



Norwegian Ministry
of Climate and Environment

Liberia Forest Sector Project

Opportunities for Charcoal and Sustainable Forest Management



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Acronyms

AFC	Authorized Forest Community
CFMA	Community Forest Management Agreement
CFMB	Community Forest Management Body
FDA	Forestry Development Authority (of Liberia)
FIFES	(USAID-funded) Forest Incomes For Environmental Sustainability
FMC	Forest Management Contract
LFSP	Liberia Forest Sector Project
MJ	Mega-Joule
NACUL	National Charcoal Union of Liberia
t	metric ton
USAID	United States Agency for International Development

Exchange rate (Nov 2018): 156 Liberian dollars (L\$) to 1 US dollar (US\$)

Executive Summary

Introduction

The Liberia Forest Sector Project (LFSP) is a US\$37.5 million grant-financed project supported by the Government of Norway via a World Bank-managed Trust Fund. Under the LFSP framework, Liberia's Forestry Development Authority (FDA) sought to investigate the potential for charcoal production to provide livelihood benefits and improved incomes for forest communities, while incentivising sustainable management of forest resources. A charcoal specialist was contracted to explore these opportunities during a country mission in November 2018, assisted by staff of the FDA and the National Charcoal Union of Liberia.

Findings

Charcoal demand in Liberia is growing rapidly from an estimated 337,000 metric tons worth US\$46 million in 2018, due to ready availability, desirable performance characteristics and a lack of affordable alternatives. The industry is thought to employ up to 28,000 people on a 'full-time equivalent' basis, though many more in practice due to seasonal or part-time involvement. Prices are among Africa's lowest due to an abundance of raw material, dominance by part-time producers with low income expectations, minimal regulation and taxation, subsidised transport, a high degree of retail competition and value chain capture by well-resourced traders. There are no official statistics on industry scale, value or employment. An FDA transportation fee is set too low to incentivise enforcement and is also waived for small loads. Efforts to introduce industry regulation have proven unrealistic, due to capacity constraints and high compliance costs. While low prices and high efficiency inhibit the introduction of more formalised systems of production and supply, there is some potential to develop economically competitive alternative models, to introduce more realistic enforcement and taxation measures, and to set up systems for better monitoring of the industry.

Intervention Options

Three potential strategies are proposed for alternative business models that could be competitive with the business-as-usual charcoal industry:

- a) **Produce charcoal from sustainably managed community forests** close to the market, where transport costs can be undercut. Within 1-2 hours of Monrovia, remaining forests can be managed sustainably for their charcoal by Authorized Forest Communities, provided that agriculture is not permitted. Proximity to market can reduce haulage costs and permit higher pricing at source, from which a financial surplus could part-fund forest conservation.
- b) **Produce charcoal from logging residues** further away, where raw material costs can be undercut, under the framework of Forest Management Contracts (on public land) or commercial use contracts (on community forest land). Vast

quantities of waste from export-oriented logging operations are currently left to rot. Organised charcoal-making groups could be given controlled access to these residues. Various regulatory aspects need to be explored.

- c) **Explore premium charcoal export markets** where higher prices can be secured for legally traceable charcoal. Well packaged, value-added charcoal with quality and traceability branding could be exported, and this should be explored by potential partners already known to FDA. The obvious source of raw material would be residues from commercial logging operations, which produce significant quantities at concentrated locations and would ensure Voluntary Partnership Agreement compliance.

Measures are also proposed to:

- d) **Review the charcoal regulations and waybill fee.** Given FDA capacity constraints and high compliance costs, the 2017 Regulation on Sustainable Wood-Based Biomass Energy Production and Marketing is unlikely to be enforceable and a full review is proposed. A realistic aspiration would be proper application of the existing waybill system at checkpoints and an end to the current waiver for small loads. More ambitious regulations could be considered at a later date. There is a short-term need to increase the waybill fee for charcoal transport and to improve rates of collection, both to generate revenue for forest management and to provide an opportunity for sustainable charcoal to be incentivised by waivers. A fee of US\$0.32 per bag (10% of retail value, similar to the current rate of the Goods and Services tax) could net US\$4.6 million/yr while a higher tax US\$0.50 per bag (16% of retail value) could generate US\$7 million/yr, both rising significantly in the future.
- e) **Improve data on the charcoal industry.** There is a pressing need for data on the charcoal industry for rational planning and policy-making. A monitoring system at road and rail checkpoints is proposed to quantify charcoal arrivals to Monrovia, later extendable to other towns. This could provide an accurate estimate of market size and would allow supply to be quantified by route, timing and mode of transport. It could form the basis for a more ambitious knowledge and data platform on the charcoal industry, extending over time to investigate value, employment and livelihood implications.

Lastly, charcoal from dedicated energy plantations is not deemed economically viable, though could be a by-product of plantations established for other purposes. Briquettes made from salvaged charcoal dust have niche potential as BBQ fuel, but are unlikely to see mass adoption due to cost and performance limitations.

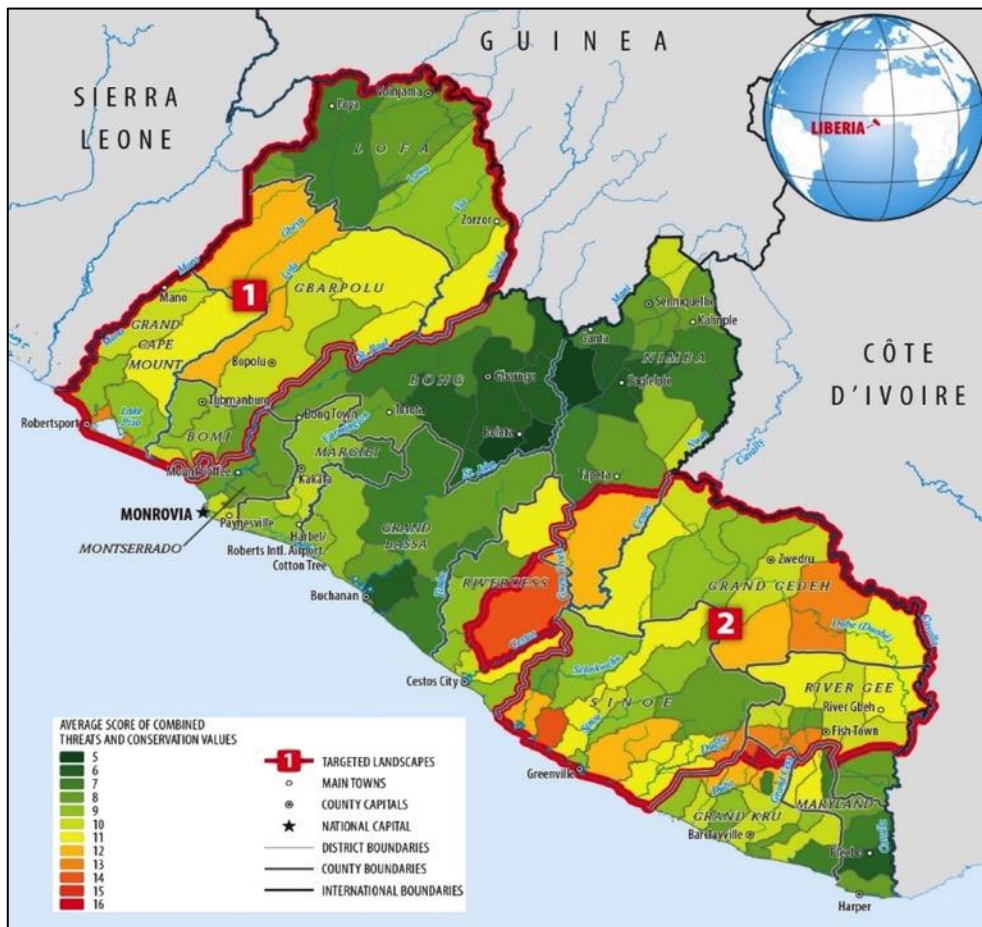
1. Introduction

1.1 Liberia Forest Sector Project

The Liberia Forest Sector Project (LFSP) is a US\$37.5 million grant-financed project supported by the Government of Norway via a World Bank-managed Trust Fund. With an overall Program Goal of “reduced deforestation and degradation in targeted forest landscapes”, the LFSP Project Development Objective is “Improved management of, and increased benefit-sharing in, targeted forest landscapes”.

The project targets two landscapes in the northwest and southeast of Liberia (Figure 1), selected based on a combination of conservation value and level of threat.

Figure 1. LFSP target landscapes



LFSP Component 2 aims to strengthen capacity for management of targeted forest landscapes. More specifically, Sub-component 2.3 (Community Forestry) is intended to support demand-driven activities which assist forest communities to:

- Strengthen community governance and institutions to manage community forestlands and common pool resources; (among other things, this involves supporting forest communities through a nine-step process which ends with

the signing of a Community Forest Management Agreement [CFMA] and the granting of Authorized Forest Community [AFC] status);

- Promote and support productive natural resource management investments; and
- Improve livelihoods by creating job opportunities and improving income from the use of communities' customary lands and forest resources.

It is under this Sub-Component that the Forestry Development Authority (FDA) expressed a wish during the most recent LFSP implementation support mission to explore the potential for charcoal to provide a source of community income that could also support forest management efforts.

1.2 Study Objectives

Under the framework of LFSP, the FDA sought to investigate the potential for charcoal production to provide livelihood benefits and improved incomes for forest communities, while incentivising the sustainable management of forest resources. Options to be investigated were: (i) the inclusion of sustainable charcoal in community-based forest management systems; (ii) charcoaling of wood residues left in the forests by commercial logging operations; (iii) interventions in the value chain to improve sustainability; (iv) production of charcoal from dedicated energy plantations; and (v) potential substitution with other fuels, including briquettes produced from food waste, crop residues or charcoal dust.

