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Chainsaw milling: supplier to local markets

EUROPEAN TROPICAL FOREST RESEARCH NETWORK



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Preface

Trade instruments are increasingly being used successfully to promote the legality and sustainability of timber production in the tropics and around the world. However, the importance of local consumption and trade of timber for achieving the goals of sustainable development is only recently being recognized in the policy arena.

International agreements regarding timber and carbon trading, such as the European Union's Action Plan on Forest Law Enforcement, Governance and Trade (FLEGT) and Reducing Emissions from Deforestation and forest Degradation (REDD+), will have an impact on local timber production and vice versa. To date, little was known about the extent of local timber trade in tropical timber producing countries, but information from this *ETFRN News* shows that local timber production is significant, with profound impacts on forest resources and local livelihoods. This emphasizes the need to address the informal and local timber sector adequately within these agreements, in order for them to meaningfully contribute to more sustainable forest management and equitable socio-economic development.

Chainsaw milling, the on-site conversion of logs into lumber using chainsaws, is supplying a large proportion of local timber markets with cheap lumber. While it offers socio-economic opportunities to local people, it is very often associated with corruption and illegalities. Regulating and controlling the practice is a challenge due to the mobility of these chainsaw milling operations. With this issue of *ETFRN News*, Tropenbos International, together with CIFOR, wishes to contribute to the discussion on how to address the domestic timber trade effectively and equitably at international and national levels.

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Chainsaw milling: supplier to local markets — a synthesis

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Introduction

Domestic timber markets in developing countries are often supplied by timber harvested in small-scale forestry operations and processed with chainsaws. Chainsaw milling (CSM) provides socio-economic benefits to local people in the form of improved livelihoods and cheap lumber for (urban) consumers. In some countries CSM is a legal and regulated activity, but in most countries it is illegal. When left unregulated, its positive impacts risk being compromised by the development of corrupt practices, through the rise of conflicts at local or national levels, or through depletion of forest resources.

Domestic timber production and trade are to a large extent unrecorded. Information in this issue of *ETFRN News* shows that in some countries it represents a high percentage of total timber production, ranging from 30–40% (in Guyana, Republic of Congo, Democratic Republic of Congo/DRC and Uganda), to more than 50% (in Ghana, Cameroon and Peru), and almost 100% in Liberia. Wood for timber is only a small part of the total domestic market; most locally traded wood is used for fuel or made into charcoal.

Governments of tropical countries around the world have failed to address the domestic timber demand and struggled to deal with the CSM subsector, which is often informal. International negotiations and agreements on tropical timber production also tend to disregard local timber consumption, although the local timber trade might be affected by these international agreements and vice versa. The European Union (EU) Action Plan for Forest Law Enforcement, Governance and Trade (FLEGT) and the (future) climate change agreements (through Reducing Emissions from Deforestation and Forest Degradation, or REDD+)¹ might be able to provide incentives to regulate local timber trade.

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This synthesis presents an overview of the scale of CSM and its actors, drivers, impacts and local policy responses, as well as the potential effects of international forestry regimes. It is based on the 28 articles in this issue of *ETFRN News* and covers 20 countries: seven in South America and the Caribbean (section 2); four in Asia (section 3); and nine in Africa (section 4).² These articles provide a good overview of the opportunities and challenges of CSM as a supplier to domestic and regional timber markets.³ Through this issue, we wish to firmly establish the scale and impact of CSM in the domestic timber trade, and flag it as an important issue to be addressed by national and international forest policies.

What is chainsaw milling and where does it occur?

Chainsaw milling is the on-site conversion of logs into lumber using chainsaws, i.e., trees are felled and cut into lumber using chainsaws. Several techniques and types of equipment are used (Pasicznik 1.1). A range of products is produced using chainsaw milling: chainsaw millers cut boards and planks that are sold directly to the market and produce blocks or scantlings that are further processed in sawmills.

Chainsaw milling has several advantages:

- it generally requires little investment;
- it can be used in areas that are not easily accessible to conventional milling;
- it can be used for the conversion of isolated trees and for lower-quality logs; and
- it involves less invasive equipment than conventional milling, e.g., tractors or people are used instead of skidders, and hand-held chainsaws are used instead of fixed mills.

Pit-sawing — felling and converting trees to lumber using handsaws — is the predecessor of CSM. In most countries chainsaws were introduced in the 1960s for felling of trees or for agricultural activities. However, operators soon discovered the usefulness of chainsaws for ripping logs (i.e., cutting along its length). Advances were made in the development of chainsaws, and they gradually replaced the labour-intensive work of pit-sawing.

Chainsaw milling is practised in developing and developed countries, with a wide range of resource availability, socio-economic conditions and forest sector development. Our emphasis is on its application in developing countries (Appendix 1 compiles some key statistics on CSM production in the countries presented in this *ETFRN News*).

The supply chain: tree owners, millers, traders and buyers

The supply chain in CSM operations involves many actors, from the tree owner to the end consumer. The organization of the CSM supply chain varies, depending on the status of CSM (legal or illegal), the organization of production (communities, enterprises or individuals), and the degree of integration between the participants in the trade chain.

Chainsaw milling teams are typically small, with an operator and assistants who mill the lumber and transport it from the felling site to access roads or rivers. Operators may work independently or as contractors to someone else, and they may own their own

equipment or operate equipment owned by others. Furthermore, CSM can be a full-time occupation or a component of a diverse livelihood strategy. Timber is sold to the end customer or traded in local markets, where a number of people are employed in handling, loading, further processing, etc. Chainsaw operations are often financed by dealers from urban centres who trade lumber in timber markets. The personnel of regulating and law enforcement agencies are also important participants in the supply chain, although in a different way.

Sources of raw material

Timber production for the local market is sourced from forests or from trees on farm lands. Access to trees varies according to formal, customary and practical tree tenure and use arrangements, and whether or not CSM teams operate legally or with assent. Access to trees is often negotiated between the CSM team and the tree owners, who in many cases (e.g., in the Congo Basin and Ghana) are customary owners, but do not officially have title to the property where the trees are growing. In Guyana CSM is permitted on State Forest lands and regulated through two-year community leases for a maximum of 8,000 ha. In the Congo Basin, the vast majority of timber comes from the non-permanent forest domain, i.e., areas with no obligation to sustainable forest management. In Ghana, farmlands are the most important sources of timber for chainsaw operators, but increasingly, chainsaw operators are entering (permanent) forest reserves because of dwindling resources elsewhere.

Chainsaw milling: supplier to regional markets

Although primarily destined for domestic markets, there are indications that chainsaw milled lumber is increasingly being traded on a regional scale. For example, markets for timber originating in the Tanimbar Islands of Indonesia have shifted from Java to destinations such as the Philippines, Vietnam and South China in response to the Indonesian government's efforts to curb the illegal trade (Roda, Langbour and Shantiko 2.3). In Africa, very effective ethnic business networks are active in trading illegal Cameroonian chainsaw milled lumber with Nigeria, Niger, Chad, Sudan, Egypt, Libya and Algeria (Langbour and Koffi 4.2). There is also some evidence that lumber is being transported from Ghana to neighbouring countries (Quartey 4.6), and from DRC to Rwanda, Burundi, Kenya and beyond (Vundu dia Masamba and Kiyulu N'yanganga 4.4).

Policies on chainsaw milling

CSM regulations are often incomplete or absent (Appendix 1), because forest laws tend to focus on the industrial timber sector. Three general models exist: CSM is permitted; it is permitted under certain restrictions (i.e., regulated); and it is not permitted (but it still takes place). Some countries have restricted CSM to domestic use only (e.g., Indonesia, Bolivia or Ghana) and/or to areas that are difficult to reach by industrial operations (Peru and Bolivia). Other countries allow CSM for small-scale commercial production (Guyana, Kenya and recently, Uganda). Where CSM is regulated, the licensing procedures for small-scale producers can be difficult, costly and time-consuming, with no incentives to comply

(Lao PDR, Indonesia, Cameroon, DRC, Gabon, Bolivia). As a result, operators often prefer to work informally than to comply with burdensome bureaucratic procedures.

In most countries chainsaw milling is associated with illegal forest activities. Even when CSM is authorized, its activities are often difficult to monitor due to the large number of people involved and the small size and mobility of its operations. The absence of CSM regulations and limited enforcement capacity exacerbate the problems of insufficient monitoring. In some countries, unclear or randomly enforced regulations give rise to illegal and corrupt practices where government officials derive personal benefits from CSM activities (Philippines 2.6; DRC 4.1 and 4.4; Ghana 4.5; Cameroon 4.1).

Guyana is an example where CSM is a legal and important subsector of the forest industry that supports rural livelihoods. The government has set up a relatively simple and workable regulatory system for small-scale producers (Office of Climate Change 3.5; Marshall and Kerrett 3.6).

In Bolivia illegal CSM activities decreased significantly after the introduction of the 1996 forest law. The legislation offered chainsaw millers a legal framework and gave land-owners the chance to benefit from their forest resource. This access allowed for the development of small-scale processing of logs transported by tractors. The processing requires less capital than conventional logging and is more efficient and less strenuous than CSM (Benneker 3.1).

In some countries (Liberia, Nigeria), CSM is not allowed but is considered quasi-legal and is tolerated in practice, because of the lack of economic incentive to invest in the formal sawmill industry due to the depletion of timber resources (Nigeria) and the unavailability of other sources of timber (Liberia).

Main drivers of chainsaw milling

Demand for cheap wood in local markets

The local demand for cheap lumber was identified as the main driver of CSM in each country covered in this *ETFRN News*. This demand is not being met by other sources of lumber.

In countries where CSM is illegal, it is still viewed as a legitimate practice by the majority of the stakeholders involved in the wood-based industry at the local level (Andrianto, Obidzinski and Komarudin 2.2; Marfo 4.5; Kamara et al. 4.8). Consumers accept low-quality chainsawn lumber because of its low price (Palacios and Malessa 3.4; Quartey 4.6; Kambugu, Banana and Odokonyero 4.11). The lack of incentives — such as price premiums for legal, higher-quality timber on the local market — and the abundance of logs keep CSM prices low and discourage people from using milling attachments (Pasicznik 1.1; Palacios and Malessa 3.4). It remains unknown whether higher requirements would result in a sustained demand for better quality products or just foster more illegal harvesting, as in Cameroon (Lescuyer et al. 4.1).

In some cases, low timber prices are a major disincentive for export-oriented formal sawmills to supply the local market. Klassen (2.1) calculated that timber prices on the domestic market in Indonesia are less than half of the timber production costs in the formal sawmill industry. Domestic prices are also far lower than export prices: in Liberia the domestic price for CSM lumber ranges from 26–54% of the export price; and in Cameroon CSM prices are 80% lower than export prices (see also Appendix 2).

Economic decline and other external calamities

In some countries (e.g., DRC, Nigeria) economic decline made the poor rural population turn to CSM as a source of income. In Peru, reduced activity from formal sawmills — a downturn associated with the international financial crisis — led to a lower availability of rejected lumber from formal sawmills on the market, increasing the occurrence of CSM (Brotto 3.8). The opposite trend could be seen in Cameroon, Ghana, Central African Republic, Congo and Gabon, where economic growth boosted the building sector and greatly increased the urban demand for lumber.

Beyond economic factors, several authors reported natural calamities as a factor that contributed to the rise of CSM. In many countries in the hurricane belt, CSM was introduced after heavy storms. When hurricanes toppled large numbers of trees and destroyed houses, an immediate demand for construction timber was created (Eckelmann et al. 3.7). The devastation prompted governments to issue chainsaw permits to salvage any available timber.

Similarly, armed conflicts in Suriname, DRC, and Liberia prompted the expansion of CSM to satisfy lumber demands in the face of the collapse of the formal sawmill industry and post-war reconstruction needs (van Kantén and Matai 3.9; Vundu dia Masamba and Kiyulu N'yangá 4.4; Kamara et al. 4.8).

Inadequate policies, policy restrictions and bans

In most countries local timber demand is not being adequately met by the formal industry, because it prefers to sell to the export market. Often, the regulatory framework is insufficient to regulate domestic timber production and trade in such a way as to satisfy the local demand for timber (e.g., in Indonesia, Ghana, Cameroon and Uganda). In Ghana, the government has directed sawmills to reserve 20% of their production for the local market, part of a policy intended to ban CSM and supply the local market from the formal industry. In Cameroon and in Gabon, community forests are supposed to supply the local timber market. Even if these quota are supplied, it would not be enough to satisfy the local demand in these countries, leaving a large gap to be filled by CSM.

A common response to CSM is to ban it, but banning can have mixed results. In Kenya, CSM increased after a ban on wood harvesting in government plantations resulted in acute timber shortages (Muthike et al. 4.7). The export-oriented timber industry in Liberia collapsed as a result of the international ban on Liberian timber products in 2003 and the subsequent cancellation of concession agreements by the government in 2006. This created a gap in the local timber supply. As a result, CSM is currently the only source of

lumber in the Liberian local market (Kamara et al. 4.8). The CSM ban in Ghana coincided with a log export ban, which unintentionally created a favourable environment for CSM; an increase in CSM capacity and profitability due to an excess supply of logs resulted in decreasing domestic prices (Quartey 4.6). The log surplus on the Indonesian market — due to the decentralization of issuing logging licences — drove down domestic log prices to the point where most concessions could no longer operate economically within the law (Klassen 2.1).

In Uganda the effectiveness of the CSM ban varied across forest types; on plantations and in natural forest reserves the policy has been largely successful in reducing CSM, but on private lands it has been compromised by corruption, political interference and lack of enforcement capacity (Kambugu, Banana and Odokonyero 4.11). In Cameroon the 1994 forest policy reform caused formal forest companies to shut down or to reduce their legal and sustainable production, and as the national economy improved, informal chainsaw operations filled the timber gap (Lescuyer et al. 4.1, Langbour and Koffi 4.2).

Corruption and political interference

Corruption and weak institutional governance have been cited in many cases as factors that foster CSM (Lescuyer et al. 4.1; Marfo 4.5; Kamara et al. 4.8; Kambugu, Banana and Odokonyero 4.11). In various cases, CSM is banned or discouraged on paper but tolerated, or even indirectly promoted, in practice.

In Ghana (Marfo 4.5), there is overwhelming evidence that corruption is prevalent among the frontline staff of law enforcement agencies. Corrupt practices and weak law enforcement have facilitated illegal chainsaw milling and made it attractive. Political interference has also greatly facilitated the drivers of chainsaw milling in Ghana. Enforcement of the ban at the operational level has not been effective due to political interference, particularly by chiefs and local politicians. Informal payments to government officials in Ghana were estimated to be US\$ 1.2 million in 2007. This is, however, only a portion of the amount that the government may be losing (estimated at up to US\$ 18 million per year) by not collecting stumpage fees from chainsaw operators (Marfo 4.5).

Tenure arrangements and inequitable benefit sharing of forest resources

Several articles mention insecure tree tenure as one of the main factors that prevents customary owners from protecting, replanting or regenerating trees (Cameroon, Ghana). In Ghana, for example, the tree tenure system effectively vests tree ownership and management rights in the state. This alienates farmers and communities from income from timber even though they decide the fate of trees on their lands. In addition, timber revenue accrues exclusively to district assemblies and traditional authorities (chiefs), not farmers. These factors have served as the impetus for farmers and community members to connive with CSM operators who pay for the right to harvest trees on farms (Marfo 4.5).

In Kenya farmers own the trees, which provide them with additional income. Trees outside forests have become important in meeting local timber demand. Farmers are now negotiating with operators over price, depending on tree quality and accessibility, urgency of cash need, and knowledge of the farmer about the value of the species (Muthike et al. 4.7).

The 1996 forest law in Bolivia is a good example of legislation that provides improved access and benefit sharing to local people, which in turn decreases illegal logging (Benneker 3.1).

Socio-economic impacts

Profitability of chainsaw milling

In many countries there is a considerable scope for profits from CSM due to the strong demand for lumber. The main determinants of profitability are market prices, investment costs, productivity, recovery, distance to market, resource characteristics, type of ownership and the nature of the market (Andrianto, Obidzinski and Komarudin 2.2; Eckelmann et al. 3.7; Popoola 4.9). CSM profit margins range from 15% to more than 50%. The evasion of taxes makes chainsaw milled lumber cheaper, although unofficial charges often increase production costs (Lescuyer et al. 4.1; Marfo 4.5). Appendix 2 provides an overview of production costs, market prices and profitability of CSM as cited in the case studies in this issue.

Adding value to rough-sawn lumber is frequently proposed as a way to increase profits and retain them at lower levels in the product chain. In Papua New Guinea (PNG), Keenan, Grigoriou and Yosi (2.5) show, however, that value adding is not always an option in mobile sawmill production; it is profitable only at a certain scale of production. Production for the local market with limited processing requirements proved to be more lucrative for owners of small sawmills than for export markets, with their higher requirements.

Employment opportunities

The possibility of making a reasonable living from CSM and the scarcity or lack of other viable livelihood alternatives in rural areas are cited by many authors as powerful drivers for people to get involved in the practice (Andrianto, Obidzinski and Komarudin 2.2; Terrazas and Gutierrez 3.2; Palacios and Malessa 3.4; Marshall and Kerrett 3.6; van Kanten and Matai 3.9; Marfo 4.5). Chainsaw milling is often seen as a means to quickly earn cash income in areas where this is scarce.

Employment figures for CSM are not readily available since in most countries it is practised in an informal way. For some countries, CSM employment is estimated to form a substantial part of the total forestry workforce (Table 1). A great deal of indirect employment is also created through CSM employment.

Table 1. Estimated CSM employment in four countries

country	estimated employment	note	article
Cameroon	45,000	three times as much as in the industrial timber sector	4.1
Ghana	97,000	comparable to the formal industry	4.5
Guyana	8,000	one third of total forestry work force	3.6
Liberia	1,500–3,850		4.8

Income generation for local people

CSM generates income for a range of participants in the trade chain, including rural people, transporters and urban traders. In some cases, the income from chainsaw operations represents a substantial proportion of household income; many examples provided by the authors show that it may be much higher than income from alternative work. In Ghana it can be as much as 24 times higher than the income from traditional agriculture (Marfo 4.5). In Cameroon the CSM revenue that remains in rural economies is four times as high as that provided by the area fee, a tax paid by industrial loggers and redistributed to local councils and communities (Lescuyer et al. 4.1). The favourable wages of CSM activities compared to other employment activities are also mentioned in the case of Liberia, the Caribbean islands, Indonesia and the Philippines.

The income generated by CSM activities also stimulates a secondary economy and can help communities purchase new chainsaws or mobile mills (e.g., in Suriname). In most countries CSM income has led to the development of services and trade in manufactured goods. In Liberia, for example, the presence of chainsaw millers has promoted the construction and repair of schools, town halls and roads. Alternatively, this income can be spent in other ways, such as on alcohol, tobacco and prostitutes (van der Ploeg 2.6).

Very often communities have limited organizational capacity to collaborate in harvesting, processing and marketing timber; this is a basic requirement for increasing local benefits from CSM and access to forest resources. As illustrated by the example of a CSM cooperative on Dominica, forming an effective collaborative organization — one that supports improved harvesting, processing and fair trade of wood — can be a real challenge. This initiative failed because of internal disputes and the dumping of low-quality timber through the cooperation (Eckelmann et al. 3.7).

The impact of CSM on indigenous communities varies according to differences in market access. Better market access may weaken traditional social structures and distribute revenues more widely in the community (Roda, Langbour and Shantiko 2.3).

Revenue distribution

It is believed that the benefits generated by chainsaw milling are distributed more widely within communities than those provided by conventional logging. This notwithstanding, from stump to market, the trading, financing, transportation and marketing processes

in the chainsaw timber supply chain can be exploitative, skewing the distribution of profits towards the urban timber dealers who sponsor the operations (Ghana, Philippines, Guyana). Customary tree owners tend to get less than 10% of the value of the timber from the standing trees they sell (Uganda, Ghana, Cameroon and Gabon).

Roda, Langbour and Shantiko (2.3) mention that CSM activities in communities do not guarantee equitable distribution; in their example, the savings and profits are not shared among the workers of the whole community, but are kept by the chainsaw owner.

In some cases the rural poor do not benefit much from chainsaw milling activities. In the Philippines (van der Ploeg 2.6) financiers, in collusion with government officials, reap the most benefits, while in DRC local chainsaw bosses, not the local people, benefit most (dia Massamba and Kiyulu N'yanga 4.4).

Income lost to government

Since CSM activities are very often practised in an informal context, substantive potential tax revenues are being lost by the state. In some countries the government may be losing more from CSM than they collect from the formal industry. The amount of foregone taxes has been estimated for several countries (Table 2).

Table 2. Lost stumpage revenue (US\$) due to illegality of CSM

country	lost stumpage revenue	article
Cameroon	13.1 million	4.1
Gabon	2.4 million	4.1
Ghana	18.0 million	4.5
Liberia	18.0–42.0 million	4.8

Health and safety

Freehand CSM is generally viewed as unhealthy and dangerous for operators. Several authors (Pasicznik 1.1; Palacios and Malessa 3.4; Marshall and Kerrett 3.6; Eckelmann et al. 3.7; Muthike et al. 4.7; Kambugu, Banana and Odokonyero 4.11) acknowledge the need for training to increase operators' health and safety and improve quality and efficiency. Chainsaw operators do not always apply the techniques they have learned, however. Examples are given from Ecuador (Palacios and Malessa 3.4) and the Caribbean (Eckelmann et al. 3.7), where operators do not apply improved techniques even when they risk contractual infringements. Several reasons are given for this reluctance: changing habits is difficult (Palacios and Malessa 3.4); it costs more to pay the assistant needed for improved production methods (Palacios and Malessa 3.4); chainsaw operators think that freehand milling is faster and as precise as using a guide bar (Eckelmann et al. 3.7); and appropriate safety and milling equipment is not always available (Pasicznik 1.1). In many cases, ignorance about improved techniques (e.g. reduced-impact logging), technologies and the illegal status of CSM are the drivers for not improving practices.

Conflicts

In many countries CSM is associated with conflict. Conflicts arise because chainsaw activities involve a multiplicity of overlapping interests and a complex network of actors in the CSM and marketing chain.

Frequently, conflicts are closely related to restrictions or bans on CSM. Forestry officials in Ghana, for example, face violence when enforcing the CSM ban. Conversely, in Ghana, Cameroon and Gabon chainsaw millers and timber dealers complain about administrative harassment and abuses of power by authorities.

The informal nature of CSM activities stimulates the development of exploitative business relations by means of which a large proportion of the revenues remains with the timber dealers or chainsaw owners; see Uganda (Kambugu, Banana and Odokonyero 4.11), DRC (Lescuyer et al. 4.1, Vundu dia Massamba and Kiyulu N'yanga 4.4), Ghana (Marfo 4.5), Indonesia (Roda, Langbour and Shantiko 2.3) and the Philippines (van der Ploeg 2.6). This imbalance may give rise to conflicts about payments. In Cameroon the relations between communities and small-scale operators are mentioned as being often unequal and difficult (Smith 4.3).

Conflicts also arise between chainsaw millers and the formal industry. In Guyana (Marshall and Kerrett 3.6) some conventional sawmillers feel that CSM has created unfair competition, given that the operating costs of conventional sawmills are much higher than those of chainsaw millers. On the other hand, many conventional sawmillers are purchasing chainsawn lumber to reprocess and export.

The case study in Merauke, Indonesia (Andrianto, Obidzinski and Komarudin 2.2) indicates that there are fewer conflicts in areas with chainsaw milling than in those with conventional logging operations, because customary land-owners are in a stronger position to negotiate with operators than when dealing with managers of large companies. Conflicts in this region are mainly due to technical issues and are easily resolved.

Environmental impacts

The impacts of CSM on the environment are mixed. The lightweight equipment used in CSM causes less damage than the equipment used in regular logging operations (no skidding trails are needed and waste wood is left in the forest), but uncontrolled or illegal CSM harvesting can lead to overharvesting, depletion of timber species, intrusion into protected areas and other adverse effects.

In Merauke, Indonesia, CSM operations have had relatively slight environmental impacts compared to the extensive deforestation and degradation associated with large-scale forest concessions in the region. In other areas, such as the Tanimbar Islands of Indonesia and Ghana, Uganda, Nigeria and Bolivia, chainsaw millers harvest selectively, searching for the best trees; this is said to lead to genetic depletion. Depending on the circumstances (e.g., level of enforcement, resource availability, accessibility of the terrain), on-site processing can have less ecological impact than other forms of logging.

Chainsaw milling can be carried out in areas that are not suitable for mechanized logging, such as steep slopes (e.g., in the Caribbean and Bolivia) and swamps (Indonesia). Chainsaw millers are, however, also entering areas that are off-limits to logging, such as buffer zones, protected areas and areas with protected tree species.

Recovery and waste

Freehand CSM is generally considered inefficient. The lumber quality is poor and the process produces large amounts of wood waste. There are several reasons for this inefficiency: the width of the kerf; the allowance for planing; and the fact that usable parts of the trees are left behind if lumber is cut to order. In addition, trees may be cut at night, which increases inaccuracy; and boards may be left behind due to interruption of illegal activities. Several authors list recovery data for CSM (Table 3). The figures vary greatly; recovery data are difficult to compare because of the variation in dimensions, species and methodologies used.

Table 3. CSM recovery rate (%)

country	recovery rate	article
Bolivia	33	3.2
Cameroon	34	4.1
Caribbean Islands	40	3.7
Ghana	27–40	4.5
Guyana	19–44	3.6
Kenya	23.3 (untrained) – 30.2 (trained)	4.7
Liberia	31–35	4.8
Nigeria	46	4.9
Uganda	20–25	4.11

Although figures vary greatly, timber recovery appears to increase when milling attachments are used, especially carriage mills (Pasciecznik 1.1). If CSM operators used improved techniques and technologies, they might substantially increase production efficiency and quality, and reduce the health and safety risks associated with freehand CSM. In Uganda (Kambugu, Banana and Odokonyero 4.11) a pilot project using a chainsaw mill with a frame showed that improved CSM increased the recovery rate from 25 to 55%. In Kenya, recovery rates increased by 7% after operators were trained in improved CSM (Muthike et al. 4.7). In PNG (Keenan, Grigoriou and Yosi 2.5) the average return on sales of lumber from portable mills increased from 0.4 to 8.15%, with an increase in productivity of 6% (from 44 to 50%).

The portable sawmill as used in PNG and Suriname is clearly a more technically advanced successor to CSM. Governments and other institutions very often see this technology as

an alternative to CSM. In general, CSM production capacity averages 0.5 to 1.0 m³ per day, while the output of a portable sawmill is 3 to 5 m³ per day (Keenan, Grigoriou and Yosi 2.5).

Some standard specifications used in the timber industry (e.g., the 4.2-metre board length in Uganda and Liberia) add to the inefficiency of timber production. In Liberia this requirement reduces the conversion rate from logs to planks from 35% to about 31%.

Impact of international policies on chainsaw milling

The domestic timber trade is primarily seen as a national concern and international policies pay little attention to it. To date, international initiatives have had a limited effect on domestic trade. Two recent international developments could change this: the European Union (EU) Action Plan for Forest Law Enforcement, Governance and Trade (FLEGT) and (future) climate change agreements (through REDD+). Both initiatives address the same underlying causes of deforestation and forest degradation that could affect the domestic timber trade; the domestic trade in timber can also affect deforestation and forest degradation. Small-scale timber harvesting needs to be considered in these forest governance initiatives in order for them to lead to sustainable forest management.

FLEGT/VPA

FLEGT, the EU's response to illegal logging, aims to facilitate trade in legal timber and improve forest governance. Voluntary Partnership Agreements (VPAs) between the EU and timber-exporting countries are being developed to implement FLEGT. In the three VPAs that have been signed so far (with Cameroon, Ghana and the Republic of Congo), the producing countries decided to include production and trade for the domestic market in their Legality Assurance System that will be put in place.

Apart from addressing illegal logging through law enforcement activities, FLEGT can put pressure on governments to recognize, legalize and organize the informal timber sector (Lescuyer et al. 4.1). The consequences of a strict VPA implementation for local forest dwellers and small entrepreneurs whose livelihoods depend on informal forest use may be significant.

Wiersum (5.1) argues that current programmes to stimulate legality in the formal forestry sector may have negative consequences on chainsaw lumber producers, because the latter very often operate under informal, and sometimes illegal, arrangements. Tightening the rules also leads to stricter technical and administrative requirements, which demand more of the administrative and organizational capacities of forestry operations. This acts as a bias against small loggers, even if they operate legally. Wiersum advocates a change in focus on legality from "hard" law enforcement, based on strict legal considerations, to "soft" enforcement, with a stronger focus on social aspects and decentralized governance. Social safeguards will be needed to mitigate the potential adverse social impacts of enforcing the present laws on people who depend on CSM.

The implementation of FLEGT/VPAs depends on an effective and legitimate system for timber legality assurance. Irregularities in the domestic market might affect the export trade when they compromise the integrity of forest law enforcement (Marfo 4.5; Andrianto, Obidzinski and Komarudin 2.2). Shifts in trade patterns of illegal CSM have been observed in Indonesia in response to the government's efforts to curb illegal trade; the market for Tanimbar Islands timber shifted from Java to other destinations such as the Philippines, Vietnam and South China (Roda, Langbour and Shantiko 2.3).

REDD+

REDD+ is the United Nations Framework Convention on Climate Change (UNFCCC) mechanism to lower carbon emissions through reducing deforestation and degradation. In this way, REDD+ promotes sustainable forest management and governance and may therefore lead to changes in timber production and trade, with likely impacts on both formal and informal economies. Brotto (3.8) gives a clear example of how REDD+ projects have an impact on timber harvesting, particularly on CSM. He concludes that neglecting the local demand for timber jeopardizes the implementation of REDD+ projects, and that timber harvesting needs to be incorporated in any REDD+ programme. Harvesting restrictions within REDD+ project areas could increase illegal CSM activities if they result in less timber being available from formal sawmills. In order to maintain benefits and forest resources for forest users in the long term, forests must be managed for multiple products and services and forest managers need to be prevented from focusing exclusively on carbon subsidies (Brotto 3.8).

When practiced efficiently and administered effectively, CSM could be a low-carbon subsector of the forestry industry and contribute to climate change mitigation. Guyana's Low Carbon Development Strategy considers CSM to have a potentially smaller carbon footprint than conventional milling (Office of Climate Change 3.5). In the Caribbean, CSM is seen to be an important part of supporting sustainable forest management, and as being easily integrated into a national REDD+ concept (Eckelmann et al. 3.7).

Reflections on how to address chainsaw milling

The articles in this issue demonstrate that CSM is widespread in developing countries and that it supplies domestic and regional timber markets. It offers socio-economic benefits to local people by providing low-cost lumber and livelihood opportunities in areas where employment is scarce. The low capital investment requirements of CSM make it an easily accessible business. Limited access to forest resources by small operators — coupled with limited enforcement capacity in most countries — invites illegality. CSM can be profitable, at least to some participants in the production chain; its profit margin is estimated by some authors to range from 15 to more than 50%.

In some countries forest cover has decreased to such a level that large-scale milling and logging have become inefficient and small-scale logging and milling, including CSM, are the best alternatives for processing trees into timber.

This issue demonstrates that CSM can make a considerable contribution to local economies, although its benefits are not always equitably distributed. Despite its importance, CSM is unaccounted for in international and, to some extent, national policies.

National policies: how to manage local demand for cheap timber

Governments of tropical countries have struggled to deal with the CSM subsector, and policy responses that effectively address CSM are rare. Where the practice is legalized, it is often associated with abuse and illegalities. Where it is banned, it still flourishes and control is difficult and compromised. Enforcement tends to be more effective in cases where CSM has been legalized. Because of CSM's mobility, the commitment of local communities would be key to an effective control system, provided that tree tenure was secure.

Most national timber production policies and legislation are primarily concerned with regulating logging and processing for exports, and forestry is regulated for foreign currency earnings and job generation. But how can an export-oriented activity satisfy the local timber demand? In many countries, timber production for local purposes is as high or higher than that for export. National governments need to start addressing this local demand. Ignoring it will lead to distortion of the market and domestic timber prices, and to an increase in illegal activities, conflicts, unsafe practices, loss of revenue to the state, corruption and a loss of forest resources.

In most cases better regulation is needed that considers local access rights to forest resources (tree tenure), taxation, enactment of legislation and policies that are perceived as fair by stakeholders, effective law enforcement, the organization of chainsaw millers, use of improved CSM technologies, and the equitable distribution of revenues. Procedures need to be simple so that local people are able to comply with their requirements.

Policies addressing domestic timber trade can have adverse effects that need to be acknowledged. Timber traders look for options that maximize their benefits, and increasingly restrictive regulations can operate as a disincentive that will cause traders to shift their markets rather than reduce their illegal practices. It is important that any policy addressing domestic timber trade be designed in a comprehensive way. The main challenge is to design an effective set of incentives for stakeholders (civil servants, sawyers, traders) to comply with the law. Regulations must be simple and easily enforceable, but incentives should be put in place to convince stakeholders that they will earn more from legal activities over the long term than from illegal practices.

Tenure and benefit sharing

National forest authorities need to put a system in place to improve the process of resource allocation. Cases presented in this *ETFRN News* show that secure forms of access to forest resources — at a reasonable cost and with equitable sharing of benefits — are needed so that forest communities and small-scale loggers can develop sustainable resource-based livelihoods and avoid unsustainable short-term logging practices.

Addressing corruption

Corruption is viewed as a key factor fostering illegal chainsaw milling practices. What would make actors in the chain change to legal practices? Chainsaw loggers will switch to legality only if the cost of doing business legally will not be significantly higher than the costs they currently incur.

Many options exist to reduce the possibility of corrupt behaviour in the chainsaw milling production chain. Chainsaw loggers must be provided with legal and financial incentives to make them switch from informality to formality and legality. Access to timber needs to be simplified with legal logging titles that do not burden the bureaucracy, and eventually formal taxes must be applied. Technical innovations will prove ineffective unless they are coupled with strong political messages that corrupt behaviour on the part of public officials will not be tolerated and will be effectively sanctioned. This will only work when it is combined with other measures, such as decent salaries for government officials and effective monitoring of law enforcement officers.

Low recovery rates

Freehand milling is a widely used technique that is inefficient as well as unhealthy and dangerous. Several authors acknowledge the need for training in improved chainsaw milling techniques to improve the health and safety of operators and increase efficiency. But how can the practice of chainsaw milling be improved when the market does not demand better quality timber? Buyers need to be convinced to pay more money for better and legal timber. Governments could play a role in this through initiatives such as procurement policies and a code of practice. It is open to question whether buyers would actually pay more for legal timber, or if a rise in price and quality would create an incentive for illegal logging.

Although the low recovery rate and wastefulness of CSM are often used as reasons to ban it, recovery data are not unambiguous. Pasicznik (1.1) recommends more research that compares CSM with other techniques, including portable mills, while considering available capital, availability of sawmilling equipment, accessibility of the site, environmental considerations, operators' health and safety, desired productivity and end products. But, again: as long as the market does not demand higher quality lumber and resources are freely available, it will be difficult to change production methods. Furthermore, Eckelmann et al. (3.7) state that waste in processing is normally the result of low timber prices, and that establishing higher prices for raw material is likely to be more successful in reducing waste than any recommendation issued by the national forest authorities. The standard specifications used in the timber sector could also be adapted to allow shorter board lengths, so that more timber can be recovered from a log.

International policies addressing local timber production

Domestic timber production has important impacts on local economies, rural livelihoods, forest resources and forest governance. These facts merit more attention from national and international policy-makers. As long as there is no clear framework that regulates domestic timber production and trade to satisfy demand for timber, there is little hope

that the illegal timber trade can be eliminated. Pressure from outside — e.g., through international agreements such as VPAs or REDD+ — is needed to support efforts to regulate the local timber trade. Pressure can include providing incentives for governance reforms and reducing illegal timber trade.

The three existing VPAs, in Cameroon, Ghana and the Republic of Congo, include timber production for the domestic market. Although it is good that these trade agreements address the whole timber sector, it also poses a challenge; studies have shown that illegal chainsawn timber supplies the majority of the domestic market in these countries (Appendix 1).

A strict application of VPA measures, without providing equivalent alternatives for local lumber consumption and livelihoods, could lead to the end of informal but well-established CSM. Bridging the numerous conflicting local and global interests that characterise CSM requires a meaningful and inclusive dialogue among all stakeholders. The voices of weaker and illegal actors easily go unheard when decisions are made, in spite of the influence they exert over what happens in the forest.

A multi-stakeholder dialogue will not solve all the problems associated with illegal logging and the domestic market, but it is critical for negotiating agreements over the difficult trade-offs between livelihoods and forest management and for introducing additional measures on capacity building and local governance — besides strict enforcement — to solve underlying problems of illegality and inefficiency. Ignorance of these factors only forces CSM further into illegality.

This is also true for REDD measures. If applied efficiently CSM could qualify as a low carbon activity, but if not, it could lead to forest degradation and have serious socio-economic impacts that would jeopardize attempts to establish a sustainable timber industry. All stakeholders need to be ready to openly and transparently debate the costs and benefits of a transition to low carbon development, and to jointly agree on scenarios to make the best use of the opportunities available.

The articles in this *ETFRN News* show that addressing CSM adequately is a challenge due to the multiplicity of overlapping interests and the wide range of actors involved. When these characteristics are effectively addressed, however, CSM can generate substantial socio-economic benefits to local people, while sustaining forests resources.

Endnotes

1. REDD+ = Reducing Emissions from Deforestation and forest Degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.
2. Information from the articles in this *ETFRN News* is referenced through the name of the author and article number or the country name and article number.
3. In most countries more advanced technologies, such as portable sawmills, are also used to convert timber for the domestic market. This issue does not consider mobile milling, except in a few specific cases.



Section 1

A technical overview

Photo credits

- p.1 Processing sawn timber at the logging site. R. Nasi
- p.3 A rail mill (Beam Machine). Nick Pasiecznik
- p.5 A carriage mill (Jobber J100). Nick Pasiecznik
- p.8. A frame mill (Granberg Mark III). Nick Pasiecznik



1.1 Sawmilling with chainsaws: a technical overview

NICK PASIECZNIK

Freehand sawmilling with chainsaws is increasingly common in tropical forests and elsewhere, as chainsaws are now relatively cheap and widely available. The technique is especially suitable for exploitation of single trees by people living in or near forests who do not have the capital to invest in more expensive sawmilling equipment. Many of the people doing the sawing do not own the chainsaw they use; they hire, rent or borrow one, or use one as a paid labourer. Many of them save up in hope of one day becoming an owner-operator, or being able to buy and rent out a saw without having to do the hard work themselves.

The availability of chainsaws has been a boon to many people. Chainsaw millers in developing countries say they are better off than before they began using a chainsaw, when many did not have regular paid work.

However, besides issues related to illegal harvesting of timber, freehand chainsaw milling has a high risk of injury and fatigue. Safety clothing is rarely used in the tropics and even basic safety precautions are largely ignored. Removing chain depth gauges to increase cutting speed is common practice, but it increases the risk of chainsaw kickback, and other long-term health impacts from poor posture and high levels of vibration and noise.

Chainsaw milling attachments, which are commercially available and relatively inexpensive, greatly reduce these problems, and produce high-quality timber safely and efficiently. They are also especially suitable where trees are few or scattered, inaccessible, or have poor form or small size (Pasiiecznik 2006). In addition, they can be more easily regulated than chainsaws (Pasiiecznik 2007). However, they are hardly known and almost entirely unavailable in tropical forest regions.



THERE IS A CLEAR NEED TO ENSURE ADEQUATE TRAINING IN CHAINSAW USE AND MAINTENANCE, BOTH TO IMPROVE OPERATOR HEALTH AND SAFETY AND INCREASE EFFICIENCY.

This article is aimed at those involved in making and implementing policies in the forestry and wood processing sectors, and companies involved in manufacturing and selling chainsaws, accessories and milling equipment. There is a need to ensure and promote adequate training in chainsaw use, make available appropriate safety and milling equipment, and develop markets for value-added end products.

A brief history of chainsaw milling

The first records of the use of toothed saws are from Egypt at least 5000 years ago. Long one- and two-handed saws became common tools for felling, cross-cutting and milling, and designs have changed little over time. The continued use of handsaws for sawmilling should not be underestimated, although they are being rapidly replaced by freehand chainsaws. The blade is used vertically, with logs that are either raised onto specially constructed frames, or more commonly as pitsaws, where a pit is dug under one end of a felled tree. The person on top of the log was once known as the top dog, and the one underneath, continuously covered in sweat and sawdust, the underdog, which is thought to be the origin of this word in English.

A revolution in sawmilling technology came with the invention of the circular saw blade in 1777, though more primitive versions were available before. It was not fully adapted for sawmilling timber until the early 1800s, coinciding with the invention of the first band saw. Both types of saw could be powered by water, though their evolution in the 1800s paralleled the rapid development of steam power applications.

However, no mill before 1900 could be described as portable. The advent of petrol-driven engines and the increasing demand for timber finally provided the incentive to develop appropriate machines for use within forests. Portable circular saws developed in the early 1900s, although these were made redundant by the arrival of the modern petrol chainsaw in 1929. The use of a continuously linked chain for cutting had been invented a century earlier in 1830 for cutting bones during surgery; it took 50 years to be adapted to cutting timber, and another 50 years of various unwieldy prototypes before Andreas Stihl came up with the chainsaw design that we recognize today.

Chainsaws were principally designed for felling and cross-cutting, and not for ripsawing (cutting logs into timber along the grain or length of a log). However, chainsaws were used in other types of less portable milling systems by the 1950s, if not earlier. The first milling attachments were frame mills; the Granberg Alaskan Mill (Granberg, USA) was commercialized in 1962, followed by the Grumette (Zimmer, France) and others. These models have changed little in half a century. Around the same time, the first ripping chain specially designed for chainsaw milling was invented and patented. It is now manufactured by several companies, notably Granberg, Oregon and Stihl. Rail mills followed, such as the Mini Mill in 1973 (Granberg, USA) and the Beam Machine in 1982 (Quadra Tools, Canada). Carriage mills are the most recent development. They include the M7 (Logosol, Sweden) and the J100 (Jobber, Canada), which use chainsaws or bandsaw cutting heads, and a bandsaw head powered by a single chainsaw engine (the Ripsaw, SIR, USA).

Two main user groups practise chainsaw milling today:

- The first group is forest-dependent people living in or near natural forests, mainly in moist tropical and sub-tropical regions. They usually mill freehand, part time or full time, and mainly but not exclusively, for local, national and regional markets.
- The second group includes woodworkers, artisans, hobbyists and farmers, living in, near to or far from forests, mostly in temperate and subarctic regions, milling part time only, with frames or other attachments, mainly but not exclusively for their own use. The latter are largely responsible for the development of chainsaw milling attachments, which have the potential to greatly improve the livelihoods of the former.

Chainsaws and accessories

Chainsaws

Chainsaws cost US\$200–2,000 and are manufactured by many companies. Stihl and Husqvarna tend to dominate the global market, although a large number of other makes are widely used in specific countries or regions, but rarely seen elsewhere. Operators prefer chainsaws with a capacity of at least 50 cubic centimetres (cc) for milling freehand or with milling attachments, costing at least US\$500. Smaller chainsaws can be used, but they have a much reduced cutting rate. A rule of thumb is that the size of the chainsaw engine in cc should be greater than the log diameter in cm. Chainsaws of 90 cc are preferred by regular chainsaw millers. The most commonly recommended models by chainsaw mill manufacturers are the Stihl 660MS (92 cc), the Husqvarna 395XP (94 cc), and the Jonsered CS2186 (85 cc); costing US\$1,000 or more. For freehand milling in tropical forests, even larger chainsaws are common, such as the Stihl MS076 (111 cc), MS880 (122 cc) and 090; costing US\$1,500 or more.



Chains

To increase cutting speed in freehand chainsaw milling, depth gauges are commonly filed down or cut off. This, however, increases vibration, the chance of kickback, operator injury and wear of the bar and chainsaw. Instead of modifying the chain, regular chisel chains can be used. Reducing the angle of the top plate from the usual 30 degrees to 0–15 degrees increases the smoothness of the cut and thus board quality. These are called ripping chains; they can be purchased (Table 1) or regular chains can be filed down as required. The Granberg ripping chain has an additional feature whereby half the teeth are reduced to “scorers,” further increasing board finish and cutting speed. Reduced-kerf chains are also available, such as the Micro-Lite (Oregon) and PMX (Stihl), for use with special thinner “picco” bars. These decrease the width of each cut to seven mm from the usual nine mm, reduce fuel use and increase cutting speed, but are more likely to break and should not be used with large chainsaws.

