

Developing a Sustainable Roadmap for Ebony Production in Cameroon

UCLA Environmental Science Senior Practicum 2016-17

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Table of Contents

I. Sustainability Roadmap for Ebony	3
A. Introduction of Stakeholders	3
Taylor Guitars	3
Crelicam S.A.R.L.	3
Congo Basin Institute	4
ICRAF	4
IBAY/HIES	5
Ekombite Plantation	5
Somalomo and Bifalome Communities	5
B. Current State of Ebony Production	6
C. Pathways to Sustainable Ebony Production	7
i. Co-cropping	7
ii. Improving Ebony Production Efficiency	8
iii. Legal and Policy Classifications	8
iv. Tissue Culture and Ebony Growth Propagation	8
Current Work	9
Challenges and Future Goals	11
v. Domestic Education and Conservation	11
vii. Community Engagement and Participatory Development	12
II. Co-cropping	13
A. Current state and application of co-cropping	13
Benefits of Co-cropping	13
Co-cropping Practices for Ebony	14
B. Co-cropping species identification and feasibility:	14
C. Stakeholders and co-cropping incentives	16
D. Recommendations	21
III. Ebony Production Efficiency	22
A. Process Overview	22
i. Production Inefficiency- Logging Level	23
ii. Production Inefficiency- Sawmill Level	25
B. Recommendations	25
i. Forest Level	26
ii. Sawmill Level	27
iii. Retail Level	28
IV. Laws and Regulations	30

A. Overview- Domestic	30
FLEGT	30
1994 Forestry Law	31
Classification of Ebony	33
Ebony Logging Permits	34
FSC	35
Taxation	35
B. Overview- International	37
C. Comparison between Legal and Illegal Forestry Operators	38
D. Setbacks	39
V. Recommendation Matrix	41
VI. Appendix	43
State of Plantations	43
Personal Reflections	44
VII. Bibliography	45

I. Sustainability Roadmap for Ebony

The are three key elements that determine the long-term survival of West African Ebony's (*Diospyros crassiflora* Hiern): extraction from the forest, processing at the sawmill and regeneration. In this report, we will provide an overview of what our client Taylor Guitars has achieved in the above areas, as well as highlighting the challenges that remain to be obstacles to sustainable ebony production in Cameroon. In order to provide sufficient context, we will examine how the various stakeholders can influence and benefit from sustainable ebony production in Cameroon.

A. Introduction of Stakeholders

Taylor Guitars

Taylor Guitars, a guitar company based in El Cajon, CA, was founded in 1974 by Bob Taylor and Kurt Listug. Since then, the company has grown into a globally renowned guitar manufacturer. Being one of the largest hardwood consumer in the world, Bob Taylor have put significant emphasis on legal compliance, environmental sustainability and corporate social responsibility in identifying hardwood sources. As an effort to promote sustainable ebony production in Cameroon, Taylor Guitars partnered with Madinter Trade, S.L, an international guitar and tonewood distributor, to purchase the Crelicam sawmill in 2011.

Crelicam S.A.R.L.

Crelicam is based in Yaoundé, Cameroon and processed ebony to Taylor Guitars, , Madinter and other international clients. Crelicam seeks engage in competitive and sustainable

ebony production while providing social and economic benefits to the Cameroonian society. Nevertheless, illegal production and corruption make achieving such goal challenging. In January 2014, the Crelicam project received the Award for Corporate Excellence from the United States Secretary of State for its efforts.

Congo Basin Institute

The Congo Basin Institute (CBI) is a research institution based in Yaoundé, Cameroon, co-founded by the University of California, Los Angeles (UCLA) and the International Institute of Tropical Agriculture (IITA). In addition to a central research facility located at IITA in Yaoundé, the CBI have also established field stations at Somalomo and Bouamir (inside the Dja Reserve). The sustainable ebony project at CBI have brought together IITA, Center for Tropical Research and the International Bilingual Academy of Yaoundé ([IBAY/HIES](#)) to research the ecology and dynamics of the West African Ebony for regeneration purposes. The leadership of CBI consists Tom Smith, Kevin Njabo, and Virginia Zaunbrecher. Additional personalities include Vincent Deblauwe, who is responsible for coordinating the research progress between CBI, IITA and HIES, and Alvine Tchouga, a Ph.D. student from IITA who focuses her research on tissue culture of ebony as well as fruit tree species.

ICRAF

The World Agroforestry Center (ICRAF) have been influential in the management of agroforestry systems throughout West and Central Africa through promoting participatory tree domestication, which involves enabling small-scale farmers to domesticate indigenous fruit trees (Tchoundjeu 2012). In particular, Dr. Zac Tchoundjeu, the Regional Coordinator for the West and Central Africa region of ICRAF, have been actively involved in Cameroonian tree

domestication efforts and is an expert on indigenous fruit trees of Cameroon.

IBAY/HIES

The Higher Institute of Environmental Science (IBAY/HIES) was founded by Dr. Zac Tchoundjeu in 2013 to undergraduate and graduate education in Cameroon. The institute provides education on the conservation and regeneration of the local environment and ecosystem. Through bringing in foreign expertise from Dr. Tchoundjeu's extensive international connections, HIES aspire to improve scientific literacy of Cameroonian students as well as deliver novel and innovative sustainability research for the Congo Basin.

Ekombite Plantation

The Ekombite Plantation, Ferme d'Akong, is the only known privately owned plantation in Cameroon to ebony and various African hardwood species. The plantation owner, Prof. Ebounou Akong, have signed a MOU with CBI and Crelicam to promote ebony sustainability. Previously keeping his data unpublished, Prof. Ebounou Akong has decided to share his extensive compilation of paperwork and resources on the establishment of the plantation with CBI. In addition, he is also collaborating with ICRAF and elites of Ekombité villages to promote participatory tree domestication in the community. This compilation of data will provide a platform for future models seeking plantation growth. Additionally, it will record and display the history of ebony growth within the plantation, giving detail to its exact locations.

Somalomo and Bifalome Communities

The Somalomo and Bifalome villages are located on the outskirts of the Dja Faunal Reserve. We carried out the first phase of ebony tree planting and co-cropping along with these community members: Mme Souzok Nane, Chief Augustin, Gaston, Geremi, Remy, Ajoni

Bibom, Samson Newpango, Madja, Bidja Marlyse, Djankoom Kanga. The sub-prefect for Somalomo, Mme Amboel Clodine, oversaw the tree planting exercise.

B. Current State of Ebony Production

Understanding the current state of ebony production is a key prerequisite in creating a sustainability roadmap. In Cameroon, it is illegal to plant and harvest ebony without permits. The Cameroonian Ministry of Forestry and Wildlife (MINFOF) allocates an annual production quota of about 3,000 tons of ebony for all logging companies (Refer to [Ebony Logging Permits](#) for details). By upholding the company's commitment to adhere to regulations and provide respectable wages and working conditions, Crelicam's production costs doubles the local average (\$8000 per m³ to \$4000 per m³) (Personal Communication. K. Njabo, April 26, 2017). In order to sustain operations in Cameroon, Crelicam has to process at least 1500 tons of ebony annually. However, Crelicam's allocation of ebony quota have been declining in the last two years: 1,200 tons in 2016 and 1,050 tons in 2017. At the same time, an ebony regeneration tax paid by foreign loggers to replenish the stock of ebony have increased ten-fold (1000%) in 2017. The decreasing quota and spike in regeneration tax have ultimately driven a net loss for Taylor Guitars' logging operations in Cameroon.

