



Liberia: Domestic Timber Value Chain Analysis

EXTRACTIVE OVERVIEW REPORT – January 2017

This publication was produced for review by the United States Agency for International Development. It was prepared by Ms. Allison Bickel, Market Research Manager for Building Markets, and Dr. Paolo Cerutti, Senior Scientist for the Center for International Forestry Research (CIFOR).



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ACRONYMS

CIFOR – Center for International Forestry Research

CoC – Chain of Custody

FDA – Forestry Development Authority

FLEGT - Forest Law Enforcement, Governance and Trade

FOB – Free on Board

GoL – Government of Liberia

Ha - hectare

LICSATDUN – Liberia Chainsaw and Timber Dealers Union

m³ – cubic meter

MSME – Micro, small, and medium enterprises

NTFP – Non-timber forest product

PUP – Private use permit

REDD+ - Reducing Emissions from Deforestation and forest Degradation

RWE – Roundwood Equivalent

SGS – Société Générale de Surveillance

VPA – Voluntary Partnership Agreement

FOREWORD

Since 2006, Liberia has developed and implemented significant regulations, laws, and reforms around the export-oriented, large-scale industrial forestry sector. Timber produced through informal and small-scale chainsaw milling operations for the domestic market has largely been ignored. As a result, such timber remains unrecorded in official statistics and is produced without a valid permit. However, Liberia recently signed a Voluntary Partnership Agreement (VPA) with the European Union under the Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan, promising to certify the legal origin of the entire national timber production.

This report defines the quantities, economic values, and dynamics of the domestic timber sector. Chainsaw milling, if uncontrolled, will have a serious socio-economic and environmental impact that will jeopardize the nation's intention to establish a viable timber export industry.

As the Forestry Development Authority, in coordination with key stakeholders and development partners, seeks to reform chainsaw logging to line up with national and international efforts to sustain Liberia's forests and support long-term development goals, the data and insights from this report will inform and support the formulation of actionable policies.

Harrison S. Kamwea, Sr.
Managing Director, Forestry Development Authority

PREFACE AND ACKNOWLEDGEMENTS

This report was researched and written by Allison Bickel, Market Research Manager for Building Markets Sustainable Marketplace Initiative in Liberia, and Paolo Cerutti, Senior Scientist for the Center for International Forestry Research.

The report responds to a gap in market information on the domestic timber sector and its value chain. It is intended to assist policy makers, development partners, and private sector actors in understanding the dynamics of the Liberian timber sector through in-depth data and analysis to inform decision-making and strategic interventions.

While Building Markets worked on this report in collaboration with the Forestry Development Authority and Center for International Forestry Research, the findings, interpretations, and conclusions expressed in this report are entirely those of Building Markets and do not necessarily reflect the views of donors, partners, or the Government of Liberia. Every effort was made to ensure the accuracy and validity of findings and conclusions; however, errors and gaps in the analysis are possible. Building Markets takes responsibility for any and all omissions or inaccuracies.

The analysis and findings from this report are based on data collected between April 2016 and June 2016.

Building Markets wishes to thank the United States Agency for International Development (USAID) for making this report possible through their generous support.

This report could not have been accomplished without the valuable contributions of many individuals, businesses, partners, and stakeholders that participated in surveys, provided data, and took time out of their busy schedules to share their experience and insights. We would like to thank Harrison S. Karnwea, Darlington Tuagben, and Edward Kamara of the Forestry Development Authority whose indispensable input and advice helped guide the study. Alpha Samson of QNA Services provided a dedicated team of enumerators to assist with data collection. Considerable assistance was also provided by: Abraham Guillen, VPA Support Unit; Oona Burke-Johnson, FLEGT Facilitation Office; Liam Walsh, Conservation International; Bob Simpson, FAO, and the Building Markets Sustainable Marketplace Initiative-Liberia team.

The authors wish to express their sincere gratitude to all individuals and organizations that contributed to the development of this publication.

Any comments or questions should be directed to Allison Bickel at bickel@buildingmarkets.org.

EXECUTIVE SUMMARY

This report provides a quantitative and qualitative evaluation of the Liberia domestic timber market. While the country has developed and implemented significant regulations, laws, and reforms since 2006 around the export-oriented, large-scale industrial forestry sector, timber produced through small-scale logging operations for the domestic market has largely been ignored. As a result, the sector has grown informally, unrecorded in official statistics, with timber produced without valid permits.

A growing domestic market, 3 to 4 times larger than the current level of exports

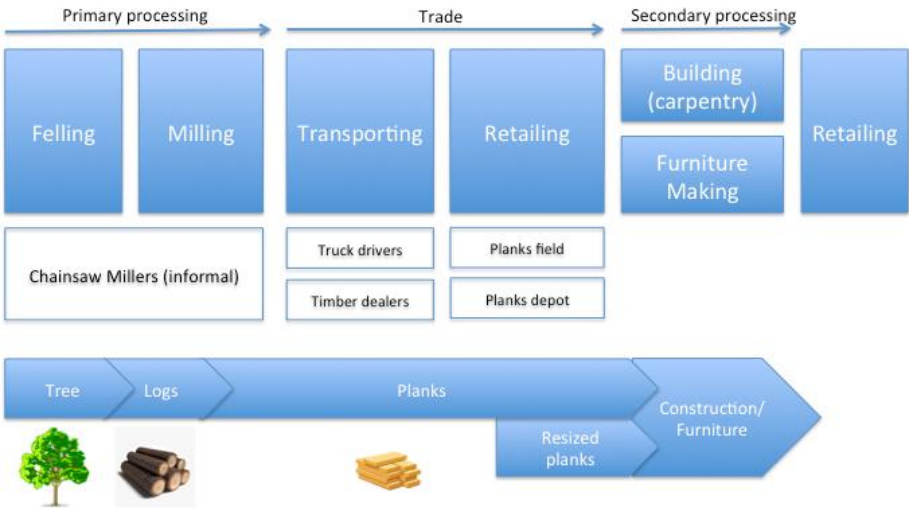
According to this survey, annual production of sawn wood from informal chainsaw milling operations ranges between 691,944 m3 and 922,591 m3 (in Roundwood Equivalents). By comparison, the projected annual volume of exported timber in 2016 is 200,263 m3 (in Roundwood Equivalents) or about a quarter of that. Both domestic and export logging focus upon the same species of trees—mainly tetra, framire, wawa, abura, niangon, and lovoa. Yet prices per cubic meter sold on the domestic market are between 50% and 70% lower than the FOB prices of industrial timber.

Chainsaw millers, at the heart of a very short and rudimentary value chain

The Liberian timber value chain is short and unindustrialized, with limited processing and transformation. From supply to construction, carpentry and woodworking products are relatively unprocessed, un-dried, and ultimately low-quality. There are no sawmills and no kiln facilities in Liberia and the entire primary processing is done on rudimentary equipment, like chainsaws and ripping machines, directly at the county level and mostly at the point of extraction. Chainsaw millers are the key element of the supply chain, contributing to the major part of the product's value (39%). Informal, they operate the entire primary transformation, felling trees and sectioning them into planks using chainsaws. Calibration, drying, treatment, dyeing, and quality control are not done or done poorly; storage, logistics and distribution facilities are open-air, which affects the quality of processing and value of the products.

At the other extreme of the domestic value chain, Liberian Micro, Small, and Medium Enterprises (MSMEs) purchase sawn wood from urban markets for construction, carpentry, and furniture making. Our survey found that furniture making MSMEs add an additional value of \$44 USD per m3 of sawn wood through the production of household and office furniture. While this amount seems significant in respect to the entire Liberian value chain, there is significant potential to increase that figure. In comparison, a 2012 study in Nigeria found that the average value added by furniture making firms to a cubic meter of sawn wood was \$271 USD.

Figure (i) - Overview of Liberia's Domestic Timber Value Chain



Chainsaw Milling, a significant source of employment

Mostly informal, chainsaw milling is a source of employment for a large number of Liberians. The sector provides between 19,000 and 24,000 more or less permanent jobs to urban and rural individuals. Informal chainsaw milling is therefore a well-developed economic sector, as demonstrated by a total estimated annual trading value (revenue) of between \$31 million USD and \$41 million USD, assuming an average value of \$152 USD per cubic meter of sawn wood.

Benefits from the domestic timber sector's annual revenue are distributed along a value chain that spans rural and urban areas. Nearly half of this revenue (approximately \$77 USD per m³) provides income to rural populations. Beyond those directly employed in chainsaw milling operations, Liberians who sell their trees according to customary law, as well as communities with forest lands, make a good living. Sawn timber generates flows of cash that contribute to poverty reduction in rural areas, at least in the short-term.

Four population groups along the value chain share the profits from informal chainsaw milling, as shown in the table below. The public authorities are the main losers in this sector, as very little of the revenue generated by chainsaw milling reaches the federal government.

Table I - Who Profits from the Timber Value Chain

Beneficiaries	Application of Revenues	Estimated Amount (Low)	Estimated Amount (High)	%
Rural Populations	Wages			
	Tree sales	\$15,776,308	\$21,035,052	51%
	Profit from sale of sawn wood to urban traders			
Transporters	Transportation	\$2,906,162	\$3,874,878	9%
Urban Populations	Wages			
	Rent for outlets	\$10,794,316	\$14,392,404	35%
	Profit from sale of wood to final consumer\$41			
Government	Formal taxes in rural areas	\$1,453,081	\$1,937,439	5%
	Formal taxes in urban areas			
TOTAL		\$30,929,867	\$41,239,773	100%

Key Constraints to the Development of the Liberian Industry

- Lack of Regulation and Understanding of Sector. Because the majority of the value chain is in the informal sphere, there is no monitoring or regulation of the industry that can be used to increase its competitiveness, manage its environmental impact, or bring the activity into the formal sector.
- Lack of Industrialization and Equipment. The absence of sawmills and other processing equipment in Liberia means that downstream value addition is limited and output from construction and woodworking firms is not competitive in regional and global markets.
- Does Not Consider Consumer Demand. Although the supply chain is relatively fluid, and the market centralized in Monrovia, this is essentially a supply-driven sector. Consumers' needs and expectations, from end users and secondary processors, are not informed throughout the supply chain, and do not drive the creation of value. Domestic opportunities are not well communicated to the supply side; regional opportunities are not communicated at all.

- Low Productivity. Over 80% of surveyed businesses do not have access to power tools and produce furniture with just hand tools. In addition, the workforce is largely unskilled, with no access to woodworking techniques or methods to improve operations.
- Low Quality. From the beginning to the end of the value chain, products are of poor quality.

Recommendations to Increase the Competitiveness of Liberian Timber Production

- Community-level Interventions are Needed. This will better manage chainsaw milling activity and should be coordinated with downstream interventions to improve the quality and efficiency of MSMEs and to develop new wood-based industries that effectively integrate Liberian entrepreneurs and businesses.
- Use Economic Incentives to Promote Sustainable Timber Production. Local interventions in forest communities should be accompanied by market-based solutions to incentivize communities to sustainably manage forest resources. Innovative business models adapted to the local context should be piloted and replicated across forested communities.
- Provide Technical Assistance to MSMEs. While developing sustainable forestry practices and primary processing are priorities, strategic technical assistance to MSMEs is critical in supporting sustainable forestry and adding value to products currently produced for the domestic market.
- Promote Linkages and Market Efficiencies. Linkages between the informal and formal sectors will strengthen the domestic market with the introduction of standards and processes that drive value creation and increase quality. Partnerships aiming at sharing knowledge and expertise, creating shared processing facilities, or developing Technical and Vocational Education and Training (TVET) interventions should also be considered.
- Undertake Market Assessments to Close Research Gaps. Research should be carried out to inform policy decision-making and to identify new markets for primary, secondary and tertiary products produced within Liberia and the region. Understanding the unknown dynamics of informal cross border trade will be critical to ensuring effective monitoring and regulation of chainsaw milling.
- Consider the Environmental Impact. Liberia has an estimated 4.5 million hectares of forest, and informal chainsaw milling affects approximately 99,000 to 132,000 forest hectares per year (3% of total forest area). While informal chainsaw milling does not solely or immediately appear to threaten Liberia's forest sustainability, it does have a significant environmental impact and demands more understanding and analysis to understand the potential short and long-term implications.

I. INTRODUCTION

Data on the industrial forest sector in Liberia is fragmented, but it is suggested that the annual sustainable production of timber could be between 800,000 and 1.3 million m³.¹ In addition to the industrial export-oriented timber sector, which exports about 200,000 m³ annually, a significant domestic timber market does exist.² The domestic timber industry involves all counties in Liberia, and encompasses production and chainsaw milling, transportation, urban market purchases and sales, and woodworking and construction businesses. It links the informal and formal sectors through a network of personal and business relationships. While the export of raw timber has valuable economic impact for the central government, value addition is non-existent and the export sector does not go beyond harvesting raw logs and paying taxes.³ On the other hand, domestic timber has an extensive and complex value chain that generates direct and indirect employment throughout the country and downstream value addition opportunities.⁴

Building Markets, with the support of the Forestry Development Authority (FDA), the Center for International Forestry Research (CIFOR), and key local partners, conducted a detailed value chain analysis of domestic timber in Liberia. The study captures how much sawn-timber is produced and transported to urban markets, the economic value of timber and the number of actors along the supply chain, the direct and indirect socio-economic benefits of chainsaw logging and the dynamics of downstream activities in the woodworking sector. The data and analysis map and define the domestic timber value chain, providing a platform for policy and regulation to improve inefficiencies, monitor environmental impacts and promote equitable linkages between the informal and formal economies.

I.1 Historical Background

The United Nations imposed an embargo on Liberian timber exports in 2003 to stop the international purchase of conflict timber and the funding of the 14-year civil war. Since the lifting of the ban in 2006 and the reform of the FDA, Liberia has continued to face challenges in monitoring and managing its forestry sector. This was most publically exposed in 2012 when a consortium of local and international NGOs uncovered the Private Use Permit (PUP) scandal, which involved the government of Liberia (GoL) selling large swaths of land for private use with little to no regulation on contract duration or cutting restrictions.⁵

In 2011, Liberia signed a Voluntary Partnership Agreement (VPA) with the EU to guarantee the export of timber from legal sources and improve forest governance and regulation. The next year, the GoL received its first payment for engaging in REDD+, a scheme to reduce emissions from deforestation and forest degradation, and conserve forest carbon stocks. These initiatives, implemented in coordination with the FDA and stakeholder partners, demonstrate recent first steps to move past Liberia's disreputable history with timber and sustainably manage resources.

¹ Blackett et al. Chainsaw Logging in Liberia: An Analysis of Chainsaw Logging (Pit-sawing) in the Natural Forests of Liberia Towards a More Sustainable Production, 2009.

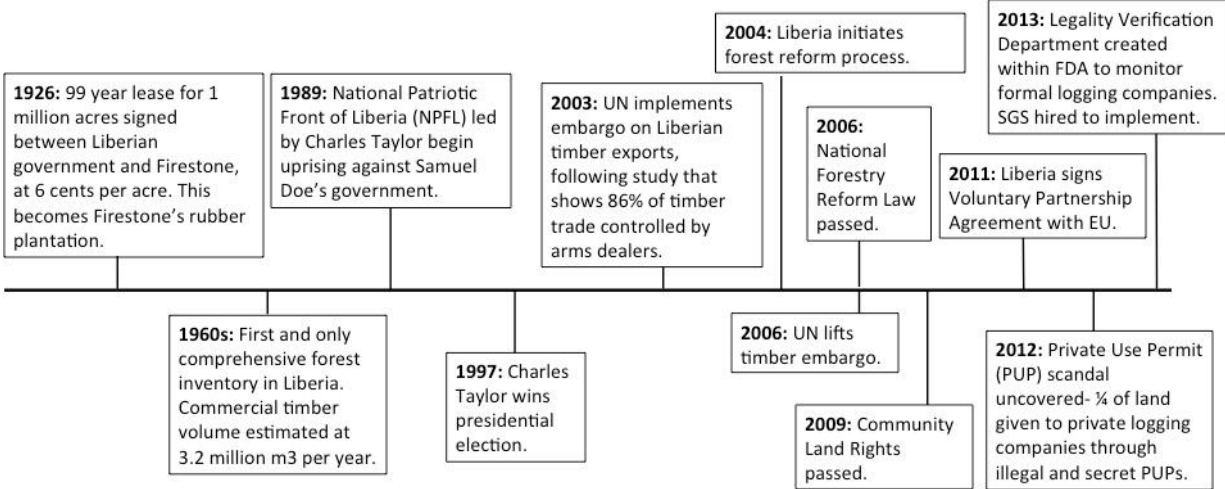
² Estimated export volume based on projected annual production by formal logging enterprises. Projections done by author from SGS data, 2016.

³ Estimated value of \$5 billion USD per year. Projections done by author from SGS data, 2016.

⁴ Value added is the additional value created at each stage of production and/or through marketing of a product. It increases the product's final price or value. This is measured as the value of the output produced minus the costs of inputs. The result is equal to wages and profits.