Table 1. Chainsaw mill and accessory manufacturers and suppliers and factory gate prices

Model	Manufacturer	Cost (US\$)	Web site
Rail mills			
Beam Machine	Quadra Tools, Canada	40	www.beammachine.com
Boardmaster	Hud-son, USA	40	www.hud-son.com
Mini Mill II	Granberg, USA	80	www.granberg.com
Lumbermaker	Haddon Tools, USA	90	www.haddontools.com
TimberJig	Logosol, Sweden	170	www.logosol.com
Micro-Mill	Accutech, Canada	200	www.accutechinnovations.com
Headcutter	Big Foot Tools, USA	210	www.bigfoottools.com
EDM Tracer	Schroeder, USA	240	www.loghelp.com
Miter Mill	Accutech, Canada	600	www.accutechinnovations.com
Big Mill Basic	Logosol, Sweden	750	www.logosol.com
Frame mills			
Alaskan Small Log Mill	Granberg, USA	140	www.granberg.com
Alaskan Mark III 24"	Granberg, USA	180	www.granberg.com
Slabbing Mill 24"	Westford, Australia	290	www.eftelcorporate.com.au/~jema1
Stihl LSG 450	Logosol, Sweden	360	www.logosol.com
Alaskan Mark III 84"	Granberg, USA	390	www.granberg.com
La Grumnette	Zimmer, France	420	www.zimmersa.com
Slabbing Mill 66"	Westford, Australia	430	www.eftelcorporate.com.au/~jema1
Big Mill LSG Pro	Logosol, Sweden	500	www.logosol.com
Stihl LSG 600	Logosol, Sweden	520	www.logosol.com
Alaskan Mark III C2	Granberg, USA	640	www.granberg.com
Carriage mills			
"Make your own"	Procut, Canada	1,000	www.procutsawmills.com
Rail Mill	Westford, Australia	1,140	www.eftelcorporate.com.au/~jema1
J100 Jobber	Jobber, Canada	1,500	www.jobber.qc.ca
Baby Bug 10XB	Wood Bug, Canada	1,560	www.woodbug.com
Chain Saw Mill	Hud-son, USA	1,800	www.hud-son.com

Woodworkers' Sawmill	Logosol, Sweden	2000	www.logosol.com
Woodbug 20XB	Wood Bug, Canada	2,260	www.woodbug.com
SM2186 Chainsaw Mill	Lennartsfors, Sweden	2,310	www.lennartsfors.com
M7 Sawmill	Logosol, Sweden	2,400	www.logosol.com
Chainsaw mill	EcoSaw, Australia	3,500	www.ecosaw.com
Milling accessories			
Winch	Westford, Australia	30	www.eftelcorporate.com.au/~jema1
Supplemental oiler	Granberg, USA	50	www.granberg.com
Helper handle	Granberg, USA	50	www.granberg.com
EZ slabbing rails	Granberg, USA	140	www.granberg.com
Bar Stinger (handle)	Schroeder, USA	170	www.loghelp.com
Double-ended bars	Granberg, USA	230	www.granberg.com
Weatherboard guide	Westford, Australia	180	www.eftelcorporate.com.au/~jema1
Log Wizard debarker	Log Wizard, Canada	290	www.logwizard.com
Log House molder	Logosol, Sweden	1,450	www.logosol.com
The Ripsaw	SIR, USA	1,590	www.ripsaw.com
Ripping chains			
Granberg chain	Granberg, USA	—	www.granberg.com
Granberg-type chain	Laser, Canada	—	www.lasersales.org
Various, + Micro-Lite	Oregon, USA	—	www.oregonchain.com
Various, + PMX	Stihl, Germany	—	www.stihl.com

Source: Pasiecznik et al. (2006). This table compiles all the commercially available chainsaw milling equipment identified in 2006. It is arranged in approximate retail price order by mill type, but gives no indication of quality, technical characteristics or maximum/minimum log size that can be sawn. The author has no commercial interest in any of the makes/models listed.

Oil

Two-stroke oil should be added to fuel at a ratio of approximately 1:25 (i.e., 200 cl of oil per 5 litres of fuel). However, some operators add at least twice this amount, believing that it increases efficiency; in fact, it significantly increases overall running costs (Pasiecznik and Carsan 2006). Oil is also required as a chain lubricant. Special synthetic chain oils are not commercially available in many countries or are prohibitively expensive. Used engine oil is sometimes used, but the small particles of metal it contains can damage the oil pump. The best alternative is any type of vegetable oil, the thinner the better, that is locally available, relatively cheap and biodegradable.

Chainsaw milling attachments

The following is a summary description of equipment that is currently commercially available, classified into frame mills, rail mills and carriage mills. For more information on chainsaws, accessories and different mill types, see Pasiecznik et al. (2006), and/or the companies' websites included in Table 1 of mill manufacturers.

Frame mills

Frame mills cost US\$140–640. They are probably the best known and most commonly available of all chainsaw milling attachments. Often called Alaskan mills or slabbing mills, they are also referred to by the manufacturer's name, especially where these are used exclusively, such as Granberg, Logosol or Stihl mills or frames. Frame mills are simple guides that are fixed parallel to the chainsaw bar. They are used with the bar and frame positioned horizontally for "live," "slab" or "through and through" sawing, and can be adjusted to cut various thicknesses. They are made of square tubular steel or aluminium, with or without rollers. Some manufacturers produce various sizes to accommodate different lengths of chainsaw bar, and the corresponding log diameters. In using a frame mill, operators must use slabbing rails, slabbing boards or similar attachments when making the first cut.



Rail mills

Rail mills cost US\$40–240. They are the cheapest and most simple type of mill, comprising of a small attachment that fixes onto the chainsaw bar and rides along a rail attached to the length of the log. They help chainsaw millers make straight cuts through a log, usually vertical. Some models require the bar to be pre-drilled to allow the attachment to be bolted on, in other models the attachment simply clamps on. Rails may be specially supplied metal units (strips, bars, angle iron, etc.) or pieces of wood, typically in common sizes such as 10 by 5 cm or 15 by 5 cm (4 by 2 inch or 6 by 2 inch), for nailing or screwing on to the log. Some rail mills have additional features such as an ability to set the chainsaw at angles other than 90 degrees (vertical), or to cut mitres, control the depth of cut or cut curved lines. They allow operators to produce custom timber, and many models have been specially designed for making log cabins and timber-frame housing.

Carriage mills

Carriage mills cost US\$1,000–3,500. The chainsaw is fixed on or into a carriage that rides along a frame or set of rails. Most carriage mills make horizontal cuts, though some make vertical (or near-vertical) cuts. These mills are larger, heavier, more expensive and require more set-up time than the rail or frame mills, but they increase productivity, reduce muscular stress and strain, and entirely eliminate the risk of accidents. When assembled, carriage mills cannot be carried by a single person, however, and share many similarities with portable band saw and circular saw mills. Several models of carriage mills have specially designed band saw heads that can be used instead of a chainsaw.

When chainsaw milling makes sense

The few studies comparing chainsaw milling with portable bandsaws and circular saws have identified conditions where milling logs with chainsaws is the most appropriate; some have also compared freehand milling with the use of milling attachments. Criteria that need to be considered are available capital, availability of sawmilling equipment, site accessibility, labour considerations, desired productivity and end products (Pasiecznik et al. 2006). Additional criteria include environmental considerations and operator health and safety.

Table 2 presents a review of results from studies on productivity and timber recovery from freehand milling and chainsaw milling with attachments. Although figures vary greatly, there appears to be an increase in timber recovery when using milling attachments, especially carriage mills. Productivity (per working team) was potentially higher with freehand milling, though carriage mills were comparable, and rail and frame mills were the least productive.

Table 2. Productivity and timber recovery from freehand chainsaw milling and chainsaw milling with attachments

country	notes	productivity m ³ /day	recovery %	source ¹
Freehand chainsaw				
Brazil	Various hardwoods	4.8	41–61%	D'Oliveira et al. 1998
Guyana	Various hardwoods	4.2	10–25%	Grisley 1998
Indonesia	Various hardwoods	2.0	<5%	Roda 2005
Philippines	Coconut	1.5	27%	Arancon 1997
Guyana	Locust and greenheart	1.2–1.8	19–22%	Clarke 2005a
DR Congo	Grevillea and eucalyptus	0.8	37–55%	Samuel, Pasiecznik and Fehr 2007
Ghana	Various hardwoods	—	40%	Tropenbos 2003
Kenya	Grevillea	—	28–39%	Onchieku 2001
Frame and rail mills				
Kenya	Granberg Mark III — grevillea	1.45	45–55%	Samuel, Pasiecznik and Fehr 2007
Australia	5 assorted mills (mean) ²	1.1	35%	Stewart and Hanson, 1997
DR Congo	Stihl LSG 450 - Grevillea/eucalyptus	1.0	41–54%	Samuel, Pasiecznik and Fehr 2007
Mexico	Rail mill (unspecified)	1.0	40%	Richards et al. 2001

USA	Granberg Mark III – oak	0.6–1.2	—	Henderson and Krier, 1997
Kenya	Granberg Mark III - Prosopis	0.27	25%	Samuel, Pasiecznik and Fehr 2007
Australia	Frame and rail mills	—	55%	Smorfitt et al. 2004
Carriage mills				
Sweden	Logosol M7 – softwood	2.3–3.5	50–60%	Company website
Canada	Procut “make your own” ³	1.8–3.6	—	Company website
UK	Jonsered 600+ ⁴ – Douglas fir	1.6–2.9	26–66%	Jones, 1998
Canada	Procut “make your own” – softwoods	1.2–2.4	—	Company website
UK	Jonsered 600+ ⁴ – oak	1.1	56%	Jones, 1998
New Zealand	FRI mill – rimu	1.0	52%	James, 1985
Canada	Procut “make your own” – hardwoods	0.6–1.2	—	Company website

Source: adapted from Samuel, Pasiecznik and Fehr 2007

1. For source references, please refer to Samuel, Pasiecznik and Fehr (2007), Table 1.2 (page 8).
2. Including: Granberg Mark III, Westford Rail Mill, Beerwah Ripper Mk IV, MacQuarrie Chain Mill, Logosol.
3. Using a Stihl 090, one man helping, averaged over seven years (www.procutportablesawmills.com/production.htm).
4. Now marketed as the Lennartsfors SM 2196.

A study in DR Congo (in Samuel, Pasiecznik and Fehr 2007) compared the economic viability of producing timber freehand and with a frame mill. It found that, although timber from a frame mill was of higher quality, that there was no local market for such timber, and the price premium that could be obtained in the non-local market was largely spent on transport. Although frame mills had a higher rate of recovery, logs were abundant, and thus there was little motivation for using milling attachments in the region. The literature on this topic is sparse, however, and more site-specific research is required in various forest and non-forest regions.

Each milling attachment has its own advantages in different situations. Table 3 summarizes these related to the type of timber required and logs available. Rail mills provide a simple means for an infrequent user to guarantee a straight board, and are used for edging timber or producing beams. These mills can be purchased very cheaply (less than US\$50), but there are benefits in using a rail and frame mill in combination. Frame mills have a wide range of uses, are able to process both very small and very large diameter and even crooked logs, and they are also relatively cheap and very efficient with medium-size logs. Although the Grumette and Westford Slabbing Mill have certain advantages, Granberg’s range of frame mills generally offers a good choice at a reasonable cost.

Carriage mills such as the Jobber J100, Logosol M7 and the two Woodbug mills are very efficient in processing large numbers of small-diameter logs, such as forest thinnings.

Table 3. Suitability of chainsaw milling techniques for different products and types of logs

	freehand milling	rail milling	frame milling	carriage milling
Type of timber produced				
Slabs	√	√	√	√
Edged timber	√	√	√	√
Quartersawn boards	x	x	x	√
Extra long lengths	√	√	√	x
Type of log to be milled				
Small diameter logs	x	x	√	√
Short logs	√	√	√	√
Crooked logs	x	x	√	x
Tapered logs	√	√	√	√
Oversized logs	√	√	x	x
Side slabs	x	x	√	x
Defective logs	√	√	√	√
Speciality cutting	x	√	x	x
Various				
Portable by one man	√	√	√	x
Approximate mill cost (US\$)	0	40–240	140–640	1,000–3,500

Source: adapted from Pasiecznik et al. 2006

Chainsaw attachments can also cut firewood into timber (e.g., Pasiecznik and Harvey 2006, poster No. 6), and process logs that static sawmills and larger portable sawmills would not accept. Logs as small as 30 cm long and 15 cm in diameter can be milled, making it possible to produce marketable timber from branches, bent, damaged or under-sized logs, off cuts, reclaimed building timber, and street and fence trees likely to contain nails.

Conclusions

There is a clear need to ensure adequate training in chainsaw use and maintenance, both to improve operator health and safety and to increase efficiency. Training should be provided through widely accessible courses, and should make available appropriate safety and milling equipment, including the range of attachments discussed above. Initial courses undertaken in Kenya indicate that there is a great interest in them — operators

were willing to pay for training — with potential benefits to be gained. Economic, social and environmental advantages would all increase with further investment in providing improved skills and better equipment to chainsaw operators. Such training should be included as a requirement in all timber certification schemes as a start, and expanded accordingly.

For more information

See <http://chainsaw.gwork.org> for many publications detailing the chainsaw milling technologies covered in this article, resulting from a DFID-funded project and related activities. The chainsaw milling manual (Pasiiecznik et al. 2006) is the definitive and independent guide to the equipment described and their use. It is summarized in a series of eight A4 posters; these, along with the manual, are available from the website in English, French and Spanish. They are supported by an economic and policy case study from East Africa (Samuel, Pasiiecznik and Fehr 2007), a series of four policy briefs, and additional articles and training course reports.

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Section 2

Country studies from Asia

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2.1 Domestic demand: the black hole in Indonesia's forest policy

ARTHUR W. KLASSEN

For more than 30 years, Indonesia's natural forests have been industrialized under a concession system. Under this arrangement, companies are granted the right to harvest; in return, they must comply with a complex and costly set of regulations and pay all government royalties and taxes. This system of forest administration was specifically designed with the intent to develop an export-orientated manufacturing industry. Due to the system's cost structure, the international export market is practically the only economically viable alternative for the sale of the country's forest products.

Domestic lumber prices are only approximately half as high as the production costs under which a legally licensed concession and sawmill have to operate. The obvious conclusion is that very little of the lumber sold in the domestic market comes from legally licensed or regulated forest management units.

Unregulated production is produced by various methods, including chainsaw milling. By far the majority of the domestically available lumber from the natural forests of Indonesia is produced at small, unlicensed and unregulated mills located along the many rivers of Sumatra and Kalimantan.

The policy implications are clear. As long as there is no regulatory framework under which the domestic demand for mixed tropical hardwood can be met, there is little hope for sustainable forest management or eliminating illegal logging and illegal land conversion.

Development of the concession system

Indonesia prepared the groundwork for the industrialization of its natural forest resources in 1967 with the passage of the Domestic (1968) and Foreign (1967) Investment acts and the creation of the forest concession system. Soon afterward, the country embarked on a rapid expansion in the number of forest concession licences. In the early days of this development, most production was in the form of log exports destined mainly for countries such as Japan and Korea.



AS LONG AS THE GOVERNMENT IGNORES THE NEED TO REGULATE AND SUSTAINABLY

MANAGE THE FORESTS THAT SUPPLY WOOD TO THE DOMESTIC MARKET, INDONESIA'S FORESTS WILL CONTINUE TO SHRINK AND SUSTAINABLE FOREST MANAGEMENT WILL REMAIN AN UNACHIEVABLE GOAL.

By 1985-86, the government had introduced a prohibitively high tariff on log export, making it economically unfeasible. This, along with a number of other measures such as the banning of sawn timber exports in 1989, forced Indonesia's forest industries to invest in manufacturing facilities. Within a few years, Indonesia had become the world's largest producer of tropical plywood. The industry peaked by 1989-90, when more than 500 concession companies were operating in Indonesia's natural forests and harvesting more than 27 million m³ of logs per year.

The development of a regulatory framework paralleled the expansion of the concession system. The TPT¹ silviculture and administration system, introduced in 1970, gradually changed into the TPTI² system in 1993 and became the centrepiece of the regulatory framework. Successive forest ministers introduced additional laws, regulations and guidelines. By the mid-1990s, forest concessions had to comply with complex procedures arising from an estimated 69 forestry laws, decrees and regulations governing the management and administration of natural forests (Bennett 2001).

This rapid expansion of the regulatory framework did not ensure the sustainable management of the country's natural forests. During the decade from 1985 to 1995, while the number of concession forest regulations more than doubled, forest cover declined by 16% (Bennett 2001). By 2005, the number of concessions had declined to approximately 259, fewer than 100 of which were known to be actively managing their concession areas.



Most of this decline resulted from companies exhausting their concessions and pulling out of the timber business or having their licences revoked for failing to conform to even the most basic principles of sustainability.

Meanwhile, Indonesia's forests have shrunk rapidly. Some of this reduction in forest area has been deliberately planned;

for example, government policies aim to convert most of Sumatra's lowland forests to pulp plantations, oil palm or other uses. The transmigration programme,³ together with a rapidly increasing population, rapidly consumed much of the country's remaining lowland forest areas. Unregulated logging and poor practices added to the rapid loss of natural forests.

Log supply

At the peak of production in 1989-90, annual cutting targets from the country's natural forests were more than 20 million m³/year. By 2002, the annual harvested volume had been reduced to approximately 12 million m³/year in an indirect attempt to downsize the industrial overcapacity in the forestry sector and to establish the basis for a more sustainable industry. The biggest single reduction in annual cutting targets came in 2003 when the government slashed the annual quota from 12 million to 6.89 million m³ in a single year. It was further reduced to 5.74 million m³ in the following year. There was much talk of this being a positive step, although it is difficult to see how anyone, either the government or the industry, benefited from this dramatic reduction.

Measures to devolve Indonesia's highly centralized administration, including the administration of much of its forest resources, came into effect in 2001. Almost immediately, district and provincial governments began issuing licences and cutting permits without any consideration of silviculture or sustainability concerns or the existence of federally granted concession licences.

The empowerment of district and provincial governments to issue logging permits had the noticeable and almost immediate effect of creating a log surplus and driving down domestic log prices to the point where most concessions could no longer operate economically within the law. The excess log supply also benefited traders, who welcomed the opportunity to supply neighbouring countries with cheap logs. This further undermined the ability of the Indonesian plywood producers to compete in the international markets.

Efforts to address domestic demand

There seems to have been some awareness in the past decades that the issue of domestic wood demand needed to be addressed. In 1994, an attempt was made to force concessions to set aside 5% of their production to stimulate small-scale businesses. Predictably, this effort failed since it was not based on economic realities.

Decentralizing the issuing of various licences and cutting permits to district and provincial governments could be viewed as an effort to generate a supply of wood for domestic consumption. This move is, however, more widely recognized as a measure to enable local governments to generate their own revenue from the natural forest resource.

In 2002, recognizing the instability that decentralization had caused for the country's forest sector, the central government repealed the right of district governments to issue cutting permits. Under a phasing-out period, all locally issued cutting permits should have been finished by September 2004.

More recently, the government has launched countrywide initiatives to deal with the most rampant aspects of illegal logging, with a considerable measure of success.

Domestic demand and local lumber prices

Indonesia, with a population of over 240 million people, consumes a lot of wood, although no one really knows how much. More significantly, no one seems to have given much thought as to where this wood comes from.

A number of studies have attempted to estimate domestic wood consumption (Brown 2000; Tacconi, Obidzinski and Agung 2004). In syntheses of available data, URS Forestry (2002) and the World Bank (2005) estimated the round log volume to be approximately 10 million m³.



Somewhat surprisingly, the repeal of locally issued cutting permits and the recent curtailment of illegal logging has had little impact on lumber prices for the domestic consumer. This indicates that the informal lines of supply to the domestic market existed long before the upheavals of the decentralization initiatives of 1999–2002 and the more recent crack-down on illegal logging. More significantly, it indicates that these lines of supply are still in place.

In rural Indonesia, outside the island of Java, lumber does not seem to be in short supply and most houses are made of wood. In the Javanese countryside, wood is often not the preferred house construction material, probably because suitable lumber is not readily available. In the major cities of Jakarta, however, thousands of small material supply shops are well stocked with the major timber species that are found only in the natural forests of Kalimantan and Sumatra.



In order to better understand where this wood comes from, the Tropical Forest Foundation (TFF) collected some sample prices from wholesalers in the old port area of Sunda Kelapa,⁴ where the traditional *kapal kayu* boats off-load rough-sawn lumber from Kalimantan and Sumatra. TFF also

collected price data from a sampling of retail building material supply shops throughout West, South and East Jakarta. It is the wholesale prices that are of the greater interest since they are closest to what a concession-based sawmill could expect to receive on the local market from its sale of lumber.

On Jalan Khalibaru, in the old port of Jakarta, wholesale prices of meranti, bankirai and keruing rough-sawn lumber varies from around Rp 1,150,000 to Rp 1,250,000 per m³, depending on dimensions. Kamper lumber prices were almost double this amount. Using an exchange rate of Rp 9,800: US\$1 and a median price of Rp 1,250,000, we can assume that the wholesale price for mixed tropical hardwood at the port of Jakarta is approximately US\$127/m³.⁵

Logging costs

The basic question now is whether a legally licensed concession, operating within the country's regulatory framework and paying all taxes, royalties and fees, can produce lumber to be sold domestically at a profit, at the wholesale price of US\$127/m³.

Two studies examined the production costs of an average sized concession and its affiliated sawmill. In 2002, the World Bank commissioned a study implemented by URS Forestry consultants (URS Forestry 2002). In 2003, the Association of Indonesian Concession Holders (APHI), together with the Faculty of Forestry at the Institut Pertanian Bogor (Bogor Agricultural University), conducted a questionnaire-based study involving more than 20 concessions.

Although cost categories are not all directly comparable, the total cost estimates in the two studies are quite similar. Averaging the totals from the two studies and allowing for a conservative 5% cost increase over time provides an average delivered log cost of approximately US\$88.6/m³ at the mill gate.

Table 1. Cost of log production from two studies (US\$/m³)

component	World Bank, 2002	APHI, 2003*
harvest planning	0.28	1.10
pre-harvest operations	0.63	0
infrastructure construction and maintenance	8.22	13.53
harvesting	28.46	30.59
post-harvest operations	4.29	1.66
administration (monitoring and security)	2.78	0.27
formal taxes	23.87	36.12
informal taxes	16.94	—
total	85.47	83.27

*Note: APHI and World Bank values were converted to US\$ at the exchange rate at the time of the study (Rp 8,500).

Sawmilling costs

During TFF's sampling of lumber prices in Jakarta, both at the wholesaler and retailer level, it was noted that both chainsaw milled and sawmill cut lumber were available. Since regulations do not permit chainsaw milling, at least half of the lumber can be considered to come from unregulated sources.

Chainsaw-milled lumber is much cheaper to produce. Furthermore, conventional sawmill costs are readily available, whereas chainsaw milling costs have not been studied in Indonesia. It was, therefore, considered more relevant to do an analysis based on conventional sawmill technology.

Few sawmills achieve more than a 40% recovery rate for rough-sawn lumber. Given a 40% conversion return for the delivered round log cost of US\$88.6/m³, the equivalent cost for the sawn lumber is US\$221.5/m³.

Sawmilling costs are conservatively estimated at US\$25/m³. Table 2 provides a summary of production costs, allowing for a 10% profit margin and a nominal transportation cost from Kalimantan to Jakarta.

Given that the actual wholesale selling price of rough-sawn lumber in the Port of Jakarta is approximately \$127/m³ and, assuming that production cost estimates are reasonably accurate, only one conclusion is possible: tropical hardwood lumber that is readily available in the major cities of Indonesia cannot possibly originate from the country's legally licensed forest concessions and their associated industries. For legally sourced and produced lumber to be available in Jakarta, the selling price would have to be at least \$273/m³. In other words, the existing lumber price would have to increase by at least 114%.

Table 2. Summary of production costs, conventional sawmill (US\$/m³)

cost	amount	note
delivered log cost	221.48	converted to sawn wood equivalent
sawmilling cost	25.00	
total production cost	246.48	
10% profit margin	24.65	
shipping cost	2.00	
indicated selling price	273.13	wholesale at Port of Jakarta

A similar analysis could be performed for the plywood export industry. Given the much higher prices of plywood on the international markets and the higher recovery rates, it is clear that the country's plywood factories, which utilize logs from legally licensed concessions, can stay in business only if they export the majority of their production at international prices.

Policy implications

This analysis leads to several policy implications:

- The Ministry of Forests has now effectively reclaimed the sole right to issue concession licences and set annual cutting quotas. Very little of the country's log supply can now be legally harvested without a licence issued by the Ministry of Forests.
- The government has designated almost the entire annual harvesting quota in the country's natural forests for conversion into finished products for export.
- The domestic demand is approximately 10 million m³ of roundwood per year (Brown 2009).
- There is no regulatory mechanism in place for lumber produced for the domestic market and no attempt to ensure that this timber is being harvested according to any principles of sustainability. In fact, according to the government's own legal arrangements, most of the domestic consumption originating from the country's natural forests is being harvested outside of the regulatory framework.

Recommendation

For more than 30 years, the Government of Indonesia⁶ has ignored this "black hole" of domestic wood production in the context of the regulatory framework. Although the government has recently started moving towards sustainable forest management, the country's natural production forests have shrunk from 64 million ha to an estimated 43.9 million hectares.⁷

As long as the government ignores the need to regulate and sustainably manage the forests that supply wood to the domestic market, Indonesia's forests will continue to shrink and sustainable forest management will remain an unachievable goal. Furthermore, any effort to control illegal logging will meet strong resistance when it affects the wood demand and supply lines that feed the local market.

The financial resources required to develop solutions should not be the major constraining factor. Institutions, responsible private sector companies and local administrations and communities are willing to explore different approaches in order to develop mechanisms that will allow natural forest areas to be managed and harvested sustainably while supplying the domestic demand for lumber.

It is clear that the existing regulations and fees are inappropriate. They cannot be used as the basis for exploring new models of forest management and regulations to sustainably manage natural forests for the domestic market.



Although the export-orientated forest concession system will, and should remain, as the core of Indonesia's natural forest management, new models need to be explored if the country is to achieve any semblance of overall sustainability for its natural forests.

The Ministry of Forests needs to encourage experimentation in this field and should allow different approaches to be applied commensurate with local situations. This will require a great deal of flexibility in terms of easing the existing regulatory framework. It will also require innovative partnerships between private sector companies, NGOs, government and international donors to monitor outcomes and apply lessons learned.

At this stage, there must be a willingness to find solutions, and the flexibility to allow such solutions to evolve. There are ample willing partners.

For more information

For information on the issues raised by this article, contact tff@cbn.net.id. For an overview of the Tropical Forest Foundation's work in Indonesia, visit www.tff-indonesia.org.

Endnotes

1. TPT is *Tebang Pilih Tanaman*/Selective Cutting System.
2. TPTI is *Tebang Pilih Tanaman Indonesia*, a selective cutting and planting system.
3. Indonesia's transmigration program was used to settle landless farmers, mainly from Java, to the less developed outer islands.
4. Data for this article was collected by the Tropical Forest Foundation in 2005. Although costs and prices have changed since then, the underlying premise of the article remains valid.
5. A survey of prices and costs was carried out by TFF in 2005. Although current prices have risen, the overall imbalance between cost and selling price on the domestic market is still relevant today.
6. The Ministry of Forests issues the concession licences and the Ministry of Industry and Trade issues the licence to establish a manufacturing industry.
7. Data from 2003 were published in *Data strategis Kehutanan*, Department Kehutanan, 2004.

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2.2 Local timber demand and chainsaw milling in Papua, Indonesia

AGUS ANDRIANTO, KRYSSTOF OBIDZINSKI and HERU KOMARUDIN

The forestry sector in Papua has experienced rapid changes since the fall of the New Order Regime in Indonesia in 1997, the establishment of Special Autonomy in Papua in 2001 and the creation of four regencies from the existing Merauke Regency in 2002. Most forest logging companies, operating under *Hak Pengusahaan Hutan* (HPH) licences, had suspended or terminated operations due to lack of capital, conflicts with local people or failure to pay timber royalties (Papua Provincial Forestry Agency 2005). The vacuum created by the absence of HPH logging was filled by small-scale logging licences (IPK-MA) issued by the Governor of Papua (Papua Provincial Forestry Agency 2006). The rapid proliferation of IPK-MA logging, associated smuggling of timber to China (Telapak 2005), and growth in small-scale chainsawing for local use caused the Ministry of Forestry and the national police to undertake security sweeps to curb illegal logging practices; these were part of *Operasi Hutan Lestari* (OHL, Sustainable Forest Operations). The government faces a dilemma: eradicating illegal practices restricts the supply of timber for local development.



CHAINSAW MILLING IS WIDESPREAD BECAUSE WOOD-BASED FOREST RESOURCES ARE IN LIMITED SUPPLY, INFRASTRUCTURE IS LACKING AND GETTING A PERMIT OTHER THAN IPHHK IS COMPLICATED.

The data used in this article originate from research carried out in cooperation with WWF-Indonesia, Almamater Foundation, Merauke Regency Forestry Agency and Tropenbos International-Indonesia. Additional data come from interviews and surveys conducted by CIFOR between 2006 and 2008.

Forestry sector in Merauke Regency

In 2004, forests in the Merauke Regency cover 4.7 million hectares (ha), comprising 1.3 million ha production forests, 1.5 million ha nature reserve, 1.4 million ha conversion forest, 0.3 million ha protection forest and 0.2 million ha for other purposes (Regional Office of Forestry Planning Agency 2005).

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Before Merauke Regency was divided in 2002 into four regencies (Asmat, Boven Digoel, Mappi and Merauke), the forestry sector was the main source of its income (Merauke Regency Planning Agency 2008). There were 11 logging concessions in natural forest, covering 2,663,400 ha, from which the Annual Allowable Cut (AAC) was set at 1.3 million m³/year. Ten industrial timber plantations (*Hutan Tanaman Industri*, or HTI) covered 1.3 million ha, although none of them were fully established. Before the onset of Special Autonomy in 2001, Merauke Regency had two plywood mills with combined capacity of 200,000 m³/year¹ and many sawmills. In 2002, all HPH concessions and plywood mills were located outside the Merauke Regency and most of the inactive HTI plantations remained in the smaller Merauke regency.

In 2005, Merauke Regency produced 1,050 m³ of sawn wood. Just one year later, in 2006, only 440 m³ of sawnwood was recorded (Merauke Regency Forestry Agency 2007). Agency staff explained that this was a result of the OHL operation, which reduced the supply of raw material. In the same year the police confiscated 8,580 m³ of illegal timber. This is an enormous increase in comparison to 2004, when the police seized only 16 m³ (Merauke Regency Forestry Agency 2007).

During this period the population of Merauke Regency is continuously increasing, particularly as a result of incoming migration. This contributes to a steadily increasing demand for wood for housing. A large gap exists between the rising demand for wood and the lack of sources of legal wood, exacerbated by a lack of response or planning by government policy-makers to ensure an adequate supply of legal wood.

Legal framework

Chainsaw operations have been carried out in Merauke for a long time to meet local needs, especially in areas where no HPH forest companies operate. Forestry regulations specify two types of licences for chainsaw operations: commercial and non-commercial.

Commercial activities

The following permits cover commercial activities:

- the Permit for the Right to Harvest Resources from Customary Law Forests (*Hak Pemungutan Hasil Hutan Masyarakat Hukum Adat*, or HPHMHA),² which is known in Papua as the Permit to Harvest Customary Law Forest Timber (IPK-MA);³ and
- the Permit for Use of Timber from Privately Owned Forests (*Ijin Pemanfaatan Kayu Rakyat*, or IPK-R).⁴

IPK-MA permits were intended for harvesting of wood for no more than one year from a forested area no larger than 1,000 ha. These permits have not been issued since 2005. IPK-R permits are issued for harvesting and using wood from forested areas that have been made available for non-forestry purposes by the Forestry Department. The permit is valid for one year and can be extended. Both types of permit generally involve timber companies or logging contractors partnering with local communities.

Non-commercial activities

Non-commercial use of wood resources is covered by a Forest Resource Harvesting Permit (*Ijin Pemungutan Hasil Hutan Kayu*, or IPHHK).⁵ The permit has two conditions: no more than 20 m³ of wood can be harvested within a one-year period and the harvested wood must be for personal use and cannot be sold. In practice, however, it is commonly accepted that timber extracted under this permit is sold and traded locally. In addition, loggers often surpass the 20-m³ maximum; their surplus is illegal timber.

The most common forms of illegal practices associated with timber harvesting and processing under these permits are extraction in excess of the volume allowed and repeated use of the same documents for timber extraction.

The Ministry of Forestry has recently put into effect a new regulation⁶ intended to provide local government with legal ways to meet the local demand for timber. The regulation requires concessions to allocate timber for local needs. It reconfirms the need for regency heads to make an inventory of local timber needs and issue appropriate permits, particularly areas having no natural forest logging concessions, such as Merauke. It also allows certain regencies to source or supply timber from/to neighbouring regencies in case of surplus or shortage.

Supplying local sawmills

Chainsaw operators work with two main parties: land-owners and wood buyers. They are mostly individuals, but can also be furniture producers or sawmill operators. Chainsaw operators usually work for bosses based in Merauke who have established relations with sawmills and construction contractors. As hired labourers, chainsaw operators work with businesses that possess IPHHK permits, so that they do not have to obtain these permits themselves.

Before they can start felling trees, chainsaw operators must report the results of an area survey to their bosses. If the operation is feasible, based on harvest potential and ease of log transport, the chainsaw operator approaches the customary land-owners for permission and establishes a contract with them to log the timber for an agreed payment. The boss then arranges permits at the Forestry Agency and coordinates with other parties to transport the timber from the forest to Merauke City. The IPHHK is issued in the name of the land-owners.

At the logging location, the chainsaw operator cuts the type and size of trees stipulated in the order from Merauke. Chainsaw operators usually work in groups of two or three loggers assisted by a helper. They camp for several days in the forest until they meet their target. Only those logs covered by an authorization letter from the Merauke Forestry Agency can be transported legally. These logs are usually destined for legally registered industrial sawmills in Merauke.



The demand for wood in Merauke

The wood coming into Merauke City originates from chainsaw operations in Jagebob, Kurik, Semayam and Sota sub-regencies. A 2006 survey of local sawmills and other timber consumers⁷ estimated that 100 chainsaw operators linked to IPHHK permits were working in the forest to produce logs, boards and blocks of various sizes to supply the city's needs.

The survey also found that Merauke Regency needed 3,627 m³ of sawn wood annually to meet the local demand (WWF 2007; Almamater 2007). The largest demand came from 18 sawmills in Merauke; they produced 2,551m³ of timber products per year. The timber demand for construction was estimated at 700 m³ per year, and the woodworking industry required another 376 m³ annually (Table 1).

Table 1. Domestic demand for sawn wood in Merauke City 2006

demand	number	source of timber	quantity of lumber (m ³)
sawmill	18	chainsaw and delivery operator	1,785
		chainsaw operators	434
		authorities	332
furniture-making and woodworking	14	sawmill	195
		chainsaw operator	83
		chainsaw and delivery operator	98
projects	4	sawmill	50
		chainsaw operator	50
individual use: housing, school and military dormitory construction	n/a	sawmill, chainsaw operator, chainsaw and delivery operator	600
total			3,627

Source: Survey by Sahul office of WWF Indonesia, 2006.

The survey produced more extensive data than that available from the Forestry Agency, mainly because the sawmills report only the lumber they mill from legal sources. Since OHL operations began, however, Merauke sawmills have primarily sourced their raw materials from chainsaw operators operating under IPHHKs, which are dispersed and do not appear in official statistics. The sawmills likewise do not report orders for sawn wood or lumber from other parties, or profits from these milling services and storage. The Forestry Agency assumes that the volume of timber used for construction in Merauke roughly corresponds to the volume of timber allowed under IPHHK permits. They do not receive or record any data on sawn timber used for government projects or the construction of private houses.

Drivers and impacts of chainsaw operations

Merauke's rapid development requires a large amount of wood, especially for construction and furniture making. The lack of forest concessions and plantation forest operations in Merauke motivates wood processing industries in Merauke to source wood from chainsaw operations through collaboration with local community land-owners.

Wood-based enterprise owners in Merauke say that chainsaw milling is the only solution to meet timber demand since the IPHHK is the single permit available in the area. They do not want to invest in developing forest concessions and plantation forests due to comparatively low commercial timber stock, marshy forests with high precipitation rates, inadequate infrastructure and difficulties they have encountered gaining access to forest land that is owned under customary law. They perceive exploitation costs as too high and the potential for adequate supplies of quality wood as too low.

Because wood-based forest resources are in limited supply, infrastructure is lacking and getting a permit other than IPHHK is complicated, chainsaw milling is widespread. Since the implementation of OHL security operations, however, which seek to control the misuse of IPHHK permits, the number of chainsaw operations, which had been the solution to the high demand for wood has declined.

Chainsaw milling has many social and economic impacts. Indigenous groups have increased income from compensation agreements with operators. The customary private land-owners are in a relatively strong position to negotiate with operators; conflicts arise mainly from technical issues and are easily resolved. This is often not the case when dealing with managers of capital-intensive undertakings such as forest concessions, which can cover thousands of hectares and may involve government officers. In Boven Digoel Regency, for example, where forest concessions and wood-use permits (IPK) operations are located, conflicts between communal landowners, forest concessions and IPK holders occur frequently (Kontras 2004).

The IPHHK, which serves as a legal framework for chainsaw operations, does contribute to state income, although the process is burdensome for the operators. The formal costs of legal chainsaw operations under IPHHK consist of permit processing costs of Rp 35,000 (US\$4.2) per permit; Forest Resource Provision costs of Rp 26,500/m³ (US\$3.2); and transportation costs of Rp 10,000 (US\$1.2) per trip. According to the report of the Merauke Forestry Agency, sawn wood production reached 400 m³ in 2006. This contrasts sharply with the survey data obtained by WWF-Indonesia and Almamater Foundation, which indicates that sawn timber production was 3,380 m³. This means substantive potential tax revenue losses.

So far, chainsaw operations in Merauke have had relatively minor environmental impacts, far less than the extensive deforestation and degradation associated with HPH logging concessions and IPK-MA operations in the Merauke region. Only specific tree species and trees of a certain size are taken. Also, no heavy equipment is used to transport the cut wood from the forest.

However, chainsaw milling is inefficient and wasteful for two reasons: the quality of the wood produced is poor; and wood waste left behind in the forest can exceed 50% of total volume cut.⁸ Chainsaw operations under IPHHK permits are not required to replant or preserve the remaining trees, which has potentially serious long-term implications for sustainability. Due to the rising demand for wood and the resulting expansion of uncontrolled chainsaw operation activities, the remaining natural forest will likely come under increasing pressure.

Conclusions and recommendations

So what are the options for fixing the current flawed situation, considering that chainsaw operations are an important part of fulfilling the demand for wood in Merauke Regency and since other sources remain unavailable?

Chainsaw milling is a proven way to meet local needs. Although it is authorized only for domestic use under the IPHHK, chainsawn lumber is being sold commercially. Despite the permit's misapplication, the local government maintains it because there are no forest concessions or plantation forests in Merauke Regency to address the local timber demand. Albeit inappropriate, chainsaw milling is the only way to meet timber demand and is supported by the majority of stakeholders involved in wood-based industries at the local level. At every point, harvesters, transporters from forest to city and the sawmills have patrons who take care of the administrative aspects and ensure their operations are secured.



The Merauke government has paid little attention to the local demand for timber. It needs to formulate a comprehensive plan on how to meet this demand. The process should include identifying and inventorying all land owned under customary law that has the potential to be covered by the IPHHK. Assistance should be provided to empower the communities who exercise customary law to engage in more effective collective action through business cooperatives and

associated institutions. The local government should also seek to procure timber from neighbouring regencies such as Boven Digoel or Mappi.

A deeply rooted long-running problem such as this is not easily overcome. Solving the problem will require a comprehensive policy that does not give rise to new problems. In the short term, we recommend that licensing continue under the IPHHK (which to some extent may be allowed for commercial purposes) but that its implementation practices are better controlled. All activities by logging teams need to be registered, as does all wood removed from the forest. The amount of sawn wood from sawmills needs to be regularly recorded. With thorough documentation, for example, the current practice of using the same permit for several logging locations can be curbed and periodic forestry law enforcement checks conducted.

Over the long term, stipulations in the IPHHK can be expanded to include mandatory replanting and cultivating trees in all logged areas. This is particularly important in degraded areas where most of the timber comes from. At the same time, government authorities in Merauke need to establish and enforce additional regulations for the local wood-based industry governing timber quality standards, pricing and production methods.

The difficulties with managing and monitoring the IPHHK system will have important implications for the implementation of the Forest Law Enforcement, Governance, and Trade (FLEGT)-Voluntary Partnership Agreement (VPA) in Indonesia. The integrity of FLEGT-VPA depends on an effective implementation of the timber legality verification system. Irregularities with IPHHK identified in Merauke are widespread elsewhere in Indonesia and therefore constitute a serious challenge to the VPA. Steps must be taken to ensure that IPHHK and related logging operations do not undermine FLEGT-VPA.

Endnotes

1. See also the list of primary forest industries in Papua Province as of January 2010 at www.bpphp17.web.id/database/data%200110/D2.htm.
2. Ministry of Forestry and Plantations Decision Letter No. 327/Kpts-II/1999 (SK 327) provided customary law communities with the right (HPHH-MHA) to cut, transport and sell wood.
3. The issuance of the Permit to Harvest Customary Law Forest Wood (IPK-MA) was based on Papua Province Governor's Decision Letter No. 22.2/3386/SET, 2002, and the Papua Province Forestry Agency Head Decision No. Kep. 522.1/1648 Tahun 2002. In this case the IPK-MA is defined as a permit to harvest the specific types of wood in the specific amounts stipulated in the permit issued to the holders of communal land under customary law that is intended to curtail environmental damage and preserve the basic function of the forest.
4. The Permit for Use of Timber from Privately Owned Forests (IPK-R) is based on Papua Province Forestry Agency Decision Letter No. 522.5/1401, issued in 2001.
5. The Forest Resource Harvesting Permit (IPHHK) is authorized by the Ministry of Forestry Decision Letter No. 6886/KPTS-II/2002.
6. The Ministry of Forestry's Regulation No P. 7/Menhut-II/2009 concerning the guidelines for meeting local demand for timber
7. The survey was carried out from July to September 2006 by WWF-Indonesia and the Almamater Merauke Foundation. See WWF 2007 and Almamater Foundation 2007.
8. See <http://repository.usu.ac.id/bitstream/123456789/1078/3/06004591.pdf.txt>.

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2.3 The chainsaw economy in Tanimbar Archipelago, Indonesia

JEAN-MARC RODA, PATRICK LANGBOUR and BAYUNI SHANTIKO

Introduction

The Tanimbar Islands are of great interest for their biodiversity (Lidon and Kartiwa 2005). Located in the Province of Maluku, Indonesia, their main city, Saumlaki, is also a district capital. The islands were extensively studied during the Tanimbar Land-use Planning Project, funded by the European Commission, which covered land-use planning, biodiversity protection and biodiversity enhancement through participatory approaches (Jewell et al. 2006; Astawa et al. 2006).

The project team analyzed the wood production system in the southern part of Yamdena Island (Lidon and Kartiwa 2005), where chainsaw activities supply most of the wood to local villages, Saumlaki, other Indonesian islands, and abroad. Two villages of South Yamdena, Wermatan and Ilngei, specialize in chainsaw milling, although at a very rudimentary level. Wermatan is accessible only by sea and has an economy shaped by its traditional social structure. Ilngei, which is very close to Saumlaki and connected to it by a paved road, has a comparatively advanced state of economic development that is reflected in its wood production system (Shantiko et al. 2004).

Wermatan

How tradition shapes the chainsaw economy

The wood activities in Wermatan basically consist of community-based chainsaw milling. Trees are felled with chainsaws and processed on site into beams or planks. The process is not efficient; the recovery rate¹ is less than 5%. A typical work team consists of one chainsaw operator and two assistants. Usually the chainsaw operator owns the machine. Sometimes a relative borrows a chainsaw; in that case, the owner and operator share the income. A team usually spends a working week² in the forest harvesting trees, processing the timber, and carrying it to the river. A team produces about 10 m³ of sawn timber per week.