Despite making a net loss, Taylor Guitars has made a commitment not to relocate its operations or export the logs out of Cameroon. Through maintaining logging and processing operations in the country, Taylor Guitars enable Cameroonians to also become the beneficiary of the ebony species. Microscopically, the aforementioned wages and working conditions improvements would lead to better livelihoods of the workers and their families. On a macroscopic level, Taylor Guitars strives to induce changes on the practice of doing business in

the country through establishing a precedent in sustainable and community-centric business model. In order to realize such goals, however, Taylor Guitars has to balance community engagement with economic viability. In response, Taylor Guitars has requested us to document the current state and limitations of Crelicam's operations in Cameroon, and identify viable solutions for ebony production in economic, environmental, social and political dimensions.

C. Pathways to Sustainable Ebony Production

After visiting Taylor Guitars' operations in Cameroon and understanding of the current state of ebony production, we are proposing a series of pathways to achieve sustainable ebony production. These include:

- Co-Cropping
- Increasing Efficiency of Ebony Production Process
- Domestic and Legal and Policy Classifications
- Tissue Culture and Ebony Growth Propagation
- Domestic Education and Conservation Efforts
- Community Engagement and Participatory Development

We summarize each of these below before focusing our analysis on co-cropping ([section II](#)), logging process efficiency ([section III](#)), and domestic legal and policy ([section IV](#)).

i. Co-cropping

Ebony trees grow sporadically and are usually found on its own in nature, which may be attributed to its poor competitive nature and the complexity of its germination (Cumò 2013). Recent work by CBI have discovered that planting ebony along with other plants, a practice

known as co-cropping, with a plant spacing of 5x5 m promotes optimal ebony growth (V. Deblauwe, March 31, 2017, Personal Communication). Economically, with ebony tree taking 60 to 200 years to become mature and harvestable, co-cropping ebony with other fruit trees will be able to provide farmers with short and medium-term income. As a result, we recommend the practice of co-cropping to be incorporated in agroforestry systems in the process of regenerating ebony. See [Section II: Co-cropping](#) for details.

ii. Improving Ebony Production Efficiency

Efficiency is key to both the economic and environmental sustainability of ebony production. Based on interviews with the stakeholders, the estimated efficiency of the entire ebony production process is 10% (B. Taylor, April 17, 2017, Personal Communication.; A. Bena, March 20, 2017, Personal Communication), leaving significant room for improvement. See [Section III: Ebony Production Efficiency](#) for details.

iii. Legal and Policy Classifications

Numerous domestic and international laws influence the production and management of ebony. While these laws and policies are intended to preserve ebony and facilitate restoration efforts, lax or delayed enforcement often hampers the sustainable management of ebony. Ebony is a type of hardwood and is typically classified as such; however, it is classified as a special species in Cameroon. See [Section IV: Laws and Regulations](#) for details.

iv. Tissue Culture and Ebony Growth Propagation

Maximizing the quality of ebony saplings through tissue culture is a promising approach to increase efficiency. It could improve the quality of ebony saplings in two dimensions:

biologically, by increasing the proportion and quality of marketable heartwood in each tree, and economically, by shortening the time to maturity so trees can be harvested sooner. Despite being a novel field, there has been notable progress in improving the quality of ebony saplings through tissue culture and ebony growth propagation techniques.

Current Work

CBI is currently the sole organization carrying out research on tissue culture of ebony in Cameroon. The current focus of CBI is accelerating the sprouting process of *D. crassiflora* to shorten the time required to produce ready-to-plant ebony saplings. Previously, conventional ebony saplings at Crelicam took 1.5-2 years to sprout (A. Bena, March 30, 2017, Personal Communication). With improvements in splitting techniques, CBI is now able to produce ebony saplings in just 6 months, saving both time and resources in nurturing saplings and ensuring a steady supply of saplings for large-scale planting projects in the future.



Figure 1. Ready-for-transplant ebony and fruit tree saplings at CBI

In addition to accelerating the sprouting process, CBI is also dedicated to produce sapling

clones of most productive ebony trees and identifying physical characteristics that are associated with high heartwood production. The lab planted the first batch of ebony saplings in March 2017. The saplings will be ready for transplant in early 2018, which will mark a significant milestone towards identifying the most desirable and productive phenotypic traits for ebony. The future outlook of the lab would include mass production of saplings and following up on the first batch of planted ebony.

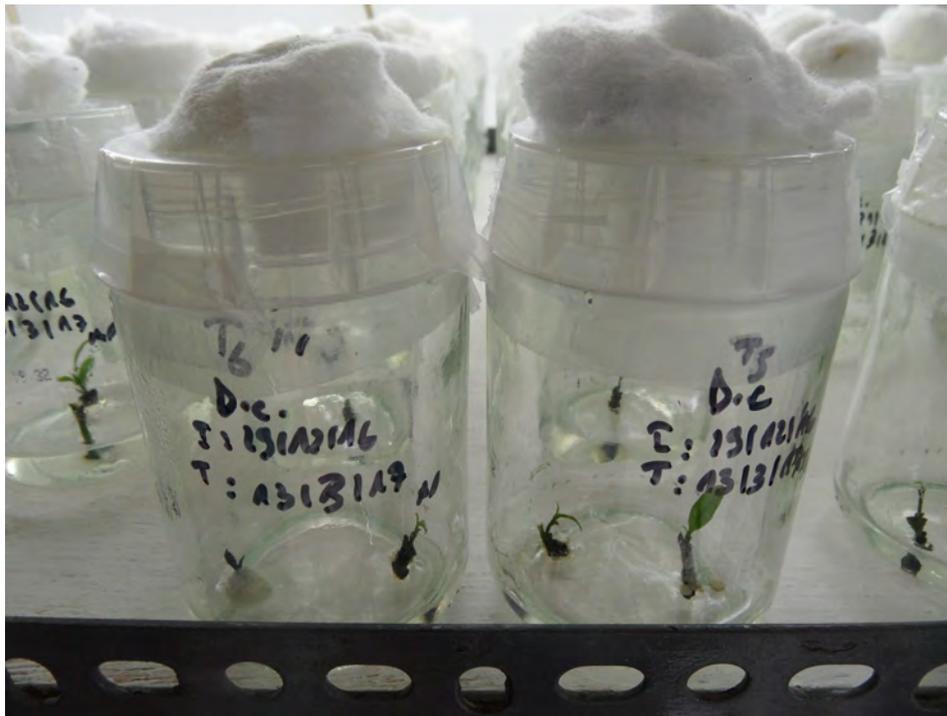


Figure 2. Seedlings of *D. crassiflora* in Tissue Culture Lab, CBI

Apart from studying the growth of *D. crassiflora*, the tissue culture lab is also applying the same techniques to stimulate the growth of various staple foods for the local community, including plantain (*Musa* spp.) and cassava (*Manihot esculentum*). The study of other plant species would greatly aid the development of co-cropping in the region and improve the food security of the community (See [Section II](#) for more information).

Additional complementary tissue culture work is also done at IBAY. Graduate students

are currently investigating in the use of hormones to stimulate the growth of *D. crassiflora* as well as developing air layering techniques that involve covering plant roots with sawdust to propagate the growth of fruit trees.

Challenges and Future Goals

Tissue culture techniques offer promise in addressing two main challenges in ebony cultivation. First, the improved saplings can be used to optimize the functionality of an ebony plantation. While the release of Prof. Ebounou Akong's data compilation have mitigated the situation, there remains to be a lack of established literature on maintenance of ebony plantations. Increased availability of high-quality ebony saplings from tissue culture would be able to bridge this research gap by enabling the identification of parameters that are essential to developing a successful ebony plantation, including optimal density, ecological requirements etc.