An independent biomass energy specialist was contracted by the World Bank to explore these opportunities. During a nine day mission to Liberia in November 2018, with the assistance of staff from FDA, the National Charcoal Union of Liberia (NACUL) and the USAID-funded Forest Incomes For Environmental Sustainability (FIFES) project, he visited charcoal production sites on customary land in Grand Cape Mount County, in commercially logged public forests in Lofa County and in an AFC area in Grand Bassa County. He consulted FDA, World Bank and FIFES staff and independent experts, as well as interviewing charcoal transporters, traders and buyers. The mission itinerary is in Annex A, a list of those consulted in Annex B and a bibliography in Annex C.

This report describes the nature of Liberia's charcoal industry, appraises areas of potential LFSP intervention and recommends appropriate actions for supporting sustainable charcoal during the remaining project period to June 2020. With a Mid-Term Review scheduled for early 2019, the opportunity to contribute ideas on charcoal is timely.

Provisional findings and recommendations were presented to FDA senior management and staff in Monrovia on November 16th 2018, and adjustments were made based on the feedback received. A list of those who attended the debriefing is in Annex D.

2. Findings

2.1 Charcoal in Liberia

Liberia's National Energy Policy estimates that at least 95% of the country's population depends on energy derived from biomass (Republic of Liberia, 2009). While firewood is the most common fuel in rural areas, charcoal dominates the urban energy sector. The last national census found that 70% of urban households use charcoal as their primary cooking fuel (rising to 85% in Monrovia), compared with 5% of rural households (Republic of Liberia, 2008). Actual usage rates are likely to be even higher due to the unrecorded use of charcoal as a supplementary fuel.

Despite the dominant role of biomass in energy supply, official data on the sector are not published. The last reliable study on biomass energy was conducted in 2011 and estimated that total demand for charcoal was 137,000 metric tons (t)/yr, of which 75% was consumed in Monrovia (van der Plas, 2011). Projected to 2018 in line with urban population growth, the equivalent figure today would be 183,000 t. This seems conservative and is significantly lower than 2018 estimates of 297,000 t derived from African Energy Commission data (AFREC, 2014)¹ and 313,000 t using projections from the UN Food and Agriculture Organisation (FAOStat, 2018)².

This author estimates demand for charcoal in 2018 to be higher still at **337,000 t**³, with an annual retail value of **US\$46 million**⁴.

Montserrado County, which includes Monrovia, dominates the market and accounts for over 65% of total demand, more than ten times greater than any other county (see Table 1 overleaf). The next largest centres of demand are Margibi (6.5%) and Bong (6%), both adjacent to Montserrado, with Nimba, Grand Bassa and Bomi ranked next, meaning that 90% of Liberia's charcoal is consumed through the country's central belt.

Given the market dominance of Monrovia, this report largely focusses on the charcoal industry feeding the capital. The principles are nevertheless applicable to other parts of central Liberia and will in due course be transferable to the rest of the country as urbanisation takes place and contributes to an inevitable continued rise in charcoal consumption.

¹ Based on an AFREC estimate for 2015 of 269,000 t and a projected growth rate of 3.4% p.a. in line with Liberian's urban population (World Bank, 2018).

² A projection extending FAO's 2010-2016 trend.

³ Assumptions: Urban pop. 2.37M; rural pop. 2.48 M (World Bank, 2018). 70.3% of urban HHs and 5.2% of rural HHs using charcoal as primary fuel (Republic of Liberia, 2008). Per capita charcoal consumption 140 kg/yr, based on 139 kg/yr in Nigeria (Ajao, 2011) and 140 kg/yr in Tanzania (Mwampamba, 2007). Balance of urban residents (29.7%) using charcoal as supplementary fuel consuming 27% less than primary users, i.e. 102.2 kg/yr (Alem, et al., 2017). No supplementary charcoal use assumed in rural areas.

⁴ L\$500 (US\$3.21) in Monrovia per bag averaging 23.5 kg (price from Central Monrovia Charcoal Sellers Association; average weight from G.Singh, Green Gold Liberia, based on sample weighing of 100 bags).

Table 1. Estimated charcoal demand in Liberia by county (2018)

County	Annual charcoal consumption (t)	Percentage of total
Montserrado	220,056	65.4%
Margibi	21,845	6.5%
Bong	20,315	6.0%
Nimba	18,708	5.6%
Grand Bassa	13,112	3.9%
Lofa	12,897	3.8%
Maryland	6,819	2.0%
Grand Gedeh	6,069	1.8%
Bomi	4,747	1.4%
Grand Cape Mount	3,323	1.0%
Sinoe	3,208	1.0%
River Gee	2,205	0.7%
Gbarpolu	1,828	0.5%
Grand Kru	668	0.2%
River Cess	811	0.2%
Total:	336,612	

Source: Total consumption from footnote 4. Percentages by county from census data (Republic of Liberia, 2008) based on number of households cooking with charcoal in rural and urban areas, multiplied by average HH size (5.00 urban; 5.37 rural), multiplied by per capita demand of 140 kg/pers/yr for primary users and 102 kg/per/yr for secondary users (sources in footnote 4).

The charcoal industry is thought to employ 27,000-28,000 people on a 'full-time equivalent' basis, comprising an estimated 14,500 people involved in production, transport and trade as their main occupation, and 23,500 involved on a seasonal or part-time basis⁵.

These are estimates drawn from research in other African countries. While the 'full-time equivalent' figure may be reliable (as production methods and the value chain structure in Liberia are typical of other countries, and labour inputs are likely to be comparable), the proportion of those involved part-time may in reality be somewhat higher, as the majority of charcoal in Liberia is a by-product of tree clearance for farming or the removal of over-aged rubber trees, which are seasonal or one-off production opportunities carried out by part-time producers.

⁵ Estimate of 27,000 comes from comparison with Malawi, where 17,590 'full-time equivalent' workers supply 221,290 t of charcoal (MARGE, 2009). Estimate of 28,000 comes from comparison with Tanzania, where 45,000 full-time plus 72,500 part-time value chain actors produce 1,035,905 t of charcoal (Tanzania Forest Conservation Group, 2018). Both figures scaled to Liberia market of 336,612 t.

2.2 Growth of the charcoal market

It is important to be realistic about the future development of the charcoal market in Liberia. As noted by Jones (2015), “there is a great need to identify real versus perceived energy futures with respect to charcoal.” Despite the aspirations of modern energy advocates, a large-scale transition to non-biomass energy sources will only occur once a certain income threshold is met. In the meantime, due to its availability, familiarity and low cost compared with potential alternatives such as liquified petroleum gas (LPG), demand for charcoal will continue to rise steadily.

Table 2 compares the current cost of cooking with charcoal, LPG and electricity

Table 2. Cost of cooking with different energy sources in Monrovia (Nov 2018)⁶

Energy source	Cost	US\$/unit	Unit	MJ/unit	Stove efficiency	US¢ per delivered MJ
Charcoal (sack)	L\$500/23.5 kg	0.136	kg	29	27.5%	1.7
Charcoal (plastic bag)	L\$40/1.8 kg	0.142	kg	29	27.5%	1.8
LPG	US\$35/12 kg	2.92	kg	46.3	48.0%	13
Electricity	US\$0.39/kWh	0.39	kWh	3.6	42.0%	26

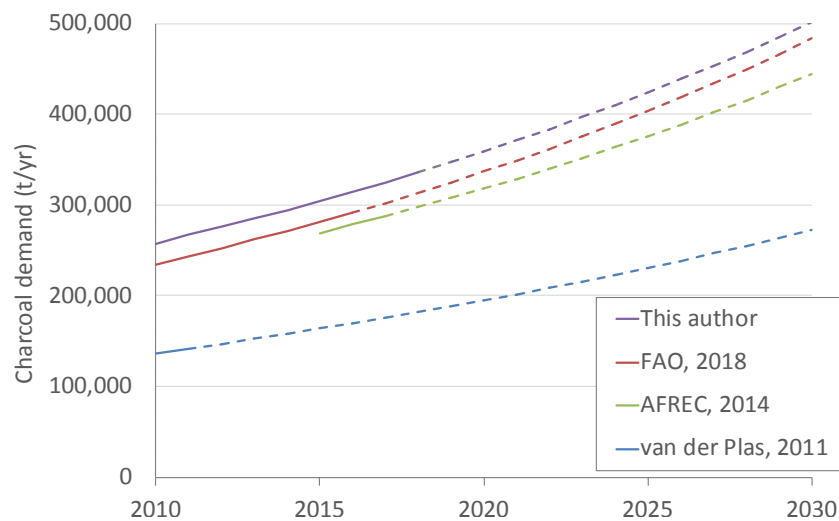
The figures suggest that charcoal is by far the cheapest urban cooking fuel and is available for less than US¢2 per unit of energy (Mega-Joule; MJ) delivered to the cooking pot. LPG is more than seven times as costly, while cooking with electricity costs 15 times more.

Even with large increases in income, the transition away from charcoal will only be partial – a recent study in Tanzania found that households switching from charcoal to LPG as their primary cooking fuel experienced only a 27% average reduction in charcoal consumption (Alem, et al., 2017) due to its continued use as a supplementary source of energy (a practice known as ‘fuel stacking’). There are certain dishes that even more affluent people prefer to cook on charcoal for reasons of taste or culture.

Given its price advantage, ready availability, cultural affinity and the fuel stacking phenomenon, evidence from other African countries suggests that growth in demand for charcoal in Liberia will track the rate of urban population growth. With an urban growth rate of 3.4% p.a. (World Bank, 2018), charcoal demand has a doubling time of 20 years and may exceed 500,000 t by 2030. See projections in Figure 2.

⁶ Charcoal & LPG prices: author’s research. Electricity tariff: www.lecliberia.com/?s=tariff Charcoal energy content: www.fao.org/docrep/x2740e/x2740e05.htm#P3854_103806 Kerosene energy content: www.claverton-energy.com/wordpress/wp-content/uploads/2012/08/the_energy_and_fuel_data_sheet1.pdf Charcoal stove efficiency: (van der Plas, 2011) LPG stove efficiency: www.ijert.org/download/4305/performance-of-lpg-cooking-stove-using-different-design-of-burner-heads Electric stove efficiency: www.aceee.org/files/proceedings/2014/data/papers/9-702.pdf

Figure 2. Projected demand for charcoal in Liberia (2010 to 2030)



As previously mentioned, an estimated 65% of all charcoal is consumed in Monrovia and a further 25% in the other counties of Liberia's central belt.