IN THE ABSENCE OF FORMAL RESOURCE MANAGEMENT, NOTHING PREVENTS THE OVER-EXPLOITATION OF THE MORE PROFITABLE SPECIES.

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The sawn timber is transported to the village by boat along the rivers, the only routes available, and stored along the seashore. Later, the timber is transported by a bigger boat to Saumlaki, where it is sold.

Development of chainsaw milling

Compared to the other villages of Yamdena, Wermatan's chainsaw milling is recent; that is, less than a generation old. Its introduction follows some of the common stages of localized industrial development: introduction by a pioneer; innovation; and cooperation among actors and diffusion of know-how.

In Wermatan, the pioneer (Mateus) had worked in the timber industries in Irian Jaya. He demonstrated that buying or borrowing a chainsaw in Saumlaki was profitable since the sawn timber could be used in the village or sold at a good price. Chainsaw teams do not usually produce more than 20 m³ per year. Chainsaw milling is perceived by the villagers as complementary to their subsistence work to quickly earn some cash to buy goods such as electric generators or boat engines.



The innovation process was also introduced by Mateus, who taught people how to use a tinted and tensed wire to mark a straight line on the wood before cutting it with the chainsaw. This method, although simple, was previously not known to the villagers and allowed them to produce straight-sawn timber. For more specific uses, the timber must be resawn or planed with industrial tools such as planers or circular saws, which are available in Saumlaki.

Skills are progressively transferred. Assistants work for a chainsaw operator for several months, and when they feel that they know enough, they acquire a chainsaw and become operators themselves. They in turn hire new assistants, and so on.

Financial cooperation exists; operators form alliances to obtain cash in order to acquire more production tools. For example, a villager wanting to buy a chainsaw³ would establish a joint harvesting operation with a relative who already owns one. The first person provides the fuel and the two share the work and the income from timber sales. In this structure, around 25 to 78 m³ of sawn timber need to be produced in order to pay for a new chainsaw, depending on the harvested species (Table 1).

The interests of the assistants differ from those of the chainsaw owner for several reasons. First, as shown in Table 2, the income of the assistants is the same for all species, while the work is easier with more diverse species.⁴ Second, cash flow (Table 3) is not equal for all members of the community according to the different species. The higher income from the more valuable species does not benefit the assistants; they earn more from species that are less valuable but easier to process. This apparent inequity gives advantages to some actors in the value chain.

Social structure and capitalization ability

In Wermatan, the society is divided into seven groups representing ancestors who arrived on the island in a mythical canoe in some distant past and founded the village. This type of traditional social structure is widespread in Melanesia, Micronesia and Polynesia.⁵

Table 1. Production costs for different wood species in Wermatan (Rp/m³)

item	wood species			
	<i>Intsia</i> sp	<i>Pterocarpus</i> sp	<i>Manilkara</i> sp	diverse species
chainsaw costs	157,500	157,500	157,500	94,500
labour costs	200,000	200,000	200,000	200,000
boat transportation cost	200,000	200,000	200,000	200,000
income of chainsaw owner	342,500	642,500	442,500	205,500
price paid by retailer in Saumlaki	900,000	1,200,000	1,000,000	700,000
retail costs	450,000	300,000	500,000	150,000
price paid by final consumer in Saumlaki	1,350,000	1,500,000	1,500,000	850,000

Note: As of June 2006, US\$1 = Rp 9500

The chiefs of the seven groups are ranked according to their place inside the canoe, from the bow to the stern. Each group and its members have specific traditional roles, and different access rights to land and timber. Not surprisingly, the two groups with decision-making power on use of the land and the forest own the most chainsaws (Figure 1).

Table 2. Production costs for different wood species in Ilngei (Rp/m³)

item	Wood species			
	<i>Intsia</i> sp	<i>Pterocarpus</i> sp	<i>Manilkara</i> sp	diverse species
chainsaw costs	157,500	157,500	157,500	94,500
workforce transport to the forest	8,333	8,333	8,333	8,333
workforce costs	83,333	83,333	83,333	83,333
income of the chainsaw owner	500,833	900,833	600,833	313,833
price paid by the retailer on roadside	900,000	1,300,000	1,000,000	650,000
retail costs	450,000	200,000	500,000	200,000
price paid by final consumer in Saumlaki	1,350,000	1,500,000	1,500,000	850,000

Ironically, the group to which Mateus the pioneer belonged owns few if any chainsaws. Since the group had limited influence over land use, it did not develop timber skills; Mateus's know-how essentially benefited two other groups.

Chainsaw milling is a diversification activity that allows households to capitalize and increase their income beyond traditional subsistence activities. The households that can diversify their activities are those that already have the “symbolic capital” provided by access and rights to forest resources, and that have accumulated money over the years.

Ilngei

How market access changes the economy and social structure

Ilngei is a village on the eastern coast of the Island, ten km from Saumlaki. It is less traditional than Wermatan, and its traditional social structure is no longer evident in the timber production system.

Its economic development is more advanced. There are two major structural differences in the wood production systems of Ilngei and Wermatan:

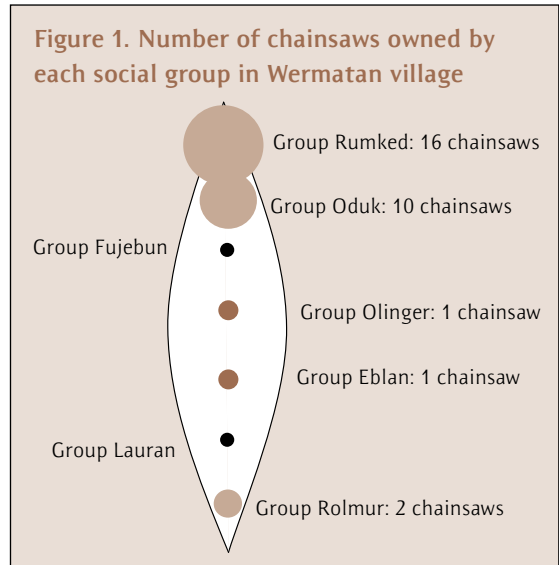
- Ilngei’s proximity to the Saumlaki market increases the potential for further development of the timber activity; and
- There is a track for vehicles that extends well into the forest (*see photo, below*). This extends the villagers’ range in the forest, but only in the direction of the road. In the other direction, operators have to walk; in that case they do not travel further than the Wermatan villagers do from their river system.

This track allows for the development of other services, too. For example, a minibus now brings the workers to their work site. This allows villagers to diversify their activities. While Wermatan villagers typically have to spend a whole week in the forest to harvest trees and process timber, the Ilngei villagers spend only three days a week in the forest. This leaves two days for other activities.



The great number of villagers involved in chainsaw milling has led to the over-exploitation of the most valuable tree species in the area. This has resulted in the harvesting of more *Kayu putih* (white wood), which are diverse and less valuable species.

Another impact of road access is the ease of selling to the market. The villagers can either bring the sawn timber to Saumlaki or just wait for traders to come along the track, with their own lorries, to buy it. For the villagers, this is an advantage, as they do not have to pay transportation costs.



Development of chainsaw milling

The development of the timber industry began at least ten years earlier than in Wermatan and is more widespread. With more time available, tasks have become more specialized and the work force is now divided into several categories. Although the typical team still exists (chainsaw operator and one or two assistants), many teams have a chainsaw owner and/or operator, a skilled and specialized assistant, and two or three basic assistants or carriers. Wages vary according to tasks.

In the cost structure in Ilngei, a larger part of the income goes to the chainsaw owner than in Wermatan. Economies of scale at the village level do not mean equity, and the savings in transportation costs are not shared by the workers of the community, but kept by the chainsaw owner. The ranking of tree species according to financial return is the same as in Wermatan, but the chainsaw owners' profit is significantly higher (Table 2).

As in Wermatan, the interests of the assistants differ from those of the chainsaw owner: the assistants' fees are the same for all species; and cash flow is also not equal among the team members (Table 3). Given the same total cash flow, assistants earn proportionally more from the less valuable and easier species. This means that they actually benefit from the disappearance of valuable species by over-exploitation, since more of the harvest then comprises diverse species.

Table 3. Cost structure of sawn timber production, Wermatan and Ilngei (%)

item	diverse species		<i>Pterocarpus</i> sp	
	Wermatan	Ilngei	Wermatan	Ilngei
chainsaw costs	11	11	11	11
transport costs	24	1	13	1
chainsaw owner income	24	37	43	60
community workforce	24	27	13	16
retail costs	18	24	20	13
final consumer in Saumlaki	*100	100	100	*100

*Due to rounding, totals do not equal 100

Social structure and capitalization ability of the village

With the longer history of timber activity and better road access, the traditional differences in social groups and access to the forest have been reduced. Differences are barely discernable. Nevertheless, a villager who wants to buy a new chainsaw would, just as in Wermatan, first borrow a chainsaw from a relative or work with him in order to save money.

Trade in timber products

Our interviews in Yamdena showed that the Tanimbar Islands supply chainsawn timber to markets as far away as Java. A typical journey between Tanimbar and Java by boat — such as the traditional or modernized *perahu*, handled by traders from Indonesian seafaring communities — would take 15 days.

In recent years, the Indonesian government's efforts to curb the illegal trade of logs and timber has led to more enforcement in Javanese harbours. According to the interviews, this has not suppressed trade, but instead has made operators use smaller boats or mix species in their loads. It has, however, made trade to Java more difficult and expensive. As a result, many traders have allegedly shifted their sales to other destinations, such as the Philippines, where some Saumlaki people have family contacts. The loads traded to the Philippines are very likely traded again to Vietnam and southern China, either directly or after regrouping in a larger load from the Indonesian outer islands,⁶ as suggested by data from Chinese customs⁷ regarding timber imports from Indonesia, although this needs to be investigated further.



Conclusion

In the case of Tanimbar Islands, the traditional social structure gives pre-eminence to some groups in land use and benefits from the forest resources (Laumonier 2006). This leads to disproportionate capitalization ability for certain groups, with little possibility for other groups to directly benefit from chainsaw operations. Social structures are the primary basis of financial cooperation and tend to keep benefits within the same social class. But, as the economic development of IIngei underlines, once economic development is firmly established, the differences in these traditional social structures are quickly eroded by other factors such as market access or infrastructure. In a community with no easy access to the market, small-scale chainsaw operations clearly bring economic benefits that can supplement subsistence activities, although benefit sharing is limited by the existing traditional social structure. In a community with easier market access, such social determinants are less powerful, and the benefits are spread more widely. But, although more people benefit, it does not mean that the benefits are more equitable.

The important factors in economic development are market access and infrastructure. In the absence of formal resource management, nothing prevents the over-exploitation of the more profitable species. This is a good reason to balance the promotion of CSM with good resource management through participatory approaches or other means.

Our interviews show that Tanimbar timber products are traded to Java or abroad through complex organizational structures. This larger trend, also noticed in other Indonesian Islands (Roda and Shantiko 2005), should be investigated further because it has many important policy implications:

- how is the trade organized?
- how does national governance have an effect at regional and local levels?
- since the operators and authorities may belong to different ethnic groups, is it more difficult to establish effective resource management?
- what strategies would curb informal harvests and the trade of these products?

These are some of the many questions that can be answered only by further investigation of the determinants of this trade.

Endnotes

1. The recovery rate is: [volume of sawn timber produced]/[volume of the log in the forest]. It is usually expressed in %. Conversely, 100% — recovery rate = % of waste from the process.
2. A working week is five working days.
3. A new chainsaw (Stihl) costs 8 million Rp and a secondhand one costs around 4 to 4.5 million Rp.
4. These species, being lighter and softer, demand less physical effort in chainsaw operations.
5. In the Cook Islands the same word means “tribe” and “canoe” (Sissons 1994). The mythical canoe (“vaka”, “waka”, “waga” or “prao”) is an important symbolic component of many societies in the Pacific (Malinowski 1922; Finney 2007).
6. From the Javanese point of view, “outer islands” is the common term to refer to all the other Indonesian islands that are not Java nor Madurai.
7. See Statistics Department, General Administration of Customs of China. Online data obtained in 2009. www.customs.gov.cn/publish/portal0.

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2.4 Local processing of logs to increase small-holder share, Lao PDR

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Smallholder teak plantations were established in Northern Lao PDR in the early 1980s. They cover about 25,000 hectares (ha) and are concentrated in the area around Luang Prabang province. An important element in the rural economy, they constitute between 25 and 55% of annual household income.

A study in 2005 analyzed the marketing channels of teak logs from Luang Prabang province (Midgley et al. 2007). At that time, trading of roundwood to processing centres was carried out by traders and intermediaries; local people were not involved in any way. Only 5% of the sawn timber remained in the region and was processed locally, 95% was transferred via Vientiane-based traders to Thailand, Vietnam and China. Midgley et al. (2007) did not find any considerable secondary processing of teak in the Vientiane region.

Current problems

Currently, none of the processing units based in Vientiane have direct access to teak growers. Traders and intermediate regional wood processing units seem to have a monopoly on the raw material in the region.

The prices of plantation teak logs at the dimensions and quality levels presently found in Laos are US\$ 250/m³ or higher at processing factories in Vientiane; this is high compared to international prices. This is partly due to the fact that the transport costs of finished products are extraordinarily high, since Lao PDR is landlocked. These prices also reflect the lower recovery rates in young plantation timber of high-value heartwood (Kokutse 2002; Perez and Moya 2007; Thulasidas and Bhat 2009). If these high prices cannot be reduced, Lao PDR will lose any competitive advantage as a wood-producing country.



CHAINSAW MILLING PROVIDES A VIABLE SOLUTION FOR PROCESSING LOGS AND FACILITATING EXTRACTION AND ROAD TRANSPORT OF LOGS FROM YOUNG TEAK PLANTATIONS IN LAO PDR.

Teak plantations mainly provide household income; whenever people need cash, they harvest trees. Unfortunately, trees are often harvested prematurely, before they reach optimum diameter, and in most cases are sold to intermediaries and traders as standing

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trees without an assessment of their volume, quality grades and subsequent timber market value. In order to address this issue efforts are underway to use standing teak trees — documented in plantation management inventories — as bank collateral in local village banking and micro-credit schemes.

One fundamental problem is the low volume of plantation teak logs (Efthymiou 2002), leading to increased handling and processing costs. Low recovery rates by participants in the first stage of value addition are further decreased by the imprecise cutting methods.

Plantation teak is harvested by hand; in many cases, handsaws are used for felling trees. Logs are cut into lengths that can be handled manually. Some local traders have chainsaws and improvised loading devices to move the relatively small logs to the roadside for transport to primary processing sites.

The issue of limited technology in the hands of small-scale farmers and tree cultivators has been discussed in several studies (FAO 1996; Lux 2005; Mohns 2006; Macqueen 2008). Teak logs are processed locally using basic technologies with great losses in both wood volume and financial return. Unless more sophisticated technology is made available to producers they are basically excluded from realizing any reasonable value addition in the initial steps of the timber processing chain. A lack of access to credit for necessary investments in the required machinery, weak organization at the producer level and managerial weakness further worsen this situation.

Forest certification and value chain analysis

Forest certification can trigger considerable benefits for primary producers, as shown in a scheme on smallholder teak timber in Luang Prabang, Lao PDR, implemented by the Tropical Forest Trust (TFT). The scheme introduced plantation management certificates that clarify rights to use land for teak plantations over at least one rotation time of 25 to 30 years, including the subsequent right to harvest, process and transport the logs.

The scheme also highlighted the limited (below 10%) share that the producers received in the timber value chain. Improvements in harvesting and transport to roadside and grading according to market requirements by producers has increased their share to around 18%. Local chainsaw milling and stationary bench sawmilling (log squaring) are expected to increase their share to nearly 50%.

The use of management certificates has led to verifiable quantification of the log value and has triggered the use of logs as collateral for micro-credit ventures. There are no other recorded cases of this elsewhere in Southeast Asia.

Chainsaw milling

The log extraction process from plantation sites

Chainsaw milling (BCNet 2005; Pasiecznik et al. 2006) is one element of the log extraction process from plantation sites to the nearest roads (FAO 1982a and 1982b; Pasiecznik et al. 2006; Sessions 2007). Presently, teak logs with diameters of up to 35 cm are sawn into logs three to four metres (m) long, each weighing about 200–300 kg. In most cases logs are hand-carried over distances of up to 1000 m by teams of two or four men.

If the terrain permits, hand-held two-wheel tractor trailers are used to transport logs. Such situations are rather limited given the country's mountainous geography. For larger log sizes and greater extraction distances chainsaws are sometimes used to square the logs, reducing the weight by up to 40%.

The TFT project is also working on systems to extract logs by hand-operated logging skid-ies, horse or buffalo and possibly, converted hand-held tractors, following the example of Scandinavian mini-skidders (FAO 1982a and b; Lawlor, Akwah and Greenberg 2004).

Initial tests with horses and mini-skidders in the northern part of the country indicate extraction costs ranging from US\$5–30 per log for distances up to 3,500 m (FAO 1982b; Forestry Commission 1997; Lawlor, Akwah and Greenberg 2004; Mohns 2006). These studies show the limitations of manual extraction, which seems to be financially and ergonomically viable only up to 500 m. It is anticipated that log squaring may reduce delivery costs from felling sites to roads over distances greater than 500 m by about 30%.

On roadsides or central processing points

CSM can also be part of the road transport of logs. Transport distances from plantation sites in Northern Lao PDR to the main processing centres in Vientiane or to Vietnam and Thailand can exceed 1,000 km. Squaring logs can reduce road transport costs by up to 40% by removing non-useable material and reducing weight through initial loss of moisture of up to 15% in the remaining wood. Savings of up to US\$30/m³ are estimated. CSM in this context can be considered a first step to mobile sawmilling; mobile band saws may be used at a later stage (Stockhausen 1999). This technology would be more efficient and economical, especially when discarded material is used for local applications.

Constraints of chainsaw milling

The existing legal situation of ownership and operation of chainsaws make the application of this technology extremely complicated in Lao PDR. Chainsaws can be purchased by individuals but must be registered with the Department of Forests and kept at the respective provincial or district forest offices. The chainsaws are released on request to the owners after payment of considerable fees. They have to be returned after use and owners must submit transport permits for the harvested timber. This cumbersome procedure is a serious disincentive for improving local harvesting and processing.

Lack of training and technical support services

There are no facilities or institutions to provide training in basic logging and chainsaw processing operations or chainsaw maintenance to individual forest owners or producer groups. A recent study has shown that there is considerable potential for private investment in this training in Lao PDR (Lindh 2009). Supply of spare parts is also not well established; this leads to considerable losses in operating time.

Conclusion

To increase the timber revenue of teak plantations to local producers, primary processing could be introduced. Chainsaw milling provides a viable solution for processing logs and facilitating extraction and road transport of logs from young teak plantations in Lao PDR.

Considerable legal reform on the possession and operation of chainsaws is needed, however, as is the improvement of support services for chainsaws and other tree harvesting and processing equipment. This is necessary to ensure the full potential of tree harvesting and processing as part of a poverty alleviation strategy.

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2.5 Financial analysis of small-scale harvesting in Papua New Guinea

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Introduction

Papua New Guinea (PNG) has about 29 million hectares (ha) of natural forest, mostly closed natural forest (Ambia 2005). The country has a population of 6.6 million, and has great ethnic and cultural diversity, with over 700 language groups. Most people live in traditional rural villages in or near forests and depend on subsistence farming (often based on shifting fallow methods) supplemented by cash crops. Almost all of the forests in PNG are under customary ownership by local communities, tribal groups or individuals and forests play a vital role in sustaining traditional subsistence livelihoods (Filer and Sekhran 1998). Forests also contribute income to government and communities. About 30% of the forest area is considered accessible for timber harvesting. A mix of forest-based industries has developed, including sawmilling, plywood and furniture production, although most timber harvested is exported as raw logs.

Developing a different path for forest management is an important national requirement to sustain the environmental, economic and social benefits for future generations of forest owners. Small-scale chainsaw milling and other types of portable sawmills can be part of that future; they have operated in PNG for nearly 40 years. They have been proposed as a potential alternative to large-scale timber harvesting by many participants in the debate over management of PNG forests. These methods provide a greater share of income to the forest owners from the utilization of forest resources, engage them more in forest production and minimize the impacts of large-scale timber harvesting operations. Mechanisms have been developed to support a combination of small-scale sawmills, certification and timber export to developed countries, particularly to Australia.¹ There has, however, been little detailed investigation of the financial viability of small-scale sawmill operations in PNG.



MARKET PRICES,
PRODUCTIVITY, RECOVERY
AND DISTANCE TO
MARKET ARE THE MAIN
DETERMINANTS OF PROFITABILITY.

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In producing timber for markets, portable sawmills usually operate near existing roads, often in areas where industrial logging has taken place and existing logging tracks and roads provide access to resources. The markets where the timber is sold (local or export) will determine the selection of species, log sizes and timber quality produced and the associated equipment needed.

Portable sawmills, with a saw blade driven by a petrol engine, are the most common type of portable sawmill used in PNG. Despite their long history of use, government has generally ignored portable sawmill operations in policy, extension and supervision, except when the operators intend to export products (in which case they require an export licence and timber permit), and there is little data on the number in operation or their production levels. In a nationwide study in 1993, Hunt (2000) estimated that about 1,500 portable sawmills were operating. Surveying 350 of these, Hunt found that operators were harvesting an average of three to four trees per week and employing about seven people each. An estimated 110 of the operations were community-based enterprises engaged in the processing and sale of timber from their forests to supply building materials to their community, to earn wages or to generate profits. A large number of mills still operate around the country producing timber for local use, sale to the domestic market or export. Three types of portable sawmills are in use: the Lucas mill, the Peterson mill and the Lewisaw.

Chainsaw mills are generally more affordable and easier for communities to operate than portable sawmills. An estimated 10,000 chainsaws are sold annually, about 20% of which are used as chainsaw mills. Chainsaw mills generally have a chainsaw head and a rail bracket attachment to produce slabs of timber. Currently, three types of chainsaw mills are being used: the Alaskan mill, the Westford slabber and the Westford ripper.

The production capacity of chainsaw mills is low compared to that of a portable sawmill (0.5 to 1.0 m³/day of sawn timber, compared to a portable sawmill output of 3 to 5 m³/day). Chainsaw mills are easier to set up and to move in rugged terrain and inaccessible areas. They can also generate higher recovery by producing round or oval stools and tabletops for furniture from buttresses and bent trees. On the other hand, chainsaw mills consume more fuel and may be more expensive to use.

The aim of this article was to examine the financial viability of small-scale sawmill operations in PNG using a simple financial model. The study is based on the harvest and processing of up to 1000 m³ of logs annually with a single portable sawmill, the minimum scale at which a community might produce economically viable timber supplies. Costs and other operating issues were researched primarily for portable sawmills. Chainsaw mills are mainly used to produce timber for domestic purposes and generally not for the market. The study also considered the financial viability of adding value through drying and planing of timber for a growing domestic urban housing market or for export.

Production and supply models

The analysis aimed to investigate potentially sustainable production models based on portable sawmills that could provide relatively continuous supplies of sawn timber to different types of markets. Timber (particularly the many dense PNG timber species that are most sought after in the market for furniture, flooring and other higher value uses) is a heavy commodity. The study analyzed the operation of a portable sawmill with supporting equipment (truck and tractor) so that community enterprises could avoid dependence on extensive manual labour to move the mill or transport timber. While many communities and groups currently operate mills, using manual labour to move equipment and transport sawn timber, this is a poor use of community members' time and unsustainable both physically and financially.

The minimum requirements for this type of operation are a single portable mill, a truck to transport the sawn timber to buyers, and a tractor to relocate the mill to the log site and move boards from the forest to the roadside. Portable mills can generally produce four classes of timber, which are related to tree species and log and board quality. We assume that an equal proportion of each class is produced. We examined the effects of varying the transport distance (from 50 to 400 km) and improving sawn timber recovery (35–50%).

Reduced-impact logging (RIL) practices were assumed to be adopted (cutting lianas, direction felling to avoid damage to retained trees, minimization of ground disturbance and limiting canopy disturbance and gap size). Trees are felled using chainsaws and the portable mill is carried to the felled tree and constructed around it. Four production and supply models were considered in the analysis:

- A. green sawn (un-dried) boards sold in the nearest commercial centre (no value adding);
- B. green sawn boards of A grade material from Category 1 species sold for export through a central marketing unit — all other timber is sold to local buyers (no value adding);
- C. value-adding to Category 1, A and B grade sawn timber through kiln drying and dressing for the timber exported — all other timber (mixed hardwoods) is sold locally as green material; and
- D. value-adding to Category 1, A and B grade sawn timber through kiln drying and dressing. All material (including green-sawn, mixed hardwoods) is sold locally (no exports).

Models included costs associated with certification as Community-Based Fair Trade, the first of three stages of full forest certification.

Financial modeling

A financial model was developed to evaluate the performance of these different production models over 20 years. The performance of each production model was assessed using the following criteria:

1. profitability in each of the first three years of operation;
2. average return on sales (or profits as a percentage of sales) over the 20-year period;
3. funds required to purchase the equipment and provide working financing;
4. the payback period (the number of years it takes to repay the start-up investment costs from the free cash flow generated by the operation);
5. accumulated profits during
 - a) the first five years of operation, and
 - b) over the 20-year period.
6. Net Present Value (NPV) – excess or shortfall of the stream of cash flows expected over the 20-year life of the operation, assuming a discount rate of 20%.

Financial model assumptions and data

The study assumed that the community owned the forest, paying no stumpage cost or log royalties to the government and that all sawn timber was sold. No time was included for replanting with natural regeneration; applying selective harvesting and RIL is assumed to provide for forest regeneration. The time required to start up the business was considered to be free time. Communities bear the full cost of certification. There was no financial value included for other non-timber forest benefits. Production per sawmill varied between 1 and 3 m³/day (depending on terrain, tree species and level of mechanization). Production was assumed to occur on 173 days per year, which accounts for the wet season and breaks for other community needs. It was assumed that communities used existing roads; road construction costs (generally very high in PNG) were not included in the analysis (Table 1).

Timber prices were established from surveys and interviews with various merchants and companies. These were adjusted over time according to the assumed inflation rate (see below):

- class 1, A grade green sawn timber sold locally, PNGK 1000/m³, exported PNGK 1300 per m³, dried and dressed PNGK 2000/m³ (same price in local or export markets);
- class 1, B grade green sawn timber, PNGK 650/m³, dried and dressed material PNGK 1300/m³;
- mixed hardwoods, A grade, PNGK 500/m³; and
- mixed hardwoods, B grade PNGK 400/m³.

Table 1. Inputs to financial model

input	cost (PNG Kina)	comment
capital costs		
portable mill, chainsaw, winches and miscellaneous equipment	100,000	miscellaneous equipment includes work gloves, protective clothing, spare cutting blades, air filters, crowbars and tool kit
truck	260,000	
tractor	162,000	
skidder	900,000	
labour costs		
wages	1,562 per week	nine staff: feller and assistant, mill operator and assistants, manager-financial controller, truck driver and tractor operator. Basic wage PNGK 101.8 per week, with an incentive factor for staff retention of 1.5 (= K153 per week)
training	27,000	Payment in first year
operating costs		
fuel maintenance	24 per day of operation	
	12 per day of operation	
	40 per m ³	
	40 per m ³	
transport to market	0.40/km	cost of fuel, registration and insurance
marketing and administration	30/m ³ for local; 60/m ³ for export	
other costs		
certification	US\$13,500 initially; US\$2,800 in years two and three; and US\$1,400 in every year thereafter	
export costs	4,000 per container	

Note: All costs are in PNG Kina (US\$0.37, except where indicated) for 2009 and subject to inflation over the life of the study (see text).

* This is as per discussions with FPCD, Madang, January 25, 2010.

Other key assumptions

The projected inflation rate was assumed to be 8% over the next four years (Bank of Papua New Guinea 2009) and to decline to 5% annually in years 6–20. Timber prices and the cost of all equipment and consumables increased each year in line with this fore-

cast. A 33% straightline annual depreciation was assumed for portable mills, chainsaws and winches (replaced every three years), with a 20% straightline depreciation for other capital equipment. Miscellaneous costs of 20% of the total of marketing, administration, training and certification were assumed. Returns and bad debts were assumed to be 5%. All purchases were assumed to be paid on receipt of goods and buyers were paid on delivery. Community enterprises do not pay individual or company tax.

Results

Exporting green sawn timber of higher value species and selling other species locally (Model B) was the most profitable option, earning PNGK 1.9 million over 20 years and with almost 15% return on sales (Table 2). It also had the shortest capital payback time (three years). Model A (no value adding and sale of all products locally) was moderately profitable (PNGK 0.6 million of accumulated profits over 20 years). Start-up capital costs were the same as in (Model B) but it took a year longer to pay them back.

Table 2. Comparison of four models for a portable sawmill (PNGK)

financial criteria	Model A	Model B	Model C	Model D
total profits, years 1–5	14,700	56,500	–507,000	69,600
total profits, years 1–20	608,000	1,914,000	–3,183,000	429,000
average return on sales	4.84%	14.86%	–19%	2.4%
start-up costs	780,000	780,000	1,800,000	1,800,000
payback time of initial investment	year 4	year 3	not possible	year 5
NPV	20%	20%	20%	20%

Note: Based on harvesting and processing of 1,000 m³ of log input per year and 50% sawn timber recovery from forests located 100 km from the point of sale in Papua New Guinea. 1 PNG Kina = US\$0.37

Investing in adding value to the output from a single sawmill was not justified given the current prices for timber. Model D — involving adding value and selling locally — was less profitable than options A and B (PNGK 0.43 million over 20 years), with a lower return on sales (2.4%).

Model C (adding value through kiln drying, dressing and export of high-quality timber, with all other timber sold locally as green material) was unprofitable (a loss of PNGK 3.2 million over 20 years, and a 16.4% average loss on sales). It was not possible to pay back the starting capital in this option.

To make value adding profitable, a significantly higher scale of production is required to cover the high fixed and variable costs associated with operating a timber yard.

Certification is a significant up-front cost that is currently not demanded by the local market. If communities choose not to pay for certification, the profitability of model A, where all timber is sold locally, would increase by 10% over the 20-year period.

None of the models returned a profit in the first year of operation. Model A and B were unprofitable in the first year, but were profitable in nearly all subsequent years. The financial outcomes are obviously highly sensitive to timber prices and costs (such as labour, equipment and costs of servicing capital).

Two other important determinants of profitability are transport distance and rate of log recovery:

- Transport distance is a key factor; the most profitable operations are situated close to markets. Assuming 50% timber recovery from each log, production model A remains profitable (net positive average return on sales) when it is located within 170 km of the point of sale. Higher prices received for export materials allow producers of green, rough-sawn boards for export (model B) to be located up to 340 km from local buyers. By adding value and selling timber locally (model D) producers can be profitable within 140 km from the point of sale.
- Recovery from each log helps determine the viability of small-scale processing operations. For example, in the simplest production option (Model A) for an operation close (within 50 km) to the buyer, reducing the recovery rate from 50% to 45% decreased total profitability over the 20 years from PNG 0.97 million to PNG 0.25 million (Table 3).

Table 3. Variation in financial indicators

	rate of recovery (%), green boards						
	44	45	46	47	48	49	50
accumulated profitability, years 1–5 (PNGK)	–1,200	3,400	8,000	12,600	17,200	21,800	26,500
average return on sales, years 1–5 (%)	–1.58	–0.10	1.30	2.70	3.97	5.21	6.41
accumulated profitability, years 1–20 (PNGK)	109,000	253,000	397,000	542,000	686,000	830,000	974,000
average return on sales, years 1–20 (%)	0.39	1.83	3.20	4.53	5.78	7.00	8.15

Note: Sawn timber recovery from processing 1,000 m³ of logs in a portable sawmill (Model A green sawn boards, sold locally)

Conclusions

This article shows that a single portable sawmill can be operated profitably in a community-based enterprise when it is worked to maximum capacity with high recovery and if the resource is relatively close to the point of sale and the operation does not have to cover road construction costs. Market prices, productivity, recovery and distance to market are the main determinants of profitability. Value adding by drying and dressing timber can double the sale price but is not justified for single small-scale operations.

Timber processing, even for small-scale portable sawmill operations, is capital-intensive. Few community-based operations in PNG currently achieve the required mill production, recovery and transport arrangements for long-term financial viability of their portable sawmill operations. Aggregating production and producing at a larger-scale can increase viability, but this presents political challenges for communities. High transaction costs are associated with being a part owner of a processing facility and significant continuing effort is required to ensure that the community receives an equitable return from its resource and labour inputs.

Access to capital to commence a portable sawmill operation is also critical to its success; harvesting a larger area can overcome problems of scale. With increased volume from a larger area, a skidder can be used to move logs to stationary mills, but this could lead to impacts such as damage to the forest floor, soil erosion and water quality problems.

Effective leadership, business skills, motivated and trained staff, attractive salaries and equitable distributions of surpluses are critical to the success of any community enterprise.

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Endnote

1. See, for example, FORCERT (www.forcert.org.pg).

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2.6 Chainsaw milling in the Philippines

JAN VAN DER PLOEG

Introduction: the giant butaka

In 2004 the municipal government of Ilagan, the capital of Isabela province, placed a four-metre wooden chair in the town centre to promote the local furniture industry. This giant “butaka” features prominently in tourist brochures and visitors are brought there to take pictures. Few people know that the hardwood for its legs was illegally harvested in the Northern Sierra Madre Natural Park. The butaka symbolizes the problem of regulating chainsaw milling in the Philippines. In theory, logging is strictly prohibited in protected areas (PAs). In practice, however, it is tolerated by the Department of Environment and Natural Resources (DENR) and by local governments.

Government officials turn a blind eye to small-scale logging activities by rural communities. They claim that environmental legislation cannot be enforced, since the poor depend on timber revenues. Banning rural communities from utilizing forest resources is considered illegitimate and ineffective.

We dispute this reasoning. Rural poverty is not the driving force of illegal logging in the Northern Sierra Madre Natural Park. Timber harvesting in the park is controlled by a few businessmen, who operate in collusion with government officials and capture most profits. The pro-poor rhetoric of DENR and local government officials is in fact a pretext for organized crime and corruption.

Slash-and-burn farming, fuel wood gathering and bamboo harvesting are important income-generating activities for poor rural households, although these activities are illegal. There are, however, important differences in the level of illegality of these activities (Inoguchi, Soriaga and Walpole 2005; Colchester et al. 2006). The environmental impact of gathering non-timber forest products such as bamboo, rattan or resin is relatively minor. Agricultural encroachment contributes to deforestation in the northern Sierra Madre but is, unlike timber extraction, primarily motivated by subsistence needs.



CHAINSAW MILLING IN THE NORTHERN SIERRA MADRE IS NOT A SMALL-SCALE LIVELIHOOD

ACTIVITY BY THE RURAL POOR BUT THE COMMERCIAL EXTRACTION OF LARGE VOLUMES OF HARDWOOD BY FINANCIERS IN COLLUSION WITH GOVERNMENT OFFICIALS.

From corporate logging to chainsaw milling

Logging companies started operating in the forests of the northern Sierra Madre in the 1960s. Companies were granted 25-year Timber Licensing Agreements for the sustainable harvest of timber. Cronyism, corruption and anarchy characterized the corporate logging industry during the administration of President Ferdinand Marcos (1965–86). Forestry regulations were violated to maximize profits, logging operations were sub-contracted to local entrepreneurs, logging roads were improperly constructed, annual allowable cuts (AACs) were exceeded, protected tree species were cut, logging took place outside concessions, and reforestation efforts were minimal. These unsustainable and illegal practices were ignored by government foresters in exchange for favours and bribes. The lion's share of the profits was captured by political cronies of Marcos; very little was invested in the local economy (Vitug 1993).

The democratization and decentralization that followed the People Power revolution of 1986 had profound effects on corporate logging. Sustainable development, social justice and the devolution of power to local governments became guiding principles for the country's forest policy. In 1992, in the wake of the Ormoc tragedy — in which more than 5,000 people died in mudslides on the island of Leyte — the Aquino administration (1986–92) issued a ban on logging in all primary forests in Isabela (Persoon and van der Ploeg 2003). Timber Licence Agreements were revoked and sawmills closed. Only three logging companies continue to operate in the forests of Isabela.



Under President Ramos (1992–98) community-based forest management (CBFM) became the national strategy to ensure equitable access to forest resources. It provides a legal framework for chainsaw milling in the Philippines (Lasco and Pulhin 2006). Cooperatives were granted permits to harvest and sell timber under long-term tenure arrangements; 19 community-based management agreements were issued to communities in Isabela, covering more than 49,000 hectares (ha).

Civil society activism and international funding led to the proclamation of the Northern Sierra Madre Natural Park in 1997. A large part of the forests of the province (287,861 ha) were included in the park (Figure 1). Logging is strictly prohibited inside the park, although timber continues to be harvested illegally in all its lowland forests.

Chainsaw milling

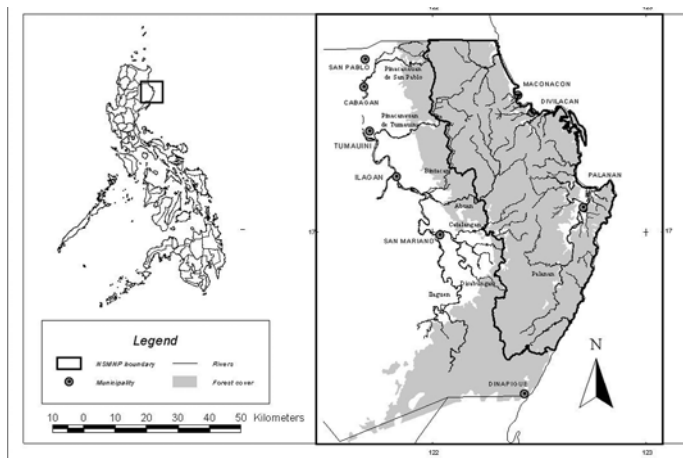
It is estimated that 20,000–35,000 m³ wood per year is illegally extracted from the park, representing a minimal market value of US\$4,750,000. The total AAC of the three remaining legal logging concessions in Isabela Province is 37,794 m³.

Illegal logging operations, or *salabadiok*, are financed by a few prominent businesspeople. In most cases these financiers are registered lumber dealers or timber plantation owners, which enables them to legalize illegal wood. They operate through middlemen in the

remote villages. The intermediaries — often local government officials — organize specialized logging teams to harvest timber in the forest. Without connections to an intermediary and financier, it is impossible to transport or sell timber in Isabela. Intermediaries claim exclusive extraction rights to specific areas in the forest: the so-called “area-area” system. Sometimes these informal concessions are marked with signboards. Financiers place an order for a certain amount of timber and provide a cash advance for fuel and supplies, which is deducted from payment when the timber is delivered.

Figure 1. The Northern Sierra Madre Natural Park

Source: Merlijn van Weerd, 2010



Timber harvesting

Timber is harvested by logging teams of surveyors, chainsaw operators, helpers and transporters. Surveyors identify suitable trees for harvesting. The chainsaw operators (*atcheros*) are often former skilled employees of logging companies. The helpers carry the equipment, fuel and supplies, maintain the chainsaw and prepare the food. The transporters (*bugadores*) transport the timber to the hauling points. Most of them are young men between 16 and 30 years old who are recruited from villages along the forest frontier. Around 3,000 people work for illegal logging operations: approximately half the households in the villages in or adjacent to the park earn income from harvesting or transporting timber.

The logging teams make temporary camps along the rivers. The chainsaw operator fells the tree and saws the log into square flitches at the felling site. All trees that exceed a diameter of 30 cm are harvested. Narra (*Pterocarpus indicus*) is preferred: the red hardwood is used to make furniture. Loggers also harvest other species (so called soft wood) for construction. Timber is primarily harvested in riparian forest. Loggers light fires to aid in surveying and skidding. Water buffaloes (*carabaos*) are used to skid the square logs to the camps, which function as log landings. Here the square flitches are sawn into boards five cm thick (*dos lapad*). Large rafts, sometimes more than 25 m long, are constructed to carry the boards to a hauling point, where they are loaded into trucks and transported to clandestine sawmills. There it is further processed. From there the wood is distributed to lumber dealers or furniture makers in the Cagayan Valley, or transported to urban centres in Central Luzon.

In general, logging teams are paid per board foot of lumber (see Table 1). A chainsaw operator receives US\$.04–.05 per board foot, depending on the species. This amounts to a daily income of around US\$8. *Bugadores* and helpers receive around US\$3 per day. This makes logging one of the most profitable activities in the forest frontier (van den Top 1998; Aquino 2004). Intermediaries are also paid by the volume produced. All payments are done on consignment, which means that if illegal timber is confiscated by the authorities, the *atcheros* and *bugadores* are not paid. This credit system is an important characteristic of chainsaw milling in the area, and makes it difficult to determine production volumes, profit margins and spending patterns. It creates a strong patronage bond between the intermediaries and the *bugadores* that extends beyond logging; credit for agricultural inputs is often paid back with logging revenue. Timber revenues are also often used to pay school fees or buy consumer goods. A considerable part of the money earned in logging is spent on alcohol, tobacco and prostitutes. Many young unmarried men are attracted to the outdoor work and easy money.

Table 1. Cost of wood production in the northern Sierra Madre

	costs per board foot (PhP)	% of total cost
direct costs		
fuel (gasoline and motor oil)	0.5–1.0	2–4
supplies (food, cigarettes, gin)	0.5–1.0	2–4
labour costs		
surveyor	1.0–1.5	4–6
chainsaw operator	2.0–3.0	8–12
helper	1.0–1.5	4–6
hauler	1.5–2.0	6–8
transport (truck)	1.0–2.0	4–8
middleman	3.5–5.0	14–20
bribes		
DENR	0.0–1.0	0–4
NPA	0.0–1.0	0–4
AFP	0.0–0.5	0–2
PNP	0.0–0.5	0–2
profits		
financiers	5.0–14.0	20–56

Note: US\$1 = PhP 50

Standard operating procedures

Although the harvesting of timber is illegal in the park, the processing and marketing of wood is legal. The furniture industry is the largest manufacturing sector in the province: there are approximately 150 furniture workshops in the five municipalities bordering the

park, employing more than 1,500 people (Greenpeace 2006). Most furniture shops obtained permits from the Department of Trade and Industry and pay taxes to their local government. In addition, eight registered lumber dealers in these municipalities legally sell and transport timber to Central Luzon.

Embezzlement and fraud attend this incongruence of illegally harvested timber and the legal sale of lumber and furniture. Logging entrepreneurs and DENR officials collude to authenticate illegal wood through a variety of legal loopholes. For example, DENR officials issue certificates to collect driftwood or residual tops and branches left by logging companies; these certificates are misused to harvest timber in the park. On several occasions the furniture shops were allowed to sell their timber stocks in return for a promise to shift to wood from plantations. But these old stocks were over-declared and are continuously replenished. In other cases permits are forged or recycled: (several wood transports are covered by the same permit). But in most cases wood is simply sold without any permits or receipts.

Financiers bribe government officials to ignore environmental legislation, evade fees and maximize profits. Intermediaries bribe forest guards to issue certificates and secure passage for the logging trucks at the checkpoints. These bribes are called "standard operating procedures." In many areas the amounts are fixed. It is estimated that US\$160,000 to 280,000 per year is paid in bribes to DENR officials in Isabela. Other government officials also get a piece of the pie: US\$30 per truck is required to pass the checkpoints of the Armed Forces of the Philippines and the Philippine National Police. Several villages have set up roadblocks and demand US\$1 per logging truck. Maoist rebels also claim "revolutionary taxes" from the loggers.



Humanizing the law

Forest protection in the northern Sierra Madre is a farce. In 2006 the DENR confiscated 478 m³ of illegal lumber, less than 2.5% of the total volume of wood cut yearly in the PA. None of these confiscations have led to a conviction in court. DENR officials claim that the strict implementation of forestry regulations would aggravate rural poverty. They therefore tolerate illegal logging activities by the rural poor, a strategy locally called "humanizing the law." This reasoning, however, is based on flawed assumptions about the scale and organization of the timber trade and the dependency of rural communities on timber revenues, and it masks resource capture and corruption.