Second, while insect activity is known to be the culprit of holes in ebony wood, there is little research insect behaviors near ebony trees (A.Bena, March 30, 2017, Personal Communication). As holes in ebony trees often reduce the quality of the ebony and increase production cost, insect activities are a source of inefficiency in the ebony production (Refer to [Section III. ii.](#) for details). Developing a comprehensive understanding of the insect activities near ebony trees and incorporating such insight when producing ebony clones would be a viable solution to this inefficiency.

v. Domestic Education and Conservation

Throughout our trip, many of our interviewees expressed their concern and frustration in motivating young people in Cameroonian communities to engage in conservation and sustainability efforts (B. Taylor, March 17, 2017, Personal Communication.; Z. Tchoundjeu,

March 30, 2017, Personal Communication.; Ebounou Akong, March 31, 2017 2017, Personal Communication.; L. Mbah a Moute, April 24, 2017, Personal Communication.). Citing promising prospects of the outside world as the main reason, the majority of our interviewees believe that the Cameroonian youths are not exhibiting enough care for their home and the environment. As a result, they believe there exists a critical need to raise awareness on sustainability and conservation, as well as develop a forward-looking vision for the next generations of Cameroonians.

vii. Community Engagement and Participatory Development

With the majority of ebony being harvested from community forests of Cameroon, it is essential for the local community to be active drivers in ebony regeneration. Community forests, are non-permanent forests managed by the local village community with the assistance of the Forests Administration under a management agreement (Decree No 95/531/PM Article 3, §11, 1995). Compared with their counterparts on private lands in a similar fashion to the Ekombité plantation, community-driven tree planting initiatives encourage individual owners to take better care of their trees as well as enable risk diversification among the community. During our trip to Cameroon, we have taken the first step of advancing a community-centric tree planting model by carrying out planner planting of 100 tree saplings which consisted of a combination of 60 ebony and 40 fruit trees that are solely owner by the Somalomo and Bifalone villagers (See the [co-cropping section](#) for more details).

Engaging the community when providing assistance is an international best practice. International financial institutions and NGOs have commonly applied the mechanism of participatory development when providing international aids, which emphasize the integration of the beneficiary's input and participation into the design of development programs (Cornwell

2002). In general, participation by local stakeholders can be classified into four forms (Tuft 2009). Our mode of operation of gifting the ownership of fruit trees and ebony trees to the ebony producing communities, lies somewhere between participation by collaboration and empowered participation. In order to further empower the villagers, we should strive to provide the owners of fruit tree more opportunities to benefit from their harvest beyond selling.

II. Co-cropping

A. Current state and application of co-cropping

Benefits of Co-cropping

Co-cropping is an agricultural practice where multiple crops are grown simultaneously, often to enhance growth amongst the different species. In addition to improving the economic prospects of agroforestry, co-cropping also serves as a risk mitigation tactic for small farmers (Magalhaes et al., 2014). It is most commonly adapted in cacao tree cultivation to mitigate risks of below-expectation yields (Vaast *et al.*, 2014). In addition, agroforestry systems that utilize co-cropping also produce higher species richness, biodiversity, and total crop yield in polyculture cacao agroforest (CAFS) (Abada *et al.* 2016). Lastly, co-cropping provides alternate benefits including pest control, increased water yield, and disease suppression (Sangeetha. & Shanmugam 2015). Ultimately, co-cropping of native fruits that provide short- and medium-term income will be a strong catalyst for the development of agroforestry systems and community programs (Sangeetha & Shanmugam 2015).

Co-cropping Practices for Ebony

Isolated in nature due to its poor competitive nature and the complexity of its germination, ebony is often found near native species (Cumo 2013). However, there is only one known instance of systematically co-cropping ebony for commercial harvesting in agroforestry operations: the plantation in Ekombité that co-crop ebony with cacao plants at 5-meter intervals. During our visit to Cameroon, we observe that most villagers adapt co-cropping practices in their farms, but they are mostly co-cropping local staple foods such as njangsang or moabi in a mostly random fashion. Thus, there exists tremendous potential in developing agroforestry systems that systematically co-crop improved native species with *D. crassiflora*. While in Cameroon, we established ten small-scale agroforestry operations that consist of a total of 60 ebony trees and 40 fruit trees in the Somalomo and Bifalome villages. On average, five ebony and five mixed fruit trees were planted per site with planting intervals ranging from 2-5 meters (Table 2). Despite its small scale, the planted trees would be able to provide both short-term and long-term income for the tree owners in the community.

B. Co-cropping species identification and feasibility:

Ecological needs, such as sunlight, water, and soil requirements, local medicinal uses, economic or food uses, and overall cultural acceptance are among the key factors in determining species to co-crop. The species to co-crop need to thrive on similar water and soil conditions with ebony, and adjust to changes in light conditions when mature ebony trees create shade. Other co-cropping options, such as *Baillonella toxisperma* also create shade. In addition, we also recognized cultural acceptance as the most important factor for determining co-crops for ebony during our trip, as the community members would be more motivated to take care of ebony on

their land if there is additional incentives provided by culturally significant products.

The species considered for co-cropping in this report were also used in our ebony plantings in Somalomo and Bifalome. These species planted include: mango (*Mangifera indica*), bush mango (*Irvingia gabonensis*), avocado (*Persea americana*), and bush plum (*Dacryodes edulis*). We also considered additional culturally significant species suggested by Dr. Zac Tchoundjeu for in forming the co-cropping fact sheet. The characteristic properties of each viable species, their growing seasons and ecological requirements are given in Table 1.

Common Name	Scientific Name	Image	Growing Season	Sun & Water Reqs	Soil	Medicinal & Major Uses
Nsangomo	<i>Allanblackia floribunda</i>		Flowering: Sept- Feb Fruiting: all year	Shade loving	N/A	Stearic acid, hypertension
African Bush Plum	<i>Dacryodes edulis</i>		All year	Shade loving, 1400-4000 mm	Deep volcanic soils	Ear infections, fever
Moabi	<i>Baillonella toxisperma</i>		N/A	Semi/full shade, 1500-3000 mm	Moist soils	Wood & fruit product
Bush Mango	<i>Irvingia gabonensis</i>		Flowering: Mar - Jun; Fruiting: Apr - Jul, Sept- Oct	1500-3000 mm	Well drained, acidic	Relieves diarrhea, fruit product
Moringa	<i>Mondia whitei</i>		Flowering: May-Oct, Fruiting: Nov-Apr	Shade tolerant, tropical enviro	N/A	Super fruit, many medicinal uses

Common Name	Scientific Name	Image	Growing Season	Sun & Water Reqs	Soil	Medicinal & Major Uses
Mango	<i>Mangifera indica</i>		Flowering: 25-30 days post initiation, Fruiting: 3-5 months	Semi/full sun, drought tolerant	Basic soils, 5.5-7 pH	Staple cultural food, antibiotic
Rambutan	<i>Nephelium lappaceum</i>		Flowering: Feb-Apr; Aug-Sept Fruiting: Jul-Aug, Nov-Jan	50% shade youth, full sun maturity, consistent rain	Well-drained, acidic	Fruit & jams, tongue diseases
Avocado	<i>Persea americana</i>		N/A	Semi- or full sun	Well-drained, acidic	Edible fruit
West African pepper	<i>Piper guineense</i>		N/A	Prefer moist environment	N/A	Widely used spice
Njangsang	<i>Ricinodendron heudelotii</i>		Flowering: May-Oct, Fruiting: Nov-Apr	Full sun, prefers rain, tolerates 500-5000mm	Well-drained acidic	Cultural fertility use, male & female plants bear fruit

Table 1: Co-cropping factsheet of possible culturally-accepted species to be planted with *Diospyros crassiflora*, which prefers moist, sandy clay and full or partial sun. N/A refers to information which needs further research.