Against this backdrop of a large, valuable and fast-growing market for an energy source on which urban Liberians are highly dependent, it is important to see charcoal as a mainstay of domestic energy security. The industry requires recognition, support and investment to become part of the formal, mainstream economy, providing sustainable benefits to those in the value chain while at the same time incentivising sound forest management.

2.3 Charcoal value chains

The Liberian charcoal industry is made up a variety of overlapping systems for production, transport and trade. There is no standard value chain, but multiple arrangements for sourcing, production, transport and sale from rural sources to urban consumers. Understanding these arrangements is key to identifying opportunities for intervention.

2.3.1 Sourcing

Liberia's charcoal comes either from **indigenous hardwoods** or from over-aged **rubber wood** (*Hevea brasiliensis*). Charcoal production from other farm-grown species (e.g. mango) is negligible, given the relative abundance of naturally growing trees and a weak tradition of private forestry. Hardwood charcoal is known as 'iron coal' and is considered superior due to high burn temperature and low ash content. It can reportedly be distinguished by its high density and surface sheen. Estimates vary of the relative proportions of the two types in the market, with one local expert estimating that up to 75% of charcoal in Monrovia comes from rubber trees, with supply dominated by plantations being cleared and replanted in Margibi County (Charles

Miller, pers. comm.). The charcoal is made from trees aged 25-30 years from which latex production has declined. Supply is expected to continue for the foreseeable future, as rubber trees are cleared and re-planted in rotation as part of the commercial life cycle of a plantation. This means that a significant (but as yet unquantified) proportion of Liberia's charcoal comes from sustainable sources. Separate research is being undertaken under LFSP into the rubber industry that should generate more reliable estimates of the contribution of these trees to charcoal supply.

Indigenous charcoal is meanwhile typically sourced from forests from which the high value timber species have already been selectively extracted. Sometimes this forest is being cleared for the first time, but more typically the charcoal comes from secondary re-growth in areas of shifting cultivation. In fact 'clearing of land for farm purposes' was the largest source of charcoal in a recent study of natural resource value chains and accounted for 39.1% of production sites (UL-PIRE, 2016). The income generated from charcoal production often subsidises the opening (or re-opening) of forest land for farming, dominated by cassava production, and the close association between charcoal production and agriculture makes it difficult to identify the primary driver of the degradation process. The peak clearing season is November to March, which is the dry period when new land is being opened up for planting crops.

2.3.2 Production

There is a cadre of **professional charcoal producers** who depend on charcoal burning for their livelihoods. They operate mainly within two hours' truck journey (100 km) of Monrovia and are producing exclusively for the capital. They typically work in conjunction with the owner or occupier of a piece of forested land that is being opened up for cultivation. The owner usually fells the trees and begins preparing the land for planting, then brings in a specialist team to cross-cut the logs and convert them to charcoal. He/she is compensated either by receiving a portion of the final product (e.g. two bags for every ten produced) or a cash payment. Such payment may be based on a visual estimation of the wood on the land, or quantified according to the gallons of petrol required to cross-cut the wood with a chainsaw. The gallon is the standard metric of charcoal production. A professional producer may produce up to 500 bags of charcoal from a single '12 gallon' kiln (i.e. 12 gallons of chainsaw fuel required to prepare the charge). These producers work to pre-arranged orders and line up the transport and buyer before they begin.

The market is also supplied by **short-term charcoal producers**. It is standard practice for almost any farmer to make charcoal as they clear their land. They may hire a chainsaw operator to cross-cut the trees and will then typically prepare the kiln, carbonise the wood themselves and haul it to the nearest roadside for sale. Output volumes tend to be lower and short-term producers burn anything from a handful of

bags at a time up to 175-200 in a '5 gallon' kiln. The average bag weight is 23.5 kg⁷. While these producers may sometimes have a pre-arranged buyer for their output, they are equally likely to rely on spontaneous purchase by passing traffic or will haul their bags to the closest town in small volumes (e.g. by motorbike) to try and find their own customers.

Charcoal by the gallon

Commercial 'chainsaw millers' are hired to cross-cut logs for charcoal production. Given the difficulty in judging the quantity of wood to be prepared, they are typically paid per gallon (3.8 litres) of petrol consumed. The going rate averages L\$1,550 (US\$9.95) per gallon, comprising L\$610 (US\$3.90) for petrol, L\$100 (US\$0.65) for 2-stroke oil, L\$40 (US\$0.25) for chain oil and the balance of around L\$800 (US\$5.10) for the saw owner's labour and the purchase and maintenance of the saw itself. The petrol is the most expensive quantifiable input, hence it is common for chainsaw millers to underfill their tank, bleed off fuel or find other surreptitious means by which to short-change the client.

35-40 bags of charcoal can usually be produced from a 'gallon' measure of wood. With an average bag weight of 23.5 kg and an estimated earth kiln efficiency of 19% by air dried weight (Kimaryo & Ngerenza, 1989; CAMCO, 2014), one gallon of chainsaw work will prepare between 4.3 and 4.9 t of wood, for an output of 820-940 kg of charcoal.

The system of self-production is usually associated with small areas of land clearance, while dedicated charcoal burners will typically be brought in when larger blocks need to be 'cleaned of sticks'. It is also more common to find professional charcoal producers operating along main roads leading to urban centres where they can sell large volumes to a single buyer with a suitably large truck, whereas short-term producers generally operate in more remote areas servicing local markets with fewer bags. But the distinction between the two groups is blurred and it is also possible for a part-time or occasional charcoal-maker to engage in large-scale production, or for a small-scale land-owner to hire professional charcoal burners (an example would be a widowed or unmarried woman with insufficient labour to do the work herself).

Charcoal is produced exclusively with the basic earth kiln, a traditional method of charcoal making used across Africa. Conversion efficiency is likely to be around 19% by air dried weight (Kimaryo & Ngerenza, 1989; CAMCO, 2014). While this may not be as high as recovery from brick kilns or retorts (which might reach 25% if well managed), the earth kiln is free, fully mobile, infinitely size-flexible and a good fit for the informal system of charcoal production that dominates the sector. Experiences of 'improved' kilns' have been largely unsatisfactory, as the high costs (in time, labour or cash) of hauling wood to central carbonising sites are not offset by the marginal improvements in recovery rates that may be achievable.

⁷ Pers. comm. G. Singh, Green Gold Liberia, based on sample weighing of 100 bags.

The fact that charcoal kilns in Liberia tend to be relatively small, with '1 or 2 gallon' kilns (35-80 bags) typical, suggests that the self-production model is dominant, with land owners focussed more on the agricultural potential of the land being cleared than the incidental yield of charcoal. It may also reflect high levels of poverty and the need to turn around the load rapidly to generate cash. Certainly the price of charcoal at source in Liberia is extremely low compared with other countries, which reflects abundant supply and the part-time engagement of many producers. Ex-kiln prices average just US¢6-7/kg⁸, compared with US¢11/kg in Kenya and Tanzania (Practical Action Consulting, 2018a).

2.3.3 Transport

Most vehicles on the roads heading to Monrovia and other major towns carry at least one bag of charcoal. It is a ubiquitous commodity transported using every available conveyance from private cars to government vehicles, from public taxis to empty container lorries, and from small pick-ups to dedicated trucks (Figure 3). Part-time producers tend to feed small volume, spontaneous roadside purchase by passing traffic, while professional producers are more likely to be supplying the bulk, dedicated charcoal transporters. Some modes of transport (e.g. private or government vehicles, or empty backhaul lorries) incur no additional cost by carrying charcoal so are effectively offering subsidised carriage.

Figure 3. Various modes of charcoal transport



Bulk transporters are required to pay FDA a fee of L\$2.50 (US¢1.6) per bag for a charcoal waybill at the first checkpoint they encounter en route to market. These are positioned at county boundaries or strategic road junctions. Once in possession of the waybill, they should not be asked to pay again at subsequent checkpoints.

The L\$2.50 rate is reportedly stipulated in government policy (Gertrude Nyaley, pers. comm.) although the source is unknown⁹. The revenue collected is meant to go to the government's Consolidated Fund, overseen by the Ministry of Finance, though FDA is not able to provide any information on the amount raised. A new Regulation No. 119-17 on *Sustainable Wood-Based Biomass Energy Production and Marketing in Liberia* stipulates a higher waybill fee of either US\$5 or 10 per load (depending on whether a

⁸ L\$200-250 per 23.5 kg bag.

⁹ A different fee of L\$5/bag to bring charcoal into the town of Buchanan was reported by charcoal producers in Barconnie, Grand Bassa County.

transporter is a member of a registered association), but this has not yet been introduced.

Although a carbon copy of each waybill is supposed to be sent to FDA headquarters by checkpoint staff, there are no collated records of these payments - hence no estimate of the quantity of charcoal being transported or the revenue collected. This is clearly a major data gap. Observations at a sample of checkpoints and interviews with traders suggest that unreceipted payments and hand-written 'receipts' are both common. This seems to be openly acknowledged and charcoal traders are quite willing to show their hand-written receipts if asked.

Loads of fewer than eight bags of charcoal are considered exempt from the waybill fee; and charcoal reaching Monrovia by train is not recorded. Thus even if data from the official waybill copies was collated, it would grossly under-estimate the quantities being transported. The small load exemption is maintained in the 2017 Regulation.

If enforced and monitored, a system of payment at checkpoints offers an ideal mechanism for both collecting revenue from the charcoal industry and for quantifying urban demand. This should be particularly simple for Monrovia, given that there are only three major incoming roads (plus one rail line). The fact that receipting is inconsistent, remittances are unknown and a waybill exception is granted for small loads means that a significant opportunity to collect revenue and collect data is currently being missed.