⁵ The government issued an order to suspend and cancel PUPs in response to the scandal.

Figure I - Timeline of Historical Events



1.2 Role of Timber

The most extensive standing rainforest in West Africa stretches across Liberia. Its complex ecosystem hosts a range of products, including timber, charcoal, non-timber forest products (NTFPs), and bushmeat; forestry potential is considered high in the country.⁶ There are 225 timber species in Liberia⁷, and high value species are harvested for commercial export according to international demand, but also felled indiscriminately for sale on the domestic market.⁸ Individuals purchase sawn timber for the construction of homes; businesses use planks for infrastructure, the construction of new buildings, and the production of furniture.

Neighboring countries have decimated the majority of their forests by clear-cutting trees for short-term and low value uses. The current situation of the export of unprocessed raw timber and chainsaw milling seems to mirror the actions of adjacent countries, and place Liberia in a potentially compromising position. Without a long-term vision for its forestry sector, which prioritizes sustainable operations and a shift towards higher value added wood processing, Liberia risks losing its forest cover and capacity to meet current domestic demand and that of future generations. If the shift towards sustainable management and value addition is initiated too late, is not properly implemented, or takes too long to implement, it will be a reactive rather than proactive measure to manage diminishing and highly degraded forest resources.

1.3 Policy Challenge

Challenge

Currently, there is no regulation or monitoring of the domestic timber value chain in Liberia, and chainsaw milling activity is increasing at exponential rates. It is a straightforward business with minimal barriers that guarantees a profit in rural areas that have limited alternative means of sustaining livelihoods and generating inflows of cash. Liberia's growing population, high levels of construction, and rapid urbanization indicate that domestic timber consumption will continue to increase; right now, chainsaw milling is the only source to meet local demand.⁹ However, the number of actors and

⁶ World Bank, Diagnostic Trade Integration Study: Wood Industry Component, 2008.
⁷ Flora & Fauna International, High conservation values: Draft national interpretation for Liberia, 2012.
⁸ US Forest Service, Gap Analysis of Targeted Domestic Natural Resource Markets in Liberia, 2015.
⁹ Formal logging concessions exclusively produce timber for export markets.

volume of sawn wood in the market continue to expand and, consequently, prices remain significantly lower than regional and global market prices.

If better managed, chainsaw milling has the potential to sustainably drive local entrepreneurship and ultimately be integrated in a more efficient and productive domestic timber value chain, leading to longer-term positive socio-economic impacts. Conversely, if the sector remains outside the scope of long-term development plans and policy improvements, its probable unsustainable nature risks increasing the current rates of deforestation and forest degradation, and ultimately limits long-term growth opportunities for Liberia.

Better management of the chainsaw logging sector is in line with the goals of Liberian government authorities, development partners and general environmental conservation efforts. It is not a new proposition; attempts have been made to address illicit pit-sawing through the 2012 Chainsaw Milling Regulation. But efforts to implement these measures have largely been unsuccessful, not just because of low enforcement capacity and a lack of resources, but also due to a lack of connection between what the policies say and what is happening on the ground. This results in overly complex regulations that small-scale operators cannot follow because they are not adapted to their needs.¹⁰

Solution

The analysis of the domestic timber value chain shows the close and inextricable ties between chainsaw logging, forest communities, and Liberian MSMEs. Therefore, the reform of the chainsaw logging sector will have implications beyond pit-sawyers and environmental sustainability. Depending on the technical and policy options chosen and the degree to which they are enforced, there will be winners and losers along the entire domestic timber value chain. This study intends to provide data to guide actionable policy, and to allow stakeholders to mitigate the negative impacts of chosen policies and accompanying enforcement, as well as enhance the positive effects.

2. SURVEY AND ANALYTICAL METHODS

The study covered three components of Liberia's domestic timber sector: (1) production in rural communities; (2) sales in Monrovia markets; and (3) downstream value addition by woodworking MSMEs.

2.1 Production

The upstream analysis was carried out on a sample of chainsaw millers and community leaders. Two methods were used to identify key areas that regularly supply timber to markets in Monrovia: discussions with plank field managers in Monrovia and key informant interviews with community leaders. The six counties in the study are located across several forest regions in Liberia and have varying degrees of infrastructure (Table 2).

A questionnaire was administered to leaders of selected communities that permit and interact with chainsaw millers. The survey elicited responses about the history of chainsaw milling in the area, the people involved, available resources, community benefits, and conflicts and potential resolutions.

Informal chainsaw millers were surveyed through a semi-structured interview that included questions on the chainsaw millers' motivations, targeted tree species, costs and profits, use of revenue earned from chainsaw milling, and

¹⁰ As is the case in most Sub-Saharan countries and beyond where recent analyses of the chainsaw milling sector have been conducted. (Wit et al. 2010, Putzel et al. 2014, Cerutti et al. 2014.)

challenges. Each chainsaw miller provided details on all costs and profits from their most recent chainsaw activities, up to a maximum of three to avoid the risk of going too far back in time.¹¹ 178 chainsaw millers described 258 operations.

Table 2 - Sample of Chainsaw Milling Activities

County	Number of community members interviewed	Number of chainsaw millers surveyed
Gbarpolu	6	23
Grand Cape Mount	6	34
Grand Gedeh	7	26
Nimba	10	50
Rivercess	5	22
Sinoe	6	23
Total	40	178

The results of the survey were not extrapolated, as there is no definitive source on the exact population of chainsaw millers operating across all of the counties. However, the consistency of the data and large sample size likely make the results representative of chainsaw milling activities in Liberia.

2.2 Timber Sales

Preliminary Survey

A preliminary survey was carried out in timber markets in Monrovia prior to the start of research activities. Timber markets can be organized as collectively managed plank fields or independently managed plank depots. There are seven plank fields, which are cooperatively managed and organized into independently owned smaller outlets, with a total of 275 outlets. In addition, there are 97 independent plank depots that operate outside of the plank fields.¹²

A meeting was held with each plank field manager. The objectives were to (1) explain the purpose of the study and ask for permission to survey outlet owners on a weekly basis; (2) ascertain the size and organizational structure of the plank field; and (3) help to select a sample of outlets to be surveyed throughout the study.

Data Collection

A representative sample of small, medium and large outlets and independent plank depots were administered a survey once a week, on the same day. Data was not collected on Saturday, the busiest day because most businesses make their weekly purchases on that day, to avoid overestimating sales. The questionnaire collected data on daily purchases and sales, including the source of products, species, and purchase and selling prices.

Data Analysis

Two assumptions were made: (1) the data collection day was assumed to be representative of sales on other days of the week (excluding Saturdays) and (2) plank fields and depots were assumed to be open 6 days a week, which again is an attempt to avoid overestimating sales, although some fields remain open 7 days a week.

¹¹ When volumetric estimates of production were made, only very recent operations were used (2016) to decrease the risk of interviewees' uncertainty in remembering exact volumetric productions from past operations.

¹² There are likely more depots than what was included in our count, as the census was limited to main roads in Monrovia and did not count depots located on tertiary roads.

Sales and purchases were averaged according to size (small, medium and large) and extrapolated to the population. Daily sales and purchases were extrapolated to weeks and then annual sales and purchases.

Data collection started at the end of April 2016 and lasted until the middle of June 2016, for a total of 8 weeks of data collection. Rain was frequent but sporadic during this time; roads were in relatively good condition.¹³ One potential bias towards over-estimation is given by the collection period, as plank field managers noted that outlet owners would need to stock planks prior to heavier rainfalls in July through September, as both chainsaw millers and truck drivers slow output due to weather conditions and poor roads. Similarly, individuals and MSMEs would likely increase their stocks of planks as they may not be able to obtain their required quantity or quality during rainy season.

Due to the relatively high turnover of planks during data collection, the analysis is presented to consider and control for seasonal variability. We extrapolate to consider the observed volume of sales for 40 and 30 weeks.

Transportation

There are three roads along which trucks can transport timber from the counties into Monrovia: Buchanan-Monrovia highway, Bomi-Monrovia highway and Margibi-Monrovia highway. In order to better triangulate data sources on the origins and volumes of timber arriving in Monrovia from the counties, enumerators were stationed at each of the checkpoints for 24 hours per day over a one week period to track the number and contents of trucks carrying timber.

2.3 Furniture-making MSMEs

Woodworking firms that engage primarily in furniture making, but also small construction projects, were randomly selected from Building Markets' database on over 4,000 MSMEs in Liberia. A questionnaire was administered to 157 woodworking firms to determine the timber products available in the domestic market, the value added to that timber, and the barriers to growth faced by these firms.

3. UPSTREAM DYNAMICS: CHAINSAW MILLING

3.1 Characteristics of Chainsaw Milling

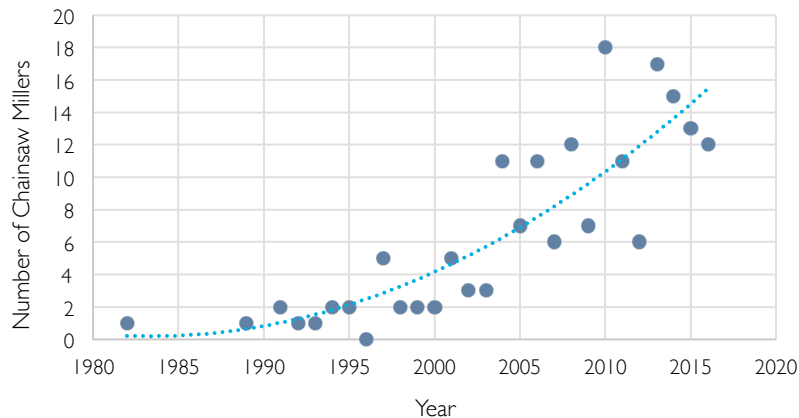
Small-scale chainsaw milling operations are present in all 6 counties in the sample and play a critical role in sustaining rural economies and livelihoods. The number and intensity of operations varies according to distance from and access to an urban market, the availability of wood, and the presence (current or former) of a logging company. Some counties provide a more enabling environment for chainsaw milling than others.

Historical Background

Chainsaw milling has been present in Liberia for decades, but prior to the ban on formal logging, operations were primarily restricted to converting unused felled logs and brush in formal concessions to produce sawn wood for the domestic market. The ban on timber exports in 2003 and the annulment of concession agreements in 2006 led to an increase in chainsaw milling activity, as chainsaw millers became the only source to meet local market demand. As demand from a booming urban population and construction increases, the number of active chainsaw millers continues to grow at exponential rates (Figure 2).

¹³ One notable exception was the broken bridge in Rivercess, which halted transportation and flows of goods and services from Rivercess, Sinoe and other counties to Monrovia.

Figure 2 - Start of Operations of Surveyed Chainsaw Millers



Chainsaw millers started chainsaw milling operations for a variety of reasons. Sixty-two percent of respondents stated that they began because they were previously unemployed, and 15% sought to increase household income. Other motivations for beginning chainsaw milling include reconstruction efforts after the war and encouragement from friends to pit-saw to make “quick money”. Several respondents began after dropping out of school.

Community members conveyed that chainsaw milling began in their forests as a way to instigate reconstruction efforts and encourage the development of their communities through the construction of buildings and homes. On average, chainsaw milling began in or around community forests in 2006, although several communities reported activities beginning as early as 1991 and as recently as 2016.

Factors that have facilitated the spread of chainsaw milling

The need to supply domestic demand for timber and respond to reconstruction needs following the civil war are the two main causes that drove the increase in chainsaw milling. Additional enabling factors have facilitated the rapid spread of chainsaw milling. These include: (1) low barriers to entry; (2) the former and current presence of concessions; and (3) the lack of regulatory enforcement.

Low Barriers to Entry

A chainsaw is the one piece of equipment that is essential to a chainsaw milling operation. Sixty-nine percent of surveyed respondents own the saw(s) that they use. Approximately 40% of saw owners own more than one saw. While the average cost of a saw is \$1,278 USD, reported prices range from approximately \$300 USD for a used saw up to \$2,500 for a new saw. In conversation, chainsaw millers reported that they had traveled to Monrovia to purchase their chainsaw(s). Purchasing a chainsaw is expensive, but it is not a prohibitive factor to starting operations.

Current or Former Presence of Concessions

Concessions fell trees for export as raw logs from 100-hectare blocks according to harvesting stipulations mandated by the FDA. Four percent canopy removal is allowed, which results in the removal of 1-10 trees per hectare.¹⁴ While it is illegal for additional harvesting to occur in concessions, these areas are ultimately vulnerable to the encroachment of

¹⁴ USFS, *Resource Survey Report to USAID*, 2015. This estimate varies based on the size of trees. Since 2006, the FDA and SGS have monitored formal concessions to ensure that they adhere to the 4% canopy removal rate. Chainsaw millers do not adhere to any cutting regulations.

chainsaw millers due to the network of roads and skid paths created by active and/or former concessions. The issuance of PUPs in community forests has likely made these areas increasingly susceptible to chainsaw milling.

Chainsaw millers report that the average time from the site of felling to a road is 26 minutes (average standard deviation of 20, min 1, max 220); longer distances become difficult for the manual transport of planks, but they exist and are an indication that in some areas the resource is becoming scarce. The prevalence of roads and paths carved by concessions throughout all of the counties in Liberia enables chainsaw millers to easily identify forested areas with access to roads to transport planks to Monrovia.

Lack of Regulatory Enforcement

The 2012 Chainsaw Milling Regulation requires that chainsaw millers register for permits that restrict their areas of operation, but there is no enforcement of these procedures.¹⁵ The only formal regulation that is actively enforced is the 60 cent tariff per plank, which is collected by the FDA officials in the counties or at checkpoints along the highways into Monrovia. Even this regulation is negligible; chainsaw millers report negotiating with officials to lower the 60 cent tariff.¹⁶

Chainsaw milling is a very direct business that guarantees a profit. While there could be powerful actors that control certain flows of domestic timber, there are many small, independent operations that have proliferated across the counties due to low costs of entry, relative ease of finding and harvesting trees, and the absence of regulations.

Structure of chainsaw milling operations

The flow of timber from chainsaw millers to outlet and plank depot owners in Monrovia varies based on the structure of upstream operations. Chainsaw millers either sell their timber directly to an outlet owner based on a specific order (pre-sale) or they sell openly on the timber market to any outlet owner (open sale).

Pre-Order

1. The outlet/plank depot manager owns a saw(s) and has employees in the bush that cut planks. The outlet owner places a specific order, pays for transportation in a truck (likely with additional orders), and then pays employees in the bush for that order.
2. The chainsaw miller owns or rents a saw(s) and produces a specific order for an outlet owner. This relationship could be facilitated by the Liberia Chainsaw and Timber Dealers Union (LICSATDUN) or personal connections.
3. A private business owns saws and trucks, and has employees in the bush that cut planks. These planks do not pass through Monrovia markets; rather, they are directly transported to the private business.

Open Sale

1. The chainsaw miller owns or rents a saw(s) and a middleman purchases planks from multiple operations to transport to plank fields in Monrovia.

¹⁵ FDA, Chainsaw Milling Regulation #115-11, 2012.

¹⁶ Each plank is marked with white chalk to indicate that the fee has been paid. It is possible that officials could receive a direct payment from chainsaw millers to encourage them to mark more planks than what is paid for or ignore planks without markings.

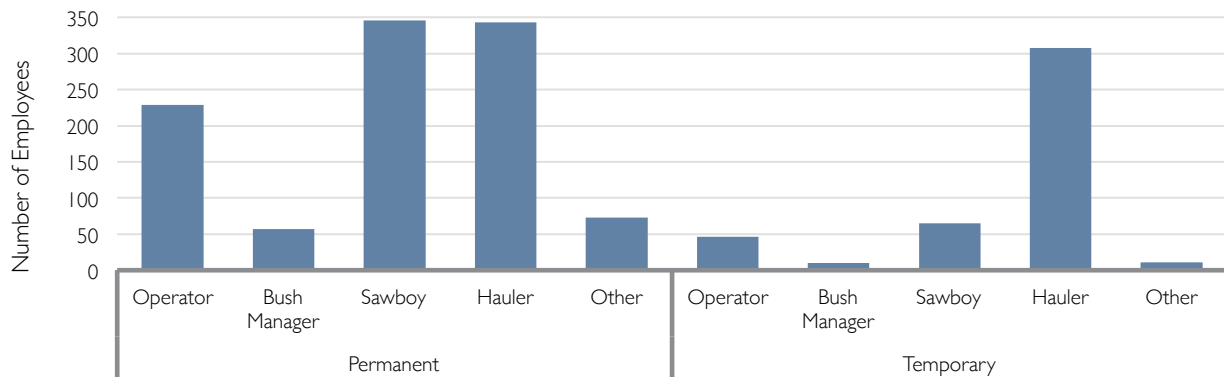
- The chainsaw miller owns or rents a saw(s) and then hires trucks to transport planks for purchase by outlet and depot owners in Monrovia.