C. Stakeholders and co-cropping incentives

Not only do these viable species provide community members with food, they also serve as incentives for the landowners of the small-scale agroforestry systems to care for the ebony on their land. Each landowner of the planting sites in Somalomo and Bifalome were given a mixture of ebony and fruit tree saplings. The ebony trees were offered by Taylor Guitars in the hopes of purchased back for production by Crelicam when the trees reach maturity. The fruit trees are offered to the farmers through CBI's fundraising efforts to incentivize the farmers to take care of the ebony over the first five years after planting. During this period, the trees are believed to be fragile and require most care. Therefore, Taylor Guitars, CBI and the tree owners themselves

will play a pivotal role in successfully growing the ebony trees. These stakeholders and the trees they own are outlined in Table 2.

Table 2: Detailed list of small-scale ebony co-cropping sites, their location and stakeholder.

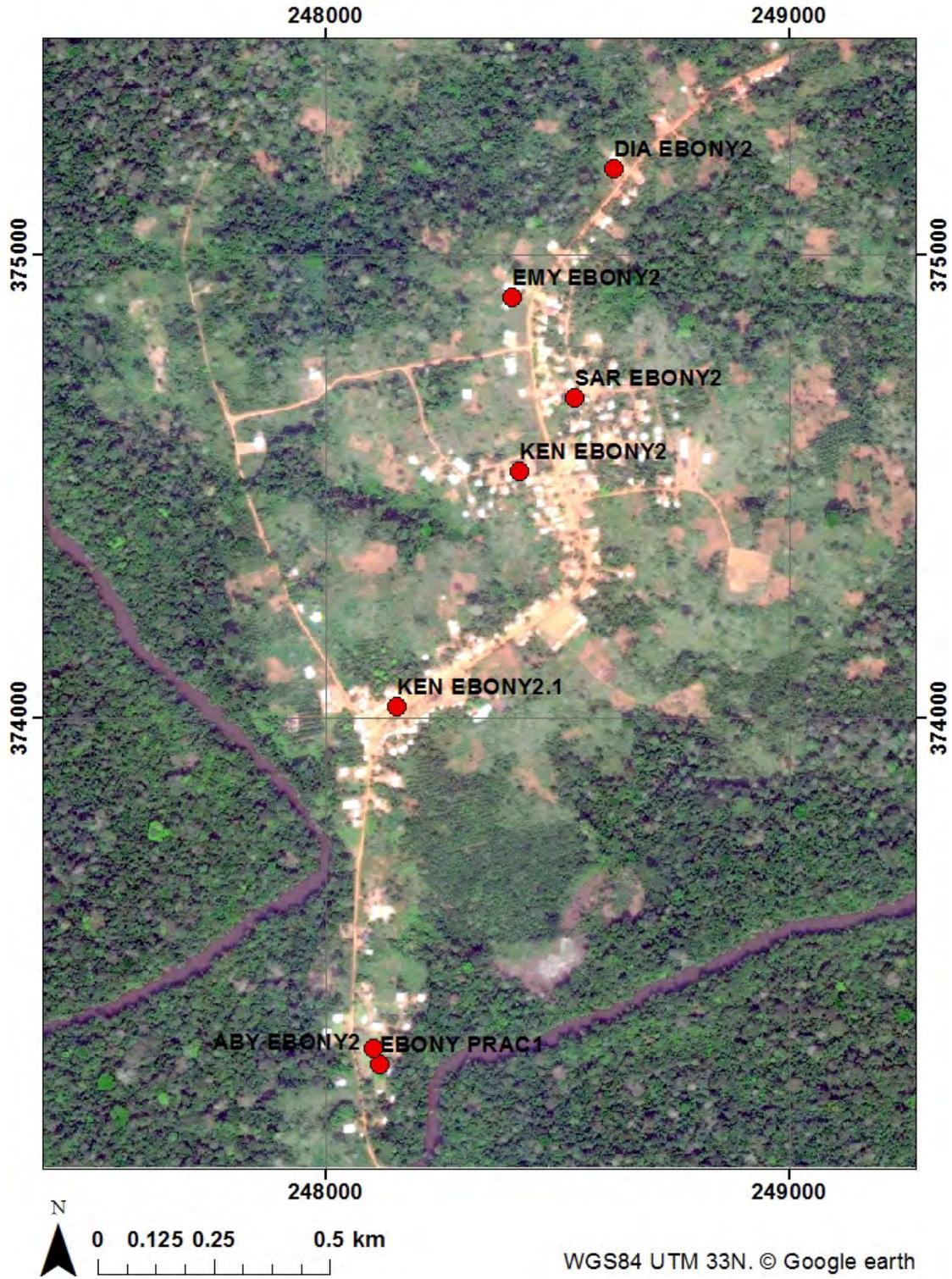
Name	# of ebony	# of mango	# of bush mango	# of bush plum	# of avocado	Owner(s) of Site	Location
Sar - Ebony 1	6	1	1	1	1	Jean-Jaques	Bifalone
Abi - Ebony 1	6	1	1	1	1	Chief Augustin	Bifalone
Dia - Ebony 1	6	1	1	1	1	Gaston	Bifalone
Ken - Ebony 1	6	1	1	1	1	Geremi	Bifalone
Emy - Ebony 1	6	1	1	1	1	Remy	Bifalone
Sar - Ebony 2	7			1		Ajoni Bibom & Mme Souzok Nane epouse Apoue Minoubelle	Somalomo
Abi - Ebony 2	7	3	2	2	2	Dja Conservator & Madame Amboel Clodine	Somalomo
Dia - Ebony 2	3	1			1	Samson Newpango	Somalomo
Ken - Ebony 2	4	1	1	1	1	Madame Souzok, Madja, Bidja Marlyse, & Maire	Somalomo
Emy - Ebony 2	5	1	1		1	Kanga	Somalomo

Figure 3. Map of planting locations in Bifalone
SENIOR PRACTICUM FOR ENVIRONMENTAL SCIENCE, IOES, UCLA
Somalomo, Cameroon



Figure 4. Map of planting locations in Somalomo

SENIOR PRACTICUM FOR ENVIRONMENTAL SCIENCE, IOES, UCLA
Somalomo, Cameroon



Location and Owners of Trees



Figure 5. A map of ebonny planting sites and their stakeholders in two villages.

D. Recommendations

The planting at Somalomo and Bifalome should only be the first phase of co-cropping ebonny in Cameroon. Building upon the success at the villages, CBI and Taylor Guitars aims to provide and plant 15000 ebonny saplings all over Cameroon in the next 2 years. We recommend that there be future follow up studies on the sites that we established over the next 5 to 10 years. These studies should examine if the trees and co-cropped species are thriving in their environment, and look for direct characteristics which have propelled that success such as sunlight or soil composition. Furthermore, these new studies should look into how directly impacted the community is by these new plots, and determine the future steps in order to

maintain their success and make improvements where needed. This follow up analysis should be done in order to encourage the regeneration of ebony as well as to promote community participation.

The team recommends that all future ebony replanting events reference the co-cropping fact sheet (Table 1) in this report in order to achieve successful agroforestry units and meet the needs of the community members involved. Following the information gained by Dr. Zac Tchoundjeu (March 31, 2017, Personal Communication), we recommend that the community members involved in ebony replanting are identified and educated through rural resource centers in order to be well equipped for caring after a polycultural system. Moreover, we recommend that for every new ebony planting site, a thorough survey and analysis of the particular village and culture be conducted in order to understand the needs of that village or tribe. This analysis is proposed in order to achieve a successful relationship between operators and indigenous individuals. Furthermore, we recommend these steps be taken because interpersonal relationships have large influence on the successful growth of newly planted ebony, especially within the first five fragile years of growth. Lastly, we recommend additional follow up studies of this project to test how correlated these relationships really are to newly planted ebony health. If proven successful, then this technique should be employed for future replanting phases in rural communities.