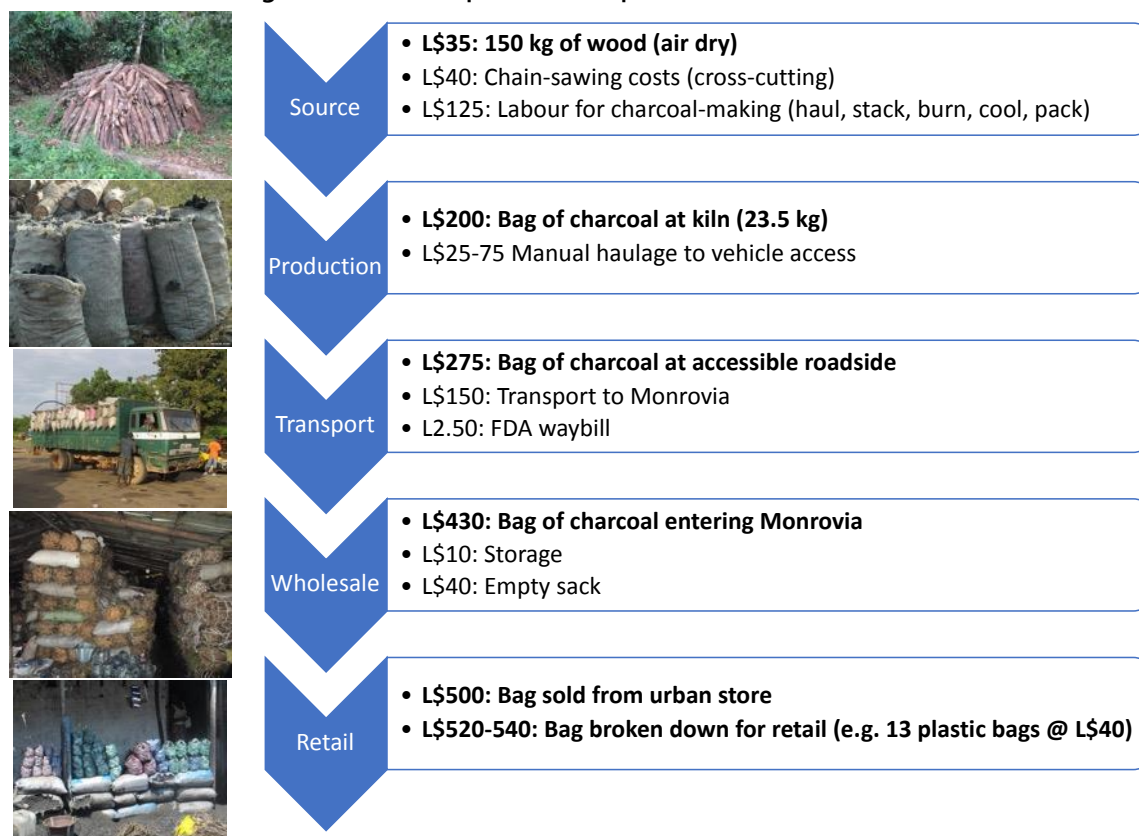
2.3.4 Sale

Incoming charcoal is usually stored at urban warehouses (for a fee of L\$10-15 per bag), to provide a buffer stock that covers traders for delivery delays caused by rain and poor roads. Some traders (exclusively men) sell the bags directly on to customers at a typical price of L\$500 (US\$3.20) in central Monrovia (and perhaps L\$450 [US\$2.90] in peripheral areas like Paynesville). This equates to L\$19-21 (US\$12-13) per kg.

Other traders (exclusively women) buy the whole bags and break them down into a bewildering variety of retail sizes and nuanced quality grades according to chunk size, density, appearance and dust content. At least four plastic bags sizes are commonly sold, each in different quality grades. A 23.5 kg sack wholesaling at L\$500 can produce 9 plastic bags retailing at L\$60 or 13 retailing at L\$40, giving a slim retailer profit on the whole sack of L\$20-40 (US\$13-26). This is a business of tiny margins and high turnover.

The full price-build-up from source to retail is summarised in Figure 4.

Figure 4. Charcoal price build-up, rural Liberia to Monrovia



Source: Field research. Assumes source area approx. 100 km or 2 hrs from Monrovia. For closer locations, ex-kiln price would be higher and transport cost lower.

At just US¢14/kg by the sack and US¢15/kg in smaller plastic bag sizes, Liberia has some of the lowest charcoal prices in Africa. In West African Sahelian countries, charcoal retails at US¢37-40/kg when sold by the sack (van der Plas, 2011), while prices in East Africa are significantly higher. For example, US¢48/kg in Rwanda where most charcoal comes from private plantations and reflects the full costs of production, and US¢65/kg in Tanzania, where charcoal is transported over very large distances (ibid.).

Prices in Liberia are suppressed due to:

- an abundance of raw material generated from annual forest clearance for farming and from over-aged rubber trees;
- dominance of supply by part-time producers with low income expectations, for whom charcoal is an incidental opportunity linked to crop production;
- minimal taxation due to weak enforcement of waybill charges and a fee waiver for small volumes;
- 'subsidised' transport by free or cheap carriage on non-dedicated vehicles;

- intense retail competition due to low entry barriers and high levels of unemployment, which make retail charcoal sales, even with minimal margins, commercially attractive; and
- increasing value chain consolidation by dominant players.

The last of these is a particularly significant trend. Urban charcoal sellers were historically distinct from transporters and simply offloaded bags at city stores for onward sale to the public or retail breakdown. In the face of intense competition, there has reportedly been a tendency for better capitalised charcoal traders to capture a growing portion of the value chain in order to cut out transporter middlemen and maximise revenue capture. They now routinely buy their own charcoal in bulk at the source and contract a truck owner to carry it to the city, where they own significant stock which they sell directly to end-users or to the female retailers described above. It is common for these large buyers to pre-finance production by sending empty sacks to the production site in advance and covering chain-sawing costs. Some are now even producing charcoal themselves using contracted professional teams and paying to have it hauled to a roadside and brought into the city. This emerging class of 'charcoal kingpin' owns the wood right from the source to the point of final purchase.

With this trend towards consolidation in the industry, a small number of well-resourced individuals are becoming increasingly powerful by capturing maximum value through the supply chain by eliminating intermediaries. This is reinforcing the downwards pressure on prices as individuals who occupy only one niche (e.g. production, transport or sale) are effectively competing with powerful rivals who have captured the whole value chain. Together with the other price pressures listed above, this means that charcoal prices are likely to remain suppressed from the source through to the point of sale, which makes it particularly challenging to find an entry point for more sustainable approaches that could generate revenue to finance sustainable forest management.

2.4 Rules and Regulations

The charcoal sector is officially governed by Regulation No. 119-17 on *Sustainable Wood-Based Biomass Energy Production and Marketing in Liberia*, which received FDA Board approval in May 2017 and was officially gazetted in October 2017, under the provisions of the National Forestry Reform Law (2006).

The Regulation sets out to:

- 1) Provide guidelines on the legal requirements for producers, transporters, and traders, on a small or large scale, engaged in the wood-based biomass energy (fuel wood, charcoal, briquettes, etc.) business in order to optimize its positive benefits and also mitigate its negative effects.

- 2) Establish a structured process by which authorization for wood-based biomass energy production and marketing/trade is requested, reviewed, and granted or denied.
- 3) Ensure that wood-based biomass energy production and marketing/trade is carried out in an environmentally appropriate manner and through procedures and practices that promote the mutual interests of producers, traders, communities and sustainable forest management in the Republic of Liberia.

(Republic of Liberia, 2017)

Running to 14 pages, the Regulation requires charcoal producers and sellers to register themselves in associations and to apply for a series of permits for each stage in the supply chain (including Forest Use Permits, Production Licences and Transportation Permits, with additional documentation required for sale and export).

Included in the appendices are:

- a list of 51 tree species that may not be felled for charcoal production;
- a schedule of registration fees for producers, transporters and exporters; and
- a schedule of volume-specific fees for production, transport and export.

Most FDA staff seem unaware of the Regulation and there has been no concerted attempt at implementation. None of the required forms are available from FDA and there are no application and approval systems in place for industry actors who might seek to comply.

The fact that the basic payment and recording requirement for charcoal waybills at checkpoints is not being implemented offers a cautionary lesson about the enforceability of other, more complex rules pertaining to the industry. If the cost of compliance exceeds the cost of evasion, then those who produce, transport and trade in charcoal will always opt for evasion; and in this course of action they find ready cooperation from corruptible or uninformed officials. It seems clear that the 2017 Regulation is not enforceable and that more realistic rules are needed, which industry players can comply with and which FDA officials can enforce.

3. Intervention Options

3.1 Introduction

As the previous section has outlined, charcoal is in high demand in Liberia and the market is growing rapidly (from an estimated 337,000 t worth US\$46 million in 2018) due to urban population growth, the fuel's attractive performance characteristics, ready availability, low price and a lack of affordable and acceptable alternatives.

Prices are some of the lowest in Africa due to an abundance of raw material as a by-product of agricultural clearance, the involvement of many part-time producers with low income expectations, a virtual absence of regulation and taxation, 'subsidised' transportation by non-specialist vehicles, a high degree of retail competition due to low entry barriers and increasing consolidation in the Monrovia market by dominant players. Despite fast-growing demand, these factors mean that prices are likely to remain suppressed. The industry meanwhile operates entirely in the informal sector and there are no official statistics on production, trade, use or employment. Supply channels are nevertheless highly structured and efficient, with reliable year-round availability in all towns.

Low prices, informality and high efficiency present significant barriers to the introduction of more formalised systems of production and supply from sustainably managed forests, because such systems have financial implications that the current low pricing structures cannot support. LFSP seeks to add value to forests that will enhance prospects for conservation and provide additional income to communities. However, more sustainable arrangements that increase community benefit will inevitably cost more than the prevailing charcoal supply system which – for the reasons explained – has low costs and downwards price pressure. Models for sustainable charcoal are needed that can compete with mainstream charcoal, and at the same time meet the conservation and benefit-sharing objectives of forest sector development.