In fact, small-scale timber poaching undermines sustainable development by destroying the resource base on which rural communities depend, by eroding the rule of law, and by distorting wood markets. Illegal logging in the northern Sierra Madre is highly exploitative: more than half the profits from timber harvesting are captured by seven financiers. The costs of uncontrolled timber harvesting are borne by society at large. Farmers along the forest frontier complain that logging trucks destroy roads, raising transport costs

for corn and rice. Fishermen claim that fish catches are declining as a result of erosion. Indigenous people say that loggers disturb wildlife, destroy swiddens and harass women (Minter and Ranay 2005). The wives of the *bugadores* are concerned about the harsh working conditions in the forest. In the lowlands, corn and rice farmers have been severely affected by flooding attributed to illegal logging (Chokkalingam et al. 2006). People are increasingly concerned about the environmental impacts of deforestation, and indignant about the corruption in the public service and the failure of government to address the basic needs of rural communities. Illegal logging epitomizes lawlessness in remote areas in the remote areas.



DENR's failure to enforce forest policy hampers efforts to create an alternative supply of legal wood. Throughout the province farmers have established yemane (*Gmelina arborea*) and mahogany (*Swietenia macrophylla*) plantations, but the availability of cheap illegal hardwood depresses the price of legal wood (Masipiqueña, Masipiqueña and de Groot 2008). Weak law enforcement also compromises CBFM (Box 1). All CBFM agreements were suspended in 2003 when it was found that they were widely misused to authenticate illegal timber (Lasco and Pulhin 2006).

Box 1. Strengthening environmental law enforcement at the local level

Although illegal logging is deeply entrenched in Isabela's political economy, democratization and devolution creates opportunities to strengthen environmental law enforcement at the local level. In 2008, the reform-oriented governor of Isabela, Grace Padaca, pressured by local environmental groups and the church, and concerned about the well-being of rural communities, took unprecedented steps to control illegal logging. Four checkpoints were set up and operated by staff of the provincial government, the army and volunteers of the environmental law group *Tanggol Kalikasan*. In 18 months a provincial task force confiscated more than 4,000 m³ of illegal timber (Lagasca 2009). Clandestine sawmills were raided, criminal cases were filed in court against lumber dealers, and the provincial director of DENR was replaced (although promptly reassigned in neighbouring Cagayan Province by the DENR Secretary). The national media covered the activities extensively, which gained Padaca nation-wide recognition. In the remote villages along the forest frontier many people see the enforcement of forest policy as a legitimate and positive change. The *atcheros* and *bugadores*, unable to transport timber, now plant rice, corn and banana. There is broad societal support for the campaign, especially after flooding in 2008 claimed more than 100 lives and caused US\$96 million damage to crops and infrastructure.

Conclusion

Chainsaw milling in the northern Sierra Madre is not a small-scale livelihood activity by the rural poor but the commercial extraction of large volumes of hardwood by financiers in collusion with government officials. In the northern Sierra Madre, uncontrolled resource extraction in a relatively small forest area will lead to irreplaceable environmental damage. The strict enforcement of environmental legislation is not anti-poor, as often claimed, but a catalyst for poverty alleviation and CBFM. Much can be gained if local forest protection initiatives, such as the provincial anti-illegal logging task force (Box 1), would get more international attention and support. Law enforcement is a prerequisite for sustainable forest management and poverty alleviation. The next step is to build a giant butaka of yemane!

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Section 3

Case studies in
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3.1 The development of small-scale logging in Bolivia

CHARLOTTE BENNEKER

Introduction

The governance of tropical rainforests is increasingly international in scope. Concerns about the effects of deforestation and illegal logging on global warming have led to renewed attention for the management and conservation of tropical forests (van Bodegom et al. 2008, 18). Previous attempts to enhance the sustainable use of tropical forests have, however, not resulted in overall reduced levels of forest degradation and deforestation.

Alternative strategies to curb deforestation are constantly being developed, based on the use of market systems (e.g., Forest Stewardship Council, or FSC), improved forest governance (Forest Law Enforcement, Governance and Trade, or FLEGT) or both (likely, as Reducing Emissions from Deforestation and Forest Degradation, or REDD). Timber sales are often an important additional or even only source of income for poor rural people. It is important that policies aimed to curb logging (legal or illegal) prevent poor people from being negatively affected (Colchester et al. 2006).



COMPLEX REGULATIONS
ALMOST BY DEFINITION
EXCLUDE LARGE PARTS OF
THE POPULATION.

A new forest law was introduced in Bolivia in 1996. It was intended to develop a forest sector that would democratize the benefits from forest exploitation and support sustainable forest management (SFM). All land-owners (including farmers and indigenous people), illegal timber loggers and private enterprises were granted legal opportunities to engage in timber exploitation if they complied with the forest management regulations established by the new law. In the same year the Agrarian Reform Law was enacted; it acknowledged major land claims from indigenous people, rural communities and farmers. This law initiated a process of regularization of land rights that aimed to secure property rights for all land-owners. Andaluz and Mancilla (2006, 5) consider that the new forest policy provided the legal conditions to develop a forest sector based on SFM. Colchester et al. (2006, 21), moreover, consider that Bolivia, compared to Cameroon, Canada, Honduras, Nicaragua and Indonesia, has the most “progressive legal framework in terms of its accommodation of rural livelihoods in forests.”

Indeed, many communities and farmers increased their benefits from forest resources; the previous forest law allowed only private enterprises to log and sell timber. However, most logging activities on farmers' and communities' lands are small-scale and generally do not adhere to the new forest management regulations. This does not necessarily mean that these logging activities are unsustainable though, as logging intensities can be very low.

The failure to adhere to regulations is partly due to incongruities in the forest law and its regulations: whereas the forest law grants forest user rights to all forest owners, forest management regulations were oriented only to industrial logging. The 1996 forest law and regulations failed to recognize land and forest use systems applied by small holders and indigenous people. They also failed to acknowledge the dynamic and innovative character of the timber market, which used this lack of regulations and control to its own advantage.

The development of the forest sector in Bolivia over the last 15 years shows that a forest sector can develop based on timber production by many small-scale producers. Specific regulations for the sector are required, however, to guarantee sustainable forest use, and the forest service has to be able to serve and monitor both small and large logging operations.



Chainsaw milling

In Bolivia, chainsaw milling is prohibited for commercial purposes but allowed for domestic use. (Chainsaw milling for domestic use is not considered in this article.) Chainsaw millers process logs to lumber in the forest, then carry the lumber to nearby rivers or roads, which is physically

demanding. The beams or planks produced are often reprocessed in a sawmill to specific dimensions and other market requirements. Chainsaw millers target high-value species as mahogany and cedar; extraction is oriented to the export market. Somewhere along the production chain the timber gets "legalized" and is further transformed and exported as if it were legally harvested.

Before the 1996 forest law was enacted, chainsaw milling was widespread. It was a common way to harvest timber for people who did not have official logging permits. A relatively small local industry existed in most forested regions for reprocessing the timber. The lumber produced was sold locally or exported. It was often sold to the forest industries that had been granted the forest concessions where the timber had been illegally logged (Kraljevic 1996).

The 1996 forest law allowed for the development of a processing industry based on small timber volumes extracted from relatively small forest areas. Logging techniques changed accordingly; chainsaw milling became less widespread. Loggers started to make use of semi-industrial extraction techniques that required relatively little capital but were more efficient and less physically strenuous than chainsaw milling.

Now logs are transported from the forest in the dry season over old or new extraction roads by small and worn-out trucks. Logs are loaded using levers and taken to sawmills in the vicinity. This change is especially predominant in the more accessible areas where old logging roads enable small trucks to move the logs, without substantial investment required in road construction. Changes in logging techniques and market demand allowed loggers to include tree species that previously had not been logged by chainsaw millers.

Chainsaw milling used to be the main logging technique in Bolivia available to smallholders that did not require a large capital investment. Since the introduction of the 1996 forest law, the use of chainsaw milling has been reduced to areas that are difficult to reach (occasionally with the consent of the forest service) and to protected areas where logging is prohibited and high-value tree species are still abundant. In these places, chainsaw millers still target high-value species for the export market. There is no official information available on the commercial timber volumes being processed by chainsaw millers.

The 1996 forest law

The objective of the 1996 Forest Law was to democratize access to the forest exploitation and establish SFM. One of the major changes was that farmers, communities, private land-owners and people previously involved in illegal logging — as well as private enterprises — were allowed to harvest timber commercially. Private and collective land-owners were granted exclusive forest user rights to their land; illegal loggers could organize themselves in a Local Social Association/*Asociación Local de Lugar* (ASL) and request a municipal forest concession; and private enterprises could convert their old logging contracts to new long-term concessions.

Options for forest management were given to a range of forest users on both private and public land at the national and municipal level. An important requirement for all these forest users was that they comply with formal forest management regulations.

Depending on the size of the forest, the requirements for a forest management plan differ considerably. Forest areas over 200 ha require a forest inventory and an extensive forest management plan. Yearly logging plans and reports are required in order to be granted transportation permits. Forest areas under 200 ha require only a relatively simple logging plan.

The management system prescribed by the forest law, however, is similar for all forest areas (i.e., the same minimal cutting diameter, maximum logging intensity and 20-year cutting cycle). All commercial logging activities (irrespective the size of the forest or logging intensity) have to transport logs to sawmills to avoid the efficiency losses of using a chainsaw to process timber.

In practice this means that operations require skidders to extract the logs, loaders to stack the logs on the truck and trucks to move logs from the forest to the sawmill. Roads, landing places and bridges have to be built. These operations all require major invest-

ments. Few rural dwellers have access to financing and no credit facilities have been set up to enable forest owners to invest in forest management. Consequently, although a wide range of forest users have been granted commercial forest user rights, most of them do not have the financial means to engage in commercial logging without capital investment from NGOs or private funders.

New participants in the timber business

A considerable number of forest users — including farmers and indigenous communities, ASLs and private forest owners — have benefitted from the new forest law (Benneker 2008). By 2006, 100 forest management plans of indigenous and farmers communities had been approved covering 1.1 million hectares (ha) of forest.

Farmers and indigenous communities

Farmers and indigenous communities who had a connection with an NGO and who owned a reasonably large and accessible forest started receiving financial and technical assistance to develop and/or implement a forest management plan. By now, many of these communities have consolidated their forest management activities and operate independently. Most communities outsource the construction of roads and the extraction of logs to private enterprises that are often also the buyers of the timber. Timber sales contracts are generally signed for one year and are thus flexible. Timber prices and secondary contract conditions have improved considerably over time, and the communities have more negotiation capacity. The communities are responsible for yearly inventories, the elaboration of logging plans and reports and for felling and limbing trees. Due to a lack of capital for extraction equipment, the communities are limited in the forest management activities they can implement themselves.

Other communities

A second group of communities received financial assistance from private enterprises. These communities are generally located in less accessible forest areas and own forests with high-value timber species. Unlike the financial and technical assistance offered by NGOs, the funds provided by private enterprises pay communities for the management plan and take care of all management and logging activities, without much participation by community members. These logging companies have de facto control over community forest areas, as if they were concessions. Communities are rarely informed about the timber volumes harvested and are commonly cheated in prices and payments. They are often locked in long-term timber sales contracts that are difficult to renegotiate.

By 2006, the management plans of 23 ASLs, covering 600,000 ha of forest, had been approved. These former illegal loggers have been partly successful in organizing themselves and requesting forest concessions from the municipalities. Their development has been easier in accessible forest areas, as extraction costs are lower and the market is familiar. For most ASLs, the legal procedures to get legally established and awarded a concession have been tedious, costly and virtually impossible without external assistance. ASLs have

also encountered problems in financing the development of their forest management and logging plans and depend on private enterprises for funding.

Owners of private rural properties

The owners of private rural properties have developed forest management plans for their land. By 2005, 173 forest management plans for private owners, covering 1.2 million ha, had been approved by the forest service.

One of the goals of the 1996 forest law was to offer chainsaw millers a legal alternative under the new forest regime to ensure that forests would be logged in a sustainable way. This strategy has been successful; a significant number of unskilled labourers in the chainsaw milling production chain, such as tree-spotters, millers and their assistants, have shifted their activities to community forest enterprises or ASLs. Moreover, the businesspeople who used to finance chainsaw milling have shifted their investments to the newly developed semi-industrial timber processing industry.

Most new timber producers, especially those with relatively large forest areas, would not consider returning to the use of chainsaws even if the technique were legalized. The costs of industrial logging are high and capital is hard to find, and logging intensity has to be high enough to recover the investments made in forest management plans and logging plans. Industrial logging methods are economically more efficient and generate higher income than chainsaw milling. Moreover, chainsaw milling is extremely strenuous and people perceive the use of more advanced technologies as a positive development and an improvement of their livelihoods. Although chainsaw milling still exists it is no longer the main logging technology used by local people.



The need for alternative regulations

Although one objective of the forest law (to democratize access to the benefits of forest resources) can be considered as partly achieved, a second objective (to source all timber from sustainably managed forest) has become increasingly problematic. None of the timber producers (small or large loggers and enterprises) comply with logging regulations completely and an increasing amount of unsustainably logged timber on the market originates from the use of small-scale logging permits (for less than 200 ha). This situation has partly been caused by the fact that although the forest law provides options to obtain logging permits for small-scale logging, it does not provide a realistic regime for the use, monitoring and control of small production forests.

These small-scale logging permits are issued by the forest service to enable farmers and owners of small forests to benefit from resources from agricultural lands and conversion forests. Forest owners can legally obtain a range of small-logging permits relatively easily and cheaply. The forest management system prescribed for small forest areas, however, is similar to that for large-scale management plans (more than 200 ha) and is unsuitable for

low-intensity logging or logging in small forest areas. The investment required is too high for small areas and the cutting cycle of 20 years is unrealistic. Forest users do not adhere to the management system, but compliance is rarely controlled by the forest service (Pacheco et al. 2008). Many entrepreneurs in the forest sector have developed strategies to make use of this weakness in the system.

Because access to small-scale logging permits is limited to forest owners, entrepreneurs (including large and small enterprises, intermediaries and consultants) have developed innovative strategies to facilitate forest owners' access to logging permits. The entrepreneurs arrange all the paperwork for the forest owners, harvest the trees and pay for the timber. Entrepreneurs prefer to use small-scale logging permits — which are cheap and easily obtainable — instead of permits for larger forest areas, which require investments in SFM plans. This is especially prevalent where there is easy access to the forest.

This practice allows timber enterprises to obtain cheap timber from forest owners without investing in SFM. As small-scale logging is widespread in the extensive forest areas owned by indigenous and farmers communities, the forest service has lost control over much of the forest. Moreover, the large volume of cheap timber on the market threatens the economic viability of the communities, ASLs and private forest owners who comply with regulations.

Conclusion

The success of the forest regime in Bolivia is based on the participation of communities, farmers, private forest owners and ASLs in industrial timber logging from large management areas. The weakness of the regime is the lack of alternative, non-industrial systems of forest use for those who are not interested in industrial logging and long-term commitments to forest management but are eager to earn income from selling trees on their land.

Under the 1996 forest law, the illegal practice of chainsaw milling was reduced and alternative semi-industrial logging techniques appeared that better suited people's needs. The rapid development of this timber production chain can largely be attributed to the denial of the importance of timber extraction from smaller forest areas by the forest service, who failed to develop applicable regulations or control small-scale logging. Forest management regulations — as well as the entire institutional framework set up by the government under the 1996 forest law — have been directed at servicing a limited number of vertically integrated enterprises and some large-scale community forestry initiatives and ASLs. Servicing, monitoring and controlling thousands of small-scale forest enterprises that source timber from thousands of private companies, farmers and community forests were never a priority. This omission caused a serious void in the forest regime and an increase in unsustainable logging practices. The Bolivian case proves that providing realistic management and monitoring options for small-scale logging practices are necessary to keep the entire forest sector healthy.

The development of the timber industry in Bolivia clearly shows that if forest governance regulations do not consider small-scale timber exploitation, chainsaw milling or other semi-industrial technologies, the sustainability of the entire forest sector could be undermined. If international initiatives such as FLEGT and FSC fail to consider small-scale exploitation too, they would encounter the same kind of problems. In developing countries, rural people do generally not have access to capital to comply with complicated regulations on forest use. Complex regulations almost by definition exclude large parts of the population.

Economic arguments are often used to exclude rural people from participation in timber exploitation. Providing adequate services to a large, poorly educated and poor population is costly and difficult. In contrast, dealing with a few large private timber companies is easier and cheaper but may in the end be unsustainable, as shown here.

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3.2 Chainsaw milling in natural tropical forests: a case study in Bolivia

RICHARD MANCILLA TERRAZAS
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Background

Approximately 15 years have passed since the implementation of Forestry Law No. 1700, making it possible to strengthen the knowledge of forest operations and management, incorporate new stakeholders, reach important development in the process of voluntary forest certification and democratize access to the forest. Chainsaw milling, prohibited by the Bolivian forestry regime, continues to create much controversy, even though many forest users — mainly informal and therefore considered illegal — consistently make use of this practice.

This article assesses the groups involved (directly or indirectly) in chainsaw milling in two regions of Bolivia's lowlands: north of La Paz and north of Cochabamba. The project implemented in-situ monitoring and evaluation of chainsaw milling, including production and transport costs, processing yield, sales in the local market and economic benefits, and recorded perceptions about the use of chainsaw milling.

We looked at jobs directly generated through chainsaw milling in various locations in the two departments. A survey was carried out in 2006 with the following stakeholder groups: forest producers; indigenous communities; local social groups; chainsaw organizations; and traders in forest products.

Survey results

The survey monitored the use of chainsaws for sawing wooden planks, which is prohibited by law. Results are provided for the villages, each of which is characterized by specific user types, topography and accessibility. Prices are expressed in Bolivianos (Bs), with an exchange rate of 7.07 Bs: US\$1.



THE MAJOR CHALLENGE IN ADDRESSING CHAINSAW MILLING ACTIVITIES IS HOW TO IMPLEMENT A CONTROL SYSTEM IN AN EFFECTIVE AND EFFICIENT WAY, WITH A COMMITMENT FROM THE COMMUNITIES THEMSELVES.

Richard Mancilla Terrazas and Rudy Guzman Gutierrez work for *Proyecto Desarrollo y Conservación in Bolivian Amazonía*.

Cochabamba rainforests

Municipalities of Ivirgarzama and Puerto Villarroel, Carrasco Province

The rainforests region is flat, with many rivers of various sizes and with moderate to easy access to the forest. Usually, the trees are located on agricultural plots and are privately owned. The average distance from Ivirgarzama to Cochabamba, capital of the department, is 230 km.

Chainsaw millers cut up to four trees per day, depending on the species. A skilled operator can produce between 250 and 300 pt (pt = board foot; 424 pt equals 1 m³ solid sawnwood).

The product at this stage is chainsawn wood blocks. Typical dimensions of these planks are 10 centimetres (cm) thick by 18 cm wide by 2 metres (m) long. Although the initial recovery rate for milling logs using chainsaws is about 54% of log volume, the irregular shape of the block requires it to be reprocessed to a more regular form with a brush and circular saw blade. This reduces the final recovery rate to 33%.

The profitability of a chainsaw milling operation is about 0.75 Bs/pt for the tree harvester. When this amount is multiplied by an economic daily production between 250 and 300 pt, it generates a daily earning between 185 and 225 Bs. The tree harvester can generate this amount without having to get a permit and without a management plan approved by the respective authority. Moreover, the land manager or tree owner where the tree is taken most often does not authorize its harvest. Consequently, the gross profit goes to the chainsaw miller.

The price of planks in the local market of Cochabamba is 2.50 Bs/pt (Table 1). Intermediaries earn between 1 and 1.30 Bs/pt for purchasing the wood planks landed along a river or gathering place and selling them at the local market in Ivirgarzama or Puerto Villarroel. Although trade in chainsaw milling products is an illegal activity that carries a great risk, as shown in Table 1, it is encouraged by the profits and by the economic opportunities for intermediaries.

Table 1. Chainsawn planks: production costs and market price in Cochabamba (Bs/pt)

stage	costs	price
cost of chainsaw milling at the stump	1.00: operator: 0.25 tree owner: 0.75 (if authorized)	
cost of transport in the forest (up to 500 m distance)	0.15 to 0.20	
cumulative plank price at the forest gate		1.15–1.20
intermediary's price at the local market		2.50
transportation cost to Cochabamba	0.75 (1,500 Bs to transport 2000 pt)	
broker's market price in Cochabamba		3.20–3.50

In Cochabamba trucks transport at least 212,000 board feet of illegal timber every month. This cargo volume requires at least 25 trucks (one truck transports on average 8,500 board feet). The estimated annual volume of chainsawn wood in the market in Cochabamba exceeds 2.5 million board feet; this is equivalent to 6,000 m³ of sawnwood or 11,100 m³ in roundwood.

The sale of this product in the city of Cochabamba generates profits of about 1.00 to 1.50 Bs per board foot. Because of the low quality of the chainsawn blocks— they are rough-edged and imprecisely squared — they are not exported.

La Paz

Caranavi Rainforests

The region is hilly, with steep slopes and moderate to difficult access. Trees are not privately owned, but are obtained from public land or protected areas (PAs). The rivers serve as the means of transport; the average distance from Caranavi to La Paz is 200 km.

Chainsaw milling for sawing and squaring generates the following levels of remuneration. Costs, which range depending on whether the wood is soft or hard, are summarized in Table 2:

- Chainsaw operators who own their own equipment (chainsaws) earn 0.30–0.50 Bs/pt for managing their teams and processing the logs into blocks or planks.
- Operators who do not own their own chainsaws earn 0.10–0.50 Bs/pt for solely managing the team and producing chainsawn wood blocks. Their assistants earn a daily wage of 20–30 Bs.
- The people who transport the planks to the collection site (*lomeado* or *jalete*), a distance of up to 500 metres, charge 0.15–0.20 Bs/pt.
- The cost of transport from the forest to Caranavi is 0.20–0.30 Bs/pt.

If the product is sold in the town of Caranavi, planks from softwoods are sold for 1.0 to 1.50 Bs/pt. The prices are a bit higher for planks from semi-hardwood or hardwood species, namely 1.50 to 2.0 Bs/pt or 2.0 to 3.0 Bs/pt respectively. The price of a plank in the city of La Paz can reach between 3.00 and 4.00 Bs/pt for semi-hard timber and between 4.00 and 4.50 Bs/pt for hardwood.

The distance from Caranavi to La Paz is 185 km. It is estimated that around ten trucks per day are leaving the area with timber, all going to the city of La Paz. The trucks carry an average of 75,000 board feet of sawn timber per day; based on this amount, around 18,000,000 pt of timber (approximately 2,500 trucks) is transported annually from the Caranavi zone to the city of La Paz. This equals 42,450 m³ of sawnwood or 128,645 m³ of roundwood. These estimates are based on information provided by chainsaw operators in the area.

Table 2. Production costs and market prices for chainsawn lumber in La Paz (Bs/pt)

stage	cost	price
cost for chainsaw cutting at the stump	direct sale by owner of the wood: 0.30 to 0.50 (operator owns chainsaw) 0.10 to 0.50 (operator does not own chainsaw)	
cost of transportation* in the forest at the collection site (up to 500 m distance) to an intermediary collection point	0.15 to 0.20	
price of planks at the forest gate collection point received by the chainsaw operator		1.20 to 1.50 (softwood) 1.50 to 2.50 (semi-hard wood) 3.00 to 4.00 (hardwood)
cost for transporting* the timber from the forest to Caranavi	0.20 to 0.30 Bs/pt, depending on whether the timber is from soft or hard wood.	
local market price in Bs/pt in Caranavi** received by the rescuer		1.0 to 1.50 (softwood) 1.50 to 2.00 (semi-hard wood) 2.0 to 3.0 (hardwood)
transport costs* to La Paz	0.35 to 0.40	
broker market price in La Paz		3.00 to 4.00 (semi-hard wood) 4.00 to 4.50 (hardwood)

* Operating costs for unloading are around 60 Bs for a truck with around 8,000 pt.

** Despite the greater distance to the local market, the price of wood in Caranavi is lower than in the forest because the means of transport is the main river.

Palos Blancos

The city of Palos Blancos is located in Sud Yungas Province in La Paz Department. The city is located approximately 285 km from the city of La Paz. The population mostly comprises indigenous Mosestenes, as well as Aymara and Quechua people.

Wood blocks (*cuartoneado*) produced by chainsaw millers are transported to the town of Palos Blancos and/or the surrounding area (Table 3).

Table 3. Wood prices in Palos Blancos and surrounding area

species density	price of wood blocks (Bs/pt)
softwood	0.80–1.00
semi-hard wood	1.20–1.50
hardwood	1.50–2.00

The prices of sawn or wood block timber in the production sites are very similar, as are costs. This area is farther from the departmental main market in the city of La Paz. To make the product more competitive and achieve a better price, chainsaw millers attempt to incorporate some degree of further processing. Carpenters have settled in the small town of Palos Blancos; they further process dimensional or pre-cut lumber from chainsawn blocks or planks and recover waste for the production of parquet for floors. This additional processing reduces the overall yield.

Yields of processing logs to wood in Palos Blancos

Determining the yield of processing logs to wood blocks was based on local information received from chainsaw operations for the specie *Platimiscium ulei* (Fam. *Leguminosae*). The average log volume was 2.16 m³. During the processing of planks using chainsaws, 1.06 m³ was recovered in the process, a recovery rate of 49%. The recovery process and processing of timber planks into dimensional wood for floors resulted in an average total recovery rate of 30% for the carpenters in the town of Palos Blancos.

Conclusions

The wood harvested in the survey was illegal; i.e., it was not authorized by the national authority. The raw materials used have a questionable origin. Stakeholders do consider it relevant whether the timber comes from slash and burn agricultural practices, conversion, national lands or from PAs in the regions (Carrasco National Park in Cochabamba and Madidi National Park and Pilon Lajas Biosphere Reserve in La Paz).

Performance

The average yield for the processing of logs in planks or blocks with chainsaws, with or without reprocessing by nearby sawmills, is around 33%. This is very similar to the yield for planks processed by chainsaw milling with a bandsaw mill. Chainsaw milling for wood processing creates opportunities for local forest users. Trees used for the lumber should come from areas with authorized management plans.

Economic possibilities

Supplying local timber markets provides substantial revenue when large volumes are traded. It can provide economic benefits to people living in rural areas, although most chainsaw milling is done informally.

People involved in these wood processing activities consider their involvement a short-term opportunity to compensate for a drop in market prices of the products which they have traditionally traded, including coffee and citrus. The continuing low prices of these products and a lack of possibilities for processing raw material for a higher value, encourages timber poaching.

The use of chainsaw milling techniques can generate good economic returns. The use of the chainsaw does not demand a large investment. Around US\$2,000 is needed for equipment and a small production unit, compared with more than US\$200,000 to establish a sawmill. This does not take into account the financial resources needed for exploitation and processing operation or the operational skills required.

The chainsaw can become an extraordinary tool for development if it is used to harvest and process timber from areas with approved management plans, that are difficult to access, or in areas with steep slopes where construction of roads can cause irreversible damage to the ecosystem. The increasing use of chainsaws results in more people becoming involved. This further degrades the forest and jeopardizes its future productivity.

Chainsaw milling in public forests and PAs, and the subsequent marketing of timber in local markets, generates a supply of illegal timber. Together with the failure to control illegal logging, this results in a continuing loss of forest values and governance over forest lands and PAs.

Achieving sustainable development in chainsaw use

The absence of regulations for the purchase and registration of chainsaws, along with weak regulatory mechanisms, makes chainsaw milling activities very difficult to control, especially in situations of poor governance.

The state has invested only in agricultural production systems in the area. This leaves the forest as an area with no control and often without an owner, which people can enter freely and alleviate their economic needs. Andean migrants consider land areas with tropical forests as “not worked” and available for conversion to other uses, even though these are not legally allowed.

The control of illegal activities is very difficult, due to the remoteness of and lack of access to the areas in question. The major challenge in addressing chainsaw milling activities is how to implement a control system in an effective and efficient way, with a commitment from the communities themselves.

Acknowledgements

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3.3 Sustainable management of guadua bamboo forest, Colombia

JUAN CARLOS CAMARGO, RUBEN DARIO MORENO and NELSON VILLOTA

Introduction: the coffee region of Colombia

The coffee region of Colombia encompasses an approximate area of 5.8 million ha between 900 and 2000 metres above sea level. The bamboo species *Guadua angustifolia* Kunth (guadua) provides almost the only existing forest cover. Therefore, its protection, conservation and sustainable management are a government priority. These forests provide raw material for different products and also generate income for farmers and other stakeholders in the coffee production chain. For the forest sector and institutions in charge of environmental management and control at the regional level, the *Corporación Autónoma Regional* (CAR), conservation and effective management of the guadua forest is a challenge. Illegal harvesting leading to forest degradation requires governance in the form of flexible and effective instruments of control and forestry development; technical assistance; access to forest extension programmes and information for development and marketing. Recently, illegality has decreased and guadua farmers are better able to sustainably manage their forest and improve their livelihoods.



IMPROVEMENTS ACHIEVED
IN GUADUA FOREST
HARVESTING MIGHT ALSO
HAVE A POSITIVE IMPACT
ON CHAINSAW MILLING ACTIVITIES.

Guadua bamboo forests in Colombia

Guadua is a woody bamboo. It is an important natural resource in Colombia, particularly in the coffee region. Traditionally, farmers used guadua to build products such as houses, furniture, handicrafts, veneers and flooring. In the last guadua inventory, the total area in the coffee region was estimated at 28,000 ha (Kleinn and Morales 2006), most of it in natural stands.

In the coffee region, timber used for domestic and commercial applications originates mainly from natural forests located along the Pacific coast. Most of the forests were eliminated a long time ago, largely replaced by agriculture. Small fragments of forest dominated by guadua are the remnants of natural forest in the area.

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Guadua forests are highly fragmented and most patches are smaller than five ha (Camargo and Cardona 2005). However, these forests are an important refuge of biodiversity where more than 400 woody species have been identified. They also provide habitat for about 50 birds species and 18 mammals (bats), which fulfill important ecological functions (CIEBREG 2008).

Because of the nature of guadua culms,¹ logging and processing is usually conducted using a machete, although recently chainsaws have been used in some places. Harvesting of guadua forest consists of the extraction of a fraction of mature culms. A significant number of standing culms with different stages of maturity remain in the forest if it is effectively managed (the density is on average 6,500 culms per ha). Further fragmentation of these forests has implications for silviculture, because larger areas of guadua stands would be required to meet demands. A number of farmers, wishing to avoid the costs of forest planning and technical assistance, are not managing the small guadua areas properly. Although most of the culms harvested are used for domestic applications and harvesting intensity is usually low, the silvicultural practices to obtain them are unsustainable.



Unsustainable domestic harvesting sometimes causes environmental damage and increases the susceptibility of guadua stands to wind and rainstorms and to decreased productivity and quality. Higher profits would be obtained if an effective technical process for harvesting were applied.

Guadua is the most highly harvested species, and provides wood for a variety of uses. Some reports show that between 2000 and 2004 roughly 2,420,000 culms of guadua were logged from 2,557 ha (Moreno 2006a). This means that about 90% of guadua stands were not harvested during that time. Guadua bamboo forests have been significant in supplying and sustaining small and medium enterprises (Held 2005) and have improved the likelihood of reaching European markets (Becker 2004). Unfortunately, data related to guadua harvesting have not been registered since 2004. According to the number of harvesting permissions requested and the number of guadua poles sold in timber stores, it is apparent that commercial use continues to be high.

When harvesting, a portion of mature and over-mature guadua culms are cut, then each is divided, usually in four pieces, according to intended use:

- *cepa* is the base of the culm, approximately the first three metres (m) of height, and is mainly used for domestic purposes such as fencing;
- *basa* is the next piece (about three to nine m of height), which has a higher commercial value and therefore is utilized for different purposes;
- *sobre basa* is the next piece (about nine to 15 m of height), which is usually manually flattened for making mats or *esterilla*;

- *puntal* is the last part of the culm — it is also used domestically, especially to support crops such as plantain, banana and tomato.

The most valuable product, *basa*, is traded by owners of farms or small companies that process and sell guadua poles; other products provide additional income for workers in charge of the harvest (*guadueros*). The use and sale of these products fulfill an important social role, equivalent to that of chainsaw milling in other kinds of forests.

Legal framework

Harvesting culms in guadua forest and processing them into low-quality products, such as *esterilla*, *cepa* and *puntal*, is permitted in Colombia, as long as these products are included in the harvesting volume authorized by the environmental authority. This compares to chainsaw milling in Colombia, which is permitted if products obtained by this technique are included in the volume permitted by the environmental authority.



Illegal logging

According to the World Bank (2006) illegal logging in Colombia provides up to 40% of total timber production. This means that about 1.5 million m³ of commercialized timber is illegal. Sufficient information is not available on illegal logging in the guadua forest, although institutions in charge of control reported that an important amount of guadua culms is illegally harvested and sold (Moreno 2006b). This is due to the difficulties in controlling the large number of small forest patches distributed throughout the coffee region; in addition, culms are used for domestic purposes in many cases.

The Bosques FLEGT/Colombia project, was formulated and led by the *Corporación Autónoma Regional de Risaralda* (CARDER). The project developed an index to estimate the extent of illegal guadua culms traded over a period of time. This index is based on the difference between the number of guadua culms transported and the number authorized by the CAR. The index is calculated based on infractions related to over-quota harvesting (Bosques FLEGT/Colombia 2010). The average percentage of illegally traded culms was estimated to be 29% in Risaralda, 37% in Quindío and 25% in Tolima State (Bosques/Flegt Colombia 2010).

Strategies for improving management and reducing illegal harvesting

A range of strategies has been developed to address the situation of guadua forests and promote its sustainable management. This process has been led by CARs through projects funded by GTZ (*Manejo Sostenible de Bosques en Colombia*) and the European Union (Bosques FLEGT/Colombia). The technological and scientific support of universities, particularly the Technological University of Pereira, has been essential. Research results have been the basis for the development of strategies.

Contribution from legislation

Since 2001 the CARs from the coffee region states (Caldas, Quindío, Risaralda, Tolima and Valle del Cauca) initiated activities in the framework of the *Manejo Sostenible de Bosques en Colombia* project to improve the forest management of guadua stands. One of the outcomes was a *Norma Unificada para el manejo de guaduales naturales* (NORM), which defined the guidelines for management within the framework of legislation. A terms of reference for the management and harvesting of guadua stands (TRMHGS) was also defined.

No precise specifications are described in the NORM or TRMHGS for each product obtained from guadua forest. The total volume authorized includes all products that can be harvested.

NORM and the TRMHGS aim to achieve the sustainable management of guadua stands. Stands that fulfill these requirements are registered as having sustainable management. In such cases, farmers receive incentives, reduction of taxes and technical assistance.

Planning of guadua forest

The *Manejo Sostenible de Bosques en Colombia* project carried on an assessment of land suitability and potential areas for establishing guadua plantations in the coffee region of Colombia. A total of 24 variables were used for analysis and to develop a model for land suitability. The variables were associated with five factors representing site conditions: topography, climate, soils, landscape ecology and socio-economics. By using a simple decision model based on the five factors, four classes of land capability were defined: low, marginal, moderate and high.

Only 2% of the total area evaluated had high capability for guadua production. These areas were located close to urban centres. The main limitation for guadua production was the lack of roads (for access) and markets. Areas over 2000 m in elevation were immediately excluded, because guadua does not grow well at that level.

Forest governance

The Bosques FLEGT/Colombia project also aimed to improve legality and governance so as to contribute to sustainable management and the improved productivity and commercialization of forest resources from small farmers. The project had several achievements:

- involvement of a range of stakeholders from the entire production chain in the development of forest management norms;
- optimization of the approval process for guadua forest harvesting;
- technical assistance to support legal forest management;
- voluntary forest management certification (FSC) for small farmers and elaboration of specific standards for guadua stands;
- articulation of the preventive, juridical, administrative and operational aspects of guadua forest management;
- cross-sector agreement for legal timber in Colombia;



- institutional coordination for strengthening forest control and alertness;
- increased market opportunities through improved technology and information;
- support for timber-processing enterprises; and
- establishment of forest management units.

Conclusions

Legislation, silvicultural practices and strategies of forest management have made a considerable contribution to improving the guadua sector in the coffee region of Colombia. The key issues for the development of the sector are consolidated in policies and through tools for better management of guadua stands. Stakeholders involved in each link of the production chain have been provided with tools, technical assistance, information on certification schemes and legislation. Although the situation has significantly improved, efforts now should focus on how to further develop market options.



Guadua forests have supplied products to timber markets in the coffee region of Colombia for several decades. Local people have benefitted from guadua production and sustained an active economic sector in this region, sometimes in conflict with other land uses such as coffee growing. This social impact is similar to that of chainsaw milling

which also has important social effects. Improvements achieved in Guadua forest harvesting might also have a positive impact on chainsaw milling activities. In order to guarantee sustainable development, we need to take an integrated approach to management that takes into account all aspects associated with the local production of guadua products or timber in the case of chainsaw milling.

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Endnote

1. Culm is the above-ground part of guadua that is harvested; it corresponds to the hollow jointed stem in rhizomes.

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3.4 Forest communities and legal timber in the Ecuadorian Amazon

WALTER PALACIOS and ULRICH MALESSA

Introduction

Three groups of people inhabit Ecuador's Amazonian ecosystems: indigenous peoples, settlers and a migratory population. Indigenous peoples are the original inhabitants of the region and live mostly in vast areas of tropical rainforest. They belong to 13 different nations. Together, indigenous groups and settlers own about 60% of the remaining forest area (Palacios and Freire 2004); 40% is within protected areas (PAs). Shifting cultivation has traditionally been practised in harmony with natural forest dynamics. With the construction of roads and the involvement of indigenous people in the market, however, the possibilities and need for income have increased (Fundación Natura 2010).

After 1970, more and more settlers began migrating to the Amazon, converting the native forest into pastures and croplands while harvesting wood for sale. Their farmlands usually cover 40 to 50 hectares (Kautz 2004).

The migratory population is linked to oil exploration and in many ways is responsible for most of the threats to the Amazon rainforest. The opening of the forest by roads, the introduction of substantial economic resources and the demand for local resources have had a severe impact on the forest.

Logging and forest conversion are direct threats to the Amazon forest. Unfortunately, their impact is intensifying, as there is an increasing demand for wood for urban areas and export.

Most production of timber is informal and illegal. In response, the state has improved forest control with a computerized permit system launched in 2009. The World Bank (2006) has stated that, in order to be effective, solutions to illegal forest exploitation caused by poverty must focus on alleviating the precarious economic situation.



IMPROVED TIMBER
PRODUCTION TECHNIQUES
CAN BE INTRODUCED ONLY
IF THERE IS A WILLINGNESS
TO CARRY OUT COLLABORATIVE FORESTRY
ACTIVITIES.

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Chainsaw milling is the main mean of production for sawn timber. Unfortunately, it yields less than 50% of the standing trunks (Gatter and Romero 2005); more efficient technologies that improve quality and the cutting process — such as guide frames or band saws — are not widely used. Implementing basic rules of forest management as a mechanism for maintaining forest cover that allows for sustainable forest use and contributes to poverty alleviation has not been widely promoted in Ecuador.

Objective and methodology

Our study¹ analyzed the use and sale of timber produced by chainsaw milling in a small selection of indigenous and settler organizations in the Amazon region of Ecuador (Box 1). Interviews with key actors and consultative meetings with selected organizations in two different situations were held.

It was assumed that small forest owners needed to cooperate in order to improve many aspects of their lives. There are three reasons for individuals to form an organization: economic, socio-political and cultural-traditional. These reasons also guide cooperatively organized market activities.

Box 1. Organizations in the study area

- The *Asociación Artesanal Agroforestal Kanus* (ASOKANUS) and the Shuar community of Yukuip (known as NASHE, its abbreviation in Shuar) are indigenous peoples' associations.
- *Pre-Asociación Madereros* (PAM) and *Asociación de Operadores de motosierras de orellana* (ASOPEM) are organizations of timber traders and chainsaw operators. Members own one or more chainsaws and have interests in a communal timber yard. They are exerting political pressure for a new agreement with forest authorities that has simplified procedures.
- *Perla de la Amazonía* and *Las Canelas* are local settlers' organizations. Their members convert forest to establish pastures and crops and sell standing trees to intermediaries. Some members own their own chainsaw, but most rent them or hire a chainsaw operator.

ASOKANUS supports its members through communal technicians and the elaboration of management plans. Under its micro-credit programme it provides about US\$250–500 for each member to cover the initial costs of timber harvesting and legal procedures. The organization itself mills the timber with two chainsaws and arranges the collaborative sale of timber. The timber is legal and has valid permits, and since its clients explicitly demand legal timber it receives a price premium. In addition, ASOKANUS was the only local organization to do an inventory of the remaining forest stocks and harvestable timber. ASOKANUS is shifting from a traditional-cultural organization to an economic one; it facilitates but does not promote logging.

NASHE has also begun to establish community control over forest resources. Half of the families within the association's area already agree with this process and have promised to comply with forest regulations. The association does not yet own chainsaws or other means of production. NASHE remains a traditional-cultural organization. It is strengthening its outreach and has a vision of moving towards community timber marketing.

Perla de la Amazonía and *Las Canelas* are traditional-cultural in nature and are not interested in developing their organizations. The main goal of PAM and ASOPEM, which are organizations of chainsaw millers and wood traders, is to generate political influence. They feel that chainsaw milling is the most appropriate way to produce timber and that this is done best by individuals.

The Shuar organizations have collective territories and have adopted internal regulations for logging. They are interested in selling legal timber. ASOKANUS has ten years of experience in timber harvesting. However, the annual production capacity from a forest area of 180,000 ha remains low, at about 300 m³ of sawn timber (*Fundación Natura* 2010). The settlers and chainsaw millers from the organizations in the province of Orellana have some recent experience with sustainable forest management (SFM).

The main problems in improving timber production

Application and enforcement of forest laws

In 2000 the Ecuadorian Environmental Ministry adopted a regulation for SFM of timber harvesting in tropical rainforests.² It established simple requirements for the harvest and transport of timber. There are no initiatives of the forest authority or stipulations within regulatory framework to improve the effectiveness of timber milling or promote reduced-impact logging (RIL).

Several studies have shown that the regulation is only partly enforced. Navarro, Del Gatto and Schroeder (2005) reported that between 1998 and 2001 the authorized annual harvest in native forests in Ecuador was about 660,000 m³, while industrial consumption amounted to 2.8 million m³. Palacios (2008a) estimated that in 2007 the illegal timber supply from the Amazon was about the same as the legal production. In Amazonian cities, the proportion of illegal timber is even higher; in Tena, it is 98% (Palacios 2009).

Participants in the project workshops confirmed different forms of illegality in timber harvest and transport. The most frequent was the misuse of transport permits by intermediaries; the timber is transported with a valid permit, but sourced from illegal logging. Intermediaries reported that once a management plan for an area is approved, transport licences are issued via the online permit system within a few hours. Of course, it is unlikely that timber would be ready to be transported within such a short time.

Only about 30 planks per day can be produced with a chainsaw. The only fast way to fill a truck with 500 planks is to buy them at the road on the edge of the forest.

In some Shuar communities,³ timber producers are bound by a local regulation. It builds on forest law, but also incorporates traditional elements.⁴ ASOKANUS owns chainsaws

and other means of production. Although it regularly sells shipments of legal timber, this activity includes only a third of its members. Many members still prefer to sell their timber on the informal market. It can be assumed that the main reason for this is the offer of immediate payment that avoids any bureaucratic or communal control.

The farms of the members of NASHE are located along a new road, which is projected to lead to the rainforest city of Taisha. NASHE applies local rules on forest management to promote legal timber harvesting, but does not own tools or sell timber. The organization is in the process of refining and enforcing its forest regulations. Its members currently produce illegal timber, but have reached an agreement⁵ to comply with local regulations in future.

Organizational levels of forest harvesting

In Ecuador, communities' organizational capacity to harvest timber is in its infancy. There are several initiatives from communities to organize themselves but these have not been consolidated. Between 1997 and 2000, about 15 organizations of Afro-Ecuadorians and indigenous Chachi people formed the Northern Community Forest Network of Esmeraldas in order to negotiate a fair price on wood (Padilla 1999). By mid-2007, five organizations in the southeast and northwest of the country, with the support of NGOs, intended to create a platform for small producers, but the organization never became operational.