III. Ebony Production Efficiency

A. Process Overview

The efficiency of the entire production process is dependent on both the efficiencies of

the logging level and the sawmill level. The logging process is roughly 50% efficient, which means that in order for Crelicam to purchase 100 tons of ebony, 200 tons of ebony and biomass have to be cut down (Personal Communication. B. Taylor, April 17, 2017). The sawmill level is about 20% efficient, which means that only 20 tons of marketable wood product is produced from every 100 tons of wood purchased by Crelicam (Personal Communication, A. Bena, March 30, 2017). Thus, the efficiency for the entire production process is about $50\% * 20\% = 10\%$. The numbers are practice-based estimates due to the impracticality of carrying out an exact quantitative analysis. In order to provide more context for the above numbers, it is useful to compare them with industrial average. According to a study carried out by the Food and Agricultural Organization of the UN (FAO) in 2001, about 60% of the biomass of harvested trees are left in the forest, which is approximately in line with the 50% efficiency at the logging level (FAO 2001).

i. Production Inefficiency- Logging Level

At the logging level, there are three main sources of inefficiency:

1) The degradation of wood during cutting and transportation. In the logging process, while natural degradation of logs due to oxidation is inevitable given the Cameroonian climate, there are two sources of degradation that are human-induced and can be prevented. The first originates from the inability to transfer large logs. As a result, the logs have to be divided up into smaller pieces, which increases the exposed surface area of logs and accelerates degradation. The second source is the mismatch in time of cutting and time of transport, which often results in unnecessary exposure of logs in the forest for extended periods and increases degradation.

2) The inefficient permitting process. With the logging permit process potentially

taking the first three months of the year, there is often insufficient time for logging companies, including Crelicam, to plan their logging operations (A.Bena, March 30, 2017, Personal Communication). As a result, logging companies have to compete for ebony trees on a first-come-first-serve basis (Refer to [Ebony Logging Permits](#) for more details). Andre Bena, the operating manager of Crelicam, summarizes the current state of permitting process:

“The permits grant you only a certain region or percentage of a region, and another person can have the same permit in the same region. Therefore, we cannot do any inventory. It is a “finder’s keepers mentality”, it is a race. Which means that we do our inventory at the same time as finding a tree. The consequence of that is very bad. Normally we need 300-400 trees to run per year... we do not get to check the trees in advance and the consequence is that for every 10 trees, maybe 1 of them is useful”

(A. Bena, March 30, 2017, Personal Communication).

3) The variegation of ebony. Like most trees, ebony has two types of wood, the sapwood (white/pale ebony) and heartwood (black ebony). Sapwood is the living, outermost portion of the woody stem, while heartwood is the dead, inner wood that comprises the majority of a stem’s cross-section. While both the heartwood and sapwood are of identical physical and musical quality, the market’s preference of heartwood have resulted in the disposal and waste of sapwood at the forest level (B. Taylor, April 17, 2017, Personal Communication. A. Bena, March 30, 2017, Personal Communication). Because loggers cannot currently assess the heartwood to sapwood ratio before felling a tree, they often cut trees with little usable heartwood and further increasing sapwood waste.

ii. Production Inefficiency- Sawmill Level

When compared with the logging level, the efficiency of the sawmill level is very difficult to increase as there is a practical limit on the efficiency of a sawmill and improving it will be very technology-intensive. The two main inefficiencies at the sawmill level are sawdust and holes in ebony planks. The former is the product of irregularly shaped logs and natural loss from saws, while the latter is the product of insect activity and often drives up production cost significantly due to costly plank repairing techniques (A. Bena, March 30, 2017, Personal Communication).



Figure 6. Holes in Ebony Plank

B. Recommendations

Understanding all of these inefficiencies and how they collectively contribute to ebony production is the first step towards achieving sustainability. Inefficiency should be tackled from three levels: forest, sawmill, and retail. Moreover, each of these levels should be addressed starting from high, medium, and then lowest immediate impact on the process.

i. Forest Level

The area of highest priority to improve on is the operations in the forest, particularly during the stages of cutting and transportation. We propose the following improvements pertaining to the forest. First, adapt new methods to carry ebony pieces out of the forest. With the absence of beasts of burden, the simplest solution is to increase the load capacity of humans. Bob Taylor has designed a prototypical wood carrying technology dubbed the “wood stretcher”. The “wood stretcher” functions by having one long piece of ebony strapped and swinging in the middle of four workers. Two people stand at opposite ends of the piece and have a harness attached to one shoulder and one piece of the log to distribute weight and maximize mobility.



Figure 7. a) Demonstration of four people carrying one piece of Ebony. .b) Side view of device being carried by 4 people, with operating manager Andres Bena sitting atop the log to demonstrate the durability of straps and effectively designed weight distribution (Photos courtesy of Taylor Guitars, World Agroforestry Tour, 2017)

This technology enables workers to transport heavier pieces of wood out of the forest. This reduces cutting losses and wood degradation since the ebony tree can be transported in fewer pieces. Additionally, the “wood stretcher” also alleviates the physical toll of the workers and reduce the risk of injury. In the future, there should be increased attention towards the mass production and application of “wood stretchers” and carrying out feasibility studies on using more advanced technologies, e.g. robotics, to carry logs out of the forest.

Another top priority area for improvement is the assessment of ebony quality before cutting. In order to mitigate waste from cutting unhealthy or undesirable ebony, it is important to conduct research on identifying phenotypic characteristics that ensure a high heartwood to sapwood ratio in mature trees as well as understanding insect behaviors near ebony trees (refer to [iv. Tissue Culture and Ebony Growth Propagation](#) for more details).

Throughout our trip, multiple experts voiced their concern on the lack of estimates on the total quantity of ebony available for commercial harvesting (A. Bena, March 30, 2017, Personal Communication. V. Deblauwe, March 31, 2017, Personal Communication). We recommend the creation of a comprehensive inventory analysis and mapping for popular logging regions of East and Central Cameroon. This would help both the government and logging companies to be aware of the total quantity of available ebony, and possibly expedite the permitting process. Lastly, we propose Taylor Guitars should continue to explore potential collaboration with pertinent local research institutions in order to achieve these recommendations.

ii. Sawmill Level

There are also numerous improvements to be made at the sawmill level. With sawdust being an inevitable source of loss, we recommend Crelicam to identify and develop alternative uses for the sawdust. Currently, Crelicam is selling its sawdust as a home cooking agent for local communities (A. Bena, March 31, 2017, Personal Communication). However, this is not the only use for sawdust as research institutions are utilizing sawdust for air layering practices for plant growth. Sawdust plays a key role in preserving moisture in the air layering applications, and therefore Crelicam can develop partnerships with institutions like IBAY to help supply them with enough sawdust for their student's experiments (IBAY Students, March 31, 2017, Personal Communication). Ultimately, Crelicam should seek to sell sawdust to agricultural institutions

that utilize sawdust for research purposes locally as well as regionally.

Optimizing the cutting process at Crelicam would also increase efficiency. This goes beyond acquiring the most efficient saws but also educating the workers operating them. Currently, Crelicam is excelling in both dimensions. Not only have they have upgraded their saws and laser-cutting technologies, but also eliminated the overcutting behaviors for orders. (A. Bena, March 30, 2017, Personal Communication. B. Taylor, April 17, 2017, Personal Communication). As long as Crelicam continues their investment into cutting equipment and sustains their cutting practices, this efficiency of the process should steadily improve.

iii. Retail Level

Lastly, we recommend Taylor Guitars further promote sapwood and other non-conventional hardwood products, which would involve including an educational component in their marketing strategy. For example, in addition to highlighting how sapwood or other non-conventional hardwood products would contribute to sustainability, we recommend a heavy focus on the fact that tone and quality between sapwood and heartwood are indistinguishable. Furthermore, Taylor Guitars should continue its efforts for promoting the exclusivity and uniqueness of sapwood products as a partner component to the educational press. Ultimately, Taylor Guitars should strive to fundamentally change the public perception of non-conventional hardwood products to be more desirable and create a trend within the industry.