This will either require a reduction in costs or the addition of value. Three potential strategies are proposed for finding this competitive edge:

- a) Produce charcoal from sustainably-managed community forests close to the market, where transport costs can be undercut.
- b) Produce charcoal from commercial logging residues further away, where raw material costs can be undercut.
- c) Explore premium charcoal export markets, where higher prices can be secured for legally traceable charcoal.

These options are elaborated below (3.2 to 3.4). This is followed by additional proposals on regulatory review (3.5), data collection (3.6) and options of secondary potential (3.7).

3.2 Charcoal from forests close to the market

Given the overwhelming dominance of Monrovia as a market for charcoal, demand in a given location is governed primarily by road distance to the capital. The frontier of charcoal harvesting is advancing outwards as prime resources are depleted. This advancing limit of demand does not follow an arc of equal radius, but is distorted outwards by the paved road network: it may be viable to haul charcoal 150 km from locations close to arterial highways, while there may be little demand from areas just 80 km from Monrovia which have only dirt road access. In general, however, demand is advancing outwards and its limit has reached 3 hours / 150 km from Monrovia where there is all-weather road access.

Areas closest to the city tend to be the most densely populated and are coming under permanent cultivation. The remaining forests here are highly degraded and revenues from charcoal production are minimal at landscape scale. It is an occasional or supplementary income-generating opportunity for farmers when remaining trees are being cleared. Given also that these over-worked areas have low biodiversity value, they are unattractive for intervention from both an economic and conservation point of view.

Further away are areas now well within the viable demand radius of Monrovia (sometimes known as the 'urban woodshed'). Charcoal prices here are attractive as transport distances are still relatively short. This price margin over more distant supply areas can potentially be leveraged to generate surplus revenue for community-based forest conservation.

These areas are under intense pressure from agricultural conversion. The standard procedure, described in the previous chapter, would be to clear the remaining forests for cropping on a block-wise basis and produce charcoal from the felled trees under a traditional system of shifting cultivation. Recovery times are now too short to allow these forests to fully regenerate and they are being progressively degraded due to shortening fallow periods.

An alternative model would see these forests protected and managed sustainably for their charcoal. Crucially, agriculture would not be permitted.

These are specific locations:

- within 2 hours of Monrovia (to keep transport costs below L\$100 per bag);
- close to paved roads (for maximum market access);
- where intact forest resources remain (and are thus worthy of protection and can yield viable charcoal volumes); and
- within the zone of current demand (under intense threat of conversion to agriculture under the pressure of an expanding population).

Accessibility to the Monrovia market means that inbound transport costs from these locations are lower than more distant source areas. It is this differential in haulage costs that can permit higher charcoal pricing and a financial surplus that could part-fund forest conservation and slow down the conversion of forests to farms - if appropriate management systems are put in place.

The first set of proposed interventions would therefore see charcoal sourced sustainably from Authorized Forest Communities (AFCs)¹⁰ in the Monrovia supply zone. The implementing regulations of the Community Rights Law already provide an appropriate legal basis for integrating charcoal production within Community Forest Management Plans (CFMPs), but this opportunity has not been sufficiently highlighted to communities, as the focus has been on the potential for timber harvesting. It has also been common practice for communities to be guided towards a two-tier zoning of 'core areas' of high conservation value and a 'greater landscape' for consumptive use. Critically, this wider landscape is usually zoned for agriculture.

The change being proposed is that part of the community forest is designated for consumptive use that does *not* include agriculture. It would be an intact block of forest from which high value timber has most likely been extracted already, but which has not yet been settled (and is now under threat).

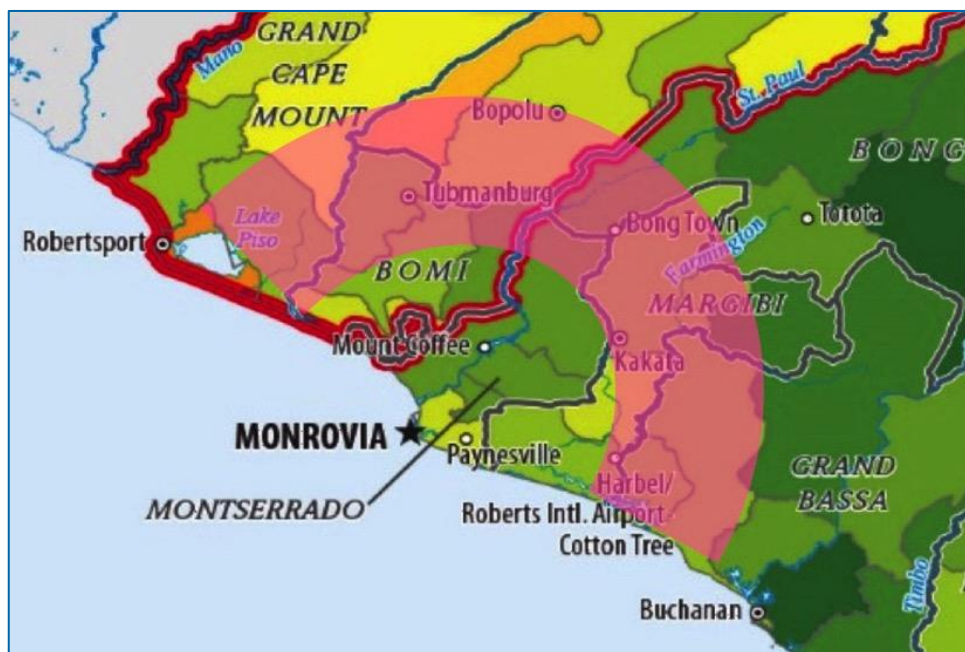
The most appropriate silvicultural system for sustainable, extractive management will be one based on frequent, light silvicultural thinning that removes the lower valued trees in favour of the higher valued trees (Hagen, 2016). Relative values of tree species should be decided by the community. Management blocks of forest would be divided into cutting units based on the number of years between thinning. If a management block is managed on a 10-year cutting cycle between thinning, then it would be divided, in the management plan, into ten equal cutting units (ibid.). This model has been operating in community-managed woodland in Tanzania for the last five years, with rotating blocks of charcoal production from woodland in Morogoro Region under the control of Village Natural Resource Committees, very similar to Liberia's Community Forest Management Bodies¹¹.

See Figure 5 for the approximate belt of land considered suitable for this production model.

¹⁰ Customary land is one of four categories recognised in the Land Rights Act. It is "owned by a community and used or managed in accordance with customary practices and standards" (Republic of Liberia, 2018).

¹¹ See <http://mjumita.org/what-we-do/projects/charcoal/index.htm>.

Figure 5. Potential zone for charcoal production in AFCs



There are currently no areas under AFC status within this belt, but this does not mean that suitable threatened forest blocks do not exist. Areas where the model could be trialled require discussion between FDA and local communities, and will depend to some extent on the applications so far received for AFC status - and of course the presence of charcoal-yielding forests that communities are willing to protect from cultivation.

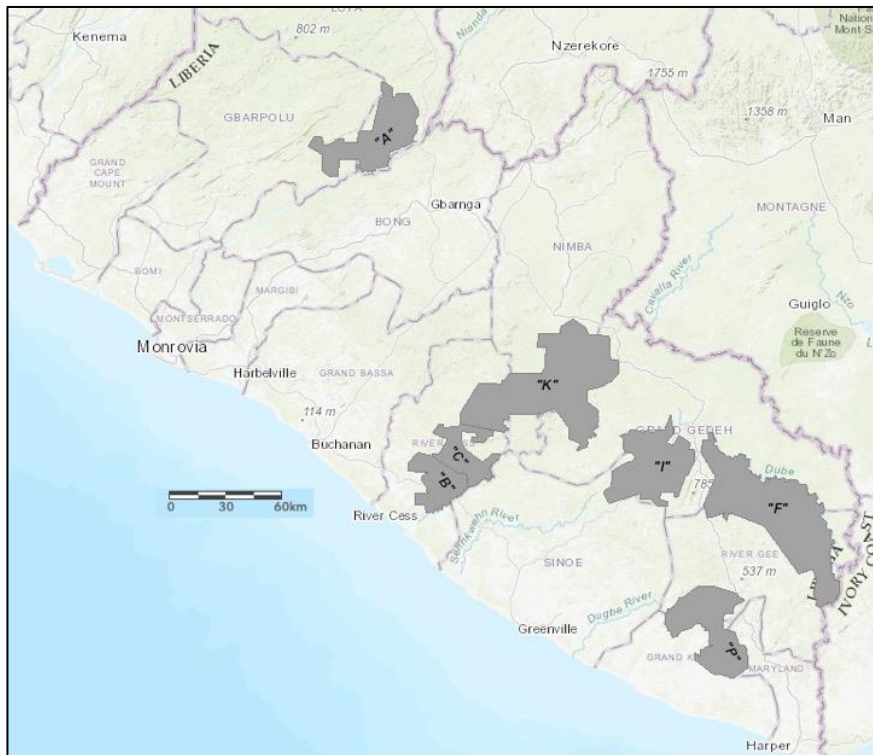
The optimal area within the current LFSP target landscapes may be Bomi County, due to proximity to Monrovia. Other source areas in Bong, Margibi and Grand Bassa Counties are outside the target landscapes but may also have suitable forest remnants that could be brought under sustainable management for charcoal production by AFCs if there was flexibility in LFSP zoning. There is perhaps an opportunity to include them after the upcoming Mid-Term Review.

3.3 Charcoal from logging residues

The second alternative charcoal production model is linked to commercial logging operations on customary or public land¹². Large-scale commercial logging is being carried out in public forests by seven companies under 25 year Forest Management Contracts (FMCs) with the FDA, the first of which were signed in 2009. The FMC locations are shown in Figure 6.

¹² Public land is “acquired by government through purchase, seizure, gift or otherwise and is not presently used by government for its facilities or operations” (Republic of Liberia, 2018).