3.2 Actors: Chainsaw Millers and Dynamics of Chainsaw Milling Operations

Employment

Each chainsaw milling operation generates jobs. In a typical operation, there is an operator who uses the saw, saw-boys that assist the operator, and a number of haulers who carry the planks from the site of felling to the nearest road. Twenty percent of operations also employ a bush manager, who is responsible for overseeing operations and managing the transportation of planks from the forest to urban areas.¹⁷

Figure 3 - Number of Employees in Surveyed Chainsaw Milling Operations



The 178 chainsaw millers surveyed across 6 counties generated a total of 1,488 jobs. This means that on average, each chainsaw miller creates 8.34 rural jobs directly related to the felling of trees and hauling of planks, corroborating previous findings.¹⁸ Seventy percent of the jobs are permanent and 30% are temporary.¹⁹ Haulers make up 70% of temporary employment; their employment is dependent on the distance and number of planks that need to be carried to the road.



Twenty-eight percent of surveyed chainsaw millers are from the communities and/or districts that they operate in; 72% do not originate from their areas of operations. While the surveyed operators tend to move to different parts of the country as short-term migrants seeking economic opportunity, it is more common for sawboys to be long-term migrants as a result of displacement from war or poverty.²⁰ Twenty-four percent of hired employees are from the communities where chainsaw milling operations occur, thus generating local jobs in remote and rural areas.

Thirty percent of surveyed community members stated that there are chainsaw millers operating in their community's forest from outside of Liberia.

¹⁷ The chainsaw miller survey was administered to the operator of the saw.

¹⁸ Blackett, 2009.

¹⁹ Temporary is assumed to mean dependent on the size of the operation, and is likely correlated to seasonality.

²⁰ Personal communication with chainsaw millers in Maryland and Rivercess counties.

These workers originated from Guinea, Sierra Leone and/or Cote d'Ivoire.²¹ While interviews indicate that there is some resentment towards the presence of foreigners in chainsaw milling activity, all of the surveyed chainsaw millers stated that they produce exclusively for domestic markets.²²

Based on the annual volume of timber sold on the domestic market in Liberia (see Section 6), we estimate that there are between 9,000 and 15,000 chainsaw milling operations in a year. This could mean that there are between 2,250 and 3,750 active chainsaw millers in Liberia, although this number could be much higher.²³ As each operator generates 8.34 jobs, between 18,765 and 31,275 people living in rural areas are directly engaged in chainsaw milling and rely on the industry to meet part or all of their basic needs. These numbers do not consider indirect or induced employment in rural communities from chainsaw milling, such as food provision and various other services.

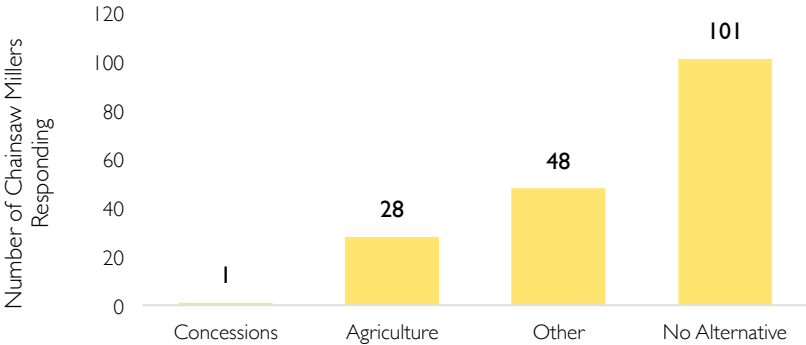
Livelihoods

Fifty-eight percent of chainsaw millers depend exclusively on chainsaw milling for 100% of their income. For those with diversified incomes, the average chainsaw miller still relies on chainsaw milling for 84% of income generation. On average, 4% comes from agriculture, 8% from services and 4% from other sources. Other streams of income include activities such as gold mining, owning a small business, and hunting.

Fifty-seven percent of chainsaw millers stated that they had no other means of sustaining a livelihood beyond chainsaw milling. Just one chainsaw miller said that they saw a potential opportunity in concessions; this low response rate could indicate that very few opportunities exist for chainsaw millers in formal logging operations.

Other potential livelihoods mentioned by chainsaw millers include masonry, carpentry, construction and owning a small business. These alternative livelihoods still demonstrate a strong reliance on timber available in the domestic market to meet basic needs.

Figure 4 - Alternative Livelihood to Chainsaw Milling



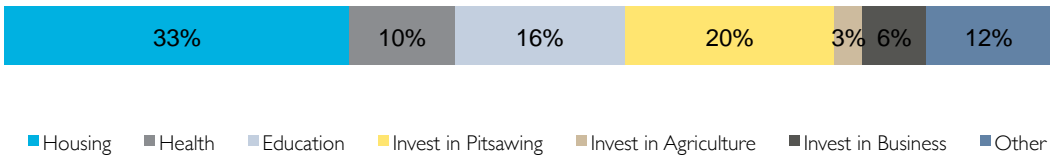
The data from Nimba County is different and interesting to mention. While 37.5% of chainsaw millers still can't identify an alternative livelihood outside of chainsaw milling, 25% said that agriculture was an option and 37.5% said that they could think of other ways to generate income. The more extensive road network, increased market access, larger

²¹ An exact breakdown of the number of foreigners engaged in chainsaw milling is not provided. While community members were open to speaking in general, it was found that chainsaw millers were less open to disclosing specific information regarding citizenship.
²² The export of sawn timber is explicitly illicit. Chainsaw millers did not disclose any information related to the export of planks.
²³ Based on estimates provided by chainsaw millers, we assume an average of 4 operations per year per chainsaw miller.

population, and rapidly declining forest areas in Nimba may contribute to the greater tendency to think of alternative livelihoods.

Income generated from chainsaw milling is used to meet chainsaw millers' basic needs. The respondents are the leaders of operations; consequently, they realize more profits than those employed in ancillary jobs and are consequently motivated to invest in their chainsaw milling operation. A 20% rate of re-investment in the business also indicates that there are guaranteed returns to chainsaw milling: chainsaw millers are confident that their investment in their operations will result in greater future gains (Figure 5).

Figure 5 - Expenditure of Chainsaw Millers



Liberia Chainsaw and Timber Dealers Union (LICSATDUN)

The Liberia Chainsaw and Timber Dealers Union (LICSATDUN) was established in 2008 with the mission to “help coordinate the activities of pit-sawyers in harvesting timber for domestic and commercial purposes while observing practices on sustainable forest management as provided for in the forest law of Liberia.”²⁴ It claims to represent the interests of both chainsaw millers and timber dealers throughout Liberia. LICSATDUN became involved in the VPA process after the EU and Liberia had signed the agreement.²⁵ It has subsequently delivered trainings on felling requirements and safety protocols to over 200 chainsaw millers to support the VPA process. It also represents the interests and voices of its members during VPA stakeholder consultations.²⁶

Table 3 presents a breakdown of LICSATDUN's most recent member listing, which was made available at the end of 2015. The listing not only shows gaps in their geographical coverage, but it indicates a heavy bias towards representing the voices of timber dealers and woodworkers in Monrovia rather than the chainsaw millers that operate in the counties. Among the chainsaw millers interviewed for the study, 90 reported that they belong to the union (50%), while 88 are not members (Figure 6). On the other hand, of the 217 timber dealers in Monrovia who reported their membership status, 176 respondents belong to LICSATDUN (82%).

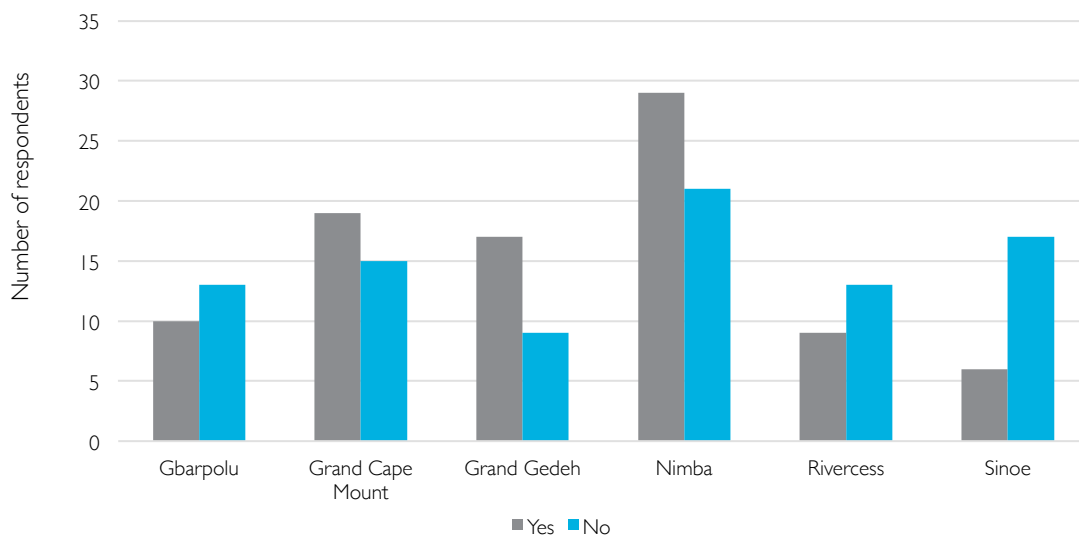
Table 3 - LICSATDUN Membership Listing, December 2015²⁷

County	Number of Members
Board of Directors, Board of Advisors, Executive Members	15
County (unspecified)	18
Gbarpolu	26

²⁴ Presentation by Arthur Kamgbea, *Sustainable Harvest Practices in Liberia*, May 2012.
²⁵ EU FLEGT, European Forestry Institute. <http://www.euflegt.efi.int/national-vpa-stakeholder-structures>. Accessed September 2016.
²⁶ Ibid.
²⁷ Many thanks to LICSATDUN for preparing and making available the membership listing.

Grand Bassa	246
Grand Cape Mount	10
Grand Gedeh	5
Lofa	15
Montserrado (plank fields, plank depots and woodworking shops)	368
Nimba	220
Rivercess	16
Total	939

Figure 6 - LICSATDUN Membership (by County and Respondents)



3.3. Economic Profitability

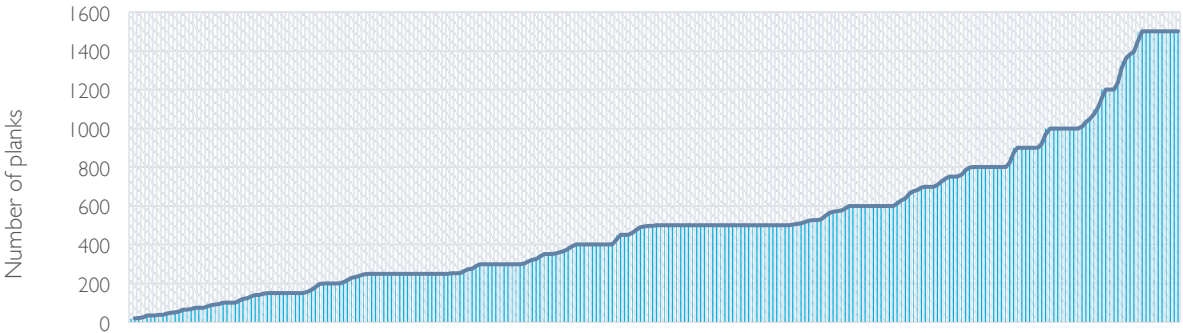
Volume

Chainsaw millers either fell trees for a pre-order or for an open sale. Thirty-nine percent of operations were for pre-order and 61% for open sale.

On average, an operation produces 511 planks from 48 trees. The duration of an operation varies depending on the number of saws, number of workers, and the availability of trees of sufficient diameter to convert to planks; it could be as short as a week or as long as six months. However, an average operation is approximately 3 months. This estimate is corroborated by similar studies done in Sub-Saharan Africa. Cerutti's 2011 study in Cameroon found that chainsaw millers fell approximately 3 trees during a one week operation.²⁸ The preference for longer-term operations can be explained by the high cost of transportation to carry planks from the forest to Monrovia and the cost-effectiveness of paying for a single, large delivery rather than multiple smaller deliveries, as well as the relatively long-term set-up of chainsaw milling camps.

²⁸ Cerutti, 2011.

Figure 7 - Operations by Number of Planks Produced



Volumes of sawn timber can be compared with official timber production and sales figures by converting them into Roundwood Equivalents (RWE). The processing rate (PR) for chainsaw milling operations in this study is estimated at 30% based on previous research on chainsaw milling in Liberia and West Africa. This figure corresponds to earlier approximations of PR using chainsaws, which were estimated within the range of 29.7%²⁹ to 32%.³⁰ Blackett observed 5 chainsaw milling operations in Liberia to find an average PR of 31%.³¹

Pre-order operations produce an average of 16.5 planks per tree, whereas open sale operations produce approximately 7.1 planks per tree.³² The power structure behind pre-order operations can be comprised of any number of actors, including an outlet owner in Monrovia and a bush manager based in the county; the social capital and economic leverage implied by this hierarchy shows that there is a likely correlation between access to larger, higher-quality trees and pre-order operations, hence the larger number of planks per tree.

Table 4 - Chainsaw Milling Production

Operation	Planks produced	m3 produced	RWE (30%)	Number of trees	RWE/tree	Distance from road (minutes)
Pre-order	496	23	82	30	3	26
Open sale	536	23	80	76	1	26
Average	511	23	81	48	2	26

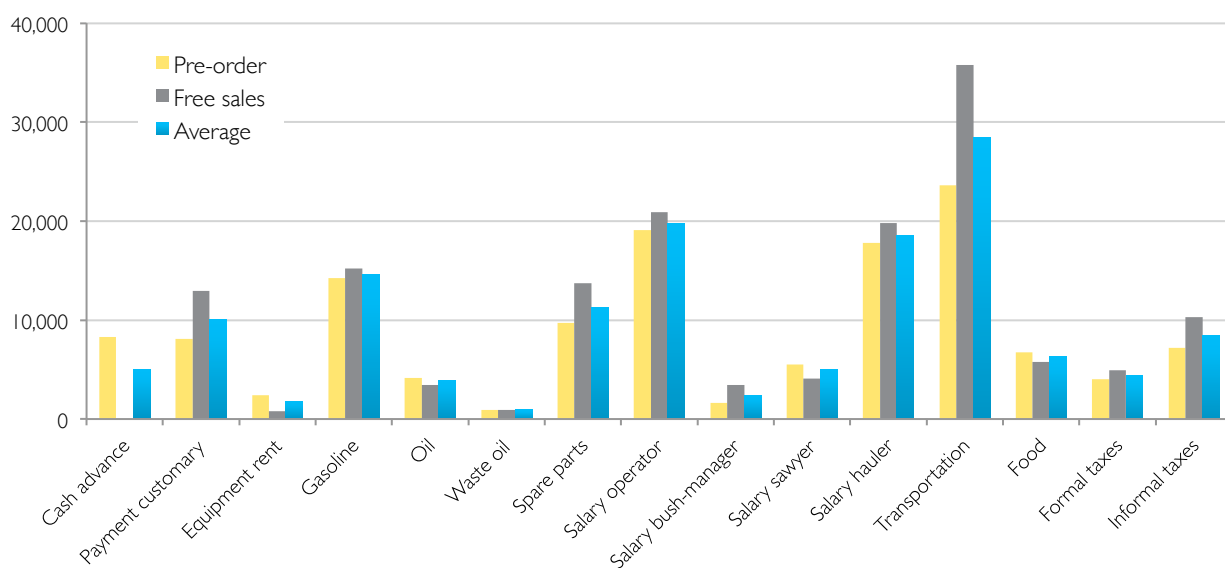
Costs, Benefits and Profits

Each operation incurs a variety of costs, which include salaries, equipment maintenance, and food for workers in the bush. On average, transportation makes up 23% of an operation's expenditure and it is the highest cost. Thirty-seven percent of expenditure goes towards combined salaries and 10% is spent on taxes.³³ Taxes can be formal (FDA, statutory government officials) or informal (community leaders). Chainsaw millers reported a much higher incidence of informal than formal taxes. On average, an operation expends 4,391 LD on formal taxes and 8,420 LD on informal taxes.

²⁹ Plouvier, D. et al. Étude du sous-secteur sciage artisanal au Cameroun, 2002.
³⁰ Rossi, M. Foresterie communautaire- Étude de cas dans le Sud et le Centre Cameroun, 2008.
³¹ Blackett, 2009.
³² Planks are cut in four main dimensions; the majority are 2 inches x 10 inches x 14 feet.
³³ If there is a bush manager, the salary of the operator is a cost. If there is not a bush manager, the salary of the operator is considered a benefit, as the operator would be the lead of the operation.