Recommendation Summary

Level	Inefficient Practice	Impact Rating	Improvement Recommendation
Forest	Wasteful cutting of ebony in forest	High	“Wood stretcher” & other possible designs aimed to increase carrying capacity and reduce cutting

Forest	Poor assessment of healthy & unhealthy ebony in the forest	High	Continue tissue culture studies for future ebony, new studies on insects that damage ebony for possible visual indicators to use in assessment
Retail	Market perception of striped ebony	High	Enhanced Market research & large promotional investment in the education and commercialization of striped ebony
Forest	Lack of knowledge of the total amount of new and existing ebony in Cameroon	Medium	A comprehensive inventory using GIS of ebony for commercial harvesting
Sawmill	Low resale strategy of sawdust produced in factory	Medium	Expanding resale market beyond local consumers for cooking; partnering with institutions to provide sawdust for experiments involving air layering.
Retail/ Forest	Partnerships with organizations that are related to ebony production, research, and advertising.	Low	Taylor Guitars is already in multiple partnerships, recommend to use these partnerships to help complete efficiency goals
Sawmill	Using the most precise blades for cutting pieces of ebony and laser technology for measuring products.	Low	Crelicam is already performing this, recommend to maintain practices & stay up to date with future technologies

IV. Laws and Regulations

A. Overview- Domestic

International trade laws, domestic permitting, forestry management, community forestry laws, and taxation all affect ebony production in Cameroon. There are seven relevant domestic laws and regulations that pertain to ebony production: 1) FLEGT, 2) FSC, 3) Law No. 94/01 of January 1994, To Lay Down Forestry, Wildlife and Fisheries Regulation, 4) Decision No. 0336 / D / MINFOF of 06 July 2006 5) Decree No 95/531/PM of 23 August 1995 Laying down the Procedure for Implementing the Forests System and 6) Decree No. 2032 and 7) Finance Law No. 2002/004 of April 2002. Many of these laws exist to protect hardwoods from exploitation. Among these laws, Ebony is labelled a special wood and requires additional permit for handling. Due to ineffective legal enforcement, actors who follow the law are at a competitive disadvantage because regulatory restrictions result in time delays, leading to delayed production, and thus monetary loss. This section aims to provide a brief overview of all laws or policies impacting ebony production and analyze their impact.

FLEGT

In 2003, the European Union created the Forest Law Enforcement, Governance and Trade Action Plan (FLEGT) to combat illegal logging and monitor timber trade. In conjunction with FLEGT, the EU also developed the Voluntary Partnership Agreement (VPA), a legally binding agreement by the EU and a timber producing country to follow FLEGT policies (European Union & Ministry of Forests and Wildlife (MINFOF) 2010). In 2010, Cameroon signed a VPA with the EU. Within this action plan, ebony is listed as a special product and

assigned a special matrix (matrix 7) to define its separate criterion. Ebony is one of the species subject to “the Cameroon Party to the Agreement adapting the CEMAC customs tariff to the code of the Harmonised System (HS) of the World Customs Organisation (WCO). The products and species may be modified as the market develops, without the need to amend the Agreement” (VPA-FLEGT). Because ebony is listed as a special product with vague management language, there is room for manipulation of the verbiage that could lead to exploitation of ebony. Denis Koulanya Koutou, the secretary-general of the Ministry of Forestry and Wildlife, has stated that “The VPA is currently being implemented by a series of forest exploitation companies under the institution and legal supervision of the government” in an article in *Legal Monitor Worldwide* (“Cameroon Readies New Law to Strengthen Forest Governance” 2014).

1994 Forestry Law

Law No. 94/01 of January 1994, To Lay Down Forestry, Wildlife and Fisheries Regulation states: “the State, local councils, village communities and private individuals may exercise on their forest and aquacultural establishments all the rights that result from ownership subject to restrictions laid down in the regulations governing land tenure and State lands and by this law” (Law No. 94/01, Part I, §7). While it does not directly govern ebony harvesting, this law affects the forestry sector as a whole. Ebony, as a harvested species under the Cameroonian forestry sector is thereby technically affected despite not being explicitly mentioned. Overall, Law No. 94/01 lays the primary groundwork for forestry operations and affects everything that Taylor Guitars does in the forestry sector. Taylor Guitars is primarily concerned with their logging concessions and ebony processing in-country and these factors depend on how they may legally operate in the forest.

Growing ebony in community forests is a feasible way of involving community members via participatory development. Decree No 95/531/PM of 23 August 1995, Laying down the Procedure for Implementing the Forests System, offers a definition on community forest: “a forest forming part of the non-permanent forest, which is covered by a management agreement between a village community and the Forests Administration. Management of such forests is the responsibility of the village community concerned, with the help or technical assistance of the Forests Administration” (Decree No 95/531/PM Article 3, §11, 1995). By Decree No. 95/531, village communities are empowered through possessing management rights of forests lands as well as collaborating with Forests Administration. In addition, Decree No. 95/531 also allows for competitive bidding of forestry land rights, which grant community members to own the land the trees are planted on and sell the trees to Crelicam and other logging operators. The purchase of ebony grown by community farmers provides capital for local farmers and keeps the ebony processing system at the community level in Cameroon. Decree No 95/531/PM of 23 August 1995, Laying down the Procedure for Implementing the Forests System, allows for competitive bidding for forestry land rights. Land rights is key because it defines which entities, for example the community versus logging exploitation companies, get to hold permits for logging a specific parcel of land.

The partnership between the community and the Forests Administration would be a long term benefit because the community members are the ones consistently on the forest floor which is the core of forestry operations in Cameroon. They are the ones who most come in contact with trees of special value, such as ebony, and would be effective resources to regenerate these precious species. We see this partnership as something that Taylor Guitars should help foster. In short, Decree No. 95/531 affects Taylor Guitars because it provides an outlet through which the

company can grow ebony and replenish the forest while involving the community. A way in which this can be fostered is through agreements with the community members regarding their role in the regeneration of ebony. These agreements will change over time as the scale of the regeneration project changes and the communities of the forest shift. We recommend that further groups look into the implications of agreements with the community members that span the lifetime of an ebony tree (approximately 80 years). The longer time frame of this type of agreement requires a projection of what the ebony market will look like in 80 years while maintaining enough flexibility to account for changes in growth strategies and market prices.

Classification of Ebony

Cameroonian Decree No. 2032 in August 2012 set forth by the Ministry of Forests and Wildlife (MINFOF) establishes Ebony as a special forest product (Décision N°2032, 2012). Ebony is listed as number one on the list of special forest species in Article 1 of Decree No. 2032. Its status as a special forest product puts it at a higher priority for regulation out of a list of products that are already scarce and valuable. For example, Article 2 of the decree states: “This list [of special forest species] is made up of products that are relatively scarce or for which quota measures are necessary because of the risks associated with the methods used to harvest them in relation to the sustainability of the resource for a profit-making operation” (Decree No. 2032 Article 2, 2012). Ebony as a special species is not regulated like other timber products in Cameroon. It requires special permitting and the use of quotas in order to regulate the amount of material being extracted from the forest. The amount that Taylor Guitars can extract for the forest is dependent on the quotas per year and how much they are allotted. Year to year fluctuations in total ebony quotas and inconsistencies in the share amount of the quota that Taylor Guitars receives contribute to uncertainty in annual business models and projections. For

example, if in the previous year, Taylor Guitars receives permits for 1,500 tons, and in the current year's business projections, accounts for 1,500 tons but only gets 1,000 tons, this creates a disconnect in the market. One way to combat this uncertainty is for the government to locate outside permit holders that also are allowed to log special species and to put these people in contact with responsible operators of the forest like Taylor Guitars.