Figure 6. Forest Management Contracts in Liberia



Source: <http://lbr-data.forest-atlas.org/>

Logging is also permitted on customary land under commercial use contracts that AFCs sign with commercial operators for longer-term forest exploitation rights. Vast quantities of waste are generated from these export-oriented logging operations and are currently left to rot. This material is of no commercial interest to the concession-holders themselves, but is currently not made available to other potential users.

Residues are left at two locations: (a) at the felling sites within the forest, where the tree stump, crown and branches are left behind as the trunk is skidded out; and (b) at consolidated log landings, where the wood is graded and scaled in preparation for outwards haulage by truck, generating large volumes of off-cut buttresses and rejected trunks (Figure 7). The material at the landings is particularly attractive for potential salvage as it is at consolidated locations and easily accessible.

Figure 7. Residues from commercial logging operations



Residues in the forest



Residues at landings

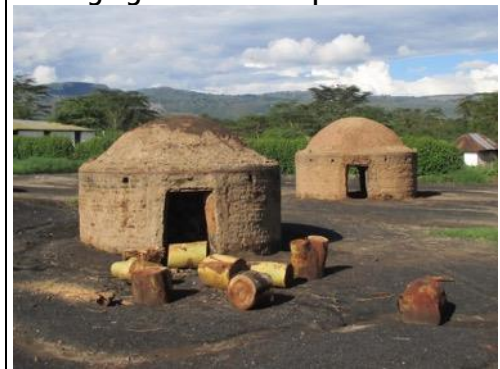
Residue generation varies considerably depending on species and local practices. The best available estimate assumes 60% wastage from Liberian commercial forestry operations and total annual availability of 6,898 million t of air dry wood (Milbrandt, 2009). At 19% conversion by weight this could produce 1.3 billion t of charcoal/yr. – close to 4,000 times current national demand!

If the wood at the landings was made available for community use, then charcoal burners could potentially avoid the raw material costs incurred when acquiring wood from cleared farmland. Most of the commercial timber source areas are relatively distant from Monrovia on poor roads, so charcoal production in these locations is only likely to be commercially viable with free inputs. The closest FMC to the Monrovia charcoal market is Alpha Logging and Wood Processing in Lofa County (Zone 'A'), where the access road from Gbarnga is being upgraded and surfaced to within 5 km of the first log landing site. Areas of community forests which have been granted to a third party under a commercial use contract may also have potential for use of waste wood for charcoal production where they lie within 4-5 hours of Monrovia.

The proposed intervention would see organised charcoal-making groups given controlled access to the grading and scaling residues at the landings. A condition of their operation could include the use of permanent brick kilns (Figure 8), which would yield higher quality and better yields, while avoiding uncontrolled spread of the operation.

There are other issues to consider with this potential production model. For example:

Figure 8. Half orange kilns suitable for high grade charcoal production



- (a) A new set of guidelines would need to be developed and enforced to permit community access to FMCs and areas in community forests that have been granted to a third party under a commercial use contract, under appropriate benefit-sharing mechanisms. This would require negotiations between the FDA, the contract-holders and community stakeholders, probably via the National Union of Community Forestry Development Committees. This is a political issue due to sensitivity around land ownership and access rights, which could take time to resolve.
- (b) On public land in particular, commercial logging firms who have signed 25 year FMC agreements might feel it unreasonable that the terms of those contracts were being altered to allow community access to their designated blocks. They might expect compensation, at least for the costs of managing community members' access, and it is unclear how this could be financed, given the small margins in the charcoal business. While discussions on site in

Lofa suggest no interest in charcoal production on the part of the FMC operator as this is simply not their core business, a formal discussion at management level would nevertheless be worthwhile to explore whether the company might consider producing charcoal itself, rather than out-sourcing the opportunity to local communities.

- (c) Limited access under strict terms could be difficult to enforce, and even charcoal-making at temporary camps at log landing sites might become a pretext for illegal incursion into the forest (e.g. for timber extraction or poaching) and could lead to demands for additional community benefits that might become unmanageable. It could be especially challenging to control access in community forests areas because concession holders would be there for a shorter time (so may lack motivation to enforce restrictions) and the communities themselves might feel entitled to move in because it is their land.
- (d) The timber waste is likely to have greater value for pit-sawing than charcoal-making. If access was permitted then it is probable that community members would opt for conversion to planks, from which profits will be greater. This would also be an excellent community enterprise opportunity that should not be overlooked. The charcoal opportunity would be relatively minor, using rejected wood or small-size residue. Differential charging might be required according to residue quality, which would be difficult to manage.

None of these issues is insurmountable, and it is clearly both wasteful and illogical for such large volumes of biomass to go unused.

3.4 Export to premium markets

A further way to intervene in the low-priced charcoal industry would be to identify higher-paying market opportunities that could support a more formal, traceable chain of supply and increase revenue for forest communities.

Well packaged, value-added charcoal with quality and traceability branding could potentially be sold in small bags via local supermarkets targeting the urban middle class. But this market segment is so small in Liberia that such a venture would have minimal impact and may be commercially non-viable.

A more significant opportunity with less price sensitivity would be the international export market, which Liberia is well placed to serve due to its coastal location and relative abundance of high grade raw material. The potential target would be the European BBQ market, via small-pack retail sizes (see Figure 9 for examples).

Figure 9. Examples of charcoal branding for premium markets



One company has reportedly already expressed interest to the FDA Commercial Department in salvaging logging residues to produce export charcoal for the Israeli market. This is a model worth exploring further with other potential export partners. This should be private sector-led. The obvious source of raw material would be residues from FMC areas and commercial use operations, as these offer significant quantities at concentrated locations. Charcoal from FMCs would also have the benefit of traceability and Voluntary Partnership Agreement compliance, with sustainability branding and a verifiable claim to be using material that would otherwise go to waste. Charcoal from community forests would meanwhile generate more community benefit, but may be seen as less environmentally credible unless equally stringent controls over sourcing were enforced.

3.5 Regulatory review

The three previous proposals entail direct value chain intervention. A further proposal is aimed at reviewing regulations and improving fee collection.

The FDA currently lacks the capacity and incentive to enforce Regulation No. 119-17 on *Sustainable Wood-Based Biomass Energy Production and Marketing in Liberia*. There is also little prospect that those in the charcoal industry will comply with its provisions as evasion will be cheaper and easier. Other African countries that have sought to bring their informal charcoal industries under tighter state control by enacting more stringent rules have similarly found that those in the industry generally find it more expedient to evade the new provisions (and potentially pay the price of corruption for doing so) rather than adhere to onerous legal stipulations¹³.

A suspension and re-appraisal of the 2017 Regulation is proposed, to be replaced by significantly simpler provisions that industry players can comply with and FDA officials can enforce. At this stage a realistic aspiration would be proper implementation of the existing waybill system at checkpoints and an end to the waiver for small loads. More

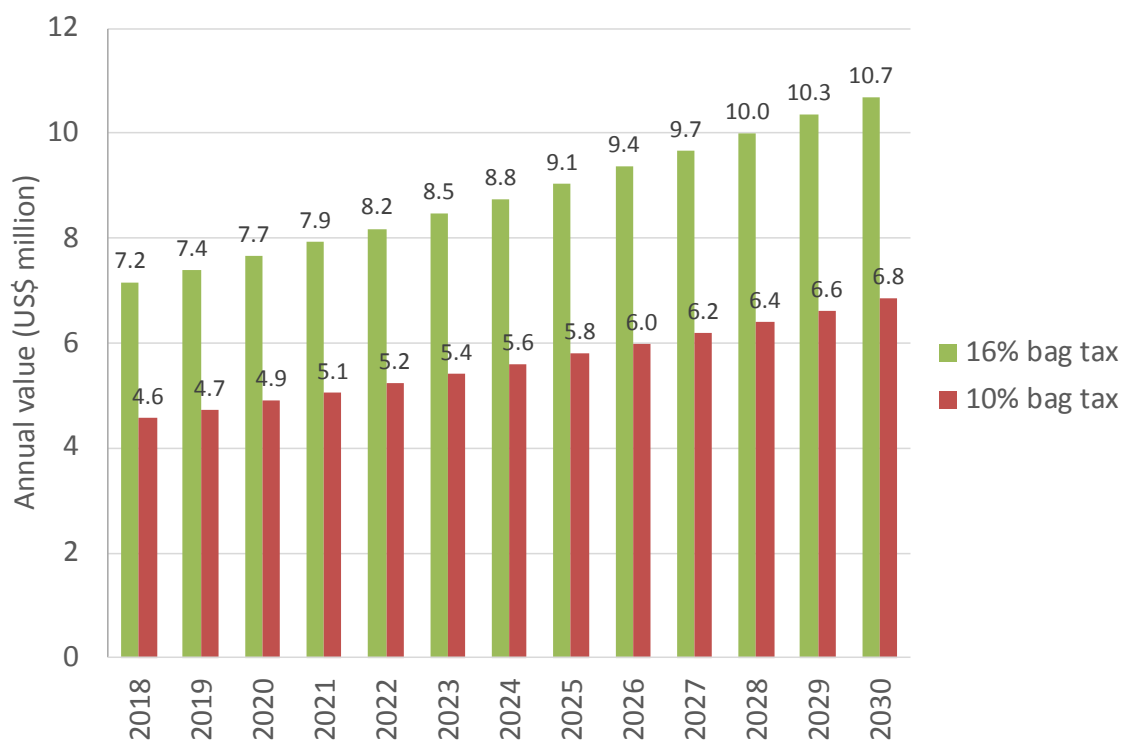
¹³ Kenya, for example, introduced new 'Charcoal Rules' in 2009 that promised to see the industry recognised and legitimised, but no production permits have yet been issued because compliance is too complex and the licensing authority lacks the necessary systems to approve applications (Practical Action Consulting, 2018b).

ambitious options could be considered at a later date, subject to successful enforcement of the waybill requirements.

The waybill fee should also be reviewed. Suppressed pricing is a significant barrier to a more sustainable and formalised charcoal industry, because there are very few opportunities to compete against a product on which little or no tax is paid. The waybill fee charged at checkpoints is currently an insignificant L\$2.50 per bag - just 0.5% of retail value - and even this is not always collected due to inefficiency, corruption and small load exemptions. A higher fee could generate revenue to support forest management and provide important financial manoeuvring room to reward demonstrably sustainable charcoal with exemptions. In other words if a significantly higher fee was introduced and enforced, it would create a financial window of opportunity to reward sustainable producers with waivers or discounts.