Figure 8 - Costs Incurred by Chainsaw Millers (Liberian Dollars)³⁴



A chainsaw miller realizes an average profit of \$821 USD per operation (Table 5). Orders for pre-sale generate significantly less profits than open sales.³⁵ This finding contrasts with other countries in Sub-Saharan Africa, but several factors might explain it.³⁶ First, operations for pre-sale are significantly smaller in terms of volume and length of time than those for open sale; therefore, fixed costs have a greater impact on the former rather than the latter. In addition, the species composition of pre-order sales (48% wawa and framire) and open sales (55% framire, tetra, niangon, and lovoa), with less valuable species found on average in the former, also contributes to price differences and increased profits.

³⁴ The cash advance is given to the chainsaw operator by the outlet or plank depot owner in pre-order operations.

³⁵ This is partially due to the difference in size of operations: pre-orders are significantly smaller than open sales. The species composition of pre-order (48% wawa and framire) and open sales (55% framire, tetra, niangon and lovoa) also contributes to price differences.

³⁶ Cerutti and Lescuyer, 2011; Lescuyer et al. 2014.

When timber passes through a shorter supply chain without downstream competition, the chainsaw millers profit on average \$28 USD less per cubic meter of timber than those that sell to the domestic market at large.³⁷ This divergence is in part explained by the tendency of timber dealers to re-invest profits in chainsaw milling in pre-order operations, rather than the operator in open sale operations. It could also indicate that open sales function as a free market: prices fluctuate in response to supply and demand dynamics, which typically generates greater profits than the price-controlled pre-orders that function as monopolies.

Table 5 - Chainsaw Milling Profits (per operation)

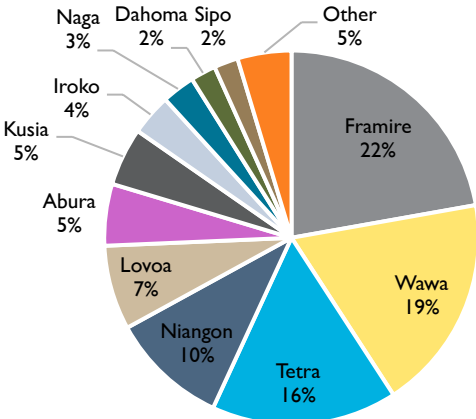
Operation	Total Benefit	Total Cost	Total Profit	Profit per m3
Pre-order	\$1,779	\$1,195	\$583	\$23
Open Sale	\$2,634	\$1,429	\$1,205	\$51
Average	\$2,106	\$1,285	\$821	\$26

Based on total volume estimates of sawn timber that is sold in Monrovia’s timber markets, chainsaw millers across all counties realize an estimated annual profit between \$5,397,150 and \$7,196,202. This could mean that chainsaw operators realize an average annual profit between \$1,439 and \$1,918.³⁸ While it is possible that chainsaw millers incur additional costs beyond the reported operational costs, chainsaw milling is a relatively profitable activity for those who own and operate a chainsaw.

Species

Sixty-seven percent of surveyed chainsaw milling production is limited to four species: framire, wawa, tetra and niangon. These are produced in varying plank dimensions. Almost all planks (99.5%) are 14 feet in length. Blackett noted that while the fixed length conforms to construction industry needs for rafters and door lengths, it is not necessary for furniture-making and the conformity to the 14 foot standard leads to overall inefficiency and wastage.³⁹

Figure 9 - Species of Trees Harvested by Chainsaw Milling Operations



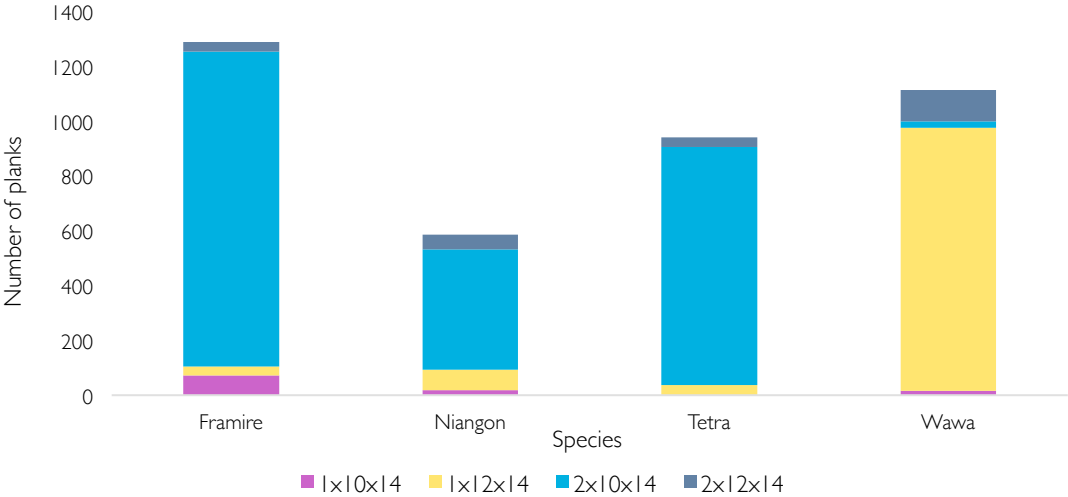
³⁷ We assume that the timber dealer, rather than the chainsaw miller, absorbs the costs of transportation and taxes for pre-orders; however, depending on the relationship, the timber dealer may pay additional costs, further reducing the calculated profit per m3.

³⁸ Assuming that there are 3,750 operators.

³⁹ Blackett, 2009.

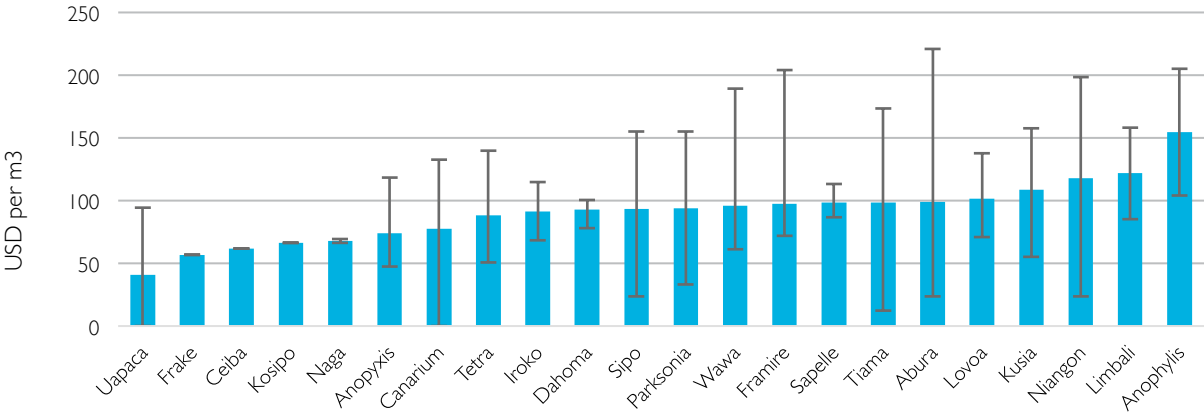
Sixty-six percent of planks are 2 inches by 10 inches by 14 feet (2x10x14). Figure 10 presents the dimensional breakdown of the top four species. The wawa species is an anomaly: 86% of planks are 1x12x14. Wawa trees are larger than other trees, and the wider dimension is consistent with the goal to extract as many planks as possible from a felled tree.

Figure 10 - Dimensions of Planks by Species



Economic profitability varies based on the quality and species of the planks. On average, 74% of species retail for less than \$100 USD per cubic meter on the domestic market. Figure 11 shows the observed average price of each species and its minimum and maximum retail price in USD per cubic meter.

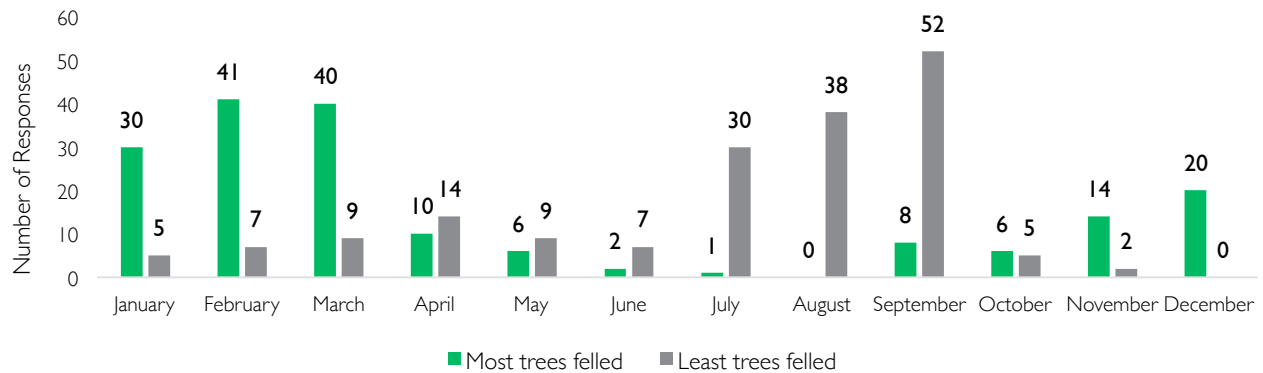
Figure 11 - Average Price of Sawn Wood by Species



Seasonal variability

Chainsaw millers reportedly fell the greatest number of trees throughout the dry season in January, February and March; they fell the least during the rainy season from July through September. The state of roads slows or even halts the transport of planks from the site of felling to roadside, and from the counties to Monrovia.

Figure 12 - Seasonal Variability of Chainsaw Milling Operations



3.4 Environmental and Community Impacts

Environmental Impacts

Chainsaw milling occurs in both primary and secondary forests. There is no regulation or enforcement that monitors or stipulates what chainsaw millers can or cannot fell beyond what communities designate as areas where chainsaw millers can operate.

In commercial concessions, a thirty-year harvest rotation is the standard to allow for the growth and re-generation of trees. Along the roads carved by formerly operative companies, most areas are prone to more extensive and frequent harvesting by chainsaw millers.⁴⁰ While concessions are obligated to comply with certain standards, neither communities nor chainsaw millers re-plant or monitor the selection of species harvested. As is common in other countries in Sub-Saharan Africa, the survey shows that chainsaw millers typically target the same species as concessions, impacting the long-term sustainability of key commercial species.

Many types of trees frequently harvested by chainsaw millers appear on the endangered species list. These include abura, dahoma, iroko, kosipo, lovoa, niangon, sapele, sipo and wawa.⁴¹

Attitudes and perceptions towards environmental impacts

Chainsaw millers' perception of the sustainability of their personal chainsaw milling operations seems to indicate a short-term vision of the future, with not much consideration given to environmental challenges that they face in their work. Sixty percent of chainsaw millers predicted that their future operations and profits will be very good, good, or the same.

In contrast to the perceived future profitability of chainsaw milling, 65% of respondents stated that it is currently difficult or very difficult to find certain species of trees compared to when they first started CSM operations. Many chainsaw millers stated that they must walk much farther from the road to find certain trees. Lovo and niangon were two species specified as particularly difficult to find today. The optimum felling size of a tree is 60 centimeters DBH

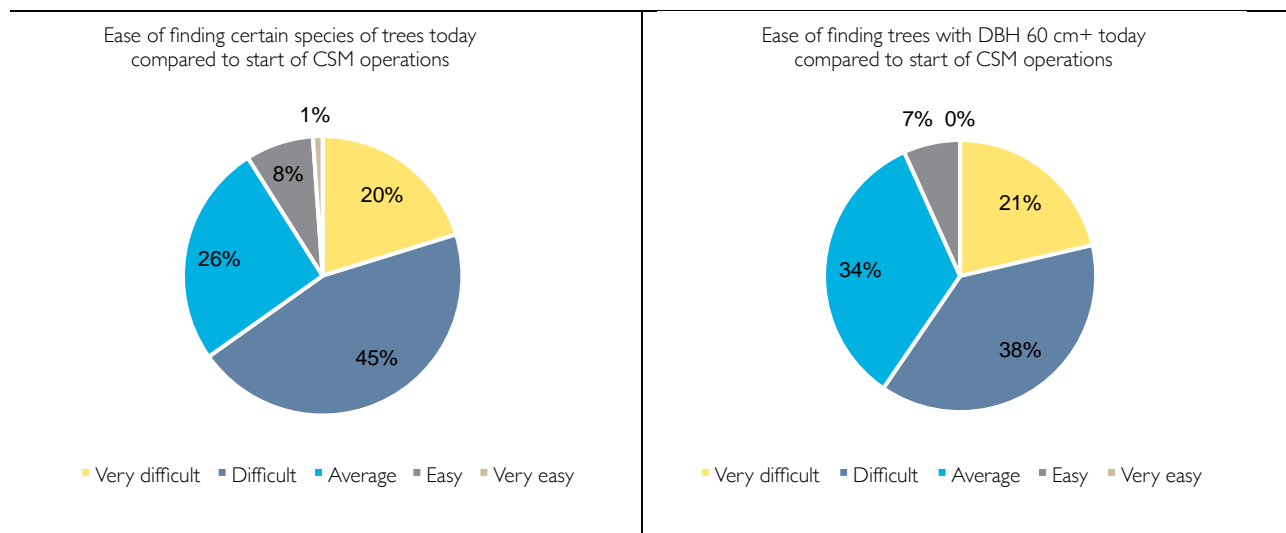
⁴⁰ USFS, 2015.

⁴¹ Flora & Fauna International, High Conservation Values: Draft international interpretation for Liberia, 2012.

(diameter at breast height). Fifty-nine percent of respondents said that it was difficult or very difficult to fell trees of 60 cm DBH today compared to the start of operations.

For both questions, respondents that replied it was still easy or very easy to find certain species and diameters of trees came from either Sinoe or Grand Gedeh. These counties have relatively expansive and dense forests, and are farther from markets in Monrovia compared to other surveyed counties.

Figure 13 - Chainsaw Millers' Perception of Environmental Impacts of Milling



The discrepancy between the predicted success of personal chainsaw milling operations and the difficulties in finding certain types and sizes of trees to fell is explained by a perception that the forest won't disappear and a failure to consider the ramifications of deforestation on future generations. A chainsaw miller explained that if there were no longer trees to fell in the current community forest he operates in, he would shift to a different community's forest. If he ran out of trees in that forest, he would move his operations to another county. The conversation stopped there. The chainsaw miller gave no consideration to what would happen if there were no trees to fell in another county or if the forest was already harvested by the increasing number of operators; he stated that such a situation was impossible during his lifetime.

3.5 Community Impacts

The majority of chainsaw milling operations takes place on land that is considered customary land. This land can be individually or collectively owned. Chainsaw millers must enter into a deal with the community to gain access to forests for felling.

Community Benefits

Chainsaw millers compensate the landowners and/or communities where they operate through an agreed upon payment in cash or in-kind. However, the benefits that the community receives vary greatly depending on the negotiation with the community leaders and landowners. Oftentimes, chainsaw millers are required to pay a registration fee and an additional fee per number of planks harvested or a certain percentage of planks. Some examples of payments made to the community by chainsaw millers include:

- A yearly registration fee of 2,000 LD, one bag of rice, and a county fee of \$35 LD per plank (Rivercess)
- Eight hundred LD for every 700 planks sawn (Rivercess)
- Pay land owner for individual trees felled (Nimba)
- Three bundles of zinc (Nimba)
- Community development, such as the construction of a pavala hut (Grand Cape Mount)

If no fee is paid to the community, this is because the saw owner is operating on family owned or purchased land. A limited number of chainsaw milling operations fall under such an arrangement.

Conflicts

Only 12% of chainsaw millers reported conflicts that resulted from their operations. Conflicts tend to be between the chainsaw miller and the community; no chainsaw millers mentioned conflict with concessions or statutory government officials.

The majority of conflicts are resolved either independently in discussions between the chainsaw miller and landowner and/or community members, or by traditional leaders. There is relatively little involvement in conflict resolution from statutory government authorities.

Table 6 - Reported Conflicts between Chainsaw Millers and Communities

Conflict	Location	Resolution
Not enough trees in chainsaw milling area designated by community	Sinoe	Traditional leaders
Community leadership did not receive share of money	Sinoe	Chainsaw millers
Land dispute between communities	Rivercess	Local government officials
Community members not realizing benefits, attempted to stop operations	Grand Gedeh	Independently
Landowner said community received more benefits than him	Grand Gedeh	Independently
Community members blocked road, said chainsaw millers made too much money	Grand Gedeh	Traditional leaders
Chainsaw miller did not inform community before starting operations	Grand Gedeh	Traditional leaders
Land dispute between chainsaw miller and landowner	Grand Gedeh	Independently
Felled trees damaged crops	Nimba	Independently
Community restricted transport to trucks with 6 wheels to carry planks	Nimba	Traditional leaders
A concessions company began operations in chainsaw milling location	Nimba	Traditional leaders
Chainsaw miller made agreement with person falsely claiming to be land owner	Nimba	Local government officials
Relatives of land-owner requested additional benefits from chainsaw miller	Nimba	Local government officials
Disagreements on community benefits, leading to halt of operations	Nimba	Independently

Community members want to give felling rights to Chinese companies	Grand Cape Mount	Traditional leaders
Community benefits increased without consultation with chainsaw millers	Grand Cape Mount	Traditional leaders
Foreign chainsaw miller was given more rights than Liberia chainsaw miller	Grand Cape Mount	Traditional leaders

Several community leaders reported conflicts with chainsaw millers, although these were almost exclusively related to the late payment of registration fees.