Ebony Logging Permits

Due to the special status of ebony, the regulations of forest management units (FMUs) do not govern the logging of ebony. Unlike common woods, a forest management unit (FMU) - area of allotted land (concession) for logging a specified number of trees - cannot be used for ebony. Decision No. 0336 / D / MINFOF of 06 July 2006 lists ebony as a special product of special interest to Cameroon, thereby requiring special permitting to log ebony. Each year, the Ministry of Forests and Wildlife (MINFOF) sets the annual quota of ebony for commercial logging. Companies seeking special permits to log ebony must apply under MINFOF following all criteria listed under Article 87(1-3) of Decree 95-531. This special permit allots a certain volume of loggable ebony to permit holder. Permit holders or operators are also allowed to buy these special permits from other permit holders.

Conventional permitting allots a region or percentage of a region for harvesting and replanting purposes. A small, independent committee determines eligibility of the forest operator and recommend the land title to the MINFOF. When the permit is granted, the operator has harvesting access to the designated land region. However, the same permit can be granted to several operators. This leads to competition for ebony trees when multiple forestry operations gain access on the same region, which often cause logging process to be rushed and increase the difficulty of keeping an inventory for ebony trees (A. Bena, March 30, 2017, Personal

Communication).

FSC

The Forest Stewardship Council (FSC) is a voluntary certifying body providing certification of sustainable forest management processes. FSC operates under ten principles - including compliance with all current laws, tenure and use rights, indigenous peoples' rights, community relations and workers' rights, benefit from the forest, environmental impact, management plan, monitoring and assessment, maintenance of high conservation value forests, and plantations. FSC principles in theory provide a strong framework. As FSC only provides accreditation without any legal mandate, only forest operators pursuing sustainable forestry management are inclined to obtain FSC certifications. In Cameroon, the appeal of FSC certification is limited as legal compliance is often the sole focus of (the majority of) forestry operators. There exists two methods for FSC certification: a Forest Management Unit certification and the Chain-of-Custody (CoC) certificate. Crelicam is only eligible for the CoC pathway. Currently Crelicam does not hold any FSC certification. If Crelicam were to obtain certification, it would have to go through the CoC pathway. A CoC certificate ensures that the Crelicam is obtaining FSC-standard ebony from a certified management unit (Forest Stewardship Council). However, it is difficult for Crelicam to obtain the certification as there is a lack of local logging operator that is FSC certified and the special status of ebony only further complicates the situation.

Taxation

Tax laws affecting ebony production include: "Felling Tax, the Annual Royalty for a Concession, the Sawmill Entry Tax (referring to logs entering processing units), income from

resale of confiscated timber (resulting mainly from illegal logging), penalties, surcharge on log exports, tax on export of processed products, and log export duty” (Amariei 2005).

Finance Law No. 2002/004 of April 2002 sets forth rates for different activities in the forestry sector. Per an article on the Forest Legality Initiative site, the purpose of the Finance Law is less to encourage legal trade practice than it is to create a revenue through fines for discouraged illegal activities through fines (“Cameroon” 2013). Where the Finance Law is most applicable to the study of economics for the purposes of the Crelicam sawmill, is the regulation regarding the private sector as outlined in Title II-Contract Management, Chapter III-Role of the State and Private Sector in Economic Affairs, Section 2-Role of the Private Sector in Economic Affairs, Article 9. Article 9, Section 1, states “the purpose of the private sector shall be to create and generate wealth” which outlines the roles of companies that participate in logging. Furthermore, Section 2 of Article 9 that states the private sector shall “comply with competition rules by avoiding fraudulent practices and by discouraging conduct conducive to corruption within the private sector” (Law No. 2002/04 2002) which would specifically refer to the discouragement of illegal logging and trade of illegally logged timber in Cameroon by members of the private sector. The way this is framed, if illegal logging happens, the entity will be fined. This is a punitive approach to discouraging illegal logging. It also does not account for those who illegally log and never get caught. A better approach to discouraging illegal logging is to make the legal logging process more accessible to those who log legally. This would entail greater government transparency, improved access to the necessary documents for legal logging, and increased education about sustainable forestry and proper usage. Internet access would be useful for improving transparency and access to documents and educational resources.

B. Overview- International

One of the international laws creating accessibility and reliability issues for Taylor Guitars is the Lacey Act. The Lacey Act, defines a plant as “any wild member of the plant kingdom, including roots, seeds, parts, or products thereof, and including trees from either natural or planted forest stands” (16 U.S.C. § 3371(f)(1) 2008). The taking of plants protected by the Lacey Act is illegal, with a few exceptions. For example, “(B) a scientific specimen of plant genetic material (including roots, seeds, germplasm, parts, or products thereof) that is to be used only for laboratory or field research; and (C) any plant that is to remain planted or to be planted or replanted” (16 U.S.C. §§ 3371(f)(2)(b-c) 2008). The Lacey Act also states: “(A) in an appendix to the Convention on International Trade in Endangered Species of Wild Fauna and Flora; (B) as an endangered or threatened species under the Endangered Species Act of 1973; or (C) pursuant to any State law that provides for the conservation of species that are indigenous to the State and are threatened with extinction” (16 U.S.C. §§ 3371(f)(3)(a-c) 2008). Ebony is a protected species under the Lacey Act as it is not exempt from the definition of a plant even as an endangered species. This requires extensive documentation for every stage of production of ebony, from cutting on the forest floor to importing back US soil. The issue that this law presents for Taylor Guitars is one of accessibility and reliability. One of the biggest challenges for Taylor Guitars to abide by the Lacey Act and protecting endangered species is on the forest floor. Due to lack of government presence on the forest floor, Taylor Guitars assumes responsibility for the logging documentation process, which includes tagging corresponding processed wood for each tree. There is a need for better documentation in official government records in order to further ensure the legality of imported ebony wood. If the status of ebony as an endangered species were to change, this would affect the way that the Lacey Act in the United States would regulate

ebony trade. This status is contingent upon the its listing on the IUCN Red List of endangered species and as a CITES species. There is an upcoming meeting by the IUCN Red List to re-determine ebony's status on the endangered species list. If the status were to be upgraded to a more critical condition, under the Lacey Act, the trade of ebony in the united states would be severely limited.

C. Comparison between Legal and Illegal Forestry Operators

There is a disconnect in the responsibilities and compliance between legal and illegal forest operators in the Cameroonian forestry sector. As a legal operator, Taylor Guitars has more regulatory tasks to complete in order to adhere to the regulations and log responsibly, which drive up production costs. Illegal forest operators are often able to circumvent such tasks by logging outside of their permits, which further increase the burden of legal operators. Most importantly, illegal logging deflates the market prices of ebony because illegally logged ebony can be sold at lower prices due to not paying for permits or other taxes, which is exemplified in an article by the World Wildlife Fund (WWF) ("Illegal Logging" n.d.). The illegal timber trade is incredibly lucrative and is estimated to bring in between \$51-152 billion every year (INTERPOL n.d.). A legal operator of the forest: pays taxes, applies for and obtains permits, operates as a legitimate company, files taxes, responsibly uses forest, involves local community members, keeps the integrity of the environment in mind. These actions contribute to the wellbeing of the forest and the Cameroonian economy. However, a lot of this comes at a price, and therefore a responsible exploiter of the forest may lose money due to the high cost of legal logging yet deflation of market prices. An illegal operator of the forest: does not pay taxes, operates without permits, does not run a legitimate company, does not file taxes, disregards the

environment, cuts trees marked for harvesting by responsible operators of the forest, and in turn overruns market with trees at a lower cost due to avoiding incurred costs in harvesting. It is useful to note that illegal and legal logging occurs in a spectrum. Companies and individuals must decide which regulations to follow or ignore and in doing this there are multiple opportunities to cut corners.