If the fee was set at, for example, US\$0.50 per bag, this would be 16% of retail value (a reasonable level of taxation, similar to VAT rates in other countries) and could net over US\$7 million/yr for the Government of Liberia¹⁴. If the fee was set lower at 10% (to match Liberia’s prevailing Goods and Services Tax), this would equate to US\$0.32 per bag and could still net US\$4.6 million/yr. Revenue from a 10% tax could potentially reach US\$6.8 million/yr by 2030, and US\$10.7 million from a 16% tax by the same year. These scenarios are illustrated in Figure 10.

Figure 10. Projected revenue from charcoal bag tax (2018-2030)



¹⁴ Assuming 14.3 million bags transported per annum.

A new system is also required to incentivise revenue collection, as the current arrangement has a significant element of corruption and revenue loss. This is partly because the fees collected do not directly benefit FDA but go directly to the Treasury. If FDA was instead assigned a majority share of a higher waybill fee, then both the potential revenue and the incentive to collect it would be greatly increased.

If fees were raised and enforcement rates improved, room would be created to offer exemptions or reductions for traceable, sustainably-sourced charcoal. A lower fee could instead be paid to an AFC or FMC-holder to support forest management. This could provide the necessary incentive to encourage a transition towards production from controlled sources. Such a system has been introduced to 36 villages in Morogoro Region in Tanzania, where charcoal from designated community-managed woodlands is exempt from central government royalty payments and incurs a lower village fee instead.

Lastly, the waybill exemption provided for in the 2017 Regulation for carriage of more than seven bags (Republic of Liberia, 2017) should be reviewed, as it seems arbitrary and has no obvious logic. All charcoal is being commercially produced and traded, so the notion of small volumes for 'personal use' offers an unnecessary loophole that is being exploited by motorbikes and car owners involved in commercial transport.

3.6 Data collection

There are currently no formal statistics generated on charcoal production, transport and trade in Liberia. Yet data on the scale and significance of the industry is a prerequisite for rational planning and policy-making. While a national database on the charcoal industry is an aspirational medium-term, in the short term it should be a relatively simple matter to set up a monitoring system at existing road checkpoints and the rail line to quantify charcoal arrivals to Monrovia. This could later be extended to other major towns in the central demand belt (e.g. Gbarnga and Kakata) and eventually to all county capitals. Such data gathering could provide an accurate estimate of total market size and would allow charcoal demand to be quantified by route, by timing (season, day of the week and time) and by mode of transport (on both dedicated vehicles and incidental carriage). The necessary data could be generated through simple observation, manning the checkpoints day and night.

Some initial data on charcoal production in the forested communities may be produced by the ongoing National Forest Survey that is already being undertaken by the FDA with support from the Liberia Institute of Statistics and Geo-Information Services. Depending on the quality and reliability of the data produced from the initial enumeration exercise, it could form the basis for a more ambitious knowledge and data platform on the charcoal industry, extending over time to investigate value, employment and livelihood benefits.

National Forest Survey

As part of LFSP, the first nationally representative forestry survey in Liberia has been undertaken. This survey applied the forestry module of the Living Standards Measurement Study to collect baseline data on household forest dependence. The generic forestry module was customized to the Liberian context, pre-tested, finalized and then rolled out to a representative sample of households by the Liberia Institute of Statistics and Geo-Information Services. 3,000 households and 250 communities from all 15 counties, living within 15 km from forests, were interviewed.

The data collected will allow a systematic analysis of various important issues, including sustainable development of forest-related sectors and incentives to conserve forests, and will help craft policies and interventions to mitigate the drivers of deforestation and forest degradation. As such, the survey will provide systematic baseline data on various forest product value chains in Liberia, including on charcoal processing, consumption, sale and cost incurred during the process (transport and marketing costs). The data will provide information on individual households, from which total dependence (based on self-consumption and sale) can be derived. Moreover, the sample will allow for an aggregation of total income from charcoal for households living close to forests.

3.7 Secondary intervention options

The study considered alternatives to traditional charcoal in the form of plantation-grown fuel and charcoal briquettes.

3.7.1 Charcoal from energy plantations

Producing charcoal in dedicated 'energy plantations' has been one possibility mooted for LFSP support, to alleviate pressure on natural forests. This model is, however, unlikely to be economically viable, either in competition with charcoal extracted from natural forests or over-aged rubber plantations or when compared with other more rewarding outputs of plantation forestry.

Growing trees in plantations entails significant direct costs for seedling production, land preparation, planting, weeding and protection against fire and pests that producers in a natural forest do not incur. It is therefore bound to be more expensive to grow trees for charcoal than to make use of logs available from agricultural clearing. The farmgate production cost of



The farmgate production cost of charcoal produced in a dedicated plantation of fast-growing exotics is around US\$12/kg in East Africa, compared with US\$7/kg for charcoal produced from a managed natural woodland (Practical Action Consulting, 2018a). The relative costs in Liberia are likely to be similar, even if the actual costs are lower.

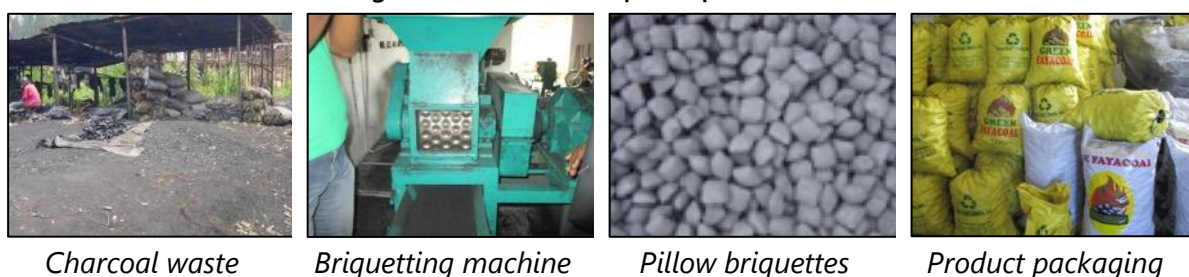
A plantation owner also needs to consider the relative value of alternative (non-fuel) outputs. Typically it will be more rewarding to produce sawn timber, transmission poles, building poles, fence posts and value-added products such as pallets, in approximately that order of declining value, before resorting to the sale of woodfuel from residual material. This has been the 'cascading value' model of established plantation forestry companies such as Miro Forestry in Ghana and others in East Africa such as Komaza and Kakuzi in Kenya, Green Resources in Uganda and Tanzania, and private eucalyptus growers in Rwanda. Charcoal production using the by-product of an integrated plantation forestry operation may be a viable option associated with a sawmill, pole processing plant or veneer factory, provided that it is located close to an urban market so that it can deliver a retail price close to mainstream charcoal (Practical Action Consulting, 2018a). In Liberia, to this list could be added rubber plantations, from which charcoal is already a by-product. But elsewhere in the country, with an abundance of natural hardwoods, plantation forestry will be economically marginal at best and charcoal will be a minor by-product of low value.

For these reasons of economic viability, investment in energy plantations for charcoal production is not recommended.

3.7.2 Charcoal briquettes

It is possible to carbonise biomass wastes such as coconut residues and agricultural by-products to generate char, which can be combined with starch binders (such as cassava flour) and densified to produce charcoal-like fuel in briquetted form. Green Gold Liberia is piloting this model on the outskirts of Monrovia with its 'Fayacoal' brand, supplementing the bio-char with discarded charcoal dust salvaged from urban trading sites.

Figure 11. Charcoal briquette production



This model has been implemented in East Africa by Chardust Ltd.¹⁵ since the late 1990s and has been adopted by spin-off operations supplying fuel for space heating in broiler houses and outdoor dining areas, for water heating (in off-grid tourist camps and domestic pre-heating systems), for domestic barbecuing and for commercial meat

¹⁵ www.chardust.com.

roasting. Some companies involved have succeeded in selling up to 5 t per day into these markets.

Briquetted fuels have not seen sustained adoption for household cooking, however, due to inherent physical limitations which restrict their potential to substitute for wood charcoal. These include relatively high ash content (which hinders lighting and stove re-loading), lower energy content (which reduces peak heat output), fragility when handling, sensitivity to water damage and inability to be extinguished and re-used. A further barrier is price: charcoal in Monrovia retails at US¢14/kg whereas Fayacoal is sold at US¢25/kg¹⁶.

As a result, no briquetting company has yet penetrated the household market at scale in Africa, though small- and medium-size enterprises (SMEs) have been able to exploit niche markets for space heating, water heating and barbecue use, as described. Liberia's tropical climate limits the market opportunity for space heating and water heating, while the weakly developed middle class is likely to make small-pack retailing of a high-end barbecue fuel a marginal and low impact opportunity.

Therefore while supporting charcoal briquetting in the urban periphery may exploit niche market opportunities, experience from other African countries and Liberia's low charcoal prices suggests that impact on substitution will be minimal. Charcoal briquetting has the potential to sustain a handful of SMEs in Liberia and LFSP assistance could help them to grow their operations, but this is unlikely to be a scaleable model due to the quality and price limitations of the fuel.

4. Summary and Conclusions

Charcoal demand in Liberia is growing rapidly from an estimated 2018 total of 337,000 t worth US\$46 million, due to its attractive performance characteristics and a lack of affordable and acceptable alternatives.

Prices are some of the lowest in Africa due to an abundance of raw material, the involvement of many part-time producers with low income expectations, minimal regulation and taxation, subsidised transportation and a high degree of retail competition. Combined with ongoing value chain consolidation by well-resourced urban traders, this means that prices are likely to remain suppressed. The industry meanwhile operates entirely in the informal sector and there are no official statistics on production, trade, use or employment. Efforts at regulation have proven unrealistic due to low enforcement capacity and high cost and complexity of compliance.