Attitudes and perceptions towards chainsaw milling

The attitudes and perceptions of community members towards chainsaw milling vary greatly, even between adjacent communities. A respondent from Rivercess said, “The community desired to enter in pit-sawing because the company that bought the bush refuses to help the community.”⁴² Yet in a nearby community, a town leader stated, “The community wants for the company to carry on the timber business, because there will be employment opportunities for community members.” Another respondent from the same county said, “We allow pit-sawing because the community has not benefited from government funding.” The diversity of opinions shows that there is not a standard relationship between communities and chainsaw millers.

Community knowledge of benefits from chainsaw milling also differs. In some communities, there is a lack of transparency around what the community receives from allocating portions of their forests to chainsaw millers for exploitation. The leader of a women’s group in Rivercess said, “I don’t know much about town benefits [from chainsaw milling] and how they’ve been used.” Other times, the benefits are clear: “Pit-sawing has help[ed] us build a guest house with everything in it just from the collection of fees.”

In contrast to chainsaw millers’ optimistic outlook on the continued success of chainsaw milling, sixty-one percent of surveyed community members view the future of chainsaw milling as bad or very bad. Many of these community members raised concerns related to the environmental sustainability of operations and the need to better develop the industry so that it can have more positive impacts. A town chief from Grand Cape Mount said, “What we have to say is stop sawing certain trees from the forest, [such as] abura and niangon.” A chief in Nimba recommended that “felling should be done several miles from the community.” In Gbarpolu, a youth leader recognized the need to increase value addition activities in the counties: “We need sawmills in our county to help get the wood in different shapes.”

4. TRANSPORTATION

There are three roads along which trucks can transport timber from the counties into Monrovia: the Buchanan-Monrovia highway, Bomi-Monrovia highway, and Margibi-Monrovia highway. FDA officials are stationed at three checkpoints to check that the 60 cent tax per plank has been paid to the FDA.

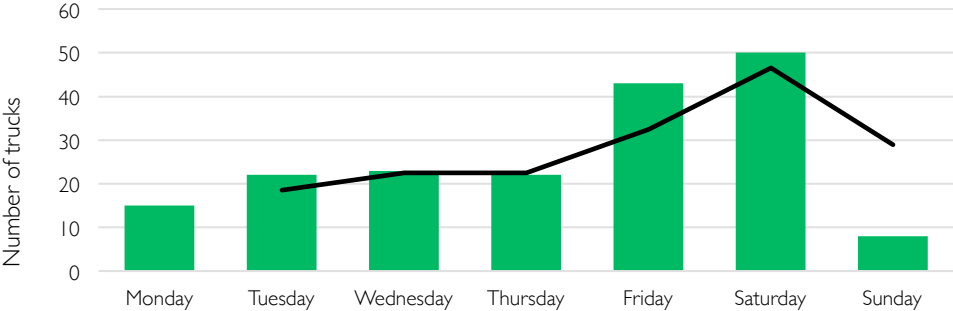
⁴² Pit-sawing is the often-used colloquial term for chainsaw milling.



The bridge that connects Rivercess and Sinoe counties, broken from the weight of a truck carrying gravel. Goods can only be transported across the river in small loads via foot or by boat; neither of these options is feasible for transporting planks. This likely decreased the volume of planks coming from multiple counties during the data collection period.

During the week-long observation, 183 trucks carrying planks passed through the 3 checkpoints, carrying a total of 52,609 planks. This equates to a weekly volume of 2,679.79 m³ and an annual volume of 139,349 m³.⁴³ Over one third of the planks originated in Nimba; the Margibi- Monrovia highway is paved between Monrovia and Ganta, and trucks can transport goods year-round with relative ease. Ninety-three trucks (51%) carrying planks entered Monrovia through the three checkpoints on Friday and Saturday (Figure 14).

Figure 14 - Number of Trucks Passing FDA Checkpoints Each Week



⁴³ Assuming that the observed week is constant over 52 weeks.

During data collection, the Rivercess bridge was broken, restricting the movement of goods from Rivercess, Sinoe, Grand Gedeh, River Gee and Maryland to Monrovia. This could imply that considerably reduced volumes of planks from these counties were entering Monrovia.

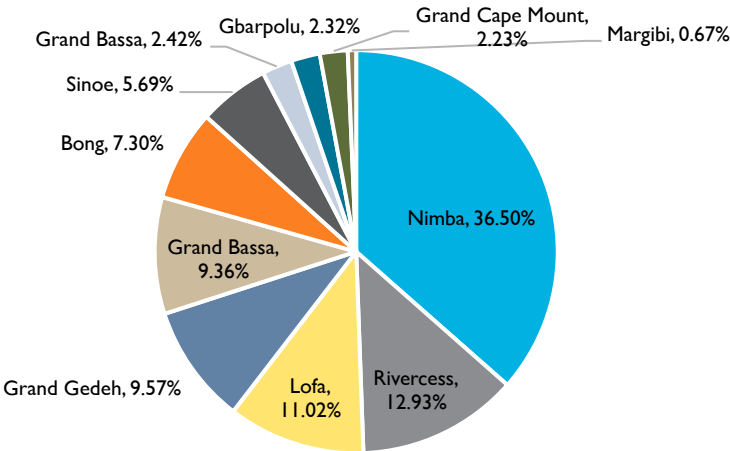
Assuming that a 60 cent LD tax is collected on each plank that passes through the three checkpoints, estimated annual tax revenues collected by the FDA from waybill fees range from \$986,734 USD to \$1,710,340 USD. Table 7 considers the revenue generated during the observed week of plank transportation to Monrovia as constant over 52 weeks, 40 weeks and 30 weeks.

Table 7 - Volume of Sawn Wood and Associated Tax Revenues Collected

	52 weeks	40 weeks	30 weeks
Number of planks	2,735,668	2,104,360	1,578,270
Volume (m3)	139,349	107,192	80,394
Annual tax revenue (USD)	\$1,710,340	\$1,315,646	\$986,734

While the FDA monitors and collects taxes on the planks that pass through these checkpoints, there are volumes of timber that pass through alternative routes to reach Monrovia. A feeder road that is in good condition allows trucks traveling from Lofa, Gbarpolu and Grand Cape Mount to skirt the Bomi-Monrovia checkpoint. In addition, out of the 183 truckloads observed during the one week, five of the drivers did not allow enumerators to see or count the number of planks that they were carrying, consequently lowering the observed volume of sawn timber transported to Monrovia. The rainfall during the week of observation could have also contributed to the inconsistency; timber sales continued to be high as the volumes transported began to decrease with the onset of rainy season.

Figure 15 - County Origin of Planks Transported to Monrovia



Ninety-six percent of the trucks reported that they were transporting goods to a plank field, although the majority declined to specify to which plank field or depot they were delivering planks. Seven trucks stated that they were going directly to private businesses. For business confidentiality purposes, they did not disclose the name of these businesses.

However, this indicates that there are independent value chains for planks outside of plank fields and depots; some businesses own chainsaws that operate in the counties and generate a direct supply of planks.

5. TIMBER PURCHASES AND SALES

5.1 Market Characteristics

Planks are sold at plank fields or plank depots throughout Monrovia. All points selling planks in Monrovia were counted and stratified according to size through a census; in total, 372 individuals and businesses sell planks in Monrovia.⁴⁴

Table 8 - Census and Sample Monrovia Timber Markets

Size of Outlet	Population of Points of Sale	Sample	Average m3 of Sawn Wood Sold Annually
Small	231	144	523
Medium	93	59	1,287
Large	48	30	2,496
Total	372	233	905

There are seven plank fields in Monrovia. Between 10 and 150 outlets are in each plank field. Outlets are owned or rented by individuals or a small partnership; an individual or group is only permitted to operate one outlet. They purchase planks from the counties through pre-orders or open sales and sell to individual customers or businesses. While each outlet operates independently, owners cooperate to meet customer requests and fulfill orders. For example, if an outlet receives a very large order from a client and they do not have sufficient stock to complete the request, they will purchase the required number and species of planks from another outlet(s) in the same plank field.⁴⁵



⁴⁴ Plank depots located off of the main roads were not included in the census. It is likely that the number of timber dealers operating in Monrovia is higher than the confirmed 372 points of sale.

⁴⁵ Sales and purchases between outlet owners were not recorded during data collection; only full orders to customers were captured to avoid double counting the timber sold.

There is a plank field manager at each plank field. The duties of this person include tracking day-to-day activities, regulating prices, settling disputes between outlet owners, collecting rent from outlets and fees from trucks delivering planks, and maintaining the upkeep of the plank field.

The plank fields have a variety of ripping, designing and processing equipment. The machines are privately owned, and outlet owners pay a small fee to process their planks with the equipment.

Each outlet pays a certain rental or ownership fee. This is an annual fee that ranges between \$24 USD and \$120 USD. A variety of formal and informal taxes were reported by the seven plank fields. While many plank fields claimed that they do not pay any informal taxes, others mentioned that they made informal payments to certain government bodies because they cannot afford formal taxation rates. Bribes to police and security personnel at checkpoints were also frequently noted. The plank field manager manages these fees by collecting required amounts from outlet owners and trucks delivering planks.

Plank Depots

Plank depots are independent sale points of planks. Ninety-seven independent plank depots that range in size from small to large operate throughout Monrovia. Trucks deliver planks from the counties directly to these depots; they do not purchase timber from plank fields. Many of the plank depots also have machinery to process sawn wood. The depots are typically clustered in certain areas of the city; due to this grouping, smaller plank depots are often able to pay a small fee to use the equipment located at a larger plank depot.

Seasonal Variability

As with harvesting, the volume of timber purchased and sold in Monrovia fluctuates depending on the season. Rainy season reduces supply and demand for planks. Pot-holed dirt roads that turn to mud during rainy season slow or halt the movement of goods from the counties to Monrovia.⁴⁶

Data collection started at the end of April 2016 and lasted until the middle of June 2016. Rain was frequent but sporadic during this time; roads were in relatively good condition.⁴⁷ Plank field managers noted that outlet owners would need to stock planks prior to heavier rainfalls in July through September, as both chainsaw millers and truck drivers slow output due to weather conditions and poor roads. Similarly, individuals and MSMEs would likely increase their stocks of planks as they may not be able to obtain their required quantity or quality during rainy season.

Due to the relatively high turnover of planks during data collection, the following analysis is presented to consider and control for seasonal variability. We extrapolate the observed volume of sales to 40 weeks (High Estimate) and 30 weeks (Low Estimate).⁴⁸

⁴⁶ Timber dealers said that feeder roads in particular need to be improved, as planks oftentimes need to be transported long distances to main roads.

⁴⁷ One notable exception was the broken bridge in Rivercess, which halted transportation and flows of goods and services from Rivercess, Sinoe and other counties to Monrovia.

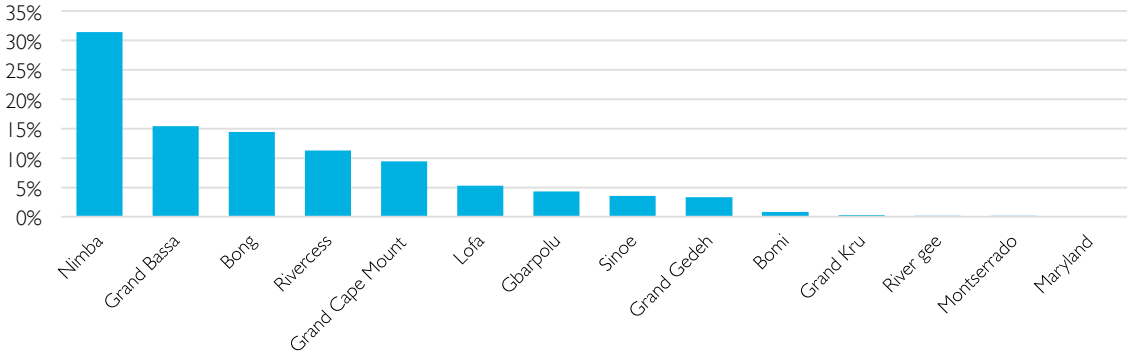
⁴⁸ Zero sales for 12 and 22 weeks are assumed for the extrapolations to 40 and 30 weeks. While interviews indicated that purchases and sales of timber slowed during the rainy season, the lack of available data on chainsaw milling and timber sales during rainy season necessitated a low-end estimate for production. Therefore, we assume zero sales for purposes of extrapolation.

5.2 Timber Sales

Origin of purchases

Planks originate from 14 counties.⁴⁹ Ninety percent of purchases made by outlet and plank depot owners came directly from the forest, indicating that no processing beyond the chainsaw occurred. Ten percent of the purchases were processed before delivery to plank fields and depots. There are no sawmills for timber in Liberia; however, rudimentary processing equipment including ripping machines exists at the county level. In Nimba, community members reported that there are also dressing and designing machines. Twenty-one percent of planks that originated in Nimba were purchased after some processing had been done; in contrast, all purchases from Lofa and Grand Kru were made without any previous processing.

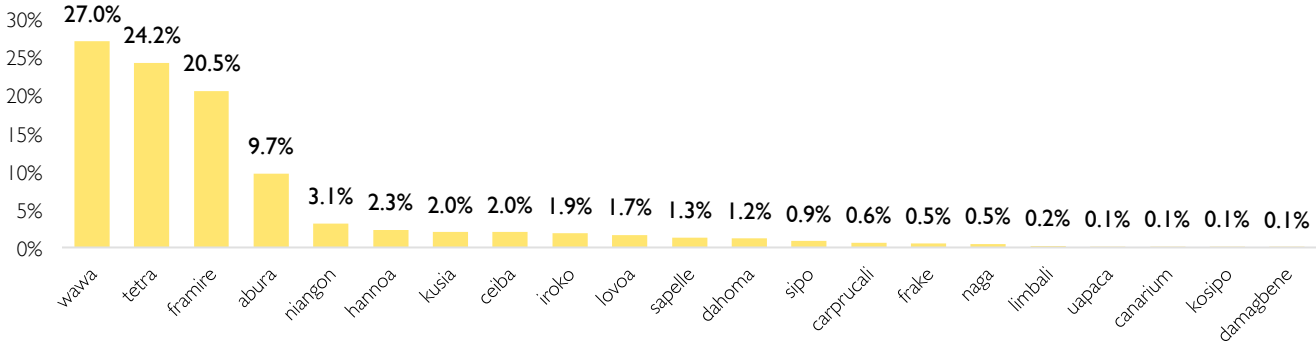
Figure 16 - County of Origin of Planks (% by Volume)



Products, Species and Prices

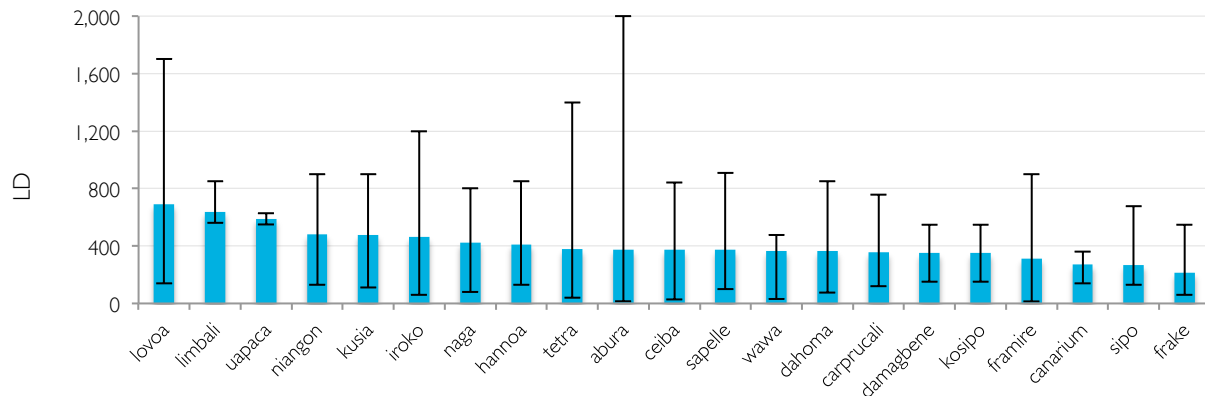
As expected from upstream production statistics, 81% of timber sales in Monrovia are concentrated in four species: wawa, tetra, framire and abura. Purchase prices vary depending on both the species and quality of plank. The average price per plank is 371 LD (average standard deviation of 212). Figure 18 shows the average price per plank of each species, as well as the minimum and maximum prices paid.

Figure 17 - Disaggregation of Timber Sales by Species



⁴⁹ Seventy-two percent of sales were recorded with an origin of the planks. During data collection, enumerators were informed by chainsaw millers and drivers transporting planks that there is a large buyer of planks based in Buchanan, which could explain the absence of planks from Margibi in Monrovia markets.