While mapping the activities of timber-related organizations, Palacios (2008a) noticed that most involved raising complaints to the authorities. It is a challenge to form collaborative organizations that support the improved harvesting, processing and fair trade of wood.



Capacity for timber production

Smallholders possess essentially all native Amazonian forest outside of PAs. Settlers and indigenous peoples also occupy most of the formally declared national forest reserve (Palacios 2008b).

In most cases, indigenous people share large communal plots of land, which can be up to 780,000 hectares (Palacios 2005). These are often divided into farms, each managed by a single family. In some cases they carry out unauthorized clear felling; this is more common when farms are located close to roads (Romero et al. 2009).

Settlers make use of felled wood or sell standing trees to intermediaries. In a few cases, but more often than indigenous families, settlers have their own chainsaws; because they have processing capacity they have the advantage of selling a more valuable product than standing trees. Mules or people transport the sawn timber from the forest to the road.

Some indigenous communities in remote places without access to roads or navigable rivers maintain ancestral forms of use and resource management. They fell trees for subsistence using borrowed chainsaws. This situation changes drastically once a road is built because

timber becomes an easy source of income. In most cases, the standing trees are sold to intermediaries, who use their own chainsaws or hire chainsaw millers.

None of the people interviewed expressed the intent to employ other, more effective milling techniques. Members of ASOKANUS have received demonstrations from NGOs on how to use guide frames to enhance productivity and product quality and reduce waste. They do not make these changes, even though the organization's technicians know that badly sawn timber is wasteful and less valuable and may not meet the terms of the contract. Changing habits is difficult; this, along with the necessity of having an assistant for improved production methods, makes it difficult to get people to adopt new techniques (Fundación Natura 2010).

Timber markets and prices

The forest offers the settlers and the indigenous people an opportunity to earn income quickly (Kautz 2004). Frequently, timber felling starts when a new road is built because of the easy access it provides to the forest. Intermediaries persuade forest owners to sell standing trees and then accumulate large volumes of timber to be transported and sold in urban centres for the domestic market. Intermediaries manage market information and have the capital to finance the timber harvest; they also maintain contact with forest managers and officials.

The forest owners receive an unfairly low price because no extra value is added to the product. The intermediaries provide all the capital, since the forest owner has basically no money, and determine the price and the contractual conditions. According to Gatter and Romero (2005), illegal timber costs less than legal timber. Poorly chainsawn timber is accepted because of its low price.

The lack of demand for legal timber or for valuable, good quality timber influences these prices (Jiménez 2000, quoted in Kautz 2004). Timber traders argue that the control of timber at its destinations such as urban traders or the timber industry is vital to reduce illegal logging and allow prices to increase. Table 1 illustrates the prices paid for timber.

Table 1. Prices for illegally produced timber, legalized through transport permits (US\$)

type and size of timber	species	price at the forest road	prices paid to intermediaries
board (<i>tablón</i>) (2.5 x 0.25 x 0.05 m)	Laurel (<i>Cordia alliodora</i>), Manzano colorado (<i>Guarea</i> sp.)	2.30	5.00 (Quito)
	Seique (<i>Cedrelinga cateniformis</i>)	3.50	7.00–8.00 (Quito)
block (<i>pieza</i>) (2.5 x 0.2 x 0.2 m)	Manzano colorado (<i>Guarea</i> sp.), Avio (<i>Chrysophyllum</i> sp.), Abio (<i>Pouteria</i> sp.)	10.00	16.00–17.00 (Huaquillas, Peruvian border)

Source: intermediaries in Lago Agrio, Ecuador

ASOKANUS was able to negotiate an agreement with a timber processor for the sale of Seique (*Cedrelinga cateniformis*). The price was as much as 25% higher than the market price since the buyer demands proven legal timber.

Conclusions

In general, the forest in Ecuador has been and is still considered to be a source of immediate income by rural people and an exploitable resource to meet the national timber demand. The current policy approach almost entirely overlooks the need for SFM to obtain a long-term yield and secure environmental services. This is evident because of the small area being well-managed and the lack of promotion of forest conservation.

Forest monitoring is recommended in order to prevent further losses due to forest degradation and conversion. Furthermore, the forest authority — in collaboration with other institutions, such as the National Development Bank⁶ — should design credit lines to improve the harvesting and sawing techniques used by small-scale millers and to offer micro-credit to harvest legal timber. These measures might prove to be even more effective when planning national measures related to Reducing Emissions from Deforestation and Forest Degradation (REDD).



One question always stands out: why is illegal timber more attractive than legal timber? Our findings reveal some possible answers:

- the production of legal timber is more expensive because of tax payments and the requirement to follow formal procedures;
- legal timber does not receive a fair price because of the lack of demand for it;
- the market accepts and often prefers illegal timber because of greater demand and the scant risk of being caught;
- the prevailing mean of production, the chainsaw, does not require formally established operations and financial monitoring, as the scale is small and little capital is involved; and
- the legal regulation does not address small-scale producers who cut only a few trees per year and chainsaw-mill them.

The solution to the problem of bad forest management and poor rate of recovery when marketing legal timber should be developed according to the ideas of local organizations, in order to have their acceptance. However, most representatives we contacted had only vague and partial ideas for improvements, most of which did not include milling technology. Freehand chainsaw milling is seen as the only feasible way to produce sawn timber. Arguments that the timber quality is bad, the dimensions vary too much and that much of the timber is lost during the process are countered with statements about the lack of capital and the forest's inaccessibility to larger equipment. In addition, chainsaws are widely available.

Different groups have different visions of the forest and its use. For indigenous peoples, living in remote areas far from roads, the forest represents their livelihood in a comprehensive sense. However, this vision is quickly being altered by more market connections and the resulting economic opportunities that new roads provide. Activities to raise awareness of the importance of standing forests and strengthen community organizations and monitoring initiatives are needed to support indigenous peoples in using the forest according to their vision.

Only organizations that have benefited from external technical assistance seem to have the resources to develop a vision of sustainable timber production. It is not known, however, if they can form a company that is capable of marketing legal timber. A business plan will have to consider the organizational aspects and limitations of an association. Improved timber production techniques can only be introduced if there is a willingness to carry out collaborative forestry activities. In such situations, chainsaw milling could be replaced by more effective methods.

For the intermediaries, the forest is a business opportunity. Their vision is simple: cut trees and sell timber. They should offset the loss of forests by planting new trees, but in reality, reforestation activities are very rare. Intermediaries heavily influence the production and trade of timber. Reforestation as a solution to the loss of native forests by these actors should be considered, but with clear ideas of where to do it, with which species, and under what technical and financial conditions.

For settlers, the forest has been the immediate source of a cash income and not a long-lasting source of livelihood. This view is changing, however. *Perla de la Amazonía* and *Las Canelas* are seeing new opportunities in the forest, related to a sustainable use of timber, development of tourism and/or environmental services. They know that some farms no longer yield as they once did due to complete deforestation. Several settlers have cultivated their farms since the beginning of colonization and worry about the state of their land when they pass it on to their children. They feel that a good farm has pasture and cropland, but also forest, which produces timber in the long term.

Endnotes

1. The project had the financial support of the VERIFOR initiative funded by the European Commission.
2. *Norma para el Manejo Forestal Sustentable para Aprovechamiento de Madera en Bosque Húmedo.*
3. The communities are composed of *Centros*, which organize several settlements and groups and control a significantly big forested land area, 160,000 ha in the case of ASOKANUS.
4. An example is the rule to fell only up to one tree per ha, which simulates traditional harvesting intensity.
5. This was supported by the local NGO *Servicio Forestal Amazónico*.
6. *Banco Nacional de Fomento*.

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3.5 Chainsaw milling and Guyana's LCDS

OFFICE OF CLIMATE CHANGE

Introduction

Lying on the northeast shoulder of South America, Guyana possesses approximately 15 million hectares (ha) of tropical rainforest, which cover roughly 80% of the country. Guyana has been practising sustainable forest management (SFM) for decades, resulting in one of the lowest deforestation rates in the world. Its forests are among the most pristine on the planet, even though chainsaw milling is widely practised.

At the same time, Guyana is a poor developing country. The great majority of the forests is suitable for timber extraction and post-harvest agriculture, and significant mineral deposits exist below its surface. The country is therefore faced with an apparent trade-off between development through deforestation on the one hand, and limited growth through little or no logging and forest usage on the other. To resolve this dichotomy, Guyana has prepared a Low Carbon Development Strategy (LCDS) whereby it seeks to maintain its pristine rainforests for the purpose of contributing to climate mitigation in return for positive incentives linked to the opportunity cost of doing so. The revenues earned would be utilized to invest in low-emission economic activities and to develop a green economy.



CHAINSAW MILLING,
WHEN PRACTISED
EFFICIENTLY, HAS THE
POTENTIAL TO BE A

LOW-CARBON SUBSECTOR OF THE
FORESTRY INDUSTRY.

The forestry sector in Guyana

The forests of Guyana are used for multiple purposes: harvesting of forest produce, agriculture, mining, research, ecotourism, sustaining the livelihoods of Amerindian communities, conservation and protected area management and biodiversity reserve protection.¹ There are some 350 forestry concessions of varying sizes, all of which are privately operated. The state holds no equity or other management interest in any forest concession. The Government, through the Guyana Forestry Commission (GFC), manages and regulates the activities of forest concessions to ensure that operators effectively implement SFM rules, guidelines and forest legislation. Logging companies are required to complete comprehensive forest management and annual plans that include forest inventories. They are also required to comply with control procedures, legality assurance measures and log tracking.

The **Office of Climate Change** is part of the Office of the President, Guyana.

Guyana's forestry and mining sectors are major contributors to the economy. The forestry sector accounts for approximately US\$45–60 million in export value and employs more than 20,000 people.² They also generate significant government revenue that is invested in public services. At the same time, they are the main contributors to Guyana's low rates of deforestation and forest degradation.

Chainsaw milling

Chainsaw milling is allowed by policy in Guyana. It is supported by an institutional framework that permits and regulates its use. On the operational side, the GFC conducts procedural and environmental monitoring to ensure that chainsaw milling activities are executed in a manner that satisfies the guidelines set forth in the GFC Code of Practice.

Regulated chainsaw milling has economic, social and environmental benefits, if practised correctly and regulated effectively. Chainsaw/portable mill lumber production ranged from 28,800 m³ in 2000 to 73,000 m³ in 2009.³ It also provides substantial employment in the forest sector. Many small- and medium-size operators have leasing contracts with community logging associations. To date, 42 associations have been established; they directly support more than 8,000 people. The operators mainly practise chainsaw milling, which in most cases is the main economic activity for these communities.

Chainsaw milling has developed in Guyana as a key subsector in the forest industry that supports rural livelihoods. The identified and preferred role of chainsaw milling activities are set out in a regulatory framework that aims to ensure that economic and social benefits do not result in negative effects on environmental sustainability or forest management.

In recognition of the importance of chainsaw milling in Guyana, a concerted and pragmatic approach has been taken from a regulatory perspective to allow for the existence of chainsaw activities through a comprehensive system of regulatory standards and requirements. The Code of Practice for timber harvesting sets the standards to be complied with in chainsaw logging. It also includes guidelines to allow for the effective protection of the forest, such as buffer zones, and to comply with health and safety standards.

While strengthening compliance with standards addresses improvement from the regulatory side, the government has also addressed the need to build the technical capacity of stakeholders through the work of the Forestry Training Centre Incorporated (FTCI). FTCI has developed a manual on chainsaw use and maintenance, tailored for small operators. The FTCI has also executed several courses with a number of communities and groups. Chainsaw milling has its context within forestry as a whole, which in turn is a vital component of Guyana's recently adopted LCDS.

Guyana's Low Carbon Development Strategy

The LCDS is based on the belief that Guyana's forests are its most valuable resource. The Government of Guyana recently completed a study⁴ to estimate the value of its forests. If the forest is harvested and the land then put to its most valuable subsequent use, the total economic value (EVN) to the nation would be approximately US\$580 million annually. Generating this high economic value, however, although economically beneficial for Guyana, would have significant negative environmental consequences for the country and the world. The deforestation that would accompany this development would reduce the important environmental benefits that Guyana's forests provide. Therefore, it would be more cost effective to provide financial incentives to compensate countries such as Guyana for leaving their forests standing as a climate mitigation measure. The financial flows could then be used to pursue low-carbon alternative livelihoods.

This is in essence the major thrust of Guyana's LCDS. Alternative low-carbon activities include development of hydro-electric power, solar wind and biomass energy, agriculture on non-forested lands, information and communication technology, ecotourism, and adaptation works such as sea and river defences, drainage and irrigation infrastructure and water conservancy management.

Another high-priority area is the development of Amerindian Communities. This will include support for the process of titling of Amerindian lands, as well as demarcation and titling of approved village extensions. Amerindian villages will have the choice about whether to participate in the interim REDD+ mechanism,⁵ following the principle of free, prior and informed consent. Those who opt in will receive their share of the revenues that flow through payments for their forest carbon. In addition to this opt-in mechanism for Amerindian communities, an Amerindian Development Fund will be established to provide grants for low-carbon energy and economic or social investments in Amerindian villages.

Forest payments will be used to invest in and support the creation of new low-carbon economic opportunities for small and micro enterprises (SMEs) and vulnerable groups. Grants will be provided to SMEs in key low-carbon growth sectors, such as fruit and vegetables, aquaculture, sustainable forestry, ecotourism and sustainable mining.

Memorandum of Understanding between Norway and Guyana

In November 2009 Guyana signed a Memorandum of Understanding (MOU) with Norway. The MOU essentially remunerates Guyana for the services its forests provide in the fight against climate change. The level of financial support by Norway will depend on the delivery of services. The rate of delivery will be measured against indicators of enabling activities and indicators of REDD+ performance that measure the reduction in emissions. Norway has committed up to US\$250 million until 2015.

To date Guyana has met all its commitments under the MOU and has reached all the established benchmarks for December 31, 2009:

- producing an outline of Guyana's REDD+ Governance Plan;
- starting work on a Monitoring, Reporting and Verification (MRV) system;

- establishing a Project Management Office (PMO) and an Office of Climate Change (OCC);
- continuing the multi-stakeholder consultation process;
- supporting an annual verification by neutral experts that REDD+ enabling activities have been completed;
- establishing a system for Independent Forest Monitoring (IFM);
- establishing the Guyana REDD+ Investment Fund (GRIF).

Norwegian financial support is being channeled through a dedicated financial mechanism (GRIF). The support will finance two sets of activities: the implementation of Guyana's LCDS and building capacity to improve REDD+ and LCDS efforts.

REDD+

Reducing emissions from deforestation and degradation and avoiding deforestation are key elements of the LCDS. Guyana strongly supports the enhanced scope of REDD (REDD+) to include forest conservation and SFM. Guyana also supports a staged approach to REDD, whereby public funding will be required for the early readiness and capacity-building phases, and a combination of public and market-based funding will support the later phases, when forest carbon can be traded in the compliance markets.

Guyana was one of the first countries to have its Readiness Plan (R-Plan) approved under the World Bank Forest Carbon Partnership Facility project to support capacity building and readiness preparation for access to REDD climate funds and ultimately, carbon market financing. This R-Plan will assist Guyana in developing the monitoring, reporting and verification system required.

Conclusion: The role of chainsaw milling in the LCDS

Chainsaw milling is relevant to Guyana's LCDS, as it is an important part of the wood processing sector. Owing to its versatility and small operation size, regulated chainsaw milling in many cases allows for a smaller carbon footprint than conventional milling. Chainsaw milling, by its very nature, leads to lower clearance rates because of limited roads and infrastructure requirements; for example, most chainsaw milling operations use tractors instead of skidders, which allow for reduced clearances from skid roads and pathways.

Additionally, conversion on site reduces the transportation of waste products and thereby reduces the fossil fuel use of operators. Infrastructure maintenance is limited; it also lends itself to a low carbon operation with relatively little environmental damage. Further, the scale and versatility of chainsaw milling allows for forest extraction activities to be confined to a shorter time and smaller area, thereby enabling the forest area and ecosystems to regenerate.

It has generally been recognized that when chainsaw milling is properly practised, the waste remaining enhances the nutrient level of the soil, boosting its regenerative capacity. Chainsaw milling, practiced efficiently, has the potential to be a low-carbon subsector of

the forestry industry. Unfortunately, some of these advantages are lost when the recovery rate is low. This is often the case; the conversion rate per tree in Guyana is usually below 40%.

Environmental and safety standards are very important in this regard. All efforts will therefore be made to ensure that operators meet these standards, while maintaining the activity as an important source of economic livelihood. From the standpoint of the government, monitoring and enforcement is being strengthened, while training and sensitization are being done on an ongoing basis. Occurrences of illegality and breach of standards will not be tolerated; the LCDS will require all operators in the managed forest area (State Forest Estate) to strictly comply with rules and regulations.

Chainsaw milling is part of forestry activities in Guyana. The LCDS is a much wider strategy that addresses more than forestry alone, and it provides a suitable framework to support forestry activities, under strict regulation and codes of practice. Guyana is moving from vision to action to demonstrate the effectiveness of providing economic incentives to reduce deforestation and forest degradation. The country has set out a practical, replicable model of how to protect its forests and reduce greenhouse gas emissions and at the same time provide a sustainable path for economic development and improved standards of living.

Endnotes

1. See Government of Guyana. 2010. Guyana's Readiness Preparation Proposal (R-PP), 2010, World Bank Forest Carbon Partnership Facility.
2. See Bank of Guyana Annual Reports.
3. See the Guyana Forestry Commission annual production report 2009.
4. This was performed by McKinsey & Company, incorporated in the U.S.
5. REDD is Reducing Emissions from Deforestation and Forest Degradation. REDD+ goes beyond deforestation and forest degradation and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.



3.6 The chainsaw milling subsector in Guyana

GODFREY MARSHALL and ROHINI KERRETT

Introduction

The tropical high forests of Guyana cover some 16.4 million hectares (ha) or about 76% of the country's total land area (Table 1); 13.6 million hectares have been designated State Forests to support forest industries, among other purposes. The forestry authority is the Guyana Forestry Commission (GFC).

Small-scale loggers have been an integral part of the forestry sector since the 1920s. Traditionally, their timber-harvesting technologies were labour intensive and they depended almost totally on the sale of logs and other products to sawmillers or other intermediaries.

The chainsaw was introduced to Guyana by FAO in 1967 (Vieira 1980) to improve the efficiency of tree-felling practices and to salvage merchantable material from non-harvestable trees. Chainsaw milling emerged in the 1970s (Lewis and Hodge 2008). Small-scale loggers, holders of communal lands and new entrants to the sector, such as ex-miners, ex-public servants, farmers and businesspeople, embraced chainsaw milling with alacrity, primarily because it offered them a more feasible livelihood option than traditional logging. The GFC had some challenges in managing chainsaw milling operations, mostly in the 1970s and 1980s, because illegal chainsaw operators moved quickly and surreptitiously through State Forests and private lands.

The local market utilizes large volumes of various grades and dimensions of rough-sawn timber for uses including bridges, piers and use in the agricultural sector (sluices, fences and pens for livestock); chainsawn lumber satisfies 80% of this market. Registered production with the GFC shows that chainsawn lumber increased from 751 m³ in 1980 to about 73,000 m³ in 2009 (Figure 1).



IN SOME COMMUNITIES, THE EARNINGS FROM CHAINSAWN LUMBER HAVE BECOME THE PRIMARY SOURCE OF INCOME, SUPERSEDING THAT FROM MORE TRADITIONAL PRACTICES SUCH AS FARMING.

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Table 1. Key facts about forestry in Guyana

land area	215,000 km ²
population	750,000
forest area	16.4 million ha
total number of people employed by the forestry sector	24,126
State Forests (managed directly by the GFC)	13.6 million ha
▪ State Forest Permission	1.7 m ha
▪ Wood Cutting Leases	0.07 m ha
▪ Timber Sales Agreements	4.2 m ha
▪ State Forest Exploration Permit	0.6 m ha
▪ Reserves	1.5 m ha
▪ Unallocated area	5.6 m ha
average annual log and other roundwood production (State Forests and private lands)	* 337,116 m ³
average annual chainsaw lumber production (State Forests and private lands)	** 67,931 m ³
recovery efficiency, chainsaw milling	19–44%
recovery efficiency, static sawmills	47–65%
deforestation rate	0%
contribution to GDP (primary production)	2.70%

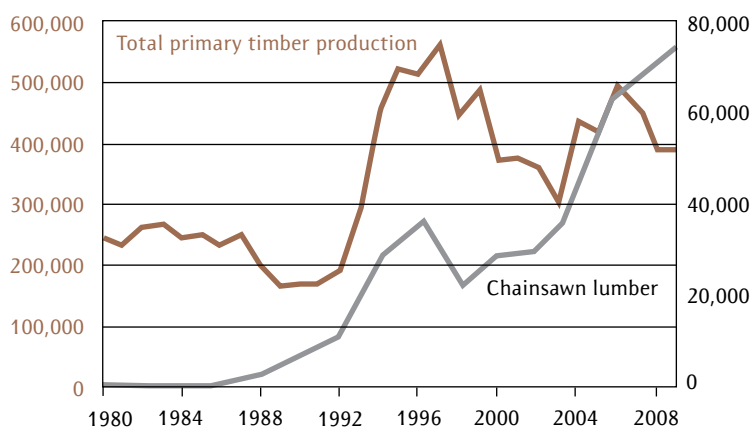
*average yearly production for 2005–09; **average yearly production for 2002–06;
Sources: GFC 2007, 2009, 2010; Clarke 2009; Kerrett and Wit 2009

Institutional and legal framework

For small-scale operators, the GFC grants State Forest Permissions (SFPs) for areas of less than 8,000 ha for periods up to two years, with an option for renewal. In many instances, groups of small-scale operators pool their resources and organize themselves at the community level into small loggers associations (SLAs). Forestry operations also take place on communal (Amerindian) lands, totaling some 2.4 million ha, and provide a means of livelihoods for SLAs. SLAs have generally embraced chainsaw milling technology.

Figure 1. Total timber production and chainsawn lumber production (m³), 1980–2008

Source: GFC 2010



To carry out chainsaw milling, a logger or SLA requires an SFP and a sawpit licence; the SFP grants permission to fell a specified number of trees while the sawpit licence grants permission to “rip” logs (i.e., saw them in the direction of the grain) at the stump site. (A sawmill licence is required for the use of portable sawmills.) The model and serial number of all chainsaws used in SFPs must be registered with the GFC, whether or not the owner intends to carry out chainsaw milling.

Most SFPs have been allocated in logged-over forests or in forested areas designated as conversion forests. Frequently, the number of merchantable trees does not meet the expectations of loggers, even though the GFC encourages them to assess the area before putting in their applications.

GFC set up its Social Development Programme (SDP) in 2001, in recognition of the growing importance of chainsaw milling to the socio-economic development of rural communities. Programme objectives are to ensure that forest-based communities utilize the forest resources allocated to them in a sustainable manner and that, whenever possible, members of the community benefit directly from their forest resources. The GFC, in line with the goals under the programme, supports the formation of SLAs, providing them with technical assistance to organize themselves and acquire the proper legal instruments. As of June 30, 2010, 42 SLAs were registered with the GFC, holding a total of 76 SFPs in State forests; a few SLAs operate on communal (Amerindian) lands.

All loggers within a community are encouraged to join their local SLA. SLAs have 20–90 members and provide the following benefits to them:

- collective negotiation on forest resources;
- collective negotiation on and use of technical assistance, training projects and donor funds; and
- a more organized approach to negotiating prices for the lumber they produce.

The operation of associations is challenging, since some loggers have considerable assets and others relatively little. These are some of the typical issues associated with management of SLAs:

- improper management of documents (e.g., removal permits and log tags) issued to SLAs by the GFC;
- improper management of revenues generated by the SLAs;
- lack of understanding of how GFC determines the number of tags and permits issued to each SLA;
- perceptions about the role, experience and behaviour of forest officers; and
- concerns over the fines applicable to offences under the *Forests Act*.

Taxes are paid on timber harvested from State Forests, but not from private or communal lands.

A major component of GFC’s monitoring practices is the log tracking system introduced in 2000. GFC assigns a two-part tag to every tree approved for harvesting: one part is placed on the stump of the felled tree, and the other is placed on the log, where it stays until the

log is processed. This allows the origin of every log to be traced. The system applies to all operations in State Forests, Amerindian titled lands and other private properties and provides data on the location, scale and legitimacy of forest operations.

There are three main concerns about chainsaw milling: illegal operations; aligning chainsaw-milling practices with other sustainable forest management (SFM) initiatives; and the dependency of communities on chainsaw milling.

The chainsaw-milling subsector in Guyana

Chainsaw milling technology is widely used in small-scale logging operations in Guyana. There is no provision for regulating the model or size of saw. Many local chainsaw operators use either the Stihl 070 or Stihl 051, equipped with a special ripping chain for chainsaw milling. Some operators use Alaskan board mills in conjunction with a Stihl 070 chainsaw, but by and large board mills are not popular. Trees are selected, felled, bucked to length and ripped to produce mostly boards and planks, but occasionally scantlings and squared lumber of size (width and thickness) including 50 cm x 75 cm; 50 cm x 100 cm, 75 cm x 7 cm, with lengths from 2.75 m. Studies indicate that most chainsaw millers achieve recovery rates between 19% and 44% (Benn 2008). Usually, logs are ripped at the stump site; the lumber is transported to the roadside and then loaded on to a semi-trailer pulled by a small farm tractor.



Drivers of chainsaw milling in Guyana

The availability of forest resources and the scope to make a reasonable living from chainsaw milling explain the popularity of chainsaw milling in Guyana. In addition, there are few if any viable livelihood alternatives in rural areas. In many rural forested areas, peoples' involvement in agriculture is seasonal and only at a basic subsistence level due to poor quality, acidic soils. Many of them wish to complement agriculture with earnings from other activities.

There is considerable scope for profits in chainsaw milling due to a strong demand for lumber. Chainsaw millers supply domestic markets with a wider range of species than sawmills. Their lumber is less expensive although the quality is lower. Chainsaw millers are also able to meet the local demand for high-value commercial species by small timber-based enterprises, such as furniture producers. Many owners of conventional sawmills purchase chainsawn lumber and reprocess and export it with lumber from their sawmills.

Impacts of chainsaw milling in Guyana

The GFC reports that 24,126 persons are directly employed in the forest sector and that 8,000 of them (about 33%) are engaged in chainsaw milling on SFPs (GFC 2009). Some 40 communities in Guyana are involved in chainsaw milling; engaging up to as many as 80% of the residents.

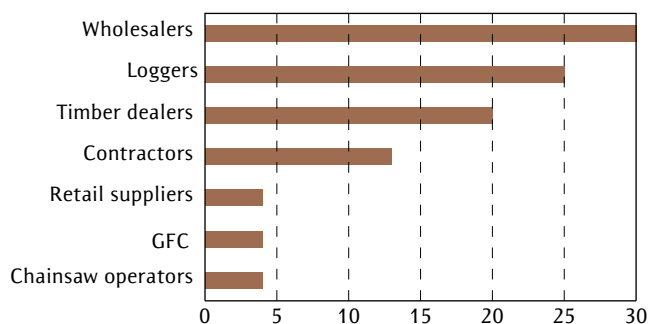
The profitability of chainsaw milled lumber depends on several factors, including type of transport, fuel costs, regional prices for supplies and distance from the point of harvest-

ing to the point of sale; it may vary between loggers by as much as 20%. The proportion of financial benefits in the supply chain increases along the chain from primary producer to retailer (Figure 2).

Figure 2. Distribution of chainsaw milling revenue (%)

Source: Clarke 2009

Note: Wholesalers are bulk suppliers of fuel, rations and other field gear; loggers actually own the forest concession and are responsible for the payment of forest fees; timber dealers purchase timber from SFP owners for resale; contractors provide chainsaws or offer to extract timber; chainsaw operators are the persons who actually produce the lumber.



The environmental effects of chainsaw milling (compared with conventional logging) in Guyana still need to be determined. Commonly reported negative impacts relate to improper felling of trees due to lack of knowledge of directional felling practices and the under-utilization of trees felled. On the positive side, chainsaw milling has a lower impact on the forest due to the lighter equipment used and the absence of skid trails (some old skid tracks are used by tractors pulling lumber).

Chainsaw milling operations' compliance with health and safety and other labour regulations has traditionally been poor. Traditionally, monitoring of occupational safety and health matters in forestry operations — where it occurs — tends to be carried out on larger companies, who manage significantly more resources and are more inclined to seek training for their forest management systems in support of third-party certification.

Conclusions and discussion

It is clear that the transition to a new technology by small loggers and communities in the 1970s and the subsequent uptake by new entrants in the subsector had far greater implications than anticipated at the policy level. The technology has emerged as a major pillar of rural livelihoods.

In some communities, the earnings from chainsawn lumber have become the primary source of income, superseding that from more traditional practices such as farming. Many communities now depend on chainsaw milling. Donors have been helping communities to optimize the use of their resources through various kinds of technical assistance, targeting operational issues such as occupational health and safety and improved milling practices as well as strategic issues such as community development plans. The development of SLAs has helped by affording local people legal access to forest resources and improving the livelihoods of SLA members.

At the policy level, three primary concerns prevail. The potential for illegal operations continues to exist in spite of the GFC's efforts. The main drivers of illegal operations are discontent with the resources allocated, the existence of protected forests, attractive

prices for lumber, and simple greed. The geographic extent of chainsaw milling operations is also a challenge for the GFC. The presence of illegal timber on the market will be a major blow to the marketing efforts of loggers, enterprises and communities, who are striving to conduct their operations in a legal and sustainable manner.

The second concern relates to commitments between the Government of Guyana and international stakeholders on issues of climate change, the conservation of biodiversity and protected areas. It will be a major challenge to ensure that all chainsaw milling practices meet the SFM standards agreed to by stakeholders. How can such a diversity of actors and the businesses associated with them share the responsibility for forest management standards?

The strong dependence of communities and SLAs on chainsaw milling is the third cause for concern. There is no guarantee that forest resources can meet the (long term) needs of the existing number of operatives and their dependents and some restrictions on the scale of logging might be necessary to bring it to sustainable levels. The fallout from such restrictions and the need to seek out alternative livelihood options are major challenges.

Guyana has embarked on a Low Carbon Development Strategy (LCDS), making a major contribution to climate change mitigation generally and SFM in particular (Government of Guyana 2010). The policy approaches underlying forest management strategies are set out in this strategy. One consequence of the LCDS is that the GFC will demand more responsible behaviour from all loggers, including chainsaw millers. Policy-makers have fostered chainsaw milling due to its positive benefits for rural livelihoods and its alignment with national poverty reduction goals. However, policy-makers and stakeholders also want chainsaw milling practices to be in line with approved SFM practices. Chainsaw operators will be expected to produce timber legally, carry out a complete pre-harvest inventory of areas allocated to them, and use reduced impact logging techniques.

Fortunately, since 2007 the Guyanese forestry sector has been benefitting from an EU-Tropenbos International chainsaw milling project, "Developing alternatives for illegal chainsaw lumbering through multi-stakeholder dialogue in Ghana and Guyana." The project is the first to study in detail the nature of chainsaw milling in Guyana and engage all stakeholders in dialogue about the major issues.

New forestry legislation and the current review of the national forest policy statement are expected to formalize the recognition by and integration of chainsaw milling practices in the forestry sector. The multi-stakeholder dialogue sessions currently underway offer chainsaw millers major opportunities to contribute to local forest policies.

For more information

See www.forestry.gov.gy and www.chainsawmilling.org.

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3.7 Chainsaw milling in the Caribbean

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Introduction

The islands of the Caribbean are a diverse group of countries. Following the pre-Columbian settlements of Amerindians in the 16th century the islands were colonized by European settlers and often changed hands between different colonial powers. Most of the smaller islands were English while the larger Antilles remained under Spanish influence. With the exception of a few smaller islands, most of the islands are now independent states.

For centuries the main income of the islands derived from agricultural production and export of agricultural commodities produced in medium- and large-scale plantations (initially sugar and later bananas). For the last 30 years, tourism has made an increasingly important contribution and is now the main source of income.

Most of the island states have a forest cover of approximately 30% of the total land area, although there are exceptions: Dominica has more than 60% of its land area under forest and Haiti has less than 5%.

Forests and the forestry sector

Throughout the insular Caribbean three main phases of forest development took place. In the first phase, forests were used as land reserves for agricultural production and as unregulated sources for timber. This phase started with colonization of the islands by Amerindian settlers and accelerated with the arrival of the European colonists in the 16th century.

The second phase was the emergence of forest management and silviculture; the first regulations to protect the forest were issued in the 17th century. As the negative impacts



IF ADMINISTERED PROPERLY CHAINSAW MILLING CAN PLAY AN IMPORTANT ROLE IN SUPPORTING SUSTAINABLE FOREST MANAGEMENT IN THE CARIBBEAN ISLANDS AND CAN EASILY BE INTEGRATED INTO A NATIONAL REDD+ CONCEPT.

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of unregulated deforestation became apparent, measures were taken to preserve the remaining forest cover. Among the first steps was the definition of forest reserves: areas where trees and timber could be harvested, but the reserve itself remained under forest cover. Rules and regulations on how to use the forests and the creation of a forest administration came in this period. Management rules were defined to preserve the forest and regulate the use of forest resources by the local population. Silvicultural systems, such as the temporary use of forests for agriculture, or the Trinidad Shelterwood System were developed during this period.

With the general decline of agriculture in the Caribbean, phase three is emerging. Following a general policy of trade liberalization, traditional agricultural exports, such as sugar and bananas, can no longer compete with world market prices. The salaries paid in the tourism industry are higher than those for agricultural labour; this contributes to the decline of agriculture. Most Caribbean islands are now net importers of food. As a consequence, areas of agricultural land are increasingly abandoned. If these areas are not converted to alternative land uses, they naturally revert to secondary forest.

The medium and large islands still produce some local timber; smaller islands produce negligible quantities of timber. All the Caribbean islands are net importers of forest products. It is difficult to get reliable data on in-country production, since the sector is very small. National production is believed to be less than 10% of each country's wood requirements.

Since most of the forests are in mountainous areas they are important to protect the watershed protection and to safeguard the provision of water for domestic use, agriculture and industry. In the past, tourism in the Caribbean has been beach-oriented but an increasing number of tourists are showing an interest in ecotourism. Many of the ecotourism attractions are in or around forest areas, which offers additional income opportunities for rural population.

Institutional and legal framework

Most of the forests in the English-speaking Caribbean islands are state owned. They are managed by forestry departments that in most cases are part of the Ministry of Agriculture. Traditionally, a person interested in buying trees approaches the local forestry officer. With the approval of the forestry officer trees are sold and released for harvest. In most countries governments set a fixed selling price per tree, also called royalty or stumpage. In many countries these stumpage fees are far below the price a private landowner would receive for selling a similar tree.

Most persons who purchase trees do not have industrial logging equipment; they fell the trees with chainsaws and use the same saw to convert them into lumber on site. There are no additional fees or costs for converting the trees on site; all costs are included in the stumpage fee.



Chainsaw milling (CSM) appears to be an appropriate way to harvest trees on small islands. Its environmental impact is far less than that of conventional logging, removing the logs with tractors and moving them to sawmills outside the forest. The mountainous terrain makes it difficult to get the logs to the roadside and skidding them causes damage to the remaining forest. With CSM the logs are converted on site; the final product is carried out and the remainder of the tree, such as slabs and bark, remain in the forest.

While conversion on site is allowed in most Caribbean countries, in Trinidad and Tobago any equipment used to convert logs into boards is considered a sawmill and requires a licence. A larger island, Trinidad had a substantive logging and forest industry. The procedures to obtain a sawmill licence were designed for industrial sawmills and the respective fees were too expensive for chainsaw operators. CSM is practised in Trinidad and Tobago, but mostly on private land. Although it is forbidden, few chainsaw millers are caught.

In the other Caribbean islands, where the conversion of logs with chainsaws is generally allowed, chainsaw milling is often associated with illegal practices. The most common offence is chainsaw millers' stealing trees from public or private forest. This is usually more prevalent in state-owned forests, since most of them are in remote areas and lack supervision and thieves run little risk of getting caught. (This is not the case in all countries, however; in Dominica, the Forestry, Wildlife and Parks Division routinely patrols all forested state lands. Private land that adjoins these state lands also benefits from this monitoring.)



Trees are felled and converted on site and boards are carried to a location where they can be hidden for later transport.

The noise level of the chainsaw can be reduced to a point where detection is difficult by extending the exhaust pipe of

the chainsaw with a hose and running the exhaust fumes through a bucket of water. This is a common practice in Jamaica.

Another illegal practice is the felling and utilization of trees without a permit even when the trees belong to the land-owner. In the Dominican Republic, for example, most of the managed forests are on private land, but all timber harvesting requires a forest management plan or an individual cutting permit for a specified number of trees. This is a long and often expensive procedure that many forest owners prefer to avoid. Any lumber produced without these permits is illegal although not stolen. Chainsaws are used to fell trees and convert them into lumber. The likelihood of people being caught felling a tree on their own land is low and the boards produced can be easily transported out of the forest.

Chainsaw milling practices

The traditional form of on-site conversion of logs was pit sawing: the log was rested on a temporary scaffold and two persons — one on top of the log and the other in the pit below — used a long manual saw to do the cutting. This form of pit sawing can still be seen in Haiti. Pit sawing disappeared with the advent of chainsaws, which are now used to cut boards and scantlings (squared lumber). In many countries, CSM was introduced after

a hurricane; when large numbers of trees were blown down and many houses destroyed, there was an immediate demand for construction lumber.

It is difficult to estimate the total volume of chainsaw lumber production (Table 1). Some forestry departments keep records on the number of trees sold from state lands, but there are no statistics on the trees harvested on private land; these may actually outnumber the number of trees sold by forestry departments, even though most of the forest is on public land. It is likely that trees on private land are sold more quickly and more consistently. Private land-owners recognize the value of timber trees and generally trees from private lands are sold at a higher price than the official stumpage fee.

Table 1. Estimated number of CSM operators and number of trees sold, 2009

country	estimated no. of chainsaw operators	average no. of trees sold to chainsaw millers per year	comments
Dominica	20	25	declined over the past years
Jamaica	35	1,500–2,500	only chainsaw operators who buy trees from the forestry department
St. Lucia	60	300	there are more than 80 chainsaw operators but they are not currently active
St. Vincent	6–8	30–50	varies from year to year
Trinidad and Tobago	30	150	estimated number of operators working on private lands

Note: Table 1 is based on the author's personal assessment and on opinions from forestry officers. The figures are not confirmed but they provide an idea of the number of persons involved in the production of chainsaw milled products. The table includes only the people operating a chainsaw, not assistants or workers carrying boards.

In most islands chainsaw milling is not a full-time job (Box 1). Two types of people are likely to get involved in CSM: most are forest workers or farmers who know how to operate a chainsaw; others are carpenters and woodworkers who want access to cheap lumber.

Box 1. Chainsaw milling income in Dominica

A chainsaw miller on the islands can produce an average of 250 board feet (BM) of lumber per day.¹ Given the local price for chainsawn lumber of approximately US\$1 per BM, a chainsaw miller could earn US\$250 per day. Deducted from this is the stumpage fee (approximately US\$20; to obtain 250 BM requires approximately two m³ of round wood at a fee of US\$10 per m³); the operating cost (approximately US\$40 per day); oil and gas for the saw (approximately US\$25 per day); and wages for an assistant or general labourer (approximately US\$25 per day). This means that daily net income could be as high as US\$140, which is approximately six times the salary of an agricultural worker. Operating a chainsaw provides a good income opportunity, provided that there is enough lumber to be cut.

Most CSM or ripping² is freehand. Many operators use the same chain as for felling the tree, although some use a special ripping chain or adapt a felling chain. Many local forest authorities consider freehand cutting a waste of wood resources and are trying to convince chainsaw millers to use a frame and a guide bar, but with limited success. Those who have learned to cut freehand claim that it is faster and as precise as with a guide bar.

Guide bars or “Alaska mills” (see photo, left) are often used by newcomers and less experienced cutters, although this varies from island to island. In Dominica, for example, only forest department chainsaw millers use guide bars; private chainsaw millers prefer to work freehand. In St. Lucia and St. Vincent, guide frames are more common. The Forest Administration of St. Vincent is introducing the Logosol mill, which is highly precise.³



Chainsaw milling is often perceived as wasteful. Although the kerf of a chainsaw cut is broader than that of a band saw or a circular saw, even freehand chainsawing can have a conversion rate of around 40% of lumber from a round log. In addition, conventional logging leaves behind some material — such as branches from large hardwood trees — which

a chainsaw miller may be able to use for smaller boards for furniture-making. A good example is the use of Caoba or Small-leaf mahogany (*Swietenia mahogani*) in the Dominican Republic. Its wood is now so rare and expensive that even small branches are converted into boards to be sold to joineries. Waste in processing is normally the result of low timber prices, so higher prices for raw material are likely to be more successful in reducing waste than any recommendation issued by national forest authorities (Box 2).

Box 2. Cooperative efforts in Dominica

A number of chainsaw millers in Dominica designed a system to encourage the more efficient use of timber: any wood left over from harvested trees was transported to a central drying facility, which also served as a small lumber market. An NGO called the Cottage Forest Industry was established as a cooperative to manage the drying facility, monitor the quality of the processed lumber and help its members get a better price for their products. Chainsaw millers were also expected to carry out timber stand improvement, environmental education, water sampling and associated research within designated concession forests.

While the idea of the Cottage Forest Industry was excellent, it was not successful in practice. The association eventually ceased operating due to internal disputes and the fact that chainsaw millers were selling better quality products directly to consumers and trying to sell the inferior material through Cottage Forest Industry. A steep reduction in the demand for locally produced lumber, due to a new furniture store on the island, also contributed to the decline of the association.

In the Dominican Republic, chainsaw milling is rare. The country has a long tradition of using small band mills to convert logs into lumber. Chainsaw milling is mostly associated with illegal harvesting of valuable broad-leaf species such as mahogany.

Forest harvesting in Cuba is practised and well regulated by state companies in the form of traditional logging operations. Chainsaws are often not available for purchase by individuals so chainsaw milling is limited. It can be assumed, however, that some chainsaw milling is carried out, despite the fact that it is illegal. It is not considered a major problem by the Cuban forest authorities.

Chainsaw milling and the market

Most chainsaw operators in the Caribbean cut lumber according to a specific order from a local buyer, for example, a carpenter or a person building a house. After securing the order the operator goes into the forest, identifies a tree and purchases it from the forestry department. The tree may contain far more timber than the order requires and the excess material is often left in the forest to rot.

Most chainsawn lumber is being sold soon after it is cut; very few chainsaw millers have the patience or the resources to stack the lumber to dry. The fact that the wood is green and often unevenly cut contributes to the perception that locally produced lumber is of inferior quality. In general the price of chainsawn lumber is 10–30% below the price of imported lumber.

The distance to the nearest forest track or location accessible by a vehicle is key to profitability. In general, chainsaw milling in the islands is limited to areas within one km of the loading point. The greater the distance, the less interested the operator is in buying trees.

It is difficult to assess the economic value of chainsaw production in the islands because the sector is very small and often part of the shadow economy (Box 3). In addition, CSM is often associated with illegal activities, which are not recorded.



Box 3. Potential value of chainsaw milling: an example from Dominica

Dominica has a forest cover of approximately 40,000 ha. Only 6,000 ha are suitable for forest management and harvesting; the remainder is protection forest. Assuming a conservative growth rate of one m³ per year per hectare, the forest could sustainably provide 6,000 m³ of harvestable wood or approximately 2,400 m³ of chainsawn lumber. This is equal to approximately 1,017,600 BM. Based on a local price for chainsawn lumber of US\$1 per BM, this represents a value of more than US\$1 million.

Conclusions and recommendations

Chainsaw milling is well suited to islands that do not have an established forest industry. It requires only a small investment; the only equipment to be bought is a chainsaw. Guide rails and other tools can be acquired locally. Boards and planks, although heavy to carry, can be moved with hand tools such as ropes, pulleys and simple trolleys. Once the boards reach a forest track they can be transported using standard pick-up trucks.



Chainsaw milling provides income for rural people. Rafters and scantlings for house construction and boards for the production of local furniture will always have a market. In light of the reduced income from traditional agricultural activities, chainsaw milling and local production of lumber may become more important. The total volume of production and employment it could provide is limited, however, given the small scale of the available forest resources and

the fact that on most islands these resources are in environmentally sensitive areas.