¹⁶ Charcoal: L\$500 per 23.5 kg bag. Fayacoal: US\$5 for 20 kg or US\$7.50 for 30 kg.

Low prices, informality and high efficiency present significant barriers to the introduction of more formalised systems of production and supply, because such systems have inevitable costs that the current low pricing structure cannot support.

More sustainable arrangements that increase community benefit will inevitably cost more than the prevailing charcoal supply system. There is a need to identify specific entry points where sustainable charcoal can compete with mainstream charcoal, and which at the same time meet the conservation and benefit-sharing objectives of LFSP. This either requires a reduction in costs or the addition of value.

Three potential strategies are proposed for alternative value chains that could be economically competitive with the business-as-usual industry:

- a) Produce charcoal from sustainably-managed community forests close to the market, where transport costs can be undercut.
- b) Produce charcoal from commercial logging residues further away, where raw material costs can be undercut, under the framework of FMCs or areas in community forests that have been granted to a third party under a commercial use contract.
- c) Explore premium charcoal export markets, where higher prices can be secured.

Additional measures are proposed to (d) review the regulations applicable to charcoal and (e) improve data on the industry. The upcoming Mid-Term Review of LFSP would provide a timely opportunity to trial one or more of these options.

Charcoal from dedicated energy plantations is not deemed economically viable, though could be a by-product of plantations established for other purposes. Briquettes made from salvaged charcoal dust have niche potential as BBQ fuel, but are unlikely to see mass household adoption due to cost and performance limitations.

Annex A Mission itinerary

Date	Activity
Thu Nov 8	Various introductory meetings at FDA headquarters.
Fri Nov 9	Meetings in Monrovia with FAO charcoal specialist, World Bank LFSP team members and management of USAID FIFES project.
Sat Nov 10	Visit Gola-Kenneh Charcoal Association in Grand Cape Mount County, including village meeting, visit to charcoal production site and discussions at FDA checkpoints. Accompanied by NACUL and FDA staff.
Sun Nov 11	Drive Monrovia to Gbarnga and overnight.
Mon Nov 12	Visit Alpha Logging concession in Salayea District, Lofa County. Meet National Union of Community Forestry Development Committees on site. Return to Monrovia.
Tue Nov 13	Visit FIFES (USAID)-supported Community Forestry Management Body at Barconnie/Hanandsville, Grand Bassa County, to investigate upcoming charcoal project. Accompanied by ACIDI/VOCA Chief of Party, FIFES Business Advisor and World Bank LFSP team member.
Wed Nov 14	Visit Green Gold Liberia (briquetting) in west Monrovia with NACUL and FDA staff. Visit two charcoal trading groups in central Monrovia. Meet NACUL management, Paynesville.
Thu Nov 15	Consolidate field notes. Prepare debrief presentation and validate with WB team.
Fri Nov 16	Present provisional mission findings and recommendations to FDA and WB team. Revise proposals. Develop report framework.

Annex B People consulted

Liberia Forestry Development Authority (see Annex D for attendance at debrief)

Gertrude Nyaley, Technical Manager, Community Forestry Department

Alvin Roberts, Senior Extension Officer, Community Department

Robert Zoma, Community Department

Blamah Goll, Technical Manager, Conservation Department

Jerry Yanmah, Technical Manager, Commercial Department

Obediah Bowah, Commercial Department

Edward Kamara, Forest Products Marking & Revenue Forecast, Commercial Dept.

Saah David, Jr., National REDD+ Project Coordinator

Hawa Johnson, Law Enforcement, Lofa County

World Bank/Liberia Forest Sector Project

Peter Aldinger, Senior Community Forestry Specialist

Zinnah Mulbah, Environmental Specialist

Remotely: Neeta Hooda, Task Team Leader

Lesya Verheijen, Senior Operations Officer

USAID/Forest Incomes for Environmental Sustainability

Glenn Lines, Chief of Party, ACDI/VOCA

Borwen Sayon, Deputy Chief of Party, ACDI/VOCA

Gboimah Genegbanyan, Charcoal Business Development Consultant

Martin Mulbah, Field Coordinator

National Charcoal Union of Liberia

Richard Dorbor, President

Aaron Barlea, Vice President, Operations

National Union of Community Forestry Development Committees

Augustus Kwalah, National President

Andrew Zelemen, Head of Secretariat and National Facilitator

Alpha Logging and Wood Processing, Lofa County

Alexander Nufeatalai, Chain of Custody

Tommy Wreh, Felling Supervisor

Augustine Zeatamah, Chief Scaler

Augustine Quiah, Camp Manager

Ricky Soper, Log Data Recorder

Baba Mwawonaleh, Data Clerk

Charcoal value chain actors

Members of Gola-Kenneh Charcoal Association, Grand Cape Mount County

Members of Barconnie/Hanandsville Community Forestry Management Body, Grand

Bassa County

Members of Central Monrovia Charcoal Sellers Association
Members of Sinkor Charcoal Sellers Association (Monrovia)

Green Gold Liberia, Brewerville City

Morris Dougba, General Manager

Gerrard Singh, Lead Technical Consultant

Others

Charles Miller, Independent forestry and energy consultant

Annex C Bibliography

- AFREC, 2014. *African Energy Commission: Bioenergy Resources Statistical Database in Africa*. [Online]
Available at: <https://afrec-energy.org/En/administration/biofuel/index.php>
[Accessed 9 November 2018].
- Ajao, A., 2011. Econometric Analysis of urban charcoal demand in Ogbomoso metropolis. *Report and Opinion*, 3(9), pp. 22-29.
- Alem, Y., Ruhinduka, R. & P, B., 2017. *Liquidity constraints, LPG stoves, and charcoal consumption in Tanzania (Policy Brief 89410)*, London: International Growth Centre.
- CAMCO, 2014. *Biomass Energy Strategy (BEST) Tanzania: Tanzania Biomass Energy Strategy and Action Plan.*, Dar es Salaam: Camco Clean Energy (Tanzania) Limited.
- FAOStat, 2018. *Statistics Division, Food and Agriculture Organization of the United Nations*. [Online]
Available at: <http://www.fao.org/faostat/en/#data>
[Accessed 9 November 2018].
- Hagen, R., 2016. *Alternatives to the Destructive Harvest of Mangroves for Charcoal and Fuelwood Case Study: Barconnie Community, Liberia*, Burlington, VT: Tetra Tech ARD for USAID-funded PROSPER.
- Jones, B., 2015. *Social and Environmental Impacts of Charcoal Production in Liberia (Master's thesis)*, Ann Arbor: University of Michigan.
- Kimaryo, B. & Ngereza, K., 1989. *Charcoal production in Tanzania using improved traditional earth kilns. Research paper no. IDRC- MR216e*, Moshi: Tanzania Forest Research Institute.
- MARGE, 2009. *Malawi Biomass Energy Strategy*, Eschborn: European Union Energy Initiative - Partnership Dialogue Facility.
- Milbrandt, A., 2009. *Assessment of Biomass Resources in Liberia: Technical Report NREL/TP-6A2-44808*, Golden, Colorado: National Renewable Energy Laboratory.
- Mwampamba, T., 2007. Has the woodfuel crisis returned? Urban charcoal consumption in Tanzania and its implications to present and future forest availability. *Energy Policy*, 35(8), pp. 4221-4234.
- Practical Action Consulting, 2018a. *Study on Sustainable Charcoal Economics, Policy and Investment in East Africa: Economic and Technical Report*, Nairobi: for The Nature Conservancy.
- Practical Action Consulting, 2018b. *Study on Sustainable Charcoal Economics, Policy and Investment in East Africa: Policy Report*, Nairobi: for The Nature Conservancy.
- Republic of Liberia, 2009. *National Energy Policy*, Monrovia: Ministry of Lands, Mines and Energy.
- Republic of Liberia, 2008. *Population and Housing Census*, Monrovia: Liberia Institute of Statistics and Geo-Information Services.

Republic of Liberia, 2017. *Regulation No. 119-17 on Sustainable Wood- Based Biomass Energy Production and Marketing in Liberia*, Monrovia: Forestry Development Authority.

Republic of Liberia, 2018. *Land Rights Act (2014)*, Monrovia: s.n.

Tanzania Forest Conservation Group, 2018. *Charcoal's role in the energy supply of a modernizing African city (in press)*, Dar es Salaam: TFCG.

UL-PIRE, 2016. *Natural resource survey of bushmeat, charcoal, non-timber forest products and domestic timber value chains in Liberia*, Monrovia: United States Forest Service in collaboration with the Forestry Development Authority of Liberia and the University of Liberia-Pacific Institute for Research & Evaluation (UL- PIRE).

van der Plas, R., 2011. *Project Identification Sustainable Charcoal Supply Chain*, Eschborn: European Union Energy Initiative - Partnership Dialogue Facility.

World Bank, 2018. *World Development Indicators*. [Online] Available at: <http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators>

[Accessed 8 November 2018].

Annex D Participants in debriefing session

The following FDA staff and World Bank consultants attended a debriefing held at FDA headquarters on November 16th 2018. Following a presentation of provisional findings and recommendations by the consultant, staff engaged in a lively Q&A session and provided helpful feedback and ideas.

Name	Position
Forestry Development Authority	
Hon. Mike Doryen	Managing Director
Joseph Tally	Deputy Managing Director, Operations
Gertrude Nyaley	Technical Director, Community Dept.
Mitchell Kumbeley	Technical Manager, Research & Development
Jerry Younma	Technical Manager, Commercial Forestry
Jallah Johnson	Assistant Protected Area Manager, Conservation Dept.
Leo Yeane	Conservation Dept.
Edward Gbaintor	Manager, Wildlife Conservation Dept.
Peaches Kumeh	Ecotourism unit, Conservation Dept.
Yanquoi Dolo	In-house lawyer
Roland Lepol	Project Officer, REDD+ Implementation Unit
World Bank	
Peter Aldinger	Community Forestry Consultant
Zinnah Mullah	Environmental Specialist
Matthew Owen	Charcoal Consultant