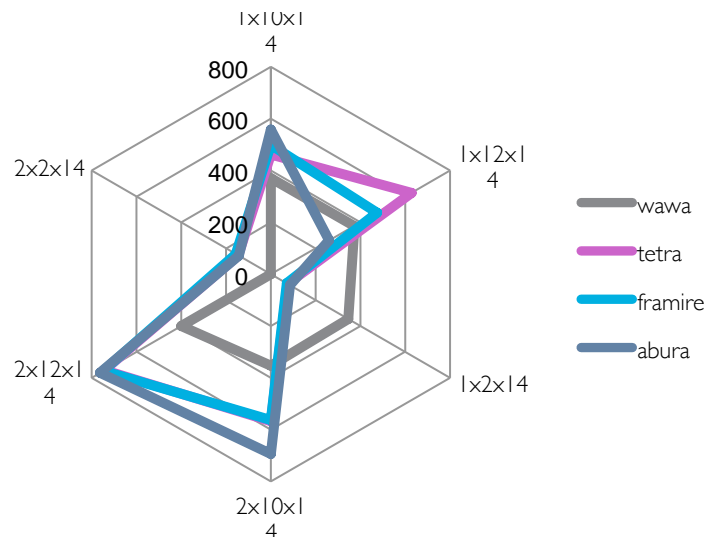
Figure 18 - Average Price per Plank (LD, by Species)



Planks are primarily purchased in dimensions of 2x10x14 (54%), 2x12x14 (15%), 1x12x14 (13%), and 1x10x14 (11%). These sizes are based on what chainsaw millers are able to carry from the site of felling to the roadside for transport to markets. Planks that are larger than this are too heavy to manually carry, and smaller planks would be charged the same 60 cent fee by the FDA.

While planks are bought in four main sizes from chainsaw millers, individuals and businesses can purchase planks from outlets and depots in a much wider variety of dimensions. All plank fields have ripping machines, which roughly cut planks into smaller dimensions. Prices also vary based on the size of planks. Figure 19 shows the average prices in LD for the top 4 species of planks in the 6 most common dimensions.

Figure 19 - Average Sale Price of Planks for Top 4 Species in 6 Most Common Dimensions (LD)



Volumes and Profits

The estimated annual volume of sawn timber that is sold on Liberia's domestic markets is between 207,583 m³ and 276,777 m³.⁵⁰ Domestic demand for timber can be estimated from the volume sold. We assume that demand is

⁵⁰ 207,583 m³ at 30 weeks of observed sales volume and 276,777 m³ at 40 weeks of observed sales volume.

concentrated in Liberia's urban population because (1) the majority of construction and furniture-making businesses are based in cities and (2) urban homes use timber in construction, whereas rural homes generally do not.⁵¹

Table 9 - Annual Volumes of Sawn Timber Produced by and for Domestic Markets

	High Estimate	Low Estimate
Average annual sales (m3)	276,777	207,583
Domestic timber consumption per capita (m3)	.12	.09
RWE (m3)	922,591	691,944

Figure 20 - Average Annual Sales per depot, by m3

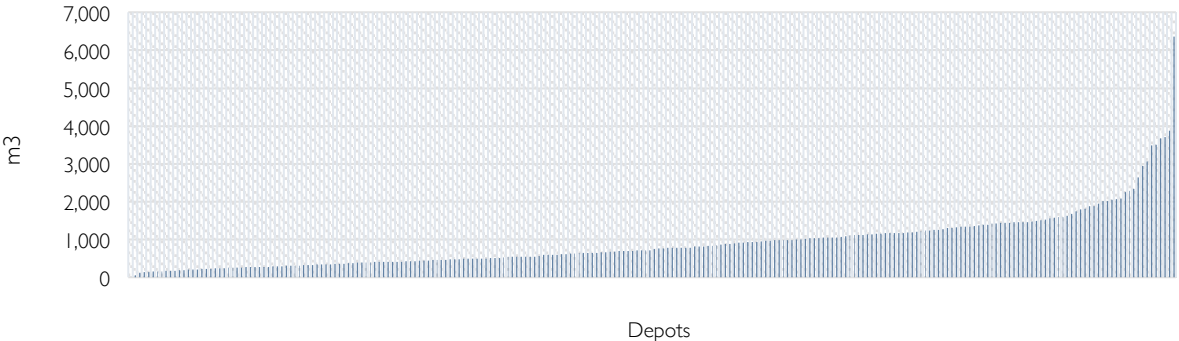
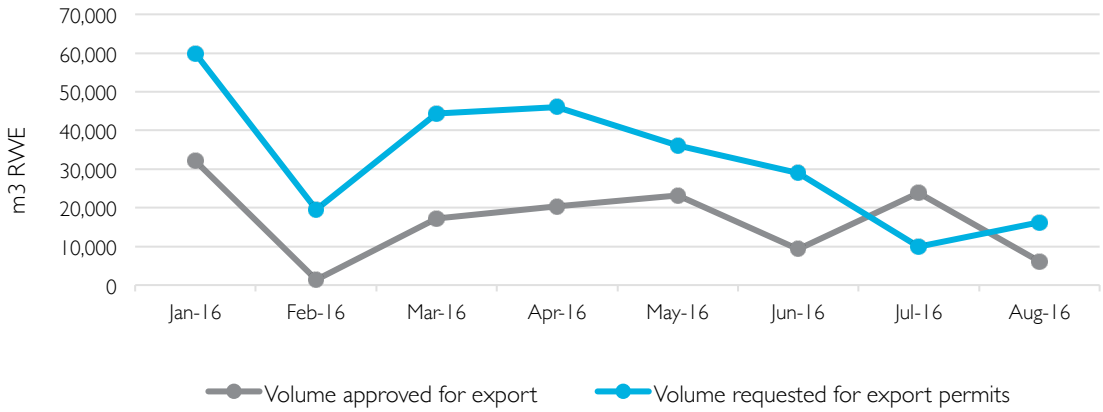


Figure 21 shows the volume of timber (m3 RWE) produced by formal commercial logging companies and approved for export through the Chain of Custody (CoC) system.⁵² Implemented by Société Générale de Surveillance (SGS) in coordination with the FDA, the CoC is a digitized system that tracks individual logs from their stump through the point of export to ensure that illegal logs do not enter the legal supply chain and that all taxes are paid. While the month-to-month volume of timber approved for export varies greatly, the 2016 annual projected volume of verified exports through the formal CoC supply chain is 200,263 m3 RWE.

Figure 21 - Volume Approved for Export with (m3 RWE)



⁵¹ UN Statistics, 2015. 2016 projected population is 4,615,000 and urban population is 49.7%, which provides an estimated urban population of 2,293,655.

⁵²SGS, Monthly COC Operation Report, August 2016.

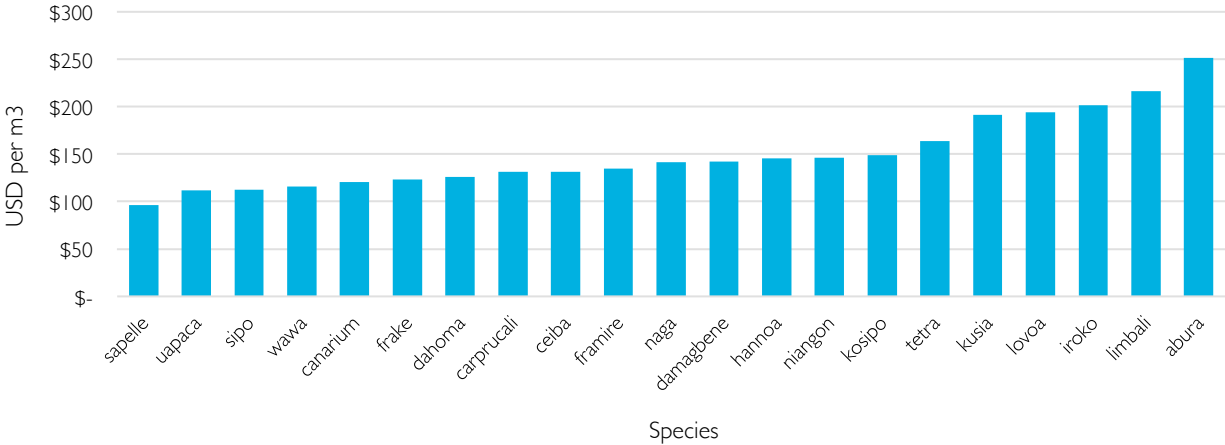
The annual turnover of cumulative small, medium and large outlets/depots is presented in Table 10. The average annual turnover of a small outlet or depot is \$68,014 USD, \$153,264 USD for a medium outlet or depot, and \$290,341 USD for a large outlet or depot.⁵³ In total, the sale of planks from outlets and plank depots in Monrovia generates an estimated annual turnover between \$25,327,572 USD and \$33,770,096 USD. Plank fields and depots pay some to no formal taxes; therefore this turnover, and the actors involved, primarily remain in the informal economy.

Table 10 - Annual Turnover of Outlets and Depots

	High Estimate	Low Estimate
Small	\$12,085,531	\$9,064,148
Medium	\$10,964,264	\$8,223,198
Large	\$10,720,301	\$8,040,226
Total	\$33,770,096	\$25,327,572

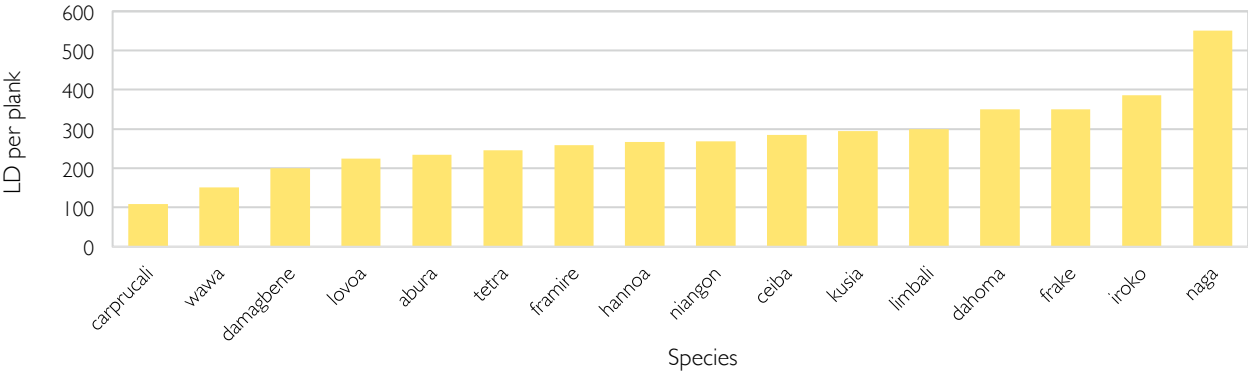
On average, a cubic meter of sawn wood sold in Monrovia plank fields and depots costs \$152 USD (Figure 22). Figure 23 details the average profit earned per plank, according to species. While profits are used to pay wages and rent, outlets typically consist of a single person owning and operating the business and rent is relatively low.

Figure 22 - Average Price of Sawn Wood by Species (USD per m3)



⁵³ Average annual turnover of individual outlets and depots based on High Estimate calculations.

Figure 23 - Average Profit per Plank, by Species



The price of exported timber cannot be directly compared to domestic market prices, as exports are unprocessed raw logs rather than sawn wood. The free on board (FOB) price for a cubic meter RWE ranges from \$170 USD to \$290 USD, with an average price of \$180 USD.⁵⁴ The FOB prices correspond to third grade prices, and are far below international market prices. The international market prices for sawn wood are significantly higher than Liberia's domestic prices (Table 11).⁵⁵

Table 11 - Average Domestic vs International Prices (USD per m3 of Sawn Wood)

Species	Liberia domestic market price (USD per m3 of sawn wood)	High international market price (USD per m3 of sawn wood)	Low international market price (USD per m3 of sawn wood)	Average international price	% difference with domestic prices
Framire	\$134.45	\$407	\$367	\$387	+34%
Tetra	\$163.38				
Wawa	\$115.73	\$367	\$311	\$339	+34%
Niangon	\$146.05	\$622	\$565	\$594	+25%
Lovoa	\$193.72				
Abura	\$251.36	\$452	\$384	\$418	+60%

Impacts

Environmental

Based on the estimated volumes of sawn wood that are sold by Monrovia plank outlets and depots, we can estimate the environmental impact of informal chainsaw milling. Chainsaw millers work close to roads and paths, often carved by concessions. This means that they are often felling trees in areas where the more valuable species and adequately sized trees have already been harvested by logging companies. While the selection of trees is sparser and would presumably increase the number of forest hectares impacted by chainsaw milling, chainsaw millers likely fell trees in a more indiscriminate manner than concessions, as they do not adhere to any formal cutting regulations. Therefore, we retain the assumption of a 30% efficiency rate for chainsaw milling and estimate that one forest hectare is affected by chainsaw milling operations for every 5 to 10 RWE m3 that is felled.⁵⁶ Table 12 presents low and high estimates of the number of forest hectares impacted by domestic timber sales.

⁵⁴ SGS, Timbe products market prices, June 2016.

⁵⁵ International prices are inclusive of shipping costs, taxes, etc.

⁵⁶ 7 m3 per hectare is used for calculations in Table 8.

Table 12 - Area of Forest by Chainsaw Milling per Year

	High	Low
Area harvested per year (ha, 7m3/ha)	131,799	98,849

Recent analysis suggests that deforestation was stable between 2000 and 2010, but that there has been a significant increase between 2010 and 2015.⁵⁷ While many factors influence the acceleration of deforestation, it is worth noting that epicenters of severe deforestation emanate from the large concessions that operate in Liberia, including Siam Darby, Equatorial Palm Oil and Golden Veroleum.⁵⁸ Chainsaw millers' preference for operating in forest locations near roads made by logging concessions and other extractive industries may contribute to the observed spread of deforestation and forest degradation around concessions.

Community

The ripping machines produce large amounts of sawdust and wood chips. The refuse is collected in bags and used by community members to stop flooding and repair dirt and potholed roads during rainy season. Plank field managers do not charge for these bags of wood chips; rather, they view it as a way to maintain good relations with surrounding community members.

The plank fields are active marketplaces and generate additional forms of employment beyond the selling of planks. Women walk through the rows of outlets selling food and drinks. Small shops selling handsaws and other tools are set up within most of the plank fields. Individuals or partnerships own the ripping, dressing and designing machines located in the plank fields, and outlets pay the owners a nominal fee to cut and process planks.



⁵⁷ Personal communication, Conservation International, September 2016.

⁵⁸ Ibid.

Infrastructure

Plank field managers expend funds collected from outlet owners to rehabilitate roads entering the plank fields to facilitate the delivery of planks, particularly during the rainy season. They stated that the poor quality of trucks and of roads, particularly tertiary roads in the counties where the majority of felling occurs, severely hinders their operational capacity.

6. VALUE ADDITION: FURNITURE-MAKING MSMES

6.1 Market Characteristics

The 157 surveyed woodworking MSMEs specialize in either furniture making or small-scale construction and carpentry. They employ a total of 1,489 workers. Sixty-six percent of these employees are permanent, which indicates that there is relatively sufficient and steady demand throughout the year for furniture and construction-related services. Women make up just 5.4% of total employment by surveyed firms.