There exists a spectrum on which legal and illegal ebony logging occurs. An example of this is how logging companies may operate the forest with different permitting and concession types. If a company holds a conventional permit, or a Forestry Management Unit (FMU), they can log the area but not log ebony which requires a special permit. However, once a special permit for ebony is obtained, one can no longer have a FMU and must seek land to log on from community forests (Kirlin 2012). This opens up opportunities for illegal logging because an operator of the forest who has a special permit for ebony could still log on an FMU when it is specifically designated for logging of non-ebony species. In this case, the forest operator has a special permit and a forestry concession but is misusing it by choosing to log the wrong species in the FMU. Conversely, someone could be logging ebony in a FMU or a community forest without a special permit, thus logging illegally without a special permit for ebony. Additionally, someone could be engaging in logging practices without any permit or concession rights. This is the spectrum of illegal logging operations.

D. Setbacks

With most projects there are setbacks, and Taylor Guitar's involvement in Cameroon is no exception to this. Laws under modification are a contributing factor in the uncertainty of regulatory operating standards. For example, the status of ebony is being currently updated under

the Convention of International Trade in Endangered Species of wild flora and fauna (CITES) due to the status of *Diospyros crassiflora* Hiern which has not been evaluated for 20 years. The current Appendix II listing of *Diospyros crassiflora* is not the species that we are concerned with in Cameroon, despite having the same name, the Hiern specification was left out (CITES 2017). Certain laws that affect ebony production may be under modification that our team is not aware of. This skews current data and information about laws and their effect on the current state of ebony in Cameroon. Additionally, whether laws are effectively enforced is hard to keep track of due to inconsistencies of recording data and government corruption. Corruption in the Cameroonian government is often a byproduct of the low salaries of the civil servants, thereby promoting the use of “tips” to supplement income and proceed with government action. Under The Foreign Corrupt Practices Act (15 U.S.C. §§ 78dd-1, 78dd-2, 78dd-3, 78m, 78ff), Taylor Guitars cannot partake in the use of “tips” in the government as it is considered “influencing any act or decision of such foreign official in his official capacity” (The Foreign Corrupt Practices Act, 1977). Not only is this illegal, it is not a part of Taylor Guitar’s operating strategy as a good operator. Another setback of the project is the inconsistencies of recording data. This is partially due to the lack of infrastructure and limited access to internet throughout the country. Furthermore, there exists many unwritten laws and customs in Cameroon that are not explicitly mentioned, taken instead as common knowledge, creating confusion through unpublished agreements for non-domestic companies. This makes doing business in Cameroon more difficult, something Taylor Guitars has faced. For example, the use of “tips” in the civil service sector is one of these unspoken laws. Transparency of government is a challenge that many business sectors in Cameroon face, affecting efficiency, time management, and business strategies. Another important setback to consider is whether or not local people are aware of laws and their

rights as a community. Local people should be involved in the forestry sector as to further their role as responsible agents of the forest. In order to do so, they need to know their rights in regards to forest ownership.

V. Recommendation Matrix

As a summary, we are presenting a compilation of all suggestions we proposed along the sustainability pathways, as well as additional recommendations we came up during our trip. We qualitatively evaluate the impact across disciplines and the difficulty of implementation for each solution, and rank them in descending priority.

High Priority						
Suggestion	Pathway	Scale & Difficulty	Impact-Economic	Impact-Community	Impact-Science & Environment	Impact-Knowledge Dissemination
Co-cropping	Co-cropping	Medium	High	High	High	High
Wood Stretcher	Efficiency	Medium	High	Medium	High	Low
Evaluating Log Quality prior Cutting	Efficiency	Large	High	Low	High	Medium
Make Sapwood Marketable	Efficiency	Large	High	Low	Medium	Medium
Insect Behavior Studies	Efficiency	Large	High	Low	High	Medium

Reusing Sawdust	Efficiency	Medium	High	Low	High	Low
Rural Resources Center	Policy	Medium	Medium	High	High	High
Medium Priority						
Documentary of Somalomo	Other	Medium	Medium	High	Medium	High
Global Case Competition	Other	Small	Low	Medium	High	High
Low Priority						
Wood transport robotics	Efficiency	Large	High	High	High	Medium
Superfruit Marketing	Other	Large	High	High	Low	Medium

Here are some detailed explanation of some of our additional, more unorthodox recommendations:

Rural Resources Center

Stemming from Dr. Zac Tchoundjeu’s efforts on developing rural education centers, we propose to develop Rural Resources Center (RRC) that provide information and resources on all agriculture-related disciplines. The focus of the centers will not only be aiding the daily farming routines of the community, but also enabling them to incorporate agroforestry and technology, into their practices through provision of education and subsidies. An example of a technology that a RRC could implement would be a “wood stretcher”, a system pioneered by Bob Taylor.

Similar to a palanquin, it distributes weight and maximizes mobility when carrying ebony out of the forest (refer to section III., Forest Level).

Global Case Competition

As Bob Taylor and various Cameroonian stakeholders have emphasized, engaging the next generation to take part in the project is crucial to the long-term health of sustainability projects. With CBI and Taylor Guitars' global connection, it is feasible to host a case competition on and invite college students worldwide to participate. The focus and the scope of work would be similar to our project currently, but on a global scale and update annually.

Superfood and Fruit-eating campaigns

With increasing Western lifestyle influences and average income, the diet of middle-class and well-off Cameroonians have become more unhealthy. As a response, we propose to identify species that would qualify as 'superfood' and packaging it as a trendy and modern type of diet. This will not only promote a healthier diet but also provide new sources of income for farmers.

VI. Appendix

State of Plantations

In addition to the Ekombité plantation, there is also another large-scale ebony plantations at Ecole des eaux et forets in Mbalmayo that consist of solely ebony planted at 3-meter intervals. However, this plantation is for research purposes and is considered off-limits for commercial harvesting (V. Deblauwe. March 1, 2017. Personal Communication.).

Personal Reflections

An important aspect of this project is the contribution of personal experiences and sentiments we gained while in Cameroon. We believe that by providing these personal reflections, we can help to motivate and prepare future projects to continue this research in Cameroon. One important reflection we have is the significant development and growth that the Congo Basin Institute is working on in-country. Prior to arriving in Cameroon, we had very marginal understanding of just how influential this institution was for both conservation and regeneration efforts in Cameroon. We encourage future projects to work closely with CBI and develop close partnerships in order to enhance their results. Thanks to their guidance, lodging, and network of researchers we were able to make this report.

Every member on the team collectively felt the frustration of trying to understand the cultural differences of how business is conducted in Cameroon. In the U.S., we are a nation that is very accustomed to instant gratification and the “time is money” way of thinking. Conversely, in Cameroon the team had to learn and accept that meetings would run over-time, underestimated travel-times, and the lack of urgency to quickly complete tasks. We hope that future researchers understand this cultural difference and most importantly, do not let it negatively affect their work. After experiencing this cultural shock, we gained a newfound respect and admiration for legal operators in Cameroon, especially Bob Taylor.

Lastly, we reflect on how the lack of infrastructure in Cameroon influences the feasibility of research. Our visit to Somalomo and the Baka Tribe would not have been possible if not for our advisor, Kevin Njabo, and the hired drivers who could easily navigate unnamed and unpaved roads through the forest. These skillful drivers were able to transport us to these remote locations purely off memory. The absence of this infrastructure should be accounted for in future research

itineraries, because they will need to not only acquire local assistance but also prepare for “worst case” scenarios such as heavy rains or muddy roadways that could postpone their activities.

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