Chainsaw milling is less damaging than traditional logging operations to the remaining forest. The lower recovery rate from chainsaw milling can be compensated by converting thicker branches to lumber and not just the trunk of the tree. In addition, chainsaw milling is generally practised close to the end user. The chainsaw miller and the end user are in direct contact; if the end user requires short dimension lumber the chainsaw miller can cut it directly from short dimension roundwood. In conventional logging operations these shorter pieces of roundwood are seldom used.

If administered properly chainsaw milling can be an important part of supporting sustainable forest management in the Caribbean islands and can easily be integrated into a national REDD+ concept.

To unlock CSM's economic potential, it is important that national forest authorities put in place a forest management system to streamline the process of resource allocation. Silvicultural planning should indicate the areas to harvest, and administrative procedures must ensure equitable and just access to forest resources. Flexible agreements on timber bidding and sales should replace timber prices that are 10 to 20 years out of date.

Open procedures for resource allocation will avoid favoritism and corruption. Simplifying administrative procedures does not mean reducing monitoring. Although the harvesting of trees, the conversion of logs into boards and the marketing of the finished product should be left to the private sector, monitoring, compliance with silvicultural practices and harvest control should continue to be the responsibility of forest authorities.

Endnotes

1. Lumber is mostly sold in board feet measurement (BM); 424 BM is equal to one m³ of lumber.
2. Ripping is cutting along the grain of the wood.
3. The Logosol mill consists of a powerful chainsaw, mounted on a slide that moves along an aluminum guide rail and is fixed to a log rest that is raised after each cut.



3.8 The impact of REDD+ projects on chainsaw milling in Peru

LUCIO BROTTTO

Introduction

Most forest degradation and deforestation occurs in the tropics; they account for at least 15% of the global anthropogenic emissions of greenhouse gases (van der Werf et al. 2009). Timber harvesting, either small scale or industrial, is one of the major direct causes of tropical forest degradation and deforestation (Geist and Lambin 2001). With the first Reducing Emissions from Deforestation and Forest Degradation (REDD+)¹ projects under development in the voluntary carbon market, it is possible to better understand their impacts on timber harvesting, particularly on chainsaw milling (CSM).

Forest products market and legislation in Peru

With 67.9 million hectares (ha), Peru has the ninth largest forest area in the world and the second largest in Latin America after Brazil. Historically, the deforestation rate has been low: -0.1% between 1990 and 2005 (FAO 2009 and 2010). Despite these forest resources, the forest sector accounts for only 1.1% of the national Gross Domestic Product (Lebedys 2008). Most Peruvian forests (about 66 million ha) are located in the tropical Amazon known as *selva* and are relatively inaccessible. The Andes Mountains separate the *selva* from the Pacific coast, where most economic and commercial activities take place. Peru tends to import high-value products (e.g., finished high-quality paper) and export secondary processed wood products (e.g., sawnwood). As a result, import values are higher than export values, with a difference of US\$288 million in 2007 (INEI 2008).



SELECTING APPROPRIATE
PROJECT ACTIVITIES AND
CAREFULLY UNDERSTANDING
LOCAL REALITIES WILL HELP

REDD+ PROJECT DEVELOPERS ADDRESS
CSM IN A MEANINGFUL WAY.

In the last ten years, the Peruvian government has favored the international timber market through reforms in the forestry sector, trading and infrastructure. With the *Forest and Wildlife Law*³ and the 2002 logging title reform, roughly one sixth of the forest area (10.4 million ha) became permanent commercial timber concessions (Oliveira et al. 2007) with a minimum title duration of 40 years. The 2009 free trade agreement with the United

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States facilitates foreign investments in the timber, mineral and fossil fuels sectors, whose resources are mainly concentrated in the Peruvian Amazon. The completion of the Inter-Oceanic Highway in 2010, passing through the Madre de Dios Region and connecting Brazil with the Pacific Coast, provides access to the Chinese timber market.

With some exceptions, the new *Forest and Wildlife Law*⁴ prohibits chainsaw milling⁵ under articles 347 and 410. Chainsaws and similar equipment⁶ are permitted only in the following situations:

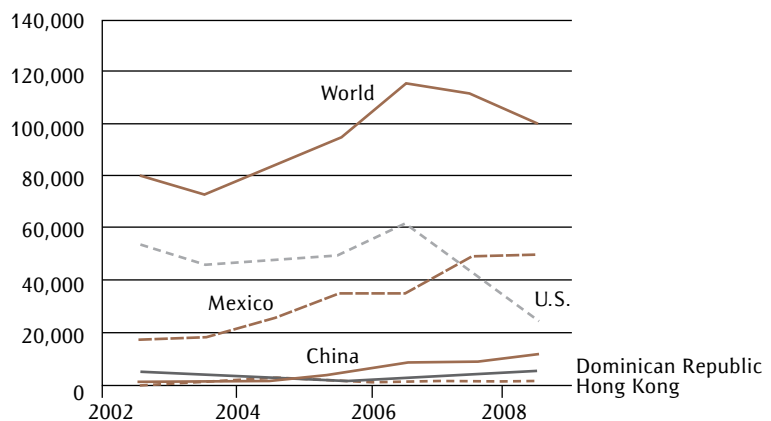
- the harvesting area is difficult to reach;
- relevant constraints are reported in the forest management plan; and
- a forest owned by native communities or a permanent timber concession allocated to qualified loggers.

All CSM equipment must be registered with the Organization for Supervision of Forest and Fauna Resources (OSINFOR).

With the 2008–09 financial crisis, major historical importers of high quality sawnwood, such as the U.S., began to lose market share while importers of lower quality sawnwood, such as China and Mexico, increased their share. In January 2009 the export value of sawnwood was 63% lower than in the same period in 2008.⁷ Exports of high-value sawn timber (e.g., mahogany, or *Swietenia macrophylla* G. Kin and tropical cedar, or *Cedrela odorata* L.) decreased considerably and were only partially compensated for by the Chinese and Mexican markets (Figure 1).

Figure 1. Major importers of Peruvian sawnwood (US\$000), 2002–08

Source: COMTRADE



In 2008 the domestic timber market consumed about 1,000,000 m³, eight times the quantity of exported sawnwood.⁸ This is the highest value ever documented (Caillaux and Chirinos 2003). The severe restrictions on chainsaw milling imposed by the new forest law and the stagnant export market has caused cheap sawmilled wood to be dumped on the local market. There is a substitution effect, however; if less low-quality sawmilled wood is available in the local market, chainsawn timber takes its place.

Timber markets in the Iñapari area

The study area (Figure 2) is located close to the borders with Brazil and Bolivia, at the east Peruvian end of the South Interoceanic Highway. The closest village is Iñapari, with approximately 6,000 inhabitants, the only centre in a radius of 300 km. Mahogany logging began in the 1960s and increased in the late 1980s, when the first chainsaws and sawmill equipment arrived (CESVI 2006). In 2002, with the reform of logging title, small-scale Peruvian loggers grouped together to form a single large company. At the same time, thanks to the new highway, foreign investments from Brazil and China contributed to the creation of other large timber companies in the area.

Figure 2. Iñapari and the Madre de Dios Region



Three timber companies operate in Iñapari with their own sawmills. They employ villagers, mainly immigrants arriving from the Peruvian Sierra and forestry workers from the Pucallpa area of central Peru. The companies export sawnwood to Brazil, the U.S. and China. One family-owned company supplies the local market (Table 1). Logs are

mainly sourced from two FSC-certified permanent forestry concessions (Maderacre & Maderyja, or M&M) and from BÉLGICA Native community forest. Skidders facilitate the extraction and logs are transported by road to Iñapari to be processed. Despite the increase in international exports, most companies have suffered from the world's financial downturn, with the exception of those involved in the export to China.⁹

Table 1. Timber companies operating in the Iñapari area, 2009

company	origin	organizational structure	source of timber	market
Maderera Río Acre S.A.C.*	Peru	small association of Peruvian forest owners	own concession (49,366 ha)	export to U.S.
Maderera Río Yaverija S.A.C.*	China	branch of Chinese Nature Flooring	own concession (49,556 ha)	export to China and flooring in Lima
Agro Industrial Victoria S.A.C.	Brazil	Brazilian-owned company	own concession (6,221 ha) and BÉLGICA Native Community forests (53,394 ha)	export to China and Brazil
Asseradero Fundo Roble	Peru	family-based company	from other companies and CSM practised by individuals	carpentry and builders' joinery for local housing, domestic market

* Forest Management/Chain of Custody certification under the Forest Stewardship Council

In the last ten years low-quality sawnwood produced by the Iñapari sawmills and unsuitable for export has almost satisfied the local demand and replaced CSM sawnwood. As a consequence, CSM has declined in the Iñapari area. In 2010, the processing volume of the Iñapari sawmills decreased due to the financial crisis. In the short term this will likely lead to a scarcity of sawnwood for the Iñapari local market and thus likely fuel CSM.

CSM is practised in only two areas:

- along the highway, where forest is formally recognized by the government as agricultural land and where clear-cuts are allowed. In most cases, immigrants occupy agricultural parcels along the road and burn the forest without logging it in order to quickly claim land rights. In some cases, forestry workers from Iñapari with skidders are hired by these immigrants to extract logs to illegally process it locally using a frame mill (*castillo*) or chainsaw. The sawnwood is sold on the informal market for local housing, in central Peru or in the Brazilian market; and
- in Bélgica Native Community forests, with the sole purpose of building new community houses. Timber companies in this community forest release logs (usually of marketable but lower-value species such as *Dipteryx* spp. or *Shihuahuaco*) close to the village yard to be legally processed by chainsaws. Since the first contract with timber companies was signed in 2003 (CESVI 2006), this practice has become less common; timber companies tend to provide villagers directly with low-quality sawnwoods sourced from the community forest and processed by the sawmills of Iñapari.



Some CSM forestry workers on agriculture land also work in the large-scale logging business.

Impacts of REDD+ projects on CSM

In 2007, two REDD+ projects began in the Iñapari area (Table 2):

- the Madre de Dios Amazon REDD project in the M&M permanent logging concessions; and
- the REDD+ project in the Bélgica Native Community forest.

The two project areas are adjacent to each other, close to the South Interoceanic Highway. They are the major timber sources for the Iñapari sawmills (Figure 3).

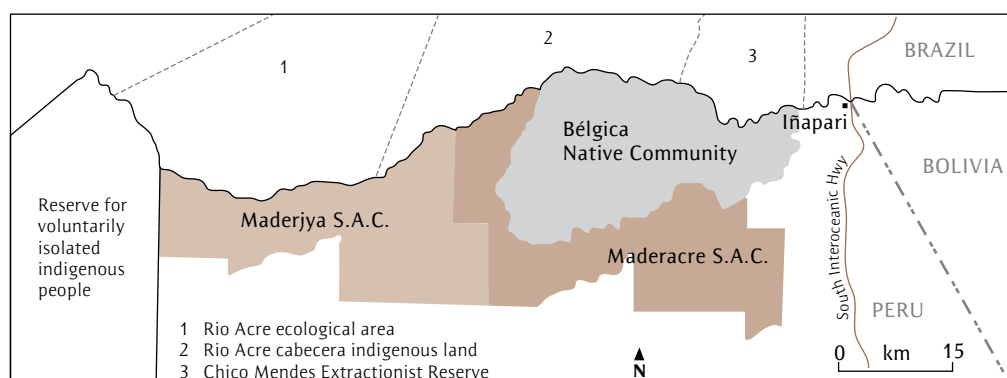
CSM occurs inside the leakage belt¹⁰ in the project region of both REDD+ projects due to the clearing of agricultural parcels by immigrants. It is considered as a driver for deforestation and forest degradation and hence is included in calculations of the deforestation rate for the project region. In Bélgica, villagers used CSM to produce sawnwood for community housing. CSM is also considered to be a cause of degradation and a source of emissions to be addressed by project activities.

Table 2. Description of two REDD+ projects¹¹ in Madre de Dios, Peru

project	M&M	Bélgica
size (ha)	98,932	53,394
FSC certified	yes: FM/CoC	no
Carbon Standard	Climate Community and Biodiversity Standards (CCB)	CCB and Voluntary Carbon Standard (VCS)
status	validated and first credits sold	contracting phase
pre-project activities inside project area	selective logging for sawmills	selective logging for sawmills, slash and burn cultivation, cattle ranching, hunting and fishing by community members, CSM by villagers
project activities	<ul style="list-style-type: none"> ▪ improved forest management (IFM) through FSC certification ▪ patrolling and establishing a new control post ▪ environmental education ▪ 100% borders delimitation ▪ agriculture land management (ALM): improve pre-existent agriculture and cattle ranching productivity in leakage belt ▪ sustainable development or rural communities living in buffer zones 	<ul style="list-style-type: none"> ▪ IFM and reducing emissions from conventional logging through FSC certification ▪ ALM: improve existing agriculture and cattle ranching productivity of Bélgica Community ▪ reduced emissions from fire and deforestation due to incursions of Brazilian farmers ▪ increased knowledge of tropical agriculture and forest management ▪ ecotourism

Source: adapted from Schroeder (2009)

Figure 3. REDD+ project areas



Improved Forest Management (IFM) is the major activity in both projects. Four Voluntary Carbon Standard¹² (VCS) methodologies are being developed that are applicable to IFM. Each of these could have different impacts on CSM (Table 3).

Table 3. Carbon methodologies under the VCS of possible use in REDD+ projects

methodology name	activities	likely impacts on CSM	likeliness of being adopted
IFM through Extension of Rotation Age	extension of rotation age	slight increase in CSM in both agriculture parcels and Bélgica due to shortness of sawnwood	likely
IFM through avoidance of re-logging and rehabilitation of logged-over forest. V. 1.0	conversion of low-productive forest to high-productive forest ¹³	decrease in CSM in both areas due to short-term higher employment of forestry workers and villagers and medium-term increase of productivity in concessions	more likely than not
Estimating GHG emissions Reduction from Planned Degradation (IFM)	cessation of selective logging activities	large increase in CSM in agricultural parcels; stable CSM in Bélgica with likely increase of illegal timber logging	unlikely
Improved Forest Management — Logged to Protected Forest Methodology. V.1.3	protect currently logged/ degraded tropical forest and unlogged forests from further logging; project activities can include traditional use of forests and forest products for domestic resources that do not result in commercial timber harvest or forest degradation	large increase in CSM in agricultural parcels; stable CSM in Bélgica with likely increase of illegal timber logging	unlikely

Source: www.v-c-s.org and own elaborations

Project developers in both M&M and Bélgica did not strictly follow any of the available IFM methodologies. Ending or considerably lowering the timber harvesting rate inside the project area would cause leakage — due to the displacement of harvesting activities to other Madre de Dios permanent logging concessions or the increase of CSM — and would have negative impacts on the local economy, which depends on timber harvesting.¹⁴ Project developers preferred to adopt reduced impact-logging (RIL) techniques and plan for voluntary certification under the responsible forest management scheme of the Forest Stewardship Council (FSC). RIL techniques include inventory of the annual harvesting area and better road planning and training of forestry operators. This is expected to reduce leakage and the consequent loss of carbon credits.

The fact that M&M and Bélgica actors are involved in CSM is an important issue in the REDD+ project design. They are at the same time agents of forest disturbances and participants in a REDD+ project; this double role could lead to perverse economic incentives. For example, if the forest degradation rate increased due to CSM and was not directly linked to industrial harvesting, the REDD+ project developers would be entitled to claim higher reduced emissions per ha. In order to address this problem, project developers developed a set of activities aimed at providing alternative income to communities, and increasing their environmental awareness and control over forest resources.

In Bélgica, villagers were not asked to give up CSM but were informed about the trade-offs of cutting down trees, the possibilities of purchasing sawnwood through carbon income and income from improved land management. They were also given information about improved housing construction techniques.

M&M project developers will use carbon income to raise environmental awareness, improve grazing and agriculture practices in the leakage belt, guide the participatory formulation of a local development plan and control forest entries.

Conclusion

The forestry law and the internationalization of timber markets marginalize CSM in Peru. In the Madre de Dios region, the large availability of sawmilled timber seems to satisfy the local market demand for housing. CSM might find renewed market possibilities given the financial crisis and the export crash in the forestry sector, combined with the scarcity of low-quality sawnwood.

Each day 300 new immigrants arrive in Madre de Dios from the Peruvian Sierra and Brazil via the South Interoceanic Highway. In the next 30 years the population is expected to increase from 110,000 to 630,000 (Schroeder 2009; INEI 2008; Aramburú 2004). How will an export-focused market satisfy the domestic timber demand for housing in the near future? CSM is not likely to become an option in Peruvian legislation, but there are several alternatives:

- differentiate in the use of timber species to favour high-grade mahogany and cedar for export and use less valuable species for domestic consumption (e.g., *pashaco*, or *Schizolobium parahyba* (vellozo) and lupuna, or *Pseudobombax septenatum* Jacq.);
- increase the processing efficiency of sawmills;
- augment the durability of timber; and
- substitute concrete and bricks for wood.¹⁵

REDD+ projects are having an increasing impact on CSM activities. During the Oslo Climate and Forest Conference in May 2010, 58 partners pledged a total of US\$4 billion¹⁶ to these projects. They are already part of the voluntary carbon market and the case studies of the Madre de Dios region show that they could have an impact on CSM.



CSM could be fuelled by harvesting restrictions in REDD+ project areas. Selecting appropriate project activities and carefully understanding local realities will help REDD+ project developers address CSM in a meaningful way. In cases such as Iñapari, where the timber

industry is the major economic driver, the FSC certification of forests represents an economic trade-off between the delivery of carbon credits and the maintenance of the local timber industry. Pursuing forest multi-functionality and preventing forest managers from focusing exclusively on carbon subsidies is essential to maintaining financial benefits for forest users in the long term, and to maintaining the forests themselves.

For more information

This research was done in the framework of the Department of Land and Agro-forestry Systems (TESAF), University of Padua (Italy). Since 1996 TESAF has carried out academic research on markets for forest products and services in Italy and Europe and in Madagascar and South America. The focus is forest multi-functionality and payment for environmental services. For more information on M&M, contact

José Luis Canchaya Toledo (jcanchaya@maderacre.com) or go to www.climate-standards.org. For information on Bélgica Community, contact Cecilia Persivale (cmpersivale@gmail.com) or go to www.asesorandes.com.

Endnotes

1. In Copenhagen in December 2009, responsible forest management was confirmed as one of the financed activities in projects aimed at Reducing the Emissions from Deforestation and Forest Degradation, or REDD+ (UNFCCC 2009).
2. All views presented in this paper are strictly those of the author and do not represent the views of the organization with which he is affiliated.
3. *Ley Forestal y de Fauna Silvestre, Ley No. 1090.*
4. *Consejo Superior de Contrataciones y Adquisiciones del Estado 2009.*
5. Madera aserrada a pulso.
6. This includes local frame mills as castillos and hechizos.
7. See www.adexdatatrade.com.
8. See FAOSTAT.
9. This is based on interviews in July 2009.
10. Project area: is the area or areas of land on which the project developer will undertake the project activities. Project region: is the spatial delimitation of the analytic domain from which information about deforestation and degradation agents, drivers and rates is estimated, projected into the future and monitored. The region includes the project area and is defined by the project developer using transparent criteria. Leakage belt: the geographical area surrounding or adjacent to the project area in which displacement of pre-project activities from inside to outside the project area is likely to occur (Pedroni 2008).
11. Although M&M is called a REDD project, it is actually a REDD+ project. At the time it began, project developers did not know what the "+" stood for.
12. See www.v-c-s.org.
13. Following the "Face the Future Foundation" methodology IFM is achieved through the protection and rehabilitation of logged-over, degraded forest from further logging and the adoption of



silvicultural techniques (cutting of climbers and vines, liberation thinning and/or enrichment planting) increasing the density of trees.

14. In the northern Iquitos region deforestation and degradation of the forest increased by 468% outside concessions areas, granted in 2004, as an effect of leakage (Oliveira et al. 2007). The major cause was the increased regulations associated with logging title reform and the attempt of the state to better monitor the harvesting level inside permanent logging concessions.
15. This is already partially implemented by the government's program *Techo Proprio* (Your Own Roof), which is going to finance 150 new houses in Iñapari made with a concrete basement, walls with bricks on the bottom and wood on the upper portion, covered by corrugated iron roof.
16. See www.oslocfc2010.no/hjem.cfm.

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3.9 Chainsaw milling in Suriname

RUDI VAN KANTEN and REWIE MATAI

Introduction

Chainsaw milling (CSM) is underestimated in the government statistics that are maintained by the Foundation for Forest Management and Production Control (SBB) in Suriname. An important part of the domestic timber market is supplied by CSM, both in production volume and source of income for forest dwellers and other people involved in the marketing chain. SBB also controls the timber markets but there are no exact figures on the extent of CSM timber in these markets.

Forests and the forestry sector

Suriname has a population of approximately 520,000 on 16.4 million hectares (ha) of land. The forest area covers approximately 90% of the country. The forest, which is considered under-utilized, contributes less than 2% to the Gross Domestic Product (GDP), most of which comes from timber production and processing. The contribution of the forest sector is slightly higher if shifting cultivation and nature-related tourism are included.

Logging in Suriname is restricted to an area known as the Forest Belt within reach of road and river transport systems. Within this area, which covers around 4.2 million ha, 2.2 million ha are timber concessions; 1.5 million ha of these are issued to private entrepreneurs and 0.5 million ha to indigenous and tribal communities (Table 1).

The country's original inhabitants or Amerindians (4% of the total population) and Maroons (descendants of African slaves who successfully fought for their freedom; 12% of the total population) depend on the forest for their livelihoods. Amerindians live in the savanna and Maroons live along the major river basins. A considerable number of the Amerindians and Maroons live in the coastal area.



THE MAIN PROBLEM FACING CSM OPERATORS IN SURINAME IS THE UNCERTAINTY OF OPERATIONS, WITH NO SECURE LONG-TERM ACCESS TO FOREST RESOURCES.

Rudi van Kantén is Programme Director, Tropenbos International Suriname and **Rewie Matai** is Economist, Foundation for Forest Management and Production Control.

Table 1. Key facts about forestry in Suriname

Land area	16.4 million ha
Population	520,000
Forest area	14.8 million ha
▪ not considered for log production	8.4 million ha
▪ destined for log production	4.2 million ha
▪ protected	2.2 million ha
Yearly average log production	160,000 m ³
Yearly average chainsaw lumber production	20–30%
Yearly average sawmill lumber production	70–80%
Deforestation rate	0.07%
Contribution to GDP	2%

Annual registered timber production, mostly roundwood, averaged 160,000 m³ from 1998–2009. Of the total roundwood production of 206,970 m³ in 2009, 10,787 m³ was produced by CSM and transported as sawnwood to the market (Table 2). SBB estimates that illegally produced CSM timber is about 20–30% of total annual production. There are about 70 sawmills, mostly in the coastal area. Logs are transported by road (60–70%) and river (30–40%). There are about 200 loggers (small companies or groups of individuals).

Table 2. Total roundwood production in Suriname (m³), 1998–2009

year	logs	hewn squares/ poles	fence posts	sawnwood pro- duced by chainsaws	total roundwood production
1998	141,031	2,524	996	3	144,554
1999	89,930	1,685	1,044	1,256	93,915
2000	171,265	2,030	1,550	1,616	176,461
2001	155,135	1,804	3,033	2,334	162,306
2002	145,353	3,972	2,682	1,769	153,776
2003	147,053	3,712	3,290	1,394	155,449
2004	153,279	1,519	2,137	2,477	159,412
2005	170,391	648	2,415	7,437	180,891
2006	190,119	654	1,591	692	193,056
2007	154,207	601	2,235	9,322	166,365
2008	178,576	689	2,021	16,108	197,394
2009	188,269	1,388	6,524	10,789	206,970

Source: SBB Timber Production Statistics, 2010

Institutional and legal framework

Suriname's *Forest Management Act* dates from 1992 and the National Forest Policy from 2003. The Forest Management Act is being updated. In 2009 a Strategic Action Plan for the forest sector was approved. It focuses on forest management and includes no specific

articles and statements on CSM. The plan does allow the on-site processing of timber, by both portable mills and chainsaws, in all types of timber harvesting licences.

Suriname has five types of harvesting licences (Table 3). Concessions larger than 150,000 ha have to be approved by Parliament. Communal Cutting Licences, which are registered in the name of village captains, are issued for an unlimited time.

Table 3. Size and duration of timber harvesting licences in Suriname

area (ha)	duration (years)	renewal (years)
less than 5,000	5	5
5,000–50,000	5	5
50,000 –150,000	10	10
larger than 150,000	10	10
community logging: average of 3,000–4,000	undetermined	n/a

Source: *Forest Management Act 1992*; Note: renewal is for one period only

After 20 years the large concessions cannot be renewed by the same licence holder. This makes management systems for longer than 20 years impractical, unless the licence is renewed in the name of another individual who is linked to the enterprise. There are no specific concessions or licensing agreements for CSM and there are no specific restrictions on CSM of privately owned trees. The activity is allowed, but policy guidelines for the use of both chainsaws and mobile mills are not yet in place. There is no data on potential conflict with other types of forest use. Chainsaws and mobile mills can be bought without any restrictions. Purchasers pay value added taxes but do not need to register the machines. CSM operators pay operational and harvesting costs (US\$30–35 for tree felling and transport per m³ of timber).

A specific planning and control system for CSM is not yet in place. The tracking system for all types of timber production systems consists of listing felled trees in a cutting register and recording the timber for transport. Sawwood is also recorded on the transport form. All recordings are the responsibility of the producers. Forest charges on sawwood are calculated on the basis of the estimated roundwood volume. SBB maintains a conversion factor of 50%. The fee is US\$6.00 and US\$5.50 per m³ for classes A and B, respectively. Area fees are SRD 0.03, (US\$0.01); SRD 0.05 (US\$0.02); and SRD 0.10 (US\$0.04) per ha per year, respectively for short-, mid- and long-term concessions. Community forests are free of charge. A concessionaire with 25,000 ha pays an annual fee of around US\$450.

One of SBB's objectives is to make the CSM sector more transparent, stop illegal logging and bring producers into the formal economy. This can be done by issuing short-term forest concessions to registered producers. Chainsaw millers are very mobile, however, and shift locations almost every day; SBB does not have the facilities or staff to locate and control them. At the time of writing this article the government had plans to establish a new Forest Management Authority (Bosnas) to improve forest management and monitoring. It is not yet known when this will occur. In the meantime SBB has invested in field posts and transportation facilities, and is planning to recruit more forest guards.

Chainsaw milling

Origin of CSM

Chainsaw milling became widespread in the mid-1990s when Maroon people started to rehabilitate villages damaged during the armed conflict in the interior (1986–92). People from Amerindian villages and the coastal area also started to use CSM to transform forest areas into agricultural plots. More and more people are purchasing mobile mills. NGOs have tried to encourage the use of mobile mills in communities and provided support in the form of training and funding. None of the initiatives were successful, partly because of the villages' lack of capacity in project administration. The fact that neither chainsaws nor mobile mills are registered upon purchase makes it difficult to regulate the activity.

CSM activities

People from the hinterland villages carry out CSM in community forests or outside the region. Producers work individually or in small groups consisting of one operator and two helpers, usually family members or friends. Most CSM operators are working or have worked in the logging and wood-processing sector. This form of CSM is illegal.

CSM is also used on land that is being cleared for shifting cultivation. This practice is not illegal. CSM is used for processing useful timber species in forest areas (1–2 ha) that are cleared for small-scale gold mining. This mining activity is often uncontrolled.

Marketing of CSM lumber

People in forest-dependent communities produce timber for their own purposes. The timber is also used in the artisanal gold-mining sector. Most of the commercial timber goes to the furniture industry or to small timber markets in the coastal area (statistics are not available). The price of CSM timber is low due to smaller production costs and lack of fees; owners of traditional sawmills claim that they cannot compete with this price.

The main problem facing CSM operators in Suriname is the uncertainty of operations, with no secure long-term access to forest resources. This makes it difficult to plan investments, such as replacing chainsaws and buying parts for mobile mills. The chainsaw business has a hit-and-run nature.

A significant percentage of CSM timber is transported to the markets in closed trucks, evading SBB forest inspectors, who are only allowed to inspect open trucks. Only the police are allowed to inspect container trucks.

Social impacts

CSM is an important source of income for people in forest-dependent communities. Some CSM operators have been able to purchase new chainsaws and or mobile mills, presumably with revenue from the activity. The structure of the communities, whereby the village captain decides the way and by whom the community forest can be utilized, can drive illegality and uncontrolled logging and chainsaw milling within and outside community forests.

CSM requires relatively little financial investment; this creates an opportunity for many unemployed people from the forest. Community members who do not have permission

from the village captain to work in the community forest try to make a living elsewhere in the forest by producing boards with the chainsaw without a licence or permission.

The Government of Suriname has started a process to provide all community members with equal development opportunities. The process is being led by the Ministry of Regional Development in cooperation with the Ministry of Physical Planning, Land and Forest Management. Under this new approach decisions on the use of resources by communal cutting licences will no longer be made solely by the village chief but by a group of villagers. Villagers do not see much of the revenue from traditional communal cutting licences and village captains often allow contractors to harvest the forests unsustainably.

CSM provides an opportunity for timber production with a relatively small investment in areas which are less accessible, such as the Afobakka Hydro-electric Lake in central Suriname. If it is efficiently carried out, CSM can contribute significantly to the development of community forestry, resulting in increased income for the local people, work opportunities and a more sustainable way of maintaining both forests and livelihoods.

Conclusions and recommendations

At this moment CSM is not considered a threat to forests in Suriname. Although data is not available, chainsaw milling is expected to increase. If conducted safely, under the principles of sustainable forest management and governed by effective regulations, CSM can contribute to sustainable livelihoods in the interior, since relatively small investments are needed to start production and there is a market to supply. Other people involved in the activity — such as loggers from other areas, transporters, lumber markets and wood processing industries — can also benefit from CSM. At present, only a few persons have accumulated enough capital to improve their business by purchasing mobile mills.

The government intends to incorporate CSM in the legal framework and transform it into a regular economic activity that guarantees steady long-term incomes for community members, helping to alleviate poverty.

In 2009 the FAO National Forest Programme (NFP) facility was launched, with SBB as the focal point and project administrator. As part of an overall NFP, the facility can improve the effectiveness of community forestry and hence CSM. Communities can apply for projects that focus on training in production skills, management and bookkeeping.

In March 2009 the country's REDD Project Implementation Note was accepted by the Forest Carbon Partnership Facility of the World Bank. In its Readiness Preparation Proposal, Suriname outlined a strategy to be eligible for REDD+ projects. The focus is on forest conservation and SFM as well as financial incentives for avoided deforestation and forest degradation. Since the latter is directly linked with the Code of Practice for SFM, it is important to include regulations for CSM in the code. Any form of CSM that does not fit in a concession from SBB will not be part of the land-use planning outlined in the REDD+ strategy and will therefore be classified as a driver of forest degradation.



Section 4

Case studies in Africa

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4.1 Chainsaw milling in the Congo Basin

GUILLAUME LESCUYER, PAOLO OMAR CERUTTI, EDOUARD ESSIANE MENDOULA, RICHARD EBA'A ATYI and ROBERT NASI

Forestry in the Congo Basin

Forest management in the Congo Basin¹ takes place in a context of widespread poverty. It is estimated that over 73% of people in the region live below the poverty line, most of them in rural areas where forest predominates (de Wasseige et al. 2009). Over the last two decades, forest policies have been used as a powerful lever to reduce poverty among the population, while also contributing to the development of the economy and the management of biodiversity.

In 2007, the large-scale industrial forestry sector in Central Africa produced nearly 8.4 million m³ of timber. Gabon, with nearly 3.4 million m³, is the largest producer, followed by Cameroon (about 2.3 million m³). The smallest producer is the Democratic Republic of Congo (DRC), with 310,000 m³ of formal timber production (de Wasseige et al. 2009).

The forest legal framework in the Congo Basin has improved in recent decades, with a large increase in the number of forest management plans. Nonetheless, the vast majority of policy reforms targeted large-scale, export-oriented forestry operations, while neglecting small-scale chainsawn timber, which is mostly sold in the domestic timber markets but also exported regionally. Although small-scale logging titles that authorize rural citizens to harvest few trees for their personal, non-commercial needs are included in all the legal frameworks in the region, they are generally not adapted to the current needs of chainsaw millers. As a consequence, the domestic timber sector remains largely informal. Despite its importance, chainsaw milling (CSM) — and its economic, ecological and social impacts — is unaccounted for in national and international statistics.



NEITHER NATIONAL STRATEGIES NOR PUBLIC POLICIES HAVE BEEN DEVELOPED TO GUIDE THE CSM SECTOR THROUGH FORMAL, TRANSPARENT AND EQUITABLE GROWTH.

Small-scale logging in Central Africa: previous appraisals

In Cameroon, the amount of wood illegally harvested by individuals or small enterprises and sold mostly on the informal domestic market was estimated at about 250,000 m³

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roundwood equivalent (RWE) in 1996 (Enviro-Protect 1997). Plouvier et al. (2002) analyzed several markets in Yaoundé and Douala and estimated the national CSM production at about 1 million m³ RWE.

Although recent estimates are not available for other countries of the region, several indications show that CSM production is significant. In Gabon, for instance, rural citizens still use family logging authorizations, which were abolished by the 2001 forest code, to harvest and trade timber around their villages. Given the number of people employed by the forestry sector as sawyers, fellers and prospectors, who have thus acquired the necessary skills, rural Gabon offers a large operational capacity and availability of resources for the production of informal timber. The law allows small-scale operators to apply for legal logging authorizations, but the administration has been very slow to implement the granting of such titles; only in mid-2009 were the first requests reviewed by the administration.

In DRC, forest resources are managed in a socio-economic and political post-conflict situation. The last decade, characterized by widespread insecurity, has prompted the vast majority of people to turn to subsistence and informal activities. The volume of logs produced by the informal sector is inherently difficult to quantify. Nonetheless, it is an important sector in DRC, as evidenced by the number of rafts that can be seen on the rivers, sawnwood planks found in many markets, and axe-cut logs in Kinshasa. Djiré (2003) estimated that artisanal loggers produce between 1.5 and 2.4 million m³, five to eight times the official industrial timber production.

In the Republic of Congo, the law allows for special permits for small-scale loggers to exploit timber and non-timber forest products. In the case of timber, special permits allow the harvesting of three trees for domestic purposes and five trees for commercial uses. The latter is allowed only in areas where people have difficulty obtaining supplies of industrial scraps. The difficulty of acquiring this permit, especially in rural areas, pushes many operators to remain in the informal sector, which causes the administration to establish checkpoints and mobilize patrol teams. The informal timber market in Brazzaville seems to have declined considerably after the intensive activity observed in the early 1990s, mainly due to the establishment of the checkpoints and to the provision of large amounts of scrap lumber in Brazzaville and Pointe Noire (Ampolo 2005).²

Methodology

Given the lack of information on CSM in the Congo Basin — and on its social, economic and ecological dynamics — it is imperative to conduct systematic studies in order to effectively reform the forest sector. This article summarizes the preliminary results of ongoing research that started in 2008 in four Central African countries: Cameroon, the Republic of Congo, DRC and Gabon. The project focused on sawn products sold in the domestic market. These are sourced all over the region using both legally produced timber, such as scraps from industrial sawmills or small-scale logging titles, and illegally produced timber, which comprises the vast majority of the chainsaw production.

A three-step approach was adopted in the four countries. First, a sample of outlets located in all districts of the main cities was monitored on a weekly basis. The wood sold

and purchased in each outlet was recorded in a comprehensive manner one day a week. These data were extrapolated to the other days of the week, then to the total number of outlets selling timber in the city. Second, timber entering the cities was monitored weekly (day and night), following the same frequency and method of extrapolation. Third, informal sawyers in the rural areas and timber sellers in cities were interviewed to analyze their activities and quantify their costs and margins (Table 1). Surveys started between March and November 2008 and are ongoing.

Table 1. Sampled cities and outlets

	Cameroon	Congo	Gabon	DRC
	Bertoua, Douala, Yaoundé, Limbe, Kumba	Brazzaville, Pointe Noire	Libreville	Kinshasa
number of outlets	882	127	210	200
number of outlets followed	177	77	30	20
number of supply routes followed	*	*	6	*
number of surveys in rural areas	340	*	212	*

* information not provided

Socio-economic impacts at the local scale

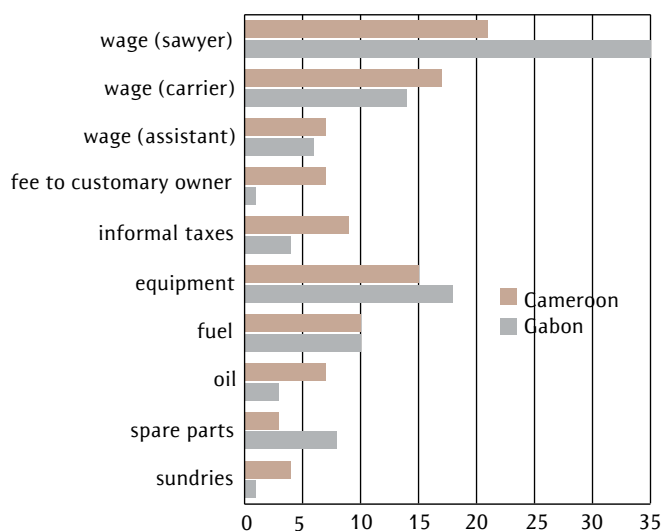
About 550 surveys were conducted till November 2009 in rural Cameroon and Gabon. CSM appears to be profitable. In Cameroon, profits for chainsaw loggers averaged about US\$15.5 per m³, while operating costs were about US\$44.3 per m³ of roundwood. The profit margin was about 26%. In Gabon, the profit was around US\$26.5 per m³, with operating costs estimated at around US\$48.6 per m³ of roundwood. The profit margin was 35%. Given the total volume of sawnwood sold on the domestic market, the financial gain generated by the informal sector — aggregating local wages, fees and profits — is estimated around US\$51.1 million per year for Cameroon and US\$3.1 million for Gabon (around Libreville only).

There are different modes of operation and/or marketing of sawnwood in rural areas. There is a significant difference between semi-professional sawyers moving out of urban centres with orders for timber species and products and rural loggers in need of cash who harvest timber without knowing who their final customer will be.

Although the difference between these two methods is negligible in Gabon, it is very important in Cameroon. Semi-professional millers, with better equipment, financial backing and political sponsors, have a profit margin of about US\$18.2 per m³, while that of freelance rural sawyers tends to be zero. The latter are frequently subjected to external pressures, including the seizure of all their wood.

CSM's contribution to rural economies is largely ignored in official statistics and policies. In fact, some costs incurred by sawyers in harvesting locations make up the largest part of the annual revenues of rural people living nearby. In Cameroon, for example, almost 50% of operating costs are payments to the local workforce while 7% of the total cost is remuneration to the customary owner of the felled tree. In Gabon wages make up 55% of the total cost, while compensation to the customary owner is lower than in Cameroon (Figure 1).

Figure 1. Chainsaw milling costs as % of total costs, Cameroon and Gabon



CSM is also a source of income for people outside the village economy, such as government officials and local elites, as they require informal payments from chainsaw millers and timber sellers. These payments average about 4% of the total operating cost in Gabon and 9% in Cameroon (Figure 1). This may represent a small transaction cost for chainsaw millers, given the overall positive impact of harvesting activities on the village economies. However, informal payments — which indicate how much millers are willing to pay — may also be considered as revenue losses by the state. If extrapolated to the overall volume of informal production, they total about US\$13.1 million in Cameroon and US\$2.4 million in Gabon.

Chainsaw millers and timber sellers listed administrative harassment and abuse of power by various authorities as the most important problems they encountered (Table 2). There are roughly the same concerns in Cameroon and Gabon. Importantly, Table 2 also shows that only a small fraction of interviewees (13 and 10% in Gabon and Cameroon respectively) noted difficulty in accessing a legal title as a problem. The vast majority of chainsaw millers harvest without a legal title (in Cameroon, about 85% of all interviewees admitted to never using a legal timber authorization during their career), and the lack of title is clearly not a major concern for operators in either country. This may be one reason for the increase in CSM over the past decade.

Table 2. Problems reported by chainsaw millers and timber sellers (% of total interviews)

	Gabon	Cameroon
administrative hassles	41	71
technical (mechanical) problems	17	13
difficulty in access to a legal title	13	10
abuse of power (businessmen, client, worker)	10	41
lack of infrastructures	8	11
relations with customary owners	5	22
lack of capital	3	7
scarcity of the resource	2	11

*Interviewees could indicate more than one problem, i.e., totals add up to more than 100 percent.

Timber sales from chainsaw milling

In Cameroon, average annual sales in July 2008–June 2009 totalled about 990,000 m³ of sawn timber. Total consumption was estimated at about 860,000 m³, as about 130,000 m³ were sold to other markets. Percentages varied among cities, but most timber was sourced from CSM operations in the forest; about 27% was sourced from industrial sawmills.³

In Cameroon, sawn timber sold on the market and sourced directly from CSM operations was estimated at about 662,000 m³, more than 2 million m³ RWE. This suggests a twofold increase from the 2002 values estimated by Plouvier et al. (2002). Most notably, domestic timber sales were larger than industrial production and exports of sawn timber, which decreased from 580,000 m³ in 2008 to 360,000 m³ in 2009.

In Gabon, about 70,000 m³ of lumber is consumed in Libreville per year. This estimate is supported by outlet sales and by monitoring the flow of supplies to the city by roads and waterways. Compared to the total official industrial production (about 3.3 million m³ in 2007) informal sector production is more modest than in Cameroon represents about 23% of the industrial production and exports of sawnwood — about 300,000 m³ — in 2007. Per capita timber consumption in Gabon (about 1.1 million inhabitants in the Libreville area) and Cameroon (about 12 million inhabitants in the southern part of Cameroon) is similar.

Preliminary data collected in the Republic of Congo show annual timber sales of about 78,000 m³. Formal national production was about 1.3 million m³ in 2007, with about 210,000 m³ of exported sawnwood. Small-scale informal production thus represents about 35% of industrial production. Per capita timber consumption in Congo (2.5 million inhabitants in Pointe-Noire and Brazzaville areas) is about half that of Cameroon and Gabon.

Preliminary estimates for the DRC show that the city of Kinshasa alone consumes about 350,000 m³ of informal sawnwood per year (Lescuyer, Eba'a Atyi and Cerutti 2009). Official figures show that industrial sawnwood exports amounted to about 30,000 m³

in 2007. Although official figures are notoriously incomplete in DRC, data collected in Kinshasa for this study show that informal timber production for domestic markets is far higher than formal production.

Table 3. Formal and informal production of sawnwood (m³)

sawnwood m ³	Cameroon	Gabon	Congo	DRC
	Yaoundé, Douala, Bertoua	Libreville	Pointe-Noire, Brazzaville	Kinshasa
annual consumption, domestic market:	860,000:	70,000:	78,000:	350,000:
▪ <i>industrial scraps</i>	198,000	n/a	n/a	n/a
▪ <i>chainsaw milling</i>	662,000	n/a	n/a	n/a
annual domestic consumption per capita	0.055	0.636	0.031	0.035
annual formal production/export (2007–08)	580,000	300,000	210,000	30,000

As shown in Table 3, chainsaw timber production in the Congo Basin, albeit largely informal, is much more important than suggested in the regulatory frameworks and official data. In Cameroon and the DRC, and to a lesser extent in Gabon and Congo, CSM volumes and dynamics call for recognition by and better integration in forest policies.

The informal timber sector provides thousands of jobs. In Pointe Noire, Brazzaville and Libreville, approximately 1,000 people derive their income directly from timber sales; in the cities sampled in Cameroon, about 4,000 people sell timber. These estimates only consider the last, and easiest to quantify, link in the chain from harvesting to transport to selling. They do not include the thousands of jobs provided in rural areas for harvesters, carriers, holders and many others. In Cameroon alone, the total number of people employed by CSM is estimated at about 45,000, about four times the number provided by the industrial timber sector. CSM is an important source of revenue for rural people and provides urban consumers with cheap timber. Its long-term influence on national economies depends on the availability of these timber resources; a rough analysis of the ecological impacts of low-scale milling, at least in Cameroon, indicates that it must be better regulated to become a sustainable source of development at the country level (Lescuyer, Eba'a Atyi and Cerutti 2009).