Figure 24 - Start of Operations by Number of Firms

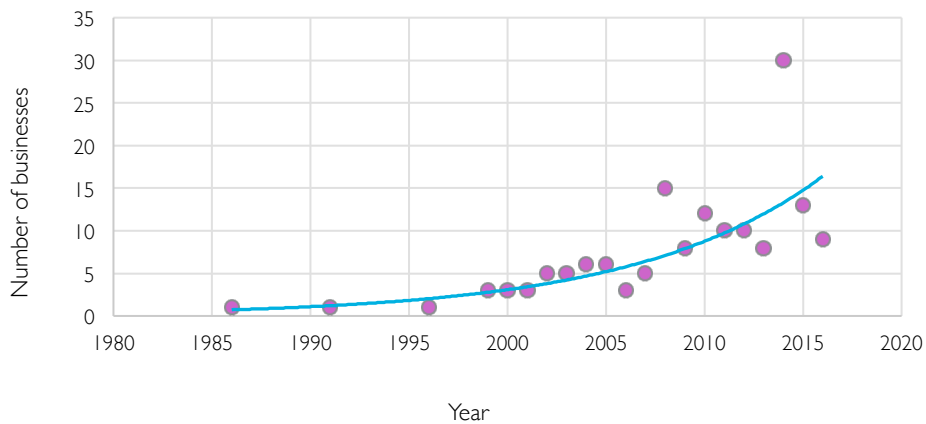
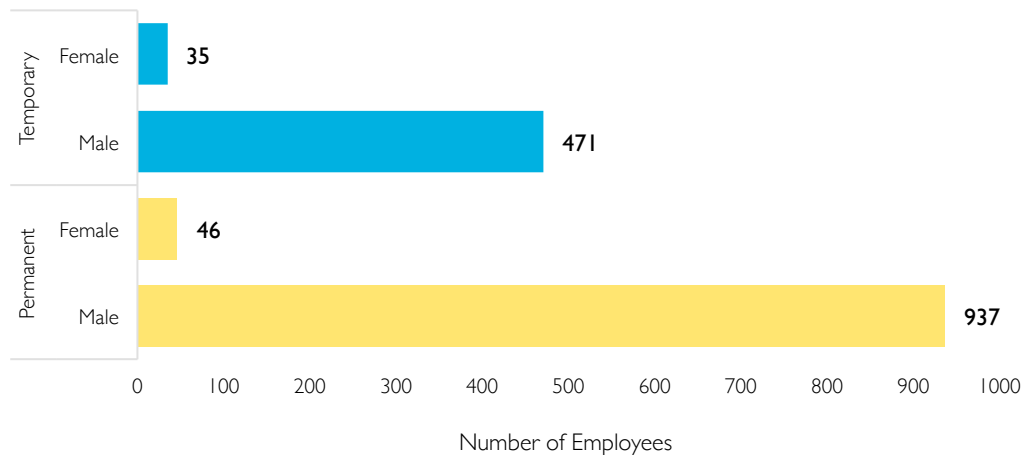


Figure 25 - Permanent vs Temporary Employees of Surveyed Firms





In addition to furniture making and small-scale construction, planks are also used in large-scale construction. This building in Sinkor, Monrovia shows the use of planks as support beams during construction.

6.2 Timber Value Addition

MSMEs add value to sawn timber through woodworking and construction. Businesses purchased thirty percent of all planks sold by outlets and plank depots.⁵⁹ Furniture making and construction firms consume different volumes of timber. On average, a furniture-making firm uses 1.62 m³ of timber for an operation and a construction firm uses 10.99 m³ for an operation.⁶⁰

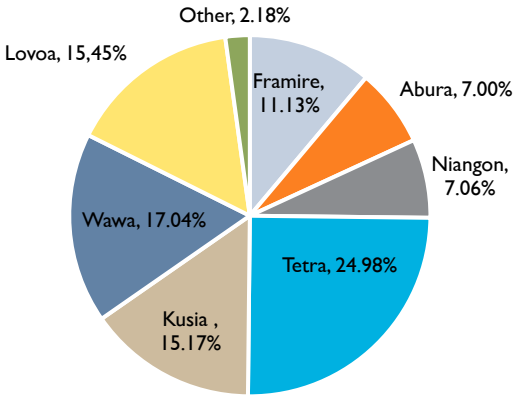
Business owners purchased 70% of the sawn wood used in their operations from plank fields and depots in Monrovia. Many MSME owners mentioned a specific plank field and oftentimes the name of a person from whom they regularly purchase timber, indicating that the supply chain is strengthened by personal networks.

On average, a construction company will pay 413 LD for a single plank. Furniture making firms reported spending up to 1,200 LD for high-quality pieces of lovoa, niangon and abura, which is consistent with selling prices reported by Monrovia timber dealers and the higher variability of prices for these species.

⁵⁹ Seventy percent of planks were purchased by individuals. Eighty-nine percent of all recorded plank sales reported whether the buyer was an individual or business.

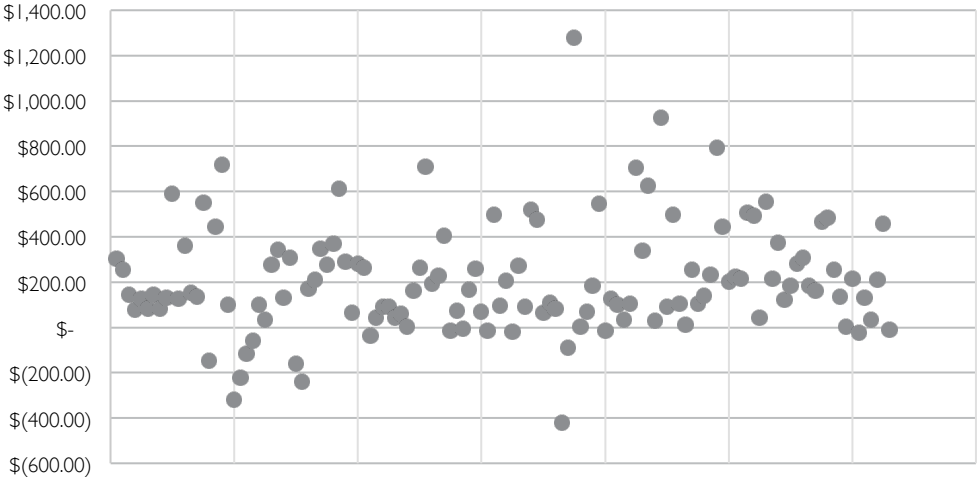
⁶⁰ Surveyed construction operations were limited to roofing and carpentry. We did not survey businesses regarding other types of construction operations.

Figure 26 - Species Purchased by MSMEs (% by Volume)



While it is impossible to standardize the value added to timber across furniture making firms in Liberia due to differences in size of businesses, quality of products and fluctuations in production, 126 firms provided details on their most recent furniture production.⁶¹ A single production varies depending on the MSME; it could be a set of armchairs, a dresser, a kitchen table, or an entire bedroom set. Furniture-making firms realize an average turnover of \$207 per operation.⁶² Aggregated turnover for the most recent furniture production across the sampled firms is \$26,121 USD. The total volume of wood used to generate this turnover across 126 firms was 134.53 m³. This is equivalent to an average value addition of \$194 USD per cubic meter of sawn wood.⁶³ As a comparison point, a 2012 study in Nigeria found that the average value added by furniture making firms to a cubic meter of sawn wood was \$271 USD.⁶⁴

Figure 27 - Turnover Realized by Furniture Making MSMEs on a Single Operation



⁶¹ Data from construction firms was not included, as it was not possible to determine profits directly related to timber in construction. Outliers were removed from the dataset.

⁶² Turnover is inclusive of realized sales and predicted sales of items that have not yet been sold. It was calculated by realized/predicted sales minus total cost of sawn wood.

⁶³ This estimate assumes no additional costs (i.e. fuel, inputs, etc.) and does not consider cost of labor.

⁶⁴ Larinde and Papoola, *Sensitivity Analyses of Furniture Parts Production from Sawn Wood*, 2012. [http://scienceandnature.org/GJBB_Vol3\(3\)2014/GJBB-V3\(3\)2014-11.pdf](http://scienceandnature.org/GJBB_Vol3(3)2014/GJBB-V3(3)2014-11.pdf)

6.3 Barriers to Growth

Just 14% of the furniture products were made for a specific buyer; however, 56% of the products had already been sold to clients. Final products are exclusively made for private individuals or the domestic market. While some businesses reported fulfilling larger contracts (i.e. producing furniture for a school), no businesses looked to sell their products outside of Liberia.

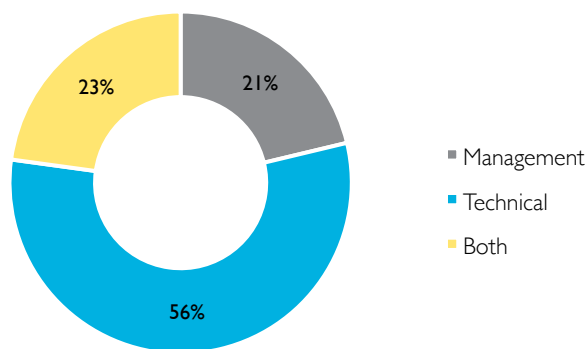
Marketing and brand imaging strategies have the potential to add value to timber products. Just 1% of the surveyed businesses use professional marketing services. Ninety-nine percent rely on word of mouth, personal networks and displaying their goods in the open to attract walk-by customers.

Fifty-four percent of businesses own the tools and machinery that they use to process sawn wood for furniture making. Over half of the equipment has been purchased by the business within the past two years; however, this does not necessarily mean that the equipment was new when purchased. In general, equipment was rudimentary and at times obsolete. When a MSME does not own the equipment required to produce furniture, they pay a fee to use the processing equipment in plank fields and depots, or rent the equipment from a friend's woodworking shop.

Seventeen percent of businesses use power tools; the rest only use manual hand tools such as saws, hammers and levels. MSMEs explain that the low rate of power tool usage is due to the cost of purchasing equipment and the lack of electricity. The exclusive use of rudimentary tools limits the quality of furniture that can be produced.

Eighty-two percent of MSMEs stated that they need training to improve their products and ultimately grow their businesses. Multiple firms commented that they would only be interested in training if it were offered at no cost.

Figure 28 - Training Needs Reported by MSMEs



Additional obstacles to growth that furniture-making MSMEs mentioned include: low demand for final products, lack of access to finance, lack of proper storage space particularly during rainy season, and difficulty of transporting goods to customers.

7. DISCUSSION

7.1 Economic Benefits, Profitability and Jobs

Over the past decade, a lot of money, media and political will have been invested in efforts to control and regulate formal logging concessions and timber exports. Apart from the 60 cent tax on planks and the yet-to-be passed 2012 Chainsaw Milling Regulation, the informal timber sector has developed without the oversight of government regulation. Similarly, international donors and local NGOs have had limited to no impact on shaping the chainsaw milling industry in Liberia.

Between 19,200 and 25,400 people are engaged in the informal harvesting of trees, transportation of planks and sale of timber in Liberia.⁶⁵ These individuals depend on chainsaw milling to meet some to all of their basic needs, and those of their families. Therefore, we can infer that the informal domestic timber market directly supports approximately 83,900 to 111,000 people.⁶⁶ These figures do not capture spillover effects in terms of indirect and induced employment generated by the informal timber sector.

The domestic timber market is the only supplier of sawn wood to the construction and furniture making industries in Liberia. Of the over 4,000 MSMEs registered with Building Markets, 901 engage in construction, renovation, furniture making and/or carpentry. While no statistics exist on the number, structure or characteristics of informal construction and furniture-making businesses in Liberia, many unregistered businesses, artisans and carpenters also depend on sawn wood to provide goods and services, and ultimately to meet their basic needs.

The average value addition to a cubic meter of sawn wood, regardless of species, sold in Monrovia timber markets and used to make furniture by Liberian MSMEs is \$194 USD. This is equivalent to approximately 17,300 LD. Table 13 presents a breakdown of where revenue from sales along the domestic timber value chain goes per cubic meter of sawn wood.

Table 13 - Breakdown of Use of Final Sales Revenue per m3 of Sawn Wood Produced

Description	Estimate (LD)	Estimate (USD)	%
RURAL PRODUCTION	6,929	\$77	39.5%
Wages to rural workers	2,263	\$25	13%
Informal payments	803	\$9	4.5%
Miscellaneous rural	1,413	\$16	8%
Rural Profits	2,450	\$27	14%
TRANSPORTATION	1,236	\$14	7%
TIMBER DEALER WAGES & PROFITS	4,711	\$52	27%

⁶⁵ We estimate that between 18,765 and 24,800 individuals are engaged in chainsaw milling operations, 200 in transportation, and 400 in the purchases and sales of planks in Monrovia. These numbers are likely much higher.

⁶⁶ This figure is calculated from the average number of people living in the same household. The average Liberian household size is 4.37 individuals (LISGIS, 2014).

FURNITURE MSMEs WAGES & PROFITS ⁶⁷	3,780	\$44	23%
GOVERNMENT REVENUE	647	\$7	3.5%
Formal taxes in rural areas	191	\$2	1%
Formal taxes in urban areas	456	\$5	2.5%
TOTAL	17,303	\$194	100%

The revenue generated by chainsaw milling and the sale of planks is realized by 4 main groups of beneficiaries: rural actors, rural communities and traditional leaders, urban actors, and the government. Forty percent of revenue is produced and retained by rural actors and communities. Thirty-four percent of revenue is generated through transportation, urban wages, and urban profits. Just 3.5% of revenue from the sales of timber through the domestic supply chain is captured by the government through formal taxation in rural areas and at checkpoints along the three main roads entering Monrovia.

The breakdown of revenue demonstrates the lucrative and profitable nature of chainsaw milling. It also shows that despite the concentration of actors in upstream production, a significant portion of revenue gain is absorbed by timber dealers in Monrovia.

7.2 Social and Institutional Sustainability

Chainsaw milling is generally accepted at both institutional and community levels. This has fostered an enabling environment for the chainsaw milling industry to grow at exponential rates.

The Community Rights Law (CRL) of 2009 states that “communities have the right to control the use, protection, management, and development of community forest resources under regulations developed by the Forest Development Authority in consultation with the connected Community Assembly.”⁶⁸ The regulations mandated by the FDA to manage community forest resources are laid out in the Natural Reforms Forestry Law (NRFL) of 2006. Customary landowners facilitate deals directly with chainsaw millers, and community benefits vary greatly. Beyond negotiating arrangements with chainsaw millers and ensuring the timely delivery of cash fees and in-kind benefits, communities and customary landowners do not play a role in managing or monitoring the felling of trees. As a result, there is no oversight of how many trees are felled, which species are targeted, and what dimension of trees are harvested.

While the CRL looks to decentralize the management of forestland by empowering communities to manage and monitor their natural resources, it continues to retain decision-making power in the FDA. There are two main problems in assuming that the management of community forests is connected to regulations mandated by the FDA: (1) the FDA lacks the resources and capacity to employ sufficient staff to regularly engage with forest communities and (2) there is a disconnect between what policies and regulations say and the reality of the situation on the ground.

⁶⁷ 30% of domestic timber purchases observed during the study were made by formal and informal businesses--furniture making is one way that such businesses add downstream value to such timber. 70% of domestic timber purchases are made by individuals mainly to conduct their own private activities such as erection of fences, houses and so on.

⁶⁸ Community Rights Law, Section 3.1 (a), 2009.

This results in a principal-agent problem. Customary landowners are motivated to utilize their lands to generate streams of revenue for themselves and for community development. This often deviates from the goals and objectives to sustain forests' resources laid out in the central government's NRFL and the CRL. Therefore, the motives of the agent, the communities, are not well aligned with those of the principal, the government.

The Land Rights Act of 2014 has yet to be passed and ratified by the GoL, but it is heralded as a groundbreaking achievement in strengthening the rights of rural communities to claim ownership of the land that they have historically owned and worked.⁶⁹ While the demarcation of community limits is facilitated through customary practices and local negotiation, the management of forest lands remains the same. Forest lands are designated as land that is "(i) not a residential area, an agricultural area, a cultural shrine or a protected area, and (ii) has timber as its primary cover" and the direct or indirect use of this land must be "in keeping with the provisions of the CRL and NRFL."⁷⁰ The ambiguity surrounding the community's role in implementing the government's regulations for sustainable community forests persists under the new legislation.

7.3 Environmental Sustainability

Chainsaw milling impacts an estimated 98,849 to 131,799 forest hectares per year.⁷¹ The targeted species are framire, tetra, wawa, niangon, lovoa, and abura. Past assessments indicated that chainsaw millers felled trees from 35 centimeter DBH and upwards, which is well below the legal minimum DBH harvesting diameter of 60 cm, and that there are often very high harvesting densities where the targeted species are located.⁷² The objective of chainsaw millers is to maximize production in the shortest time possible; therefore, the quality and diameter of the felled trees are secondary considerations.

The unregulated exploitation of forests by chainsaw millers risks resulting in significant environmental consequences. Chainsaw millers claim to use directional felling, but anecdotal evidence points to high incidences of uprooted trees, broken tops, and scarring of other trees in areas where large trees are felled.⁷³ The surrounding bush is often open by cutlasses to clear paths to the trees. Some trees are found to be defective due to age or disease after felling and crosscutting; these trees are abandoned. The effects of high density and intensive felling and clear-cutting go beyond the loss of forest cover, albeit temporary. The forest ecosystem that depends on trees for food and shelter, as well as valuable non-timber forest products, is also impacted by chainsaw milling activities. The remote location of chainsaw milling camps, which are often far from markets and that remain for weeks in a row in the forest, indicates that bushmeat is consumed by employees of chainsaw milling operations. With little to no access to alternative sources of protein, community members and employees of the chainsaw milling operations reported hunting bushmeat to sustain workers in the bush.

It is important to note that in some ways, chainsaw milling could have less environmental impact than large scale logging operations. Because they do not use heavy machinery, there is very little soil erosion in areas where chainsaw millers operate.⁷⁴ In addition, given the relatively low extraction rates and unless re-entry in already harvested areas becomes very frequent, openings in the forest to reach the target trees could regain their cover in a few years. While the efficiency rate of chainsaw milling is lower than that of modern sawmill technology, chainsaw millers and

⁶⁹ Human Rights Watch, 2016. <https://www.hrw.org/news/2016/08/17/why-liberia-needs-protect-land-rights>.

⁷⁰ Land Rights Act, Article 43: Forest Lands, 2014.

