihoods*, by J. van Dam. Rome: Food and Agriculture Organization of the United Nations. www.fao.org/forestry/energy.
- FAO. 2017b. Greening Zambia's Charcoal Business for Improved Livelihoods and Forest Management through Strong Producer Groups, by V. Ziba and S. Grouwels. Rome: Food and Agriculture Organization of the United Nations.
- FAO. 2018. Forest and Farm Facility Country Achievements – Zambia. Rome: Food and Agriculture Organization of the United Nations. Accessible at: (website changed to...

<http://www.fao.org/forest-farm-facility/en/> OR IS THIS THE ONE?
<http://www.fao.org/3/CA0517EN/ca0517en.pdf>

- GRZ. 2008. National Energy Policy, Ministry of Energy and Water Development, Lusaka, Zambia: GRZ.
- GRZ. 2015. The Forests Act 2015 of the Laws of Zambia. Lusaka, Zambia: GRZ.
- GRZ. 2017. National Investment Plan to Reduce Deforestation and Forest Degradation (2018-2022). Lusaka: GRZ Ministry of Lands and Natural Resources.
- Gondo, P.C. 2012. A Review of Forest Financing in Africa. Prepared for the United Nations Forum on Forests (UNFF). Harare, Zimbabwe.
- Gumbo, D.J., K.B. Moombe, M.M. Kandulu, G. Kabwe, M. Ojanen, E. Ndhlovu, and T.C.H. Sunderland. 2013. Dynamics of the Charcoal and Indigenous Timber Trade in Zambia: A Scoping Study in Eastern, Northern and Northwestern Provinces. Occasional Paper No. 86. Bogor, Indonesia: CIFOR.
- Helmenstine, M. A. 2019, November 5. Feedstock in Chemistry and Engineering. Retrieved from: <https://www.thoughtco.com/definition-of-feedstock-605121>
- Hibajene, S.H. and O.S. Kalumiana. 2003. Manual for Charcoal Production in Earth Kilns in Zambia. Lusaka, Zambia: Department of Energy, Ministry of Energy and Water Development.
- Johnson, W.O., H. Wanjiru, T. Taylor, and X.F. Johnson. 2018. Overcoming Barriers to Sustainable Charcoal in Kenya. Stockholm, Sweden: Stockholm Environment Institute.
- Kalinda, T., S. Bwalya, J. Munkosha, and A. Siampale. 2013. An Appraisal of Forest Resources in Zambia Using the Integrated Land Use Assessment (ILUA) Survey Data. *Research Journal of Environmental and Earth Sciences* 5.10: 619-630.
- Kapiyo, R.A. 1996. Wood Fuel Production, Consumption and Conversion Systems: A Paper Prepared for Participants of the Regional Training Course for the Promotion of Social Forestry in Africa. Nairobi, Kenya.
- Living Conditions Monitoring Survey (LCMS). 2015. Lusaka, Zambia: Central Statistical Office.
- Mabeta, J., B. Mweemba, and J. Mwitwa. 2018. *Key Drivers of Biodiversity Loss in Zambia*. Biodiversity Finance Initiative Policy Brief No. 3. Lusaka, Zambia: Biodiversity Finance Initiative.
- Minde, I.J. and T.O. Nakhumwa. 1998. Unrecorded Cross-border Trade between Malawi and Neighboring Countries. Washington, DC: US Agency for International Development. Office of Sustainable Development, Bureau for Africa.
- Mulenga, B.P., S.T. Tembo, and R.B. Richardson. 2018. Electricity Access and Charcoal Consumption among Urban Households in Zambia. *Development Southern Africa*. 36.5: 585-599. Published online: 03 Sep 2018. DOI: 10.1080/0376835X.2018.1517036.
- Mweemba, B. 2018. An Inventory of Existing Financing Solutions for Biodiversity Conservation in Zambia. Policy Brief No. 2. Lusaka, Zambia: Biodiversity Finance Initiative.

- Mwitwa, J., R. Mwila, and B. Mweemba. 2018. Policy and Institutional Review for Biodiversity Conservation in Zambia. Policy Brief No.1. Lusaka, Zambia: Biodiversity Finance Initiative.
- Richardson, R., L. Olabisi, N. Sakana, K. Waldman, and P. Grabowski. 2015. The Impact of Sustainable Intensification on Landscapes and Livelihoods (SILL) in Zambia. [Ibadan, Nigeria: International Institute of Tropical Agriculture](#). Accessed November 17, 2019. <http://mel.cgiar.org/xmlui/handle/20.500.11766/4797>.
- Sedano, F., J.A. Silva, R. Machoco, C.H. Meque, A. Siteo, N. Ribeiro, K. Anderson, Z.A. Ombe, S.H. Baule, and C.J. Tucker. 2016. The Impact of Charcoal Production on Forest Degradation: A Case Study in Tete, Mozambique. *Environmental Research Letters* 11.9: 094020.
- Sepp, S., C. Sepp, and M. Mundhenk. 2014. Towards Sustainable Modern Wood Energy Development. Bonn, Germany: Global Bioenergy Partnership.
- Syampungani, S. 2008 Vegetation Change Analysis and Ecological Recovery of the Copperbelt Miombo Woodland of Zambia. Ph.D. Thesis, University of Stellenbosch, South Africa.
- Tembo, S.T, B.P. Mulenga, and N. Sitko. 2015. *Cooking Fuel Choice in Urban Zambia: Implications on Forest Cover*. IAPRI Working Paper No. 94. Lusaka, Zambia: IAPRI.
- Vinya, R., S. Syampungani, E.C. Kasumu, C. Monde, and R. Kasubika. 2011. Preliminary Study on the Drivers of Deforestation and Potential for REDD+ in Zambia. Lusaka, Zambia: FAO/Zambian Ministry of Lands and Natural Resources.
- Vos, J. and M. Vis. 2010. Making Charcoal Production in Sub Sahara Africa Sustainable. Utrecht, The Netherlands: NL Agency.
- World Bank. 2012. Establishing a Green Charcoal Value Chain in Rwanda: A Feasibility Study. Washington, DC: World Bank. <https://openknowledge.worldbank.org/handle/10986/16760> License: CC BY 3.0 IGO.
- Zulu, L.C. and R.B. Richardson. 2013. Charcoal, Livelihoods, and Poverty Reduction: Evidence from Sub-Saharan Africa. *Energy for Sustainable Development* 17.2: 127-137.