Products and prices

Selling prices vary with the quality, type and origin of product, and by timber species. In Cameroon, average prices for ayous⁴ planks and formworks (21% of total sales) were about US\$34.0 and US\$31.4 per m³ RWE (Table 4).

The prices of products in the domestic market (Table 4, column e) average about 80% lower for timber sourced from CSM than FOB prices — which are linked to the interna-

tional market — applied for the industry in Cameroon (Table 4, columns f and g). There are several reasons for these differences:

- First and foremost, the quality of the product required by the international market is higher, and specifications stricter.
- Domestic timber is not charged with formal taxes — stumpage, sawmill entry, export fees — so its production costs are lower.
- There is much more competition in the domestic market, with thousands of chainsaw millers able to source the market, than in the industrial one, where only a handful of logging companies specialize in a few products and species.
- Timber is much cheaper for chainsaw millers, as the commercial value of trees is underestimated by customary owners.

Table 4. Selling prices of the most used products per species

a. source	b. product	c. species	d. sales (%)	e. selling price (US\$/m ³ RWE)	f. FOB price (US\$/m ³ RWE 2009, Cameroon)	g.% of export price (E/F)
chainsaw milling	plank	ayous	4.7	34.0	183.4	18
	formwork	ayous	16.3	31.4	183.4	17

Conclusion and recommendations

Chainsaw lumber production in the forestry sectors of the countries of the Congo Basin has been under-researched and neglected by official policies. As a consequence, data about the sector, and its impacts on rural and national economies, are often excluded from official statistics.

All Congo Basin countries are involved in the FLEGT/VPA process⁵ that requires all wood commodities — for export or domestic consumption — to be legally produced and tracked. This puts a massive pressure on states to recognize, legalize and organize the informal sawnwood sector.

Preliminary results of this project show that the domestic timber market has boomed in recent years, with an overall annual production — about 1.2 million m³ of processed products — similar to industrial production, and with important impacts on local economies, rural livelihoods and governance.

Many challenges lie ahead, in formalizing and improving the sector's contribution to national economies. Neither national strategies nor public policies have been developed to guide the sector through formal, transparent and equitable growth. This forces thousands of people to produce and sell illegal timber, because of the lack of a legal framework for their activities, and because many vested interests (decentralized civil servants, urban businesspeople, military forces) challenge the development of a national formal timber market. Although illegality is not considered to be a problem by most chainsaw millers

and even constitutes a source of income for corrupt civil servants, the states of Central Africa would see a great economic benefit if CSM was formalized.

The adoption and decentralized distribution of logging authorizations is a necessary first step. Ad hoc legal frameworks should be adapted to the needs of local actors, rather than to those of central administrations. Second, reform should aim at professionalizing chain-saw millers, while concurrently providing workable incentive schemes for civil servants, in order to decrease corrupt practices. Effort is urgently required by government to issue and implement effective sanctions for civil servants who participate in corrupt practices, in order to improve the overall governance of the sector.

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Endnotes

1. The Congo Basin is usually considered to include Cameroon, Central African Republic, Congo, Equatorial Guinea, Gabon and Democratic Republic of Congo (DRC). This article focuses only on Cameroon, Congo, Gabon and DRC.
2. Except for a few case studies carried out in the Batéké highlands, no data at the national level confirm or refute this finding.
3. Estimates for Cameroon and Gabon are based on 12 months of data collection; estimates for Congo and DRC are based on six months data collection, extrapolated to 12 months.
4. Ayous, also known as obeche, is timber from *Triplochiton scleroxylon*.
5. This is the Voluntary Partnership Agreement (VPA) on Forest Law Enforcement, Governance and Trade (FLEGT).

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4.2 The chainsaw supply chain in Cameroon: the northern trail

PATRICK LANGBOUR, JEAN-MARC RODA and YEBOA ALEXIS KOFFI

Cameroon

Cameroon (Figure 1) has the largest forest area in Africa. Industrial logging operations export timber products to Europe, America and Asia, and informal chainsaw milling (CSM) operations supply the domestic market and many other African countries. The “northern trail” is an informal supply chain that supplies Northern Cameroon and other African markets as far as Nigeria, Niger, Chad, Sudan, Egypt, Libya and Algeria. This supply chain is organized by ethnic business networks, and represents more than 40,000 m³/year of chainsawn timber, with a cash flow of more than 6 billion FCFA/year.¹

Introduction

In December 2003, our team witnessed an event that brought our attention to the Sudano-Sahelian inter-African trade of sawn timber. In the timber yard of a sawmill near Bangui, in the Republic of Central Africa (RCA), a small truck (*bachée*) was loading sawn timber of various species and of low quality (domestic trade quality). The only thing unusual was the final destination of the truck: Mauritania. That Mauritania could be sourcing sawn timber in RCA was almost unbelievable, given the road distances involved. Yet the truck was there.² This seemed to have important underlying consequences for forest resource management in Africa. Such distances and probable costs and risks suggested the existence of undocumented domestic and regional trades in informal sawn timber from humid African forests. In 2004 our team launched a study to investigate the existence of this northern trail. One of the authors of this article, Koffi Yeboa, followed a segment of it within Cameroon, from the forest and the chainsaws to the border with Chad (Koffi 2005).

Background

Inter-African trade has been active for centuries (Hopkins 1973) and increased after the colonial period due to improvements in infrastructure and communications (Leplaideur 1989). The trade includes formal and informal activities (Potter and Lloyd-Evans 1998).



TRADE NETWORKS ARE BASED ON ETHNIC IDENTITY AND PROVIDE A SOCIAL STRUCTURE AND INFORMAL INSTITUTION. THEY EXIST IN THE CONTEXT OF WEAK FORMAL INSTITUTIONS, FAILING ADMINISTRATIONS AND RAMPANT CORRUPTION.

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The informal sector is omnipresent in Sudano-Sahelian trade. It can be seen as a tertiary refuge sector,³ stimulated by ongoing urban development (McGee 1979; Portes, Castells and Benton 1991; Santos 1979).

One of the main features of inter-African trade networks of the Sudano-Sahelian regions is their strong ethnic component. Networks are based on ethnic identity and provide a social structure and informal institution. They exist in the context of weak formal institutions, incompetent administrations and rampant corruption. These ethnic networks can secure trade relationships with the trust necessary to organize trans-national economic exchanges. David (1999), for example, has studied the onion trade from Niger through Burkina Faso to Ivory Coast. The Haoussa ethnic network constitutes of a secure yet informal international institution for dispute settlement, financial support, information sharing and trade facilitation (David 1999).

In the case of inter-African trade of wood products (timber or firewood), harvesting is essentially informal. There are many supply chains, relatively easy to identify with the appropriate methods, each answering to specific demand, transportation, production system, resource and functions (Bertrand 1989). In Cameroon, people equipped with chainsaws or mobile saws operate clandestinely in agro-forest zones, forest reserves and even Forest Management Units (FMUs). Although these activities became illegal in 1999 after a ban imposed by the Forest Department of the Environment (MINEF 2003), they did not end.

Methodology

The Forest Product Networks methodology for surveys was used.⁴ It consists of semi-directed interviews, collection of data on forest products and trade, and in situ observations and measurements. In this case study, the trade chain was limited to the timber flow from Cameroon to Chad over the Kousséry-Ndjamena bridge (Figure 2). Some time was spent studying the main timber and furniture markets of Yaoundé.⁵

Figure 1. Map of Cameroon

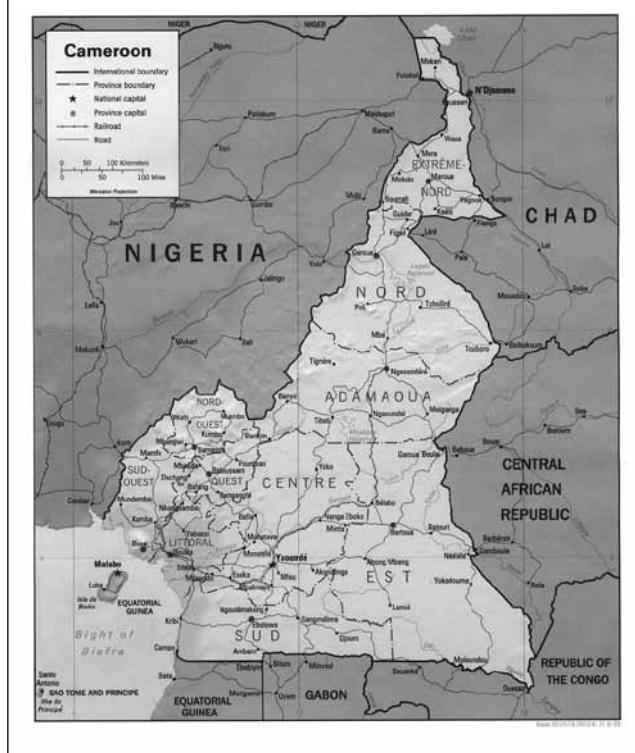
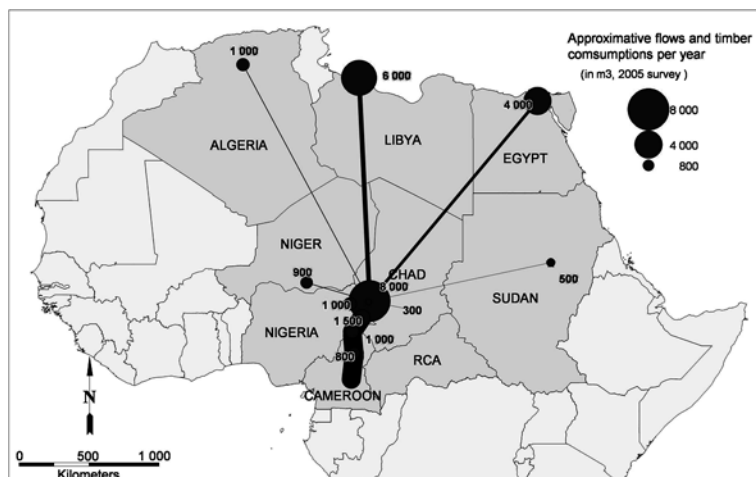


Figure 2. Sawn timber exported from Cameroon through the Kousséry-Ndjamena bridge (m^3 /year)

Source: survey in 2005



Timber trade

The North Cameroon demand for timber is not new and has been documented (Bare 1989). By the end of the 1980s, North Cameroon was a collection point for timber from Bangui and Batalimo in RCA, which then continued on to Chad, Niger, Nigeria and beyond. Nowadays, most timber comes from the humid forests of East Cameroon, supplying North Cameroon as well as the even greater demand of other countries without forest resources.

Timber, mostly from the forests bordering the Sanaga River, travels through East Cameroon to Chad. A bridge over the Logone River, which is the border between North Cameroon and Chad, connects Kousséry and Ndjamena (capital of Chad). From Ndjamena, the timber is dispatched to the rest of Chad, and to other markets as far away as North Nigeria, Libya and even Algeria (Figure 2). The annual volume crossing this border point has been assessed at 40,000 m^3 /year of sawn timber, equivalent to more than 130,000 m^3 /year of roundwood (Koffi 2005). This assessment is conservative; actual quantities could be higher.

According to our interviews, the domestic and inter-African trade of sawn timber has existed for many years. Before 1998, it was not an informal trade and the wood was officially bought from several forest companies. After the 1998 reform of the Cameroon forest sector, the licensing criteria changed, and since none of the forest companies that supplied the northern trail were able to meet the new conditions, they shut down. Many informal chainsaw operations then developed to meet the demand. The demand for sawn timber in north Cameroon is limited (800 m^3 /year in Ngaoundéré; 1,000 m^3 /year in Garoua; 1,500 m^3 /year in Maroua); the real engine of the trade is the demand from other countries, including Sudan, Egypt, Niger and Algeria. The timber supply is highly seasonal (Table 1), because the rainy season (from June to October) complicates felling operations and transport.



Table 1. Seasonality of the sawn timber trade

season	dates	total annual sales (%)	market price in Belabo (FCFA/m ³)
high	November–January	46–50	50,000
intermediate	February–May	around 30	n/a
low	June–October	16–20	27,000

Source: adapted from Koffi 2005, 38

Three main types of sawn timber are found in the domestic markets of North Cameroon:

- sawn timber rejected from industrial sawmills (low quality);
- dense and semi-dense hardwoods (such as bubinga, niangon, moabi, sapelli, iroko and bibolo) from chainsaw operations; and
- light and white woods (such as ayous, fraké and fromager) from chainsaw operations.

This wood supplies the domestic construction and furniture markets. The northern trail is used almost exclusively for light and white woods. Table 2 compares the prices of white woods (ayous) in eight towns in Cameroon.

Table 2. Prices of light white woods

location	price (FCFA)	species
Douala (before export)	150,000–240,000 FOB	ayous
Yaoundé (domestic trade)	77,000	ayous, fraké, fromager
Bertoua and Belabo (domestic trade)	55,000–62,000	ayous, fraké, fromager
Ngaoundéré (domestic trade)	65,000–70,000	ayous, fraké, fromager
Garoua (domestic trade)	75,000–80,000	ayous, fraké, fromager
Maroua (domestic trade)	125,000–132,000	ayous, fraké, fromager
Kousséry (domestic trade)	135,000–140,000	ayous, fraké, fromager
Ndjamena (Chad)	150,000–156,000	ayous, fraké, fromager

Source: adapted from Koffi 2005, 30

The people

The traditional trading networks of West and Central Africa were, and still are, dominated by the Haoussa, Mandingue, Yorouba, Bamiléké, Peulh, Mourrides, and Alhazaï ethnic groups (Egg, Igué and Coste 1988). This specialization also applies to the informal production system of chainsawn timber in Cameroon. For example, the Ibos originating from Nigeria dominate the domestic market of Douala. The Banens originally controlled the domestic market of Yaoundé, but with the economic difficulties and the increase of informal activities, the Bamiléké, Bety and other people also joined the business (Koffi 2005).

Each segment of the production system on the northern trail is controlled by different groups. Chainsaw operations are conducted by the Maka, Boli, Lossou, Mezimé and other people from the forest. The Aladji traders⁶ are the key actors of the transaction system, between the chainsaw and the export phases. They have a prestigious position in their communities.

Export operations are led by the Fulbé and Gouren, who are Showa Arabs originally from Chad. They share a language, religion and a tradition of doing business, forming a transnational network of trade and finance based on mutual trust and on ethnic conventional rules. This makes it difficult for other ethnic groups to compete. From Belabo to Maroua, legal associations of Aladji traders control the timber economy. The Aladji of each city represents an Aladji from another city downstream, and so on. For example, one Aladji in Belabo represents a chain of 106 people who make a living from informal sawn timber, from the forest to the Chad border (Table 3). We estimate that around 2,000 actors directly depend on the sawn timber trade between Belabo and Ndjamená (Koffi 2005). This does not take into account those who are indirectly involved (services, transport, administration, etc.).

Table 3. Chain of actors directly dependent on one Aladji in Belabo

location	categories of actors	number of actors
village	1 lineage chief and his family	20
forest	1 sawyer, 1 assistant sawyer, 4 porters, 3 loaders	9
road transport	1 truck owner, 1 driver, 1 apprentice	3
Belabo	1 Aladji trader, 1 Aladji assistant, 4 unloaders, 6 timber graders, 6 loaders, 2 porters	20
Ngaoundéré	1 Aladji trader, 1 Aladji assistant, 6 unloaders, 6 loaders, 2 timber graders, 2 porters	18
Garoua	1 Aladji trader, 1 Aladji assistant, 6 unloaders, 2 timber graders, 2 porters	12
Maroua	1 Aladji trader, 1 Aladji assistant, 6 unloaders, 2 timber graders, 2 porters	12
Kousséry	1 Aladji trader, 1 Aladji assistant, 6 unloaders, 2 timber graders, 2 porters	12
Total		106

Source: adapted from Koffi 2005, 51

The value chain

When they receive an order from northern customers, the Aladji traders give an order to the chainsaw operators and partially finance them. This enables the operators to

purchase the standing trees from villagers in the forest, and buy fuel, food for the workers and other necessary items (Table 4). The villagers do not take any risk, and just collect the “rent” from the natural forest. The chainsaw operators do not take a big risk either, but can lose a lot of money if the government seizes the timber and tools. The Aladji are the most vulnerable, because they pre-finance the operations, and because the timber is not entirely secured until it is locked down in a rail wagon in Belabo, or, in case of road transport, it arrives in Ngaoundéré. Seizure of the timber by the government results in the trader’s bankruptcy. Therefore, the members of the value chain easily accept an informal taxation that averages 10% (Table 4).

Table 4. Value chain of one load of 87 m³ of chainsawn timber on the northern trail

place	operation	costs (FCFA)	informal taxes (FCFA)	cumulative production cost (FCFA/m ³)	market value (FCFA/m ³)
forest	purchasing trees sawyer fees porter fees lubricant and fuel food chainsaw rental	130,000 805,000 483,000 605,000 348,000 260,000	130,500	31,700	—
Belabo	transport	700,000	43,500 126,000	33,690	55,000–62,000
Ngaoundéré	rail transport	1,000,000	200,000	47,483	65,000–70,000
Garoua	transport	1,000,000	100,000	60,126	75,000–80,000
Maroua	transport	1,200,000	350,000	77,943	125,000–132,000
Kousséry	transport	1,400,000	60,000	94,724	135,000–140,000
Ndjamena	customs fees	1,800,000		115,414	*150,000–156,000

Source: adapted from Koffi 2005, 47

* By comparison, the value of sawn ayous (a light whitewood typical of the trade to Ndjamena) was between 150,000 and 240,000 FCFA in the same period in Douala harbour, FOB.

In Kousséry, the trade is formalized through Chadian custom procedures. Five different official documents are filed;⁷ a total of 60,000 FCFA is paid to obtain these papers. It is one of the paradoxes of this production system: informal timber receives official documents in order to cross the border. The most expensive administrative procedure is custom clearance in Ndjamena, Chad. Clearance costs are 1,800,000 FCFA for one truck, independent of the quantity of timber imported (Table 4). Trucks of 30 to 35 tonnes, meant to carry a load of 50 m³ of timber, are regularly loaded to a minimum of 80 m³ and sometimes up to 95 m³ in order to deliver in Ndjamena at a profit.

Discussion and conclusion

Conservative assessments (MINEF 2003) estimate the Cameroon domestic consumption of sawn timber to be around 300,000 m³/year in 2003. No one can consider it a small-scale activity; the northern trail organized by the Aladji traders represents an annual cash flow of six billion FCFA (Koffi 2005).

The influence of the African domestic timber trade on the management of natural forests has been neglected for years. Many African and international institutions, as well as NGOs and other bodies, saw the African timber sector through the lens of international exports dominated by big foreign companies⁸ (Roda 2005). The dominant vision was that the domestic timber trade was a local affair, especially in the humid forests of Africa. Unlike the international trade by sea, the domestic sawn timber trade was supposed to produce little profit margins by international standards, which would certainly not allow international trade by road transport over long distances.



It appears now that, against all apparent logic, sawn timber — as well as other agricultural products (David 1999) — is shipped over long distances, crossing many borders and bearing substantial transport costs and financial risks. Effective trade networks are at work. They display evident abilities to adapt to regional political contexts, which change rapidly. They are an important part of the process of regional integration through a more or less⁹ informal trade. The progressive weakening of the states of the region, the increase of conflicts in the last decades and economic uncertainties may have helped these networks succeed.

Another important factor is the increasing demand for wood in the Sudano-Sahelian regions. Two simple indicators demonstrate this demand: the large distances that are involved, and the price. What are the forces that can create such a demand, despite low average purchasing power? Demographic forces and urbanization are important drivers. Africa is one of the less urbanized continents and has one with the fastest urban growth rates.

There is a need to study how demographic dynamics, regional inequalities, and an increasing need for shelter and construction materials have an impact on forest resources. Wood is one of the most versatile construction materials, but also one of the scarcest in Sudano-Sahelian regions. None of these areas can produce the five-metre beams that are one of the most demanded products along the northern trail (Koffi 2005).

What are the long-term consequences of these trends on forest resources in Africa? Existing international regulations and initiatives focus on market tools such as log bans, eco-certification, FLEGT, REDD, etc. These tools have no direct effect on the domestic trade, although they can influence it in some unexpected way, as in the case of European bans boosting the illegal trade of domestic teak wood in Indonesia (Guizol et al. 2005). Structural measures aiming to protect the forest can produce unintended effects when

states do not have the means to enforce their policies (Karsenty 2003). The existence of the northern trail after the forest reforms of 1998 is one example.

What kind of institutional or market tools should be invented in order to steer the African domestic trade in a sustainable way? What new mechanisms could be designed in order to ensure forest sustainability, fair regulation, and fair material supplies in the context of poverty, when the inter-African trade is fostered by the increasing need for wood? These questions call for African and international institutions — as well as NGOs and other bodies — to cease seeing the timber sector through the reductionist lens of international exports dominated by big foreign companies. Further research as well as policy debates should reconcile the demands of local and regional populations and the protection of tropical forests.

Endnotes

1. The rate of exchange is €1 = 657 FCFA.
2. According to the driver of this truck, his boss used to travel regularly from Mauritania to Ivory Coast in order to buy “good tropical timber,” which is scarce in Mauritania but in great demand, at an excellent price. After the start of the civil troubles in Ivory Coast, it became much safer for him and other merchants to go farther east, up to Cameroon and, at that time, up to RCA through Chad, because of increasing difficulties caused by the Cameroon’s administration.
3. The term “tertiary refuge sector” refers to heterogeneous informal activities, including informal trade and services, small-scale workshops, street vendors, etc.
4. It synthesizes three methodologies already practised by various scientists for forest products and capitalizes on the methods developed by Bertrand for Sudano-Sahelian Africa (Roda 2004; Bertrand 1990).
5. For the markets of Messa and Olézoa, see Koffi 2005.
6. “Aladji” is a phonetic derivation of the Arabic term “El Hadji” (meaning “one who made the Mecca pilgrimage”).
7. These are *Sauf conduit international*, *Bordereau de route*, *Quittance de transport*, *Certificat de circulation* UDEAC, and *Déclaration en douane* D6 or D15 or D16.
8. As an example, in 2006 the fiscal audit of the forest sector ordered by the Government of Cameroon focused on big industrial companies of the forest sector, paying little attention to the domestic trade (Karsenty et al. 2006).
9. The chainsaw timber trade documented in this paper is mostly illegal, since forest regulation 0944/D/MINEF/DF of 1999 bans the individual harvesting authorizations that constitute the basis of most chainsaw operations. At the same time the forest administration and other government services collect fees and deliver official documents for the products. The trade becomes formal at a certain point, even if the statistics do not exist.

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4.3 Chainsaw milling in community forests in Cameroon

WYNET SMITH

Community forests in Cameroon are intended to involve local people in forest management and provide them with benefits (Brown and Schreckenberg 2001; Burnham 2000). Studies have documented, however, that these forest managers have often encountered problems and conflict (Djeumo 2001; Nguiffo 1998).

The regulatory framework

Community forests are a category of forest created through the 1994 *Cameroon Forestry Law*, which divided forests into permanent and non-permanent zones. The permanent forest zone includes parks and nature reserves and large, industrial concessions, which are allocated to private logging companies.

The non-permanent zone allows the use of industrial logging and road building. Community forests up to 5,000 hectares (ha) in size are restricted to this zone. It consists of fragmented forest areas; as a consequence, communities often gain access to small areas of relatively degraded forests with low timber-production potential. However, these forests are usually more easily accessible as they are often located close to existing road networks. Smaller, short-term industrial logging areas, based on a specific volume of wood, are also allowed in the non-permanent forest zone.



WITHOUT THE CAPACITY TO PRODUCE SAWNWOOD AND TO SELL IT TO THE MARKET, THE BENEFITS OF THE FORESTS — AT LEAST FROM TIMBER PRODUCTS — WILL REMAIN LIMITED.

Regulations require communities to invest substantial amounts of time and money before they are able to acquire rights to the forest, its products and any benefits. Members of a community must first form a community forest association (CFA) and apply to the Ministry of Forests for the right to manage and use a given forest area.¹ According to some ministry officials, the process — which includes filing an application, development of a simple management plan and signing of an agreement — can take up to two years. Under the agreement the government entrusts a part of the national forest estate to a community to be “managed, conserved and used in the interests of the community.”² The process is expensive and time-consuming. Ministry officials report that the process could cost from US\$4,000–10,000.³

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The 1994 *Forestry Law* specified that only certain types of harvesting rights apply to community forests: sales of standing volume and smaller-scale permits for local people. Widespread concerns about the use of community forests as an easy source of timber led the government to make changes in 2001 that prohibited road construction and the use of industrial logging machinery.⁴ Consequently, community forests are supposed to be logged via footpaths, using chainsaws and portable sawmills.

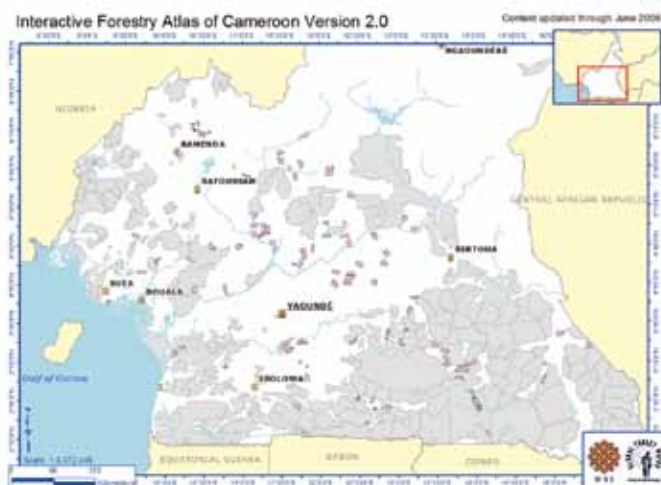
These regulatory restrictions have contributed to a situation where communities require considerable start-up capital, which they usually do not have, to obtain permits. In addition, they usually lack the capacity — in technical skills and market knowledge — that logging requires. As a result, communities often work closely with small-scale operators to obtain a community forest authorization and/or log the forest area (Smith 2008).

Logging in community forests

As of late 2004, there were 67 community forests in Cameroon (Mertens et al. 2007) (Figure 1). Most were working with small timber companies; three out of four community forests near Lomié were working with a small-scale company from Douala, the port city of Cameroon.⁵ They usually consisted of operators working with chainsaws and a portable sawmill. Operators reached the forests via a footpath, felled trees with a chainsaw and used a portable sawmill to produce lumber. A similar situation existed in a community forest in Southwest Province and in two community forests in South Province.

Figure 1.
Map of Cameroon

Source: Mertens et al. 2007



An alternative model of chainsaw milling exists in the CODEVIR community forest in East Province. The forestry association, which involves four local communities, had the technical support of the Netherlands Development Organization (SNV) to obtain a community forest authorization and pursue logging activities. They used external funding to purchase a few chainsaws, safety equipment and a gruminette (a small steel frame that is used with a chainsaw to turn a log into rough planks). This allowed them to produce timber by themselves.

In one community forest in South Province, the community forestry association (CFA) had entered into a relationship with a company from Douala. The company was illegally building roads and using heavy equipment, both of which were prohibited. It was also transporting logs to Douala for processing, which was also illegal.



Uneasy and unequal relationships

Relationships between communities and companies are complex and variable. In some cases, communities establish a relationship with a company when they initiate a community forestry application. In others, local elites who were involved in establishing the community forest set up contacts with logging companies to carry out the actual logging. Sometimes companies approach community forest associations after a community forest is in place to propose logging operations. This situation was common in the community forests in East Province, where communities had assistance from international agencies to establish their forests and did not already have a relationship with a company.

Costs and benefits

Communities and companies see both benefits and costs from their relationship. In cases where relationships are established at the outset, the company often funds the entire endeavour, from the application process through to the logging and processing activities, as well as the sale of the sawnwood for export to the region (and occasionally even Europe). If the relationship is established later, the company is usually responsible for supplying the logging equipment (such as chainsaws and milling equipment) and covering the costs of logging operations (including labour) and transportation. Communities usually receive no lasting benefit in terms of capacity or equipment for future logging activities once the company leaves.

CFAs can also earn revenue from working with a company. The company and those responsible for the community forest negotiate a volume-based fee for the amount of wood felled and processed. The amount to be paid is usually calculated based on the volume of sawnwood that the company actually transports. The revenue that communities obtain from their partners varies considerably. The highest payment per cubic meter (m³) was US\$80 in East Province; the lowest were in South and Southwest Provinces, where a number of village chiefs reported that the community received only US\$2 per m³.

Another benefit for CFAs is access to buyers and timber markets. The CODEVIR community forest had difficulties in finding a profitable market for its sawnwood; while it was possible to sell locally, members were not able to make a profit based on local prices. They did not have the contacts to find buyers in either the domestic or international markets, where the prices are higher.

Another benefit of logging operations is employment. Local people, particularly youth, often find temporary employment as labourers to assist with felling and sawing operations. Local people can also earn money by carrying sawn planks to the road. In the CODEVIR forest, local youths were trained and hired as chainsaw operators and millers.

Community forests are an important source of timber for small-scale timber businesses. Logging rights are limited to small-scale operators. Large forest management contracts are restricted to companies with significant capital; even the small volume-based licences tend to go to bigger companies. Community forests provide a commodity that companies can sell to the domestic or international timber markets, usually for much higher prices than they get locally. Some high-value timber species had export prices of well over US\$200 per m³ in 2004, compared to the US\$1–80 the company may have paid the CFA. At least two of the companies operating in community forests during 2004 were selling wood to the international market in 2004 (Smith 2008).

Conflicts

Despite these benefits, relationships between the communities and the companies are rarely without conflict. In many cases, companies have failed to fulfill their promises with regard to social obligations, payments, and even salaries for labourers. Most of the community forests in East Province reported these types of problems.

By mid-2004, the communities associated with one forest area in East Province had “chased away” the logging company that had been operating in their forest, according to one elder. The company had allegedly not paid all of the money owed to the communities for the volume of timber felled and processed. Young men who had worked as labourers in late 2003 for the company complained that more than six months after the end of logging operations they had not been paid. However, it was not clear if the company had not paid or whether there were problems with the CFA, which appeared to be in disarray.

Community members feel resentment when a company do not make good on their promises, whether these involve a road, clinic or pipe-borne water. Some residents of a community in Southwest Province felt misled by the company operating in their forest, which had not fulfilled its promise to build local facilities, including a clinic. In this case, where the company was using industrial equipment to build a road, local people were pleased with the work and explained that the promise of a road was one of the main reasons they had supported working with this particular company. Other community members, however, expressed anger that the company was destroying farms and crops along the road route and not compensating the affected farmers. Interestingly, none of villagers interviewed seemed aware that the roadwork was prohibited by community forest regulations and could endanger the legal status of their forest if the authorities chose to intervene.

Imbalances in power within communities can also lead to conflict. Local village elites may use their position of respect and knowledge to gain control over forest activities. The president of a CFA can negotiate a deal that is not transparent and not necessarily the most beneficial for the community. Local CFA members are in a position to abscond with money that was intended for the entire community or for the members of the association.

Conclusion

In Cameroon, community forests were established to provide benefits from forest resources. However, CFAs have experienced problems in gaining access to the forest, timber, benefits and external markets. Communities have often worked with small-scale chainsaw and portable sawmill operators and these relationships are often unequal and fraught with conflict.

Support and capacity-building for communities engaged in establishing community forests are important. The level of support and education communities receive helps determine whether they will succeed. The most successful community forests are those near Lomié, a pilot community forest area, where international donors provided intensive assistance and capacity-building during the early years of the community forest. As a result, the CFA



members in this area seemed most aware of regulations, and had the best knowledge to negotiate labour and payment contracts. Support to these communities also allowed one forest group to choose an alternative model based on self-reliance and capacity building, although they faced challenges in selling their product. Some communities in South Province also had some international help but it was less focused on education and training.

The biggest challenge for the CFAs is to be able to fell and produce timber and find a market for it. Without the capacity to produce sawnwood and to sell it to the market,

the benefits of the forests — at least from timber products — will remain limited. Many large companies operating in Cameroon expressed an interest in buying timber from community forests but were reluctant to pursue relationships because of the lack of community capacity and uncertainty about what it would be like to work with the communities.

Several changes would help improve the Cameroon model of community forestry and provide more benefits for local residents:

- The Government of Cameroon should simplify regulations and procedures to make it easier and less expensive for communities to form a CFA.
- Civil society and donors should focus on education and capacity building so that communities are prepared to undertake activities themselves or to enter into more equitable relationships with operators.
- Donors and companies should place more emphasis on analyzing the timber value chains and market possibilities to assist CFAs in obtaining access to timber markets and revenue from selling their timber.
- Purchasers of timber — both domestic and international — should engage with CFAs to ensure that any timber entering the market from these forests meets appropriate standards and benefits the residents of the forests.

Endnotes

1. The government developed a Manual of Procedures with support from the Community Forestry Development Project, funded by the UK Department for International Development.
2. See Cameroon government, 1995 decree, Article 3 (16).
3. Other researchers have estimated the process can cost from US\$3,000–5,000 (1.5 to 2.5 million FCFA) to US\$28,000– 58,000 (Klein, Salla and Kok 2001). The lower estimates reflect cases where there is local capacity to undertake significant portions of the work required.
4. Ministry of Environment and Forests (MINEF) circular of 23 February 2001.
5. The author visited ten community forests.

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4.4 Chainsaw milling and poverty reduction in Democratic Republic of Congo

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Despite the post-conflict context and the pressure of human activities on forest resources, the annual deforestation rate of the Democratic Republic of Congo (DRC) is relatively low: 0.20% (de Wasseige 2009). However, several threats compromise the sustainable management of the forest, which is estimated at about 145 million hectares (ha).¹ They include shifting cultivation, firewood collection, poaching, artisanal exploitation of timber and gold and uncontrolled industrial operations. These activities involve local and indigenous people as well as migrants from neighbouring countries.

Artisanal exploitation

Artisanal exploitation involves adding value to wood or other forest products and services such as the use of the forest for tourism and recreational purposes, as a profession, either manually or using basic equipment, by people for their own benefit, alone or with help from family members or a team of workers.² Chainsaw milling (CSM) is one of the informal economic activities that represent 80% of the economy in the DRC (Debroux et al. 2007). Can it help reduce poverty?



IT IS CLEAR THAT CSM BRINGS WEALTH TO LOCAL CHAINSAW BOSSES, BUT NOT TO A MAJORITY OF THE POPULATION OR THE STATE ECONOMY.

Chainsaw milling in DRC: the issues

CSM began in the 1940s, in the colonial period. Since 2000, after the breakdown of modern economic structures, the criminalization of the Congolese economy in the 1990s, the looting of infrastructure (1991 and 1993) and increased unemployment and recurrent conflicts, the impoverished rural population has increasingly turned to CSM in search of income (Debroux et al. 2007). There are three main issues related to CSM:

- access to forest resources;
- mechanisms to optimize benefits for local communities; and
- forest governance.

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Access to forest resources

The management approach of chainsaw millers in their concessions used to follow customary rights (Adebu and Abdala 2010; Pax Christi 2007). These customary rights are still in place; they function parallel to the current regulatory framework, which acknowledges customary authority in land management. This leads to a situation where land parcels subject to a property agreement, customary rights and a cutting licence can exist side by side. A concession can be obtained through the customary authorities or the local chief by giving cash (approximately US\$1.5 per ha)³ or in-kind contributions (such as steel plates, motorcycles and cattle). After a logger signs an agreement with the local leader he can begin his logging operations and apply for cutting licences from the technical environment service and the province.

According to Pax Christi (2007), the concessions for CSM in Eastern Province (69,512 ha) were larger than those from the industry in the area, estimated at 58,000 ha in 2007. Because of the possible lack of information on the part of the communities about the rights and obligations defined in the new forest law, the village authorities act as the rights holders without any support (Karsenty 2009).

Benefit-sharing mechanisms

Karsenty, Bertrand and Montagne (2006, 451) state clearly that, like poverty, the informal sector is the result of the large-scale exclusion of important social groups. Credits are not available and few local loggers have capital. This results in logging operations being pre-financed by foreign traders and timber being exported to neighbouring countries. CSM is the main supplier of local sawmills and other social actors — such as missionaries, politicians and public servants — providing products such as sawn timber, beams and boards for doors and windows. The price per m³ has declined over the years. In Kisangani, the price for one m³ is US\$250, compared to US\$350 per m³ before 1996; in the Bas-Congo, the price is US\$150, compared to US\$200 in 1995.

A variety of stakeholders are found in the sector: loggers, local carpenters, sawmill owners, mechanics, development partners (NGOs, UN organizations), transporters and traders, wholesalers and retailers. CSM provides jobs and services in both rural and urban areas and makes an important social and economic impact by reducing poverty among rural populations. But who benefits most? Neither the local and indigenous population hired as cheap labour nor the administration offices without fiscal recipes. But according to Lescuyer, Eba'a Atyi and Cerutti (2009) informal logging is very profitable in economic terms. It does not benefit the national economy, however; informal and formal fees profit only private individuals.

Chainsaw milling in DRC: the challenges

Demographic challenges

The population of the DRC was estimated to be 69 million in 2010, with very high densities along the borders with Uganda, Rwanda, Burundi (more than 100 inhabitants per km²) and Angola. With per capita GDP estimated in 2008 at US\$156.6 (UNDP 2009) this population pressure is exacerbated by the presence of refugees and uncontrolled armed elements that cause the loss of forest cover and will ultimately reverse any development.

Several studies⁴ report the negative impact of CSM activities, especially those related to subsistence agriculture. The mobilization of the active layers of the population in logging operations causes a decline in agricultural production. Thus, as noted by Pax Christi (2007), CSM activities cause people to be hungry, because all active hands are used in forestry.

Ecological challenges

The combined effect of unsustainable logging, the introduction of chainsaws (in the Mombasa area the number of chainsaws varies between 200 and 300) and the local perception that forest resources are infinite, has resulted in habitat degradation. Some people say "*la forêt est rasée*" (the forest is plundered). CSM, as a newly introduced technique and accessible to local communities, provides an opportunity to change from unsustainable logging techniques to modern operating standards respecting minimum logging diameters, CITES species and principles of sustainable management.

Governance challenges

The main governance challenges are the regularization of CSM and the traceability of wood.

Regularization

The forestry code, the legal basis of the sector, does not mention CSM specifically. The code notes CSM only in Articles 112 and 113, which deal with the exploitation of community forests and which require the forest manager to seek approval from the state. Observers of Congolese forest legislation are split on this issue:

- Some people think it is detrimental to communal forest managers, whose importance to the economy is not yet apparent; and
- Some people think the legislation is realistic since there is no control over this category of forest managers, and regulatory authorities, who are better aware of the problems in the sector, should be responsible for the appointment of appropriate organizations.

At the same time, Regulation No. 035/CAB/MIN/ECN-EF/006 of 5 October 2006, which follows the new Forest Code, contains provisions for the approval of forest exploitation and local cutting permits.

The current law recognizes only one category of chainsaw millers (pit-sawyers), while the trade chain also involves sawyers, retailers, firewood traders, mill owners and log trans-

porters.⁵ Article 23 of the regulation specifically states that a chainsaw miller must be a Congolese national using a handsaw or chainsaw. This demonstrates that the legislation is disconnected from the real situation.

A third difficulty results from Articles 8 and 24 of the regulation, the wording of which is certainly due to a misreading of Articles 112 and 113 in the Forestry Code; they suggest that CSM is allowed only in community forests.

These controversies further weaken the CSM sector by pushing its participants into informal or even illegal activities. That could be expected, since the community forestry law has not yet been made operational.⁶ This compromises the existence of small-scale forestry as a separate entity not only from industrial forestry, but also and especially from the local community.

Traceability

Another challenge relates to the traceability of timber from CSM and the persons involved in the supply chain.⁷ Weak borders, corrupt public officials and customs, and the existence of a trans-national network of illegal trade, hamper the control over timber trafficking and the actors involved. How can bona fide operators be distinguished from the small numbers of illegals who work under the protection of military and political authorities? Given the lack of information, it is difficult to detect or sanction illegal activities. The lack of objective and reliable statistics contributes to the practice of fraud that extends to licensing documents and tax payments on harvested volumes and exported volumes. CSM is subject to the payment of official and unofficial fees for area, province, replanting, loading, security service, migration service, police and military authorities.

A striking example of lack of appropriate statistics is the truck loaded with wood that broke the Lubiriya River Bridge with a load of 60 m³, while the amount reported was 10 m³.

According to statistics from the Eastern province, 192,842 m³ of timber was produced in 2006 and 2007 by 12 industrial loggers while 28,731.5 m³ was produced by 44 groups of chainsaw millers. These figures are at odds with estimates from other studies. IKV Pax Christi (2007) reports that the public service of Mombasa reported a timber harvest of 13,774.70 m³, while field data showed that 56,119.25 m³ of timber was harvested.

Poor governance has been profound in CSM. Corruption and conflicts are the reason why local communities still live on less than one dollar a day.

Possible solutions: participatory structuring of the sector

The integration of the informal sector into the overall economy and government standards requires that the authorities put in place a policy and support programme that addresses the local economy. The government must in the long term formalize CSM by giving it a specific legal framework and clarifying the status of its participants. A set of



incentives (granting micro-credit and securing legal rights) needs to be put in place by the public authorities. It is unclear how to address these issues — and the problems of the participatory zoning process and the creation of community forests — with the active involvement of civil society.

So far, the authorities have been interested in taxation of the industry instead of addressing a broad perspective of land-use planning and the rights of indigenous and local communities. The transition from informal to formal also means a change of approach in fighting illegal practices and networks, which are established and well consolidated. Development and research partners (IUCN, CIFOR, FORAF and WCS) need to support governments in this struggle.

Conclusions

It is clear that CSM brings wealth to local chainsaw bosses, but not to a majority of the population or the state economy. Solutions are urgently needed.

If the formalization of CSM is the ultimate step to reconciling poverty reduction and environmental protection, it involves intermediate steps that require the strengthening of state control, the harmonizing of transboundary trade regulations and the mobilization of funds. The combination of domestic and external pressure is an important link in promoting legality. The establishment of a national regulatory framework, discussed and validated by all stakeholders, will provide opportunities for organizational improvements in the sector.

Endnotes

1. See PFBC (*Partenariat pour les Forêts du Bassin du Congo*). 2006. *Les Forêts du Bassin du Congo, Etat des forêts*.
2. See Vundu dia Massamba, *Présentation sur la réglementation de l'exploitation artisanale des bois en RDC*, in *Rapport de la journée de concertation sur la réglementation de l'exploitation artisanale des bois en République Démocratique du Congo*, IUCN, Kinshasa, February 29, 2010.
3. In the Mombasa area, cash payments are higher, ranging between US\$100 for 10 ha and US\$600 for 50 ha.
4. See de Wasseige et al. 2006; presentations at the International Conference on the management of the DRC forests (Brussels, 2007); Studies on the REDD+ potential of the DRC by the Ministry of Environment, Nature Conservation and Tourism, and studies by IKV Pax Christi (2007) and Adebun and Abdala (2010).
5. This is from the communication of the *Association Congolaise des Exploitants Forestiers Artisanaux* (ACEF) to its members.
6. The regulations for community forestry are still being developed.
7. In DRC, timber is exported to Angola via Uganda and Kenya; to Uganda via Kasindi; to Sudan via Aru; and to Rwanda and Burundi via Butembo-Goma.

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4.5 Chainsaw milling in Ghana: context, drivers and impacts

EMMANUEL MARFO

Introduction

Chainsaws were introduced in Ghana in the 1960s and gradually replaced the use of manual saws for felling and cross-cutting trees. Chainsaw milling (CSM) became widespread in the early 1980s, when large-scale sawmill operations decreased along with a nationwide economic decline.

CSM has been outlawed in Ghana since 1998. The ban has failed to limit the activity, however; CSM is now one of the main forest governance problems in the country. Chainsawn timber is the main source of supply for the growing domestic market and its production generates rural incomes and employment. Chainsaw milling has raised significant public debate but a workable approach on to how to deal with it in policy and in practice has not yet emerged. A range of policies, laws and institutions has evolved to govern the practice and manage its consequences.

The Voluntary Partnership Agreement (VPA) between the European Union (EU) and Ghana emphasizes the need to resolve the CSM issue. The question of legal timber — and how it can be addressed in the context of the domestic market — is central. Within the current regime of prohibition and ineffective enforcement, it is difficult to see how Ghana will be able to satisfy the legality assurance criterion of the VPA when its domestic market sells illegal chainsawn lumber.