⁷¹ See Table 11.

⁷² Blackett, 2009.

⁷³ Ibid.

⁷⁴ Ibid.

communities sometimes make use of lower branches and refuse for charcoal and firewood production, therefore increasing overall efficiency. Moreover, chainsaw milling involves local communities, through direct employment in operations, community benefits, and ancillary livelihoods, to a greater extent than formal logging concessions.⁷⁵

Yet, the environmental impacts of chainsaw milling will likely continue to increase in the near-term due to two main factors: (1) the lack of community management of chainsaw milling and (2) growing domestic demand for sawn wood.

Customary landowners are motivated to permit chainsaw milling on their land to generate cash income. Beyond this, they do not have any foundation in the management of commercial tree species and no incentive to preserve forests for sustainable, long-term use. As a result, neither the customary landowner nor the chainsaw miller practices afforestation, reforestation, or assisted natural regeneration. Moreover, the commercial tree species favored by chainsaw millers are oftentimes the same ones in demand on the international market. This means that targeted commercial species could become increasingly rare if improved management options are not adopted.

Currently, the supply of planks increases in response to growing demand for sawn wood, which is not filled by sales from the formal logging sector. As a result, and because the quality of finished products is not currently the top priority for harvesters or traders, domestic market prices remain low. This is neither conducive to long-term success of the value chain nor to the sustainable sourcing of the resource or the livelihoods that it supports. As urban populations grow and the construction of domestic residences and commercial buildings increases, demand for timber will expand at a rate that cannot be matched by sustainable supply. Given an efficiency rate of 30%, we calculate that the total volume of logs processed by chainsaw milling is between 700,000 and 900,000 m³ RWE. This estimate does not include purchases and sales outside of Monrovia's plank fields and depots, or the potential illicit trade of planks across borders. Outside of targeted interventions, none of the domestic timber is harvested according to forest management plans or rules laid out by the FDA.

Right now, formal logging concessions do not sell any significant amount of timber on the domestic market. Even if they did, commercial production does not produce enough timber at affordable prices to meet local demand. The FDA, in coordination with stakeholders, should consider the economic, environmental and social impacts of both the formal logging concessions and informal chainsaw milling to adopt the appropriate policies and strategies for regulating and sustaining forest resources.

7.4 Downstream Value Addition

Shifting towards higher value added wood processing and production could support the preservation of Liberia's forest cover and its productive capacity to meet present needs and those of future generations.⁷⁶ Currently, informal chainsaw milling supplies construction, carpentry and woodworking businesses and entrepreneurs with relatively unprocessed, un-dried, and ultimately low-quality planks because there are no kiln facilities or mobile/permanent sawmills in the country.⁷⁷ Likewise, concessions export raw logs because they have not set up primary processing facilities in-country. As a result of low labor productivity and obsolete or non-existent technology, downstream value addition is limited and output from construction and woodworking firms is uncompetitive in regional and global

⁷⁵ Auzel, P et al. Estimation des coûts de production du bois des forêts communautaires à partir des résultats du sciage d'un bossé clair et d'un kossipo dans la forêt communautaire de Kompia. Community Forests Project, Yaoundé, Cameroon, 2001.

⁷⁶ World Bank, Diagnostic Trade Integration Study: Wood Industry Component, 2008.

⁷⁷ The sawmills that do exist are for rubber wood, and are owned by Firestone and a private company in Kakata.

markets. Beyond potential illicit cross border trade, there are no formal Liberian MSMEs that export primary, secondary or tertiary timber products outside of the country.

Value addition needs to start with formal logging concessions. Concession agreements specify that companies have a two-year grace period to export 100% of logs, and then they must start processing by the third year of operations.⁷⁸ This hasn't happened. A team of private investors from Ghana visited concessions and forest areas in Liberia, and concluded that basic road conditions were so poor that it would be extremely expensive to transport wood to sawmills.⁷⁹ Beyond poor enabling factors for investment in processing, there are internal barriers of inconsistent applications of requirements at all levels, making business processes unfriendly.

However, both Firestone and a private company in Kakata operate sawmills to process rubber wood. As of September 2016, International Consulting Capital (ICC) has invested in a kiln drying facility to begin processing high quality wood for European furniture markets.⁸⁰ ICC could be a significant driver and example for other logging concessions operating in the country.

While initial investments in primary processing facilities should and will start with logging companies as per obligatory requirements in concession agreements, the profitability and success of these companies depends on efficiency. Only some very large companies have vertically integrated operations to the extent that they can combine and profit from land management, logging, sawmills, manufacturing and exports; these logging giants are not present in Liberia and capital investment limitations of companies that are active in Liberia will likely prohibit the establishment of vertically integrated operations. Yet concessions are contractually obligated to do something, and with enforcement by the FDA and partners, it is likely that there will be growing investment in smaller scale sawmills and processing facilities.

This is a window of opportunity to structure incentives and market-based solutions around smaller scale logging companies, and to integrate informal chainsaw milling into formal production and processing. As concessions are required to follow through on contractual obligations, stakeholders should consider how to link informal domestic production and formal concessions to foster dynamic, sustainable forestry and primary processing activities that meet domestic demand, keep generating jobs, maintain or increase the number of households and their livelihoods that are currently sustained by the informal sector, and facilitate regional and international market linkages.

8. RECOMMENDATIONS

The domestic timber value chain shows the close and inextricable ties between chainsaw logging, forest communities and Liberian MSMEs. Therefore, the reform of the chainsaw logging sector will have implications beyond chainsaw millers and environmental sustainability. Depending on the regulations chosen and the degree to which they are enforced, there will be winners and losers along the entire domestic timber value chain.

The value chain analysis can inform policies, strategies, and interventions at the government, donor, and private sector levels. We offer the following recommendations.

⁷⁸ World Bank, 2008.

⁷⁹ Personal communication, FLEGT, September 2016.

⁸⁰ Equipment was held at the port for about 60 days because the LRA imposed a \$33,000 USD tax on the shipment. The convoluted process for duty-free approval delayed the release of equipment.

8.1 Empower Communities to Monitor and Regulate Chainsaw Milling

Communities are the critical link to chainsaw millers; without their permission, chainsaw millers cannot operate. Under the status quo, some rights have been decentralized to the community level, but there are two problems: (1) there is no enforcement or regulation to determine whether or not communities are properly managing forests; and (2) decision making power still resides at the central government level. This means that government policy isn't effectively applied at a local level and individuals tend to make decisions in their best interests. Community-led forestry is present insofar as communities have authority over land; however, they do not have the capacity or mechanisms to monitor the use of forest resources.

The study found that communities have very different relationships with and perspectives of chainsaw milling. Therefore, it is unlikely that a single strategy, policy or regulation will be effective in every community. Communities should be part of their specific forest management decision-making process. However, local institutions, traditional leaders and authorities are often not equipped to manage a forest. Devolution should therefore be accompanied by capacity building at the local level to ensure the enforcement of regulations.

8.2 Use Economic Incentives Rather Than Prohibitive Restrictions & Rigid Regulation

The domestic timber value chain informally employs an estimated 19,200 to 25,400 people. The revenue from the sale of sawn wood generates cash in both rural areas and Monrovia. The planks support construction, carpentry and woodworking industries, as well as individual construction and maintenance of homes. It is not advisable to implement prohibitive restrictions and rigid regulations, due to the far-reaching economic and social impacts of chainsaw milling.

Rather, we recommend economic incentives. Local capacity building should be accompanied by market-based solutions to incentivize communities to sustainably manage forest resources. Lessons learned from community forest initiatives in Liberia and the region should inform the set-up of collectively managed forest-farm landscapes that represent multiple stakeholder interests, create jobs, and generate cash streams to rural areas. Innovative business models adapted to the local context should be piloted and replicated across forested communities.

Economic incentives that target timber-producing rural communities should consider the cash that individuals and communities receive as a direct result from chainsaw milling. Rural production directly generates an average of \$77 USD per cubic meter of sawn wood. Community forestry initiatives and new rural business models should consider each community's estimated production of timber, and the associated cash stream, to determine how to introduce competitive and sustainable livelihoods and businesses.

It will also be important to monitor the impacts of community-level interventions in Monrovia timber markets. The volume and prices of sawn wood entering the urban markets should be tracked on a regular basis. Any gaps in supply or increase in price could have negative ramifications on businesses and urban individuals. It will be critical to explore how rubber wood and non-timber forest products (NTFPs), including bamboo and rattan, can meet demand to mitigate potentially significant price increases.

8.3 Target Strategic Value Addition Activities

Current value addition activities are limited to chainsaw milling, limited processing in plank fields and depots, and construction and rudimentary furniture production. No sawmills or large-scale processing exist in Liberia. Therefore,

the country is in the very early stages of industrialization, and is hindered by low labor productivity and obsolete technology. Investments should be made in equipment for primary processing, such as sawmilling or plywood. Ultimately, efficiency improvements along the value chain can lead to additional value added activities.

While developing sustainable forestry practices and primary processing are priorities, strategic technical assistance to MSMEs is critical in supporting sustainable forestry and adding value to products currently produced for the domestic market. Technical and Vocational Education and Training (TVET) interventions should target construction and woodworking businesses in coordination with the FDA. Strategies to encourage the use of lesser used species (LUS) and NTFPs in domestic construction and furniture production could conserve higher value commercial species for more lucrative export markets while meeting local demand. Networks among furniture makers should be fostered to ensure collective use and coordination with any investment in processing equipment or facilities. Holistic interventions to improve business management, marketing and technical skills will upskill the labor market and final products. Demand side interventions can incrementally support TVET; for example, specifying the species and/or NTFPs of locally sourced furniture products in government procurement and local content policies.

8.4 Promote Linkages and Market Efficiencies

The domestic timber value chain demonstrates how informal and formal sectors are intrinsically linked. In Liberia, the informal sector is large and undefined; furthermore, it is heterogeneous and firms do not necessarily conform to a single definition of formality. Along the domestic timber value chain, actors primarily operate outside of the formal sector, but they comply with varying degrees of formality, from chainsaw millers paying a 60 cent tariff on planks to plank fields paying different amounts in formal taxes to government authorities. Any enforced regulation along the domestic timber value chain is going to have implications for the informal economy.

There are different meanings of formalization for different segments of the informal economy, and this should be recognized in decision-making processes. Policies and interventions should promote market efficiencies and equitable linkages between the informal and formal economies.

In addition to informal-formal sector linkages, regional linkages should be considered for access to new markets for primary, secondary and tertiary product produced within Liberia. Market assessments of regional opportunities as new markets for Liberian wood products should be done to inform policy decision making.

8.5 Close Research Gaps

While information on the actors, economic benefits and dynamics of the domestic timber sector is open and accessible because it functions as a relatively free market, there are gaps in information. The trade of planks across borders is adamantly denied, but porous borders and demand for timber in countries with less forest resources than Liberia imply that timber is informally exported to neighboring countries.⁸¹ Understanding the volumes of timber and the dynamics of cross border trade of timber is a critical component of regulating and monitoring informal chainsaw milling.

The most recent forest inventory was conducted in the 1960s.⁸² At that time, extractable commercial timber harvest was estimated at 3.2 million m³ per year. However, as of 2009, sustainable harvest estimates were reduced to 800,000 to 1.3 million m³ per year. An updated forest inventory will allow policy makers to implement measures that

⁸¹ Blakett, 2009.

⁸² Ibid.

simultaneously maximize economic benefits and conserve forest resources. Stakeholder meetings to determine and define the purposes, uses, and cost-burden of such a survey are the first step in closing this knowledge gap. Applying lessons learned from recent forest inventories in West Africa and the continent will be important in developing methodology and a research action plan.

9. CONCLUSION

Over the last two decades, individuals and MSMEs operating in the informal timber sector through chainsaw milling and domestic timber value chains have become a landmark characteristic of most Sub-Saharan countries. Liberia is no exception. This in-depth assessment found that the domestic timber market consumes between 207,000 and 276,000 m³ of sawn wood, annually. This means that between 700,000 and 900,000 m³ of logs are harvested from approximately 100,000 hectares of Liberian forests. Such production is between 3 to 4 times the current and formal industrial one, and focuses on the same species targeted by the formal, export-oriented logging companies. Yet the prices per cubic meter sold on the domestic market are between 50% and 70% lower than the Free on Board prices of industrial timber.

The lack of value addition activities to domestic timber beyond chainsaw milling, limited processing in urban markets, rudimentary furniture production and rapid construction foster this enormous price discrepancy between what is produced by formal logging for export markets versus informal chainsaw milling for domestic markets. Without targeted and long-term interventions to foster higher-quality and more efficient primary, secondary and tertiary production of finished wood products by Liberian MSMEs, the domestic timber sector will likely continue to be confined to informal and inefficient markets and value chains.

Notwithstanding the many possible improvements to the quality of finished wood products and the efficiency of the value chain, the domestic timber value chain does have broad and positive socio-economic impacts in both rural and urban areas. More than 100,000 people directly and indirectly benefit from the sector. However, while the environmental impacts of the sector demand more research, they do not seem to be conducive to a long-term, sustainable sector. The resource is largely harvested in areas already harvested by large-scale and formal companies, making un-managed re-entry potentially negative. This is compounded by the absence of effort by chainsaw millers, communities or the government towards reforestation.

Informal chainsaw millers and timber dealers, and formal sector woodworking and construction MSMEs are deeply connected. Therefore, suggestions for improvement of one cannot be completely split from the other. Community-level interventions to better manage chainsaw milling activity should be done in coordination with downstream interventions to improve the quality and efficiency of MSMEs and develop new wood-based industries that effectively integrate Liberian entrepreneurs and businesses.

ANNEX I: SPECIES UTILIZED IN THE DOMESTIC TIMBER SECTOR

Local Name	Scientific Name
Abura	<i>Hallea ciliate</i>
Anophylis	?
Anopyxis	<i>Anopyxis klaineana</i>
Canarium	<i>Canarium schweinfurthii</i>
Ceiba	<i>Ceiba pentandra</i>
Dahoma	<i>Piptadeniastrum africanum</i>
Didlotia	<i>Didelotia idea</i>
Frake	<i>Terminalia superba</i>
Framire	<i>Terminalia ivoriensis</i>
Hannoa	<i>Hannoa klaineana</i>
Iroko	<i>Milicia excels</i>
Kosipo	<i>Entandrophragma candollei</i>
Kusia	<i>Nauclea diderrichii</i>
Limbali	<i>Gilbertiodendron preussii</i>
Lovoa	<i>Lovoa trichilioides</i>
Naga	?
Niangon	<i>Heritiera utilis</i>
Parksonia	?
Sapelle	<i>Entandrophragma cylindricum</i>
Sipo	<i>Entandrophragma utile</i>
Tetra	<i>Tetraberlinia tubmaniana</i>
Tiama	<i>Entandrophragma angolense</i>
Uapaca	<i>Uapaca spp</i>
Wawa	<i>Triplochiton scleroxylum</i>

ANNEX II: GLOSSARY

Chain of custody (CoC)	A system for tracking individual logs from their stump through to the point of sale/export in order to ensure that illegal logs do not enter the legal supply chain and that taxes are paid.
Chainsaw	A mechanical power-driven cutting tool used by chainsaw millers to fell and section trees into planks.
Chainsaw milling	On-site conversion of logs into planks using chainsaws
Community forestry	The local community plays a significant role in forest management and land use decision making by themselves in the facilitating support of government as well as agents of change.
FDA	Forestry Development Authority, the agency with the mandate to manage forests in Liberia.
FLEGT	Forest Law Enforcement, Governance and Trade. The EU's FLEGT Action Plan was established in 2003 to reduce illegal logging by strengthening sustainable and legal forest management, improving governance, and promoting trade in legally produced timber.
FOB	Free On Board. The 'FOB price' is the price paid for a shipment when the seller fulfills his or her obligation to deliver the goods of the ship's rail at the port of shipment. The buyer has to bear all further costs and risks to loss of or damage to the goods.
Operation	Unit of production used in the following study to define (a) the total volume of sawn wood produced by chainsaw millers for transportation to a buyer; and (b) set of furniture produced by MSMEs for sale to a buyer. Operations vary in terms of volume, length, and associated revenue.
Plank	A piece of sawn wood that is produced by chainsaw millers from a felled tree. Planks are exclusively 14 feet in length, but are produced and sold in varying height and width dimensions.
Plank depot	A single, independently managed point of sale of planks.
Plank field	A point of sale of planks that is overseen by a plank field manager and is organized into many smaller outlets that independently purchase and sell planks.
REDD+	A voluntary climate change mitigation approach that aims to incentivize developing countries to reduce emissions from deforestation and forest degradation, conserve forest carbon stocks, sustainably manage forests, and enhance forest carbon stocks.
Sawmill	A mill of machine for sawing logs.
VPA	Voluntary Partnership Agreement. A voluntary and legally binding trade agreement between the European Union and a timber-producing country outside the EU. The purpose of a VPA is to ensure that timber and timber products exported to the EU come from legal sources.

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