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RESOURCE.

Forests and the forestry sector

The total land area of Ghana is more than 23 million hectares (ha) (Table 1). Forest lands are owned by local communities and vested in “stools” (chiefs and families). The forest resources, however — whether in forest reserves or outside of them — are managed by the Forestry Commission (FC). Thus, even though traditional authorities are recognized as land-owners and receive benefits as such, they do not have any management rights over “their” forest.

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Ghana used to be rich in forest resources, and forests were an important part of the economy. There is a large local timber sector, which is predominantly export-oriented and unable to fulfill the demands of the less lucrative domestic markets. Today, the country's forest resources are highly degraded. Wildfires, agriculture and indiscriminate logging (including through CSM) have contributed to this problem.

Table 1. Key facts about forestry in Ghana

land area	238,500 km ²
population	22.5 million
estimated number employed by forest industry	100,000
forest area (forest reserves)	1.6 million ha (16,000 km ²)
off-reserve forest area	400,000 ha (4,000 km ²) over an area of 6 million ha
Annual Allowable Cut (AAC)	2 million m ³ per annum (1.5 million in off-reserve forests; 0.5 million m ³ in forest reserves)
installed processing capacity	5 million m ³ per annum
deforestation rate	65,000 ha/year
export value wood products	GHC 366 million (US\$260 million)
contribution to GDP	6%

Institutional and legal framework

Chainsaw milling was a recognized enterprise before the 1980s, after which registration by District Assemblies became required. In 1991, direct controls were instituted; logging procedures and post-logging inspection measures were tightened. CSM continued in an excessive and uncontrollable way, and in 1998 the practice — including transportation and trade of its products — was completely prohibited by law. This ban has not ended the practice, however, and CSM continues to dominate supply to the domestic market.

CSM is mainly regulated through the *Timber Resource Management Act* and its legislative instruments. The Timber Resources Management Regulations of 1998 have specific provisions that criminalize chainsaw milling and operations for commercial purposes.

If the lumber is not meant for sale, exchange or for any commercial purpose, then CSM is permitted. The source of the timber — whether from forest reserves, farms within forest reserves or community forests — is not relevant. Although the law seems to allow CSM with a registered chainsaw for household purposes, it does not allow this lumber to be transported unless accompanied by a conveyance certificate. To address this contradiction, some District Managers of the Forestry Services have issued waybills to allow the transport of CSM lumber.

In November 2009 the first VPA between Ghana and the EU was signed and ratified on legal timber exports, including the domestic market.¹ Illegal chainsaw milling challenges Ghana's ambitions to develop a legal and sustainable forestry sector.

The chainsaw milling subsector

Chainsaw enterprises are generally small and loosely structured. CSM is often carried out by a small group of operators with assistants who help mill the lumber and transport it from the felling site to access roads. Operations are mostly financed by dealers from urban centres who trade lumber in the timber markets, although some individual operators are reportedly self-financing.

Timber production and trade

Based on a nationwide survey (TIDD/FORIG 2009), 72 species were processed through CSM and processed into 112 product dimensions. About 84% of the lumber in the domestic markets studied was supplied by chainsaw operators; 16% came from sawmills (Marfo, Adam and Obiri 2009 and TIDD/FORIG 2009).

Chainsawn lumber is 12–74% cheaper than sawmilled lumber from the same tree species, quality and dimensions and the range of species and dimensions it offers is much larger. (Adam and Dua-Gyamfi 2009; Obiri and Damnyag 2009b).

Conversion efficiencies for CSM in Ghana range from 27–40%, averaging 30.3% (Marfo 2010). The annual harvest volume by chainsaw operators ranges from 2.2 to 2.9 million m³; given an average tree volume of almost 3 m³, this is equivalent to about 745,000 to 970,000 trees per year. If non-market direct consumption by households for building, roofing, etc. was included, the estimate would be even higher. This means that the harvested volume could be higher than Ghana's official AAC of 2 million m³ per year, suggesting that CSM contributes substantially to the country's forest loss.

The profit from CSM over the value chain ranges from 15–22% of total production costs with an average profit of GHC 66.6/m³ (Obiri and Damnyag 2009a.). The transporter and supplier of the machines, fuel and accessories each receive approximately 10% of the gross revenue;²

the operator receives 19%; and labourers and production assistants, providing various services, jointly earn 25%. Lumber merchants receive the highest proportion of revenue (27%) from chainsawn lumber. The difference in gross margin between the operator and the lumber merchant's income is about 8%. As tends to be the case in many commodity chains, the sellers at the end of the chain make the most money.

Employment

Recent studies (Marfo and Acheampong 2009; Marfo 2010) estimate that more than 97,000 people could be participating in production, hauling, resawing and retailing in the domestic market alone (Table 2), almost as many as in the formal industry. Many other



people indirectly derive income from services at the timber markets or depend on chainsawn wood for their work.

Table 2. Summary of CSM statistics

total annual gross revenue from CSM	GHC 279 million
annual gross revenue retained by chainsaw operators	GHC 52 million
total annual profit from CSM	GHC 37 million
net profit of CSM	GHC 66.6/m ³
volume of trees annually harvested by CSM	2.5 (2.2–2.9) million m ³
number of trees harvested	842,000 (745,000–970,000)
conversion efficiency of CSM, based on total usable tree volume	30.3%
number of species processed by CSM	72
dominant species supplied to market	mahogany, wawa, dahoma, ofram
volume of CSM lumber sold in the market	558,054 m ³
volume of chainsawn lumber consumed in Ghana from the domestic market	496,815 m ³
proportion of chainsawn lumber in the market	84%
number of people directly engaged by CSM	97,000
annual potential stumpage revenue lost by the FC	GHC 25 million
estimated annual value of informal payments	GHC 33.5 million

Source: Marfo 2010; at time of writing, US\$1 = GHC 1.4

Drivers of chainsaw milling

Chainsaw milling has persisted in Ghana even though it is banned. In order to design effective policy responses, it is necessary to know the key factors that drive chainsaw milling. Marfo, Adam and Obiri (2009) distinguished the following drivers:

- corruption and weak institutional governance;
- a high level of rural unemployment;
- strong market demand for cheap lumber and an inability of formal sawmills to meet this demand;
- political interference in Forest Services Division (FSD) operations;
- lack of political will to enforce the ban and implement alternatives;
- an unclear legal framework and an inadequate policy response to the domestic timber demand;
- inadequate tenure arrangements and inequitable benefit sharing of forest resources;
- and
- strong support for CSM by local communities, particularly farmers.

Impacts of chainsaw milling

Socio-economic impacts

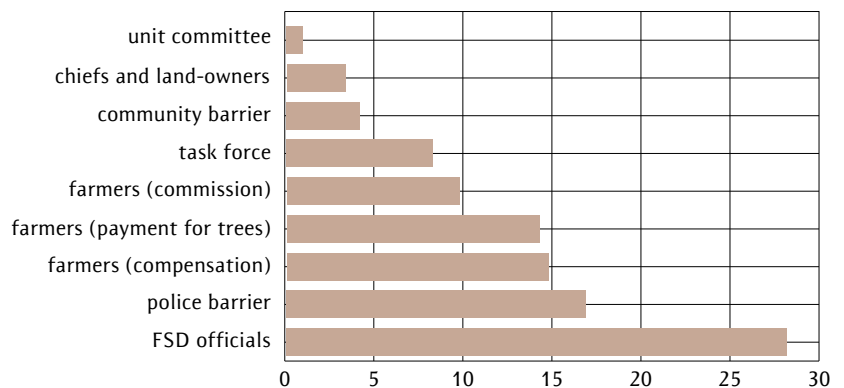
Chainsaw lumber production helps sustain rural economies and livelihoods in six ways: employment; community benefits such as provision of schools and wells; informal taxes collected by District Assemblies; supply of lumber; supply of firewood; and services such as transportation (Obiri and Damnyag 2009b).

The most important economic benefit to rural communities is the provision of jobs. The income earned from chainsaw operations is higher than that from alternative labour activities in the communities (Obiri and Damnyag 2009b). Operators working full time on chainsaw operations may earn as much as 24 times the income of alternative work such as subsistence farming.

Chainsaw operators do not pay a stumpage fee for trees they fell because of the absence of a legal framework, but they need to make substantive informal payments in order to keep their operations going. Based on the estimated CSM production, the stumpage revenue foregone by the state is more than GHC 25 million (US\$18 million) per year. Informal payments accrue to a wide range of people; public officials (FSD, police and task force) directly involved in enforcing the ban capture at least 50% of these payments (Figure 1).

Figure 1. Informal payments (%) per single operation in eight study districts

Source: modified from Obiri and Damnyag 2009a; n = 120



Conflicts are part of the everyday struggle over commercial access to timber. Ongoing conflicts related to CSM involve operators and communities (farmers) and operators and forestry officials (including court cases). The two main causes of operator-community conflicts involve lack of consultation with farmers before logging and insufficient compensation for crop damages. Forestry officials face the possibility of violence when they have conflicts with illegal operators; violent clashes have been reported (Marfo and Nutakor 2009). Conflict is costly to the FC. Its officers report that they spend 25–75% of their time on chainsaw-related matters. If a conflict reaches court, an average of seven court appearances is needed to resolve the matter (Marfo and Nukator 2009).

Environmental impacts

The most pervasive argument against CSM is its negative environmental impact. Marfo, Adam and Obiri (2009) noted several negative environmental consequences compared to conventional logging:

- logging intensity can be as high as seven trees/ha, which exceeds the standard of two to three trees/ha;
- some valuable tree species are felled below recommended size limits;
- most chainsaw operators do not practise directional felling — this can lead to the destruction of young trees and agricultural crops; and
- chainsaw operators have invaded ecologically sensitive sites such as Globally Significant Biodiversity Areas and convalescent areas of production forest reserves.

The problems related to CSM seem to stem from lack of technical skills and from the illegal framework within which it operates. A regularized environment could support administrative development and capacity building to address issues such as directional felling, logging intensity and choice of sites.

Conclusions

Ghana is in a dilemma as to how to deal with CSM in both policy and practice. A specific economic, social and political environment drives CSM. Most stakeholders recognize that it is important both as an employer of rural youth and a supplier of domestic timber. Regularization or eradication of CSM would adversely affect the rural economy and the enterprises that depend on it for lumber. It would also reduce employment and income-earning opportunities for rural people.

If the current level of exploitation continues, however, a serious shortage of merchantable trees is imminent. Ghana would lose much of its remaining forest and the services they provide. Based on the estimated CSM harvest of about 2.5 million m³ and the AAC of 2 million m³, the annual harvest can be estimated at about 4.5 million m³. This is approximately four times the recommended allowable cut — a figure that is itself probably outdated.

The current regime of benefit sharing — which alienates communities — needs major restructuring in order to gain community support for the management of forest resources. Tenure reforms that recognize some ownership or management rights on the part of communities, especially outside forest reserves, are an important consideration.



The ratification of the EU-Ghana VPA in 2009 further emphasized the need to address the CSM issue. If Ghana is not able to assure the legality of the domestic market, including CSM, the country's export trade with the EU is likely to be affected. A strict implementation of the VPA — with its legal assurance systems and law enforcement — could spell the end of CSM, which provides a living for hundreds of

thousands of people in Ghana. Bridging the numerous conflicting local and global interests that characterize CSM requires a meaningful and inclusive dialogue by all stakeholders.

Chainsaw operations need to be regulated, either through effective enforcement of the current ban or by being integrated into mainstream forest management and operations. Declaring that CSM is illegal without addressing the timber markets that sell its illegal products is not realistic or effective. Legalizing a practice that is clearly operating at unsustainable levels is also not an option.

The way forward

For any policy option to be effective, it must optimize the advantages of CSM while reducing adverse environmental and socio-economic effects. Policy should also address the factors that drive CSM. The domestic market demand for lumber has been identified as the major driver for illegal CSM in Ghana. Without addressing this issue within the context of the production and supply of legal timber, it may be impossible to develop and enforce an adequate CSM policy. Because of the significance of CSM, solutions must be discussed and agreed to by a wide range of actors. The illegal nature of the practice makes it difficult to formally engage chainsaw millers in dialogue, but this is necessary to build support for sustainable solutions.



Since 2007, a process of multi-stakeholder dialogue has involved both legal and illegal actors and aims to find a consensus on the CSM challenge.³ The process aligns with the National Forest Forum and VPA implementation processes and so far has increased common understanding of the main issues and identified acceptable options to address CSM and domestic market supply.

Participants in the process agreed that, based on lessons learned from the CSM ban and experiences elsewhere in Africa, the transformation of CSM into regulated artisanal milling⁴ is worth exploring. The way forward lies in reconciling the demand for adequate legal timber for the domestic market with the sustainable production capacity of the country's forest resources. Export policies should be fully aligned with domestic market policies since both markets draw timber from the same resource. Ultimately, supplies may have to come from plantations or imports. For now, the process considers three possible policy directions:

- Option 1: Sawmills alone to supply the domestic market with legal timber. This implies the maintenance and full enforcement of the CSM ban, and the development of a range of options to encourage sawmills to supply domestic markets.
- Option 2: Sawmills and artisanal millers to supply the domestic market with legal timber. This implies allocation of harvesting rights to artisanal millers and the logging industry. Options must be developed to create equitable conditions for sawmillers and other participants in the domestic market.
- Option 3: Artisanal millers alone supply the domestic market with legal timber. This implies allocation of harvesting rights to artisanal millers.

These options are being discussed within the forestry sector. Studies — including an economic analysis of the costs and benefits of these options for various stakeholders — are underway to help participants in the multi-stakeholder process to develop suitable ways forward.

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Endnotes

1. VPAs between the EU and timber-exporting countries implement the EU Action Plan for Forest Law Enforcement Governance and Trade (FLEGT).
2. This is equivalent to total sales before production and transaction cost (informal payments) are deducted.
3. The “Developing alternatives for illegal chainsaw milling in Ghana and Guyana through multi-stakeholder dialogue” project aims to find sustainable solutions to the problems associated with the production of lumber for local timber markets by involving all stakeholders in dialogue, information gathering and the development of alternatives to unsustainable chainsaw milling practices. See www.chainsawmilling.org.
4. Artisanal millers are trained and organized chainsaw millers who use more efficient equipment, such as Logosol or Wood-Mizer.

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4.6 Chainsaw milling in Ghana: assessing its economic impact

JONATHAN D. QUARTEY

Introduction

Chainsaw milling has been the most important part of the informal wood sector in Ghana for a long time. Originally, the chainsaw was not the common method for processing lumber for commercial use in Ghana. According to the Food and Agricultural Organization (FAO), the main purpose for the introduction of the chainsaw into Ghana was to fell trees during logging and prepare land for plantation farms (FAO 1974). In the 1980s, however, a period of severe economic hardship, sawmill operations reached record low levels. People in Ghana resorted to the use of chainsaw milling (CSM) to produce logs and lumber on a commercial scale (Parker 2008).

Although the initial response of the Government of Ghana was to recognize and legislate for CSM, but in 1998 it banned the practice for several reasons, including environmental degradation, equity considerations, economic inefficiency, corruption and conservation of the forest resource. Clearly, the ban on chainsaw milling in Ghana has not achieved its objective. The Forest Services Division (FSD) of the Forestry Commission has reported that CSM operations are increasing rather than decreasing (Parker 2008).



GENERALLY, THE EFFECT OF THE CSM BAN IN THE CONTEXT OF GHANA'S LOG EXPORT BAN HAS BEEN A DECREASE IN DOMESTIC PRICES AND AN INCREASE IN MILLING CAPACITY AND PROFITABILITY.

Ghana's forestry sector

The assessed forest cover for Ghana was 5.5 million hectares (ha) in 2008, comprising about 1.2 million ha of forest reserves and 4.3 million ha of off-reserve area. Next to cocoa and gold, the forestry sector has been the next highest earner of foreign exchange for Ghana, accounting for 7–10% of export earnings from 2001 to 2005 and contributing about 6% of GDP. Amelia et al. (2007) reported that 60–70% of Ghana's population depends on forest resources for livelihood and cultural purposes.

The informal timber sector in Ghana contributes 70% of the value of export earnings. This sector includes a variety of unregulated transactions and activities that are not legal but are tolerated by the state. The informal sector also serves as the main source of domestic wood supply; CSM supplies about 80% of this (EC 2008). The informal sector

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had a comparable turnover in monetary returns as the formal sector in 2007, although it supplied only the domestic markets (Birikorang et al. 2008). Birikorang (2007) estimates that, based on financial and economic return assessments, the informal sector makes a more significant contribution to employment than the formal sector.

Ghana is exporting less timber to Europe, partly because of European Union (EU) requirements regarding the source and legality of timber. The shortage of timber has resulted in some factories shutting down in Ghana. The regional market (West Africa) is growing in importance, however; the Sahel region is a prominent destination for timber, mainly illegal. Trade in illegal timber is on the increase, compared to trade in legal timber. The EC (2008) indicates that the informal sector is responsible for about 52% of the largely illegal timber trade in Ghana. In the formal sector, about 19% of timber comes from illegal sources. This shows that about 71% of the annual log volume could be illegal. A study by the EC (2008) indicates that it is easy to obtain documents to authorize illegal logs in Ghana.



Illegal timber harvesting reached 1.7 million m³ in 2008, supplying about 40% of the formal industry needs and more than 80% of the informal (mainly domestic) sector needs (Birikorang et al. 2008). The processing capacity of the milling industry was seven million m³ at that time, concentrated in ten companies found mainly in Kumasi and Takoradi.

Institutional and legal framework

Ghana's forestry policy has established a legal and institutional framework for operations in the sector. The harvest of trees and control of timber movements in Ghana leaves much to be desired, however. FSD is responsible for checking of harvests at the stump site, but frequently fails to do so. In many cases, checks of timber in transit by the Timber Industry Development Division (TIDD) are a mere formality due to corruption. This allows illegal timber to be a part of the economy.

Bans on exporting logs have been a recurring feature of Ghana's timber industry. Two such bans were instituted in 1979 and 1988. The International Institute for Environment and Development (IIED) observed that these bans might have been more effective if they had been accompanied by appropriate supply-side measures such as felling controls (IIED 1993). The log export ban imposed in 1995 was followed by a total ban on CSM.

Chainsaw milling in Ghana

The local wood market in Ghana, unlike the export market, has not been given enough official attention. Formal sector firms (sawmills) are required to supply the local market with 20% of their output by law, although many do not comply. Even when they do, the supplies were usually too expensive, took too long to arrive or were processed according to export specifications and did not suit the needs of local consumers. This distorted the domestic market, which had to satisfy this demand. CSM helped fill the gap created by the inadequate supply of lumber.

Chainsaw milling is an important part of the Ghanaian economy. Because CSM is largely illegal, it is difficult for the Forestry Commission to monitor and control deforestation.

Chainsaw milling also causes these problems:

- logging protected species through the indiscriminate nature of their felling operations;
- logging in protected areas;
- removing undersized trees from forests; and
- extracting more timber than allowed.

Some chainsaw operators duplicate felling licences and obtain logging concessions through bribes. In this way they harvest, transport and sell timber in violation of official regulations. The official annual allowable cut (AAC) is 2 million m³, and the official harvest in 2005 was 935,000 m³. The estimated unofficial harvest by formal industry and chainsaw loggers was 2.3 million m³ (EC 2008).

There is such a solid socio-economic framework in place for CSM in Ghana that enforcing a ban would be more costly than managing the operations. The banning of CSM in Ghana has failed, and the government must regulate it instead.

The ban on chainsaw milling

The ban on CSM in Ghana came into force in 1998.

Chainsaw milling in Ghana can be seen as a criminalization problem or a management or regulation problem. If it is a criminalization problem, the only way to halt deforestation will be to stop the use of CSM. Many firms, particularly in the informal sector, would have to shut down since they could not afford more sophisticated equipment. Other economic activities — such as carpentry, house construction, furniture making, cooking with fuel wood — would also come to a halt, as would firms that depend on chainsawn lumber (the majority of wood-dependent firms in Ghana). The economic implications of such steps are obvious; it would mean the almost complete shutdown of the forestry sector. The first steps have already been taken in this direction by declaring CSM illegal.

If CSM is seen as a forest management problem its costs and benefits are shared among all stakeholders. With this approach, the state must ensure that the CSM sector functions efficiently. This can improve the socio-economic welfare of all stakeholders.

CSM has been estimated by Hansen and Treue (2008) to be responsible for about 75% of all illegal logging in Ghana, despite its criminalization. This confirms the FSD's assertion that CSM is on the increase in Ghana (Parker 2008). The practice has thrived due to the callousness of forest fringe communities and chainsaw owners, who might be wealthy individuals living in an urban area. The local people provide services to CSM operators as assistants, porters and loaders. Some of the illegal milling teams are said to carry firearms, making it dangerous for the Forestry Commission to apprehend them (Sarfo-Mensah 2005).



The Kumasi wood market

This is one of the main wood markets in the country. It started more than 60 years ago in a suburb of Kumasi (Anloga), the second largest city in Ghana, and covered an area of about 15 ha. The market was run by lumber brokers, who obtained their wood stocks from sawmills and chainsaw operators. The main activities were sales of lumber and secondary and tertiary processing of chainsawn lumber. Recently, the market was relocated to Sokoban Wood Village, which was jointly funded by the French and Ghanaian governments at a cost of about US\$10 million. This ultra-modern facility has been designed to accommodate almost 1,000 business entities on more than 12 ha. Relocating the market displaced about 8,000 persons engaged in various business ventures; 141 permanent structures were demolished in the first quarter of 2010.



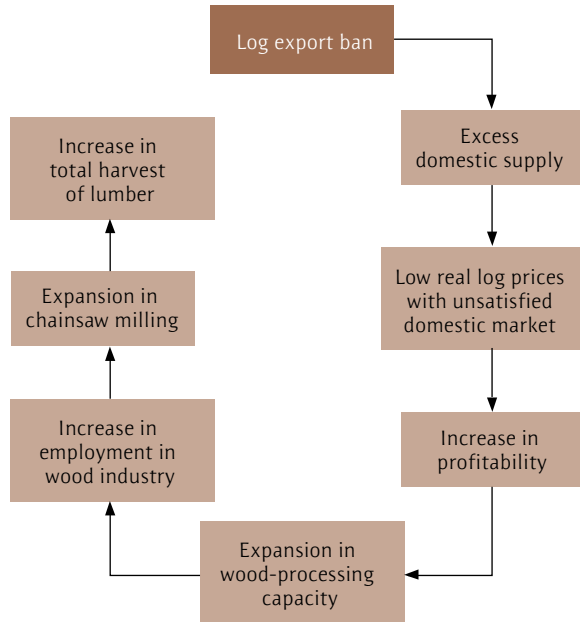
Since the government facilitates the operation of this market, which is mainly supplied by timber from CSM, it goes without saying that CSM has been endorsed: as long as chainsaw millers do not get caught, the illegal timber gets approved in the market (VAT is even being charged on the timber).

Economic impact analysis

The ban on CSM must feature in any meaningful economic impact analysis. In Ghana, the purpose of the ban is to conserve the forest through controlling or preventing over-logging. The variables considered in this economic impact analysis are wood processing capacity, domestic demand and log price, log supply and the profitability of logging. These inter-related variables produce economic impacts that determine the contribution of forest policy to economic growth. A log export ban, like the one in place in Ghana since 1995, leads to a drop in log exports. The excess supply created as a result forces domestic prices down. This drives up the profitability of wood processing and domestic processing capacity. Eventually the domestic market attains enough capacity to absorb harvest levels at least as high as those that existed before the ban. Harvested logs that were previously exported would now end up in the domestic market (Dundley 2004).

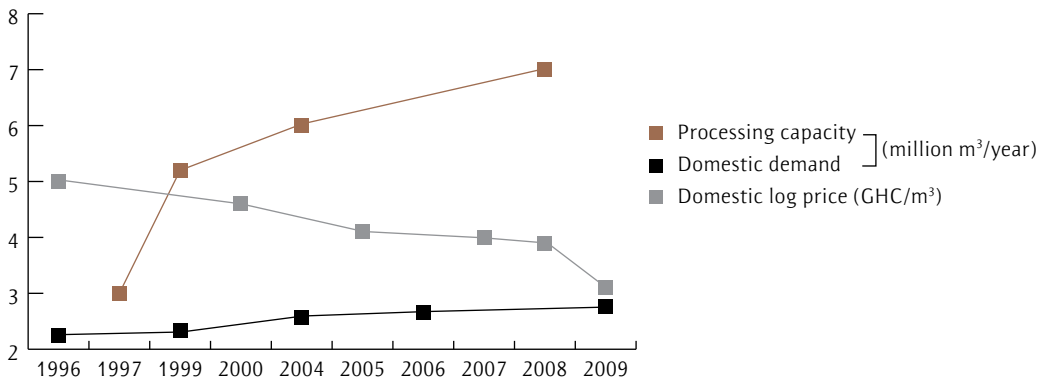
Figure 1 provides some insight into the chainsaw lumber economy cycle in Ghana. As a result of expanded capacity, more people are employed in the wood industry, including the CSM sector. This leads to an increase in the total harvest of lumber. This in turn creates excess supply in the domestic market, adding to the excess due to the log export ban. Hence the cycle continues.

Figure 1. Cycle of chainsaw milling economy, Ghana



The relationship between processing capacity and domestic log price is shown in Figure 2. Domestic demand increases alongside increasing processing capacity due to the drop in domestic log price, growth in the local building construction industry, and growth in GDP and population.

Figure 2. Relationship between domestic log price and processing capacity



Real wood prices (wood prices relative to the rate of inflation) as against nominal wood prices (wood prices in only monetary terms) have almost always decreased in Ghana. Illegality, corruption and government interference render the wood market non-competitive. Illegal CSM lowers the cost of log harvesting and hence the real price of wood on the market. This makes the wood trade very profitable. From 2005 to 2009 the average increase in the price of wood in the domestic market was about 12% while the average inflation rate over the same period was about 22%.

The increase in milling capacity (Figure 3) is related to profitability in the milling industry. As shown, capacity increased 250% from 1994 to 2008. A greater processing capacity, supported by an ever-increasing domestic demand and by relatively cheap domestic log prices, have resulted in an increase in logging, most of which is harvested by CSM.

Figure 3. Increase in milling capacity, Ghana (millions m³/year)

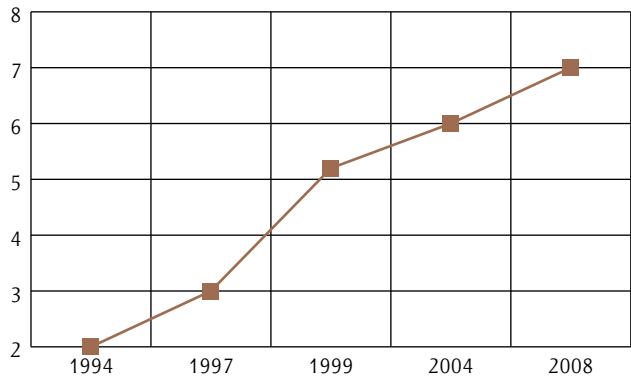


Figure 4 indicates that the log export ban had only a short-term effect on total log harvest in Ghana. The anticipated effect of the ban was of course that the total log harvest would remain low. In fact, the log harvest has increased since 2002. Since Figure 4 shows only official volumes of production, and about 70% of total harvest is illegal, then the forest extraction situation is grave.

Figure 4. Log harvest in Ghana (millions m³/year)

Note: The log harvest curve has been corrected for illegal log harvest

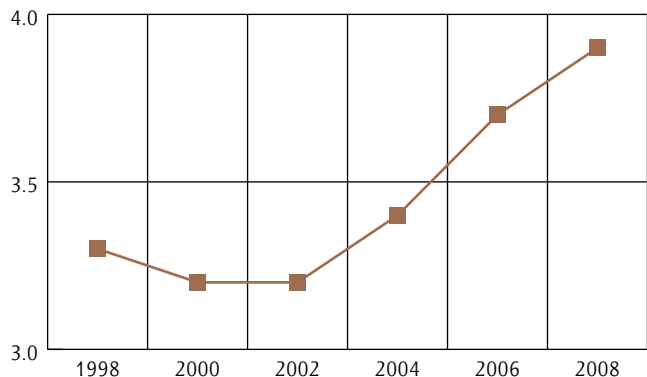


Figure 3 clearly shows an increasing processing capacity, which was supported by a growing domestic demand and relatively cheap domestic prices. This creates an ever-increasing harvest trend, particularly through CSM. Given this trend of total log harvest, it is economically inefficient to maintain the ban on CSM.

Generally, the effect of the CSM ban in the context of Ghana's log export ban has been a decrease in domestic prices and an increase in milling capacity and profitability. This has resulted in an increased log harvest, which has created a favourable environment for chainsaw milling, contrary to the expectations of the ban. Clearly, the objective of the ban has not been achieved.

With current practices, CSM will continue to thrive in Ghana. Increased log harvests will worsen deforestation. The greatest challenge will be to break this cycle. Chainsaw milling needs to be decriminalized and managed in a sustainable way to support the Ghanaian economy.

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4.7 Chainsaw milling in Kenya

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Kenya's forest resources

Kenya is internationally considered to have low forest cover since less than 10% of its 569,250-km² land area is classified as forest area (MENR 2005). Nevertheless, the forest sector provides forest-related goods and services and is a vital part of the livelihoods of the Kenyan people. The forest's most significant contributions are energy for domestic and industrial processes, timber for construction and environmental services such as regulation of water flows, regulation of local climate conditions and provision of carbon reservoirs and sinks. It is estimated that 80% of the population uses biomass wood for energy while urban people rely heavily on hydro-electric power (Luvanda and Muthike 2008).

The forests contain 50% of the nation's tree species, 40% of larger mammals and 30% of birds. Indigenous forests also contain some endemic and threatened species. In addition, they serve as cultural, ceremonial and recreational sites and provide a variety of non-timber products.

Most closed canopy forests are gazetted forest reserves managed by the newly established Kenya Forest Service (KFS). A few gazetted areas are national parks or game reserves managed by the Kenya Wildlife Service (KWS). An estimated 100,000 ha of forests are managed by county councils, which hold the land in trust on behalf of the local people. Forest exploitation in these trust land areas is often not well managed. In some cases, total deforestation has taken place due to a lack of capacity in the councils to manage these forests. An unknown area of indigenous forest is privately owned. Although these holdings tend to be small, they are considered important for water catchments and environmental conservation. Their exploitation is also difficult to control.



THE HIGH DEMAND
FOR TIMBER IN
KENYA AND THE
BAN ON LOGGING

OPERATIONS IN FOREST PLANTATIONS
DRIVE ON-FARM TIMBER PROCESSING.

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The sawmill industry: processors of the wood

The first sawmill in Kenya was set up in 1913 (Table 1). The number of sawmills increased steadily, to about ten in 1920. The second notable increase in the number of sawmills took place during World War II (1939–45), and was attributed to the high demand for timber for the construction of army barracks and railway sleepers for both local and export markets (MENR 1972). Another increase occurred just after the war, mainly to produce timber for reconstruction work. The Mau Mau rebellion of 1952–60 and the years before independence in 1963 resulted in a sharp decrease in the number of sawmills due to uncertainties about the future of the country. Many British sawmill owners left the country at this time.

The sawmill industry experienced its greatest growth between 1965 and 1970, due to the establishment of the Africanization programme and the Investment Credit Development Corporation (ICDC) by the government shortly after independence. ICDC financed the purchase of existing sawmills and the start-up of new ones with African participation. The rebate on royalties for export timber was also highest (50%) during this period, which encouraged many sawmillers to export timber, especially hardwoods.

Table 1. Number of sawmills in Kenya, 1913–94

year	number of sawmills			remarks
	inside forest	outside forest	total	
1913–15	1	—	1	operating under special concessions
1920	<10	—	<10	initial growth of the sector
1930	>10	—	>10	mainly providing timber for consumption of local settlers
1940	>20	—	>20	timber export markets open up
1945–50	60	—	60	during and after World War II
1960–64	34	—	34	Mau Mau rebellion and independence struggle
1970	200	150	350	Africanization programme
1980–85	220	150	370	ban on exports of all indigenous timber (1985)
1990	—	361	361	government regulation to remove sawmills from inside the forests
1994	—	450	450	
1999	—	450	450	ban on all operations on state plantations

Source: MNR Annual Reports, 1964–99

This growth was negatively affected by the 1982 order to stop the exploitation of Camphor wood (*Ocotea usambarensis*) and the 1984 presidential ban on the export of indigenous timber. In 1985 this ban was extended to cover all timbers unless the Office of the President issued special clearance. Consequently, most sawmills turned to the processing of plantation-grown softwood for local markets and some export.

With the availability of softwood timber in gazetted plantations, the number of sawmills increased further. Due to the over-exploitation of the forests and a low replanting rate, however, the government again imposed a ban on operations from gazetted forests by all timber processors. The ban, which is still in force, caused most sawmills to close due to a lack of raw materials.

The emergence of chainsaw milling

Before 1999, chainsaw milling (CSM) was insignificant, since sawmills were able to meet the demand for sawn timber. The ban on wood harvesting from government plantations, however, resulted in an acute shortage of timber. This prompted increased imports from neighbouring countries and cross-border timber trade, both legal and illegal (Samuel, Pasiecznik and Fehr 2007). Trees on farms became the principal alternative, and quickly made up a significant proportion of all traded timber.



A substantial amount of *Grevillea robusta* was planted on farmlands in the 1980s. *Grevillea* and *Eucalyptus* species were also promoted for shade in coffee and tea plantations. Many indigenous species are also found on farms, remnants of natural forests. The few sawmills still operating

processed on-farm trees, although this became uneconomical as distances to the tree source increased. Consequently, portable mills and tractor-mounted circular saws were used to harvest on-farm trees (Muthike, Githiomi and Onchieku 2006).

Farm forestry has continued to receive support by the government and development partners in the last decade. Several initiatives promote on-farm tree growing in the drylands. Through the Kenya Forestry Research Institute (KEFRI), the government has also dedicated a large portion of its research grants to farm forestry and on-farm timber projects.

On-farm timber value chain

Unlike natural and plantation forests, which belong to the government and are managed through KFS, trees growing on farms belong to the farmers, who either planted or inherited them. Most farmers sell standing trees, which generates little if any added value. Negotiations over price depend on the urgency of the farmer's need for cash, tree quality, accessibility and the farmer's knowledge of the tree's value. At present, timber prices are relatively high due to a shortage of supply, although farmers see little of this revenue.

Farmers are approached by several types of buyers:

- private individuals, who require timber for a project — they hire a chainsaw operator or a chainsaw and bench saw in combination to saw the trees into the desired dimensions; this category also includes some larger corporate users such as tea factories, schools and hospitals, which mainly fell trees for fuelwood (valuable timber trees are commonly felled for fuelwood);
- timber dealers, who buy standing trees —they either saw them on-site with their own bench saw and/or chainsaw or take the logs to a sawmill; the dealers sell the sawn timber to other dealers or end users;
- timber brokers, who buy standing trees from farmers and sell them to processors, making a profit without any physical effort — brokers usually offer the lowest prices to farmers; and
- tree finders, who are hired by any of the three groups above to locate suitable trees and negotiate the cheapest price —they are paid a commission by the processors/ brokers, with the amount depending on the number of trees found and the price negotiated.

Institutional and legal framework

Since independence, many constraints have hampered the development of the forest sector. A weak legal framework prevented the private sector or communities from participating in forest management, and the Forest Department (FD) from managing resources outside gazetted forests. The *Forest Act 2005* put in place the reforms necessary to revitalize the sector. They provide for the participation of more stakeholders in the management and conservation of forests.

Under the old *Forest Act*, the FD was characterized by centralized decision-making and inadequate financing. This resulted in ineffective management, best illustrated by the poor condition of industrial plantations and the degradation of indigenous forests. Under the new Act, sustainable forest management is being carried out by KFS.

The service is charged with forest administration, policy development, forest regulation, training, extension and protection of natural forests. It also promotes commercial tree growing by the private sector, farmers and communities by providing incentives for forest development. In addition, KFS works closely with various sectors, such as agriculture, water, land, energy and tourism.



Policy and legislation

Before the 1999 ban on wood harvesting from government plantations, timber dealers who bought trees from plantations used CSM to convert them into beams for ease of transport. CSM was also used to convert illegally acquired timber from both government indigenous and plantation forests. Its use has since extended to timber of commercial sizes, especially on farms.

Today, CSM is a source of major legal challenges due to frequent misuse. Chainsaws are legal in Kenya and can be used by operators without restrictions. Currently, no licences or levies are imposed on chainsaw operators; therefore, it is difficult to know how many chainsaws are in use. While it is assumed that most of the traded timber comes from farms, substantial amounts are illegally sourced from government plantations, especially in areas bordering natural forests (Samuel, Pasiecznik and Fehr 2007). To minimize illegal practices, two requirements have been put in place by the government:

- a certificate of tree origin is required by farmers who intend to sell standing trees on their farms —it is obtained from the local chief's office before felling and affirms that the trees are from individually owned farms; and
- a loading and transportation permit from the local district forest office certifies that the timber is from the trees identified by the chief and shown in the certificate of origin and is authorized for transportation.

Although these documents are considered essential to minimize illegal trade in timber products, enforcing them is a challenge. Since there is no supervision during harvest operations, unscrupulous traders can acquire a certificate of origin from the local administration officer for a few trees, steal and process wood from a nearby plantation as well and obtain a transportation permit for the mixed timber.



Although the transport permit is supposed to be signed after a forest officer has supervised the loading of the timber from the sawing site, some traders process timber from different sites and store it in one place. Illegally obtained materials are difficult to differentiate from legal timber and can easily find a legal way to market.

Abuse of the legal requirements — e.g., bribes given to administrative officers to release certificates of origin or transport permits — have been reported (Luvanda and Muthike 2008), as have cases where security officers at roadblocks delayed timber lorries to extort bribes. This abuse increases the costs of providing timber to the market. In most cases these costs are passed on to the farmer (in terms of reduced tree price) and the timber consumer (in terms of increased timber price).

Other steps to reduce illegal timber trade in Kenya include meeting the demand for timber by increasing timber-deficient regions' capacity for timber production and processing. With natural forests protected and plantations having to compete with agriculture, growing timber trees outside forests is increasingly being seen as a way forward (World Agroforestry Centre 2004). Farm forestry has shown an enormous potential to meet the demand for more wood, and Kenya's vast drylands are slowly being turned into productive agro-forests, supported by appropriate skills and tools.

Drivers and impacts of chainsaw milling

Three on-farm sawing methods are commonly used: chainsaws, mobile bench saws and pit saws (Muthike 2004). CSM is preferred because it is faster than pit sawing, it requires only one operator and at most an assistant, and it is cheaper and less limited by terrain than tractor-pulled bench saws (Oksanen, Pajari and Tuomasjukka 2002). When operated free-hand, however, CSM has a low mean recovery rate (Holding, Njuguna and Gatundu 2001), due to the wide chain kerf, machine vibration and to some extent to the lack of operator skills (Table 2). A large amount of wood is lost in form of sawdust (Muthike 2004). Free-hand milling also results in a poor surface finish.

Table 2. Mean comparison results for sawing methods and training

sawing method	mean recovery, untrained operators	mean recovery, trained operators
chainsaw	23.30	30.20
mobile bench saw	27.40	35.05

Source: Muthike 2004

Unlike large-scale industrial harvesting and processing techniques, on-farm methods are often inefficient. Chainsawn timber is generally of poor quality. Users have to purchase larger dimensions than required to allow for the excessive planing needed to obtain a consistent thickness and acceptable finish. This is partly because chainsaw operators are unskilled, inexperienced or drink alcohol to overcome fatigue while sawing.

Chainsaw milling has a number of social and economic benefits, however. The main social impacts include local employment opportunities and business opportunities, provision of building materials and adding value to farm trees. With improved sawing systems and training, the social and economic impacts of CSM could be increased to include improved timber recovery, high-quality timber, operator safety and improved income. On-farm timber processing is likely to continue as tree growing is promoted and demand for timber is rising.

Chainsaw ownership and benefit-sharing

CSM in Kenya is a lucrative business in areas with trees on farms and near forests. A variety of ownership structures exist:

- In most cases, people purchase chainsaws and employ operators. When a sawing job is found, the chainsaw owner buys fuel and lubricant and pays the tree owner, based on either running foot of timber or amount of fuel used. The payment is shared in three equal parts: to the machine owner as profit; to repay the cost of fuel and maintenance of the chainsaw; and split by the operator and the assistant (at a ratio of 2:1).



- Some operators own their own chainsaws. In this case, the sawing charges are paid directly to them and they employ assistants only when a job is found. The assistants are paid based on the length of time they work.
- In a few cases machine owners rent their machines to operators for a given period of time. In this case, payments to the machine owner are worked out per day irrespective of whether the machine is used or not. In such cases, the operator has to be aggressive in finding work for the machine.

Improved on-farm timber processing

The current research focus is on inexpensive portable sawing systems that can greatly increase the value of on-farm trees as sawn timber. KEFRI began studies on chainsaw frames in 2006 with the objective of improving timber recovery rates.



Frames guide the operator in sawing timber with consistent size, relatively smooth surface and improve timber recovery. They require a special ripping chain, which makes the technology more difficult to acquire. KEFRI has, however, been able to modify standard felling chains. Results show that the technology recovers more timber than freehand milling and results in improved surface quality (Muthike et al. 2008). It also greatly improves the operator's safety. The technology has been demonstrated and training conducted in various parts of the country, and the frames

have been successfully modified and fabricated locally. It is expected that such efforts will generate strong incentives for the farmers to grow more trees on their farms, increasing tree cover and reducing their dependence on natural and plantation forest stands.

Conclusions and recommendations

Conclusions

Chainsaw milling is illegal in prohibited government gazetted forests. It is legal on farms as long as the appropriate permits are obtained. Chainsaws are more commonly used than tractor-pulled bench saws. The high demand for timber in Kenya and the ban on logging operations in forest plantations drive on-farm timber processing.

Currently, farmers have little knowledge of tree growing, log and milling characteristics or market requirements. The labour capacity is limited and most people are unskilled or semi-skilled. This results in a low recovery rate. Training of logging crews on general safety, chainsaw maintenance and timber recovery at various stages of log processing is still infrequent and poorly organized.

Recommendations

These changes would improve the productivity and capacity of on-farm CSM activities:

- training of farmers in silvicultural treatments and management through simple on-farm tree inventory and valuation, timber marketing and utilization to improve tree prices;
- training of millers to improve on-farm timber processing through the use of appropriate machinery in harvesting and conversion, machinery and equipment maintenance and safety measures and timber quality, marketing and utilization specifications;
- improving CSM techniques by reducing kerf, weight and level of vibration to enhance timber quality and increase recovery; and
- promoting the use of chainsaw guide frames and encouraging chainsaw operators to invest in technology to enhance timber recovery and surface quality. This could be aided by the development of policies incorporated in forestry law.

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4.8 Chainsaw milling and national forest policy in Liberia

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Background

In the past, chainsaw milling (CSM)¹ was used to convert commercial forest harvest residues (e.g., large branches and rejected logs). However, the operators felled and milled trees independent of the commercial timber contract holders. CSM used to be a small-scale activity, but started to expand during and after the civil war (1990–2003), when formal concession logging became erratic. The international ban on export of timber products in 2003 and the subsequent cancellation of concession agreements by the government in 2006 as a result of malfeasance in their management, collapsed the export-oriented industry and created further gaps in the local timber supply.

CSM has gradually become widespread in virtually all regions of Liberia and currently provides the only source of lumber to the local market to support national reconstruction efforts after the recent war. Many people, including ex-combatants, are involved in CSM. The practice has major socio-economic impacts in Liberia. Some of the affected forest areas overlap some of the important biological hotspots in West Africa. In order to consider these issues more holistically and concertedly, the Forestry Development Authority (FDA) commissioned a comprehensive study on chainsaw milling in Liberia in 2009.²

Institutional and legal framework

The FDA has a mandate to formulate forestry policy, manage forest resources, monitor the management of concessions, and facilitate the collection of revenue from forest activities. The National Forestry Reform Law (NFRL 2006) and the Ten Core Regulations (FDA 2007) constitute the principal laws and regulations governing commercial forestry. The NFRL provides four types of contracts and permits (Table 1).



CSM, 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.

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Table 1. Forest contracts and permits

type of forest contract/permit	description
Forest Management Contracts (FMCs)	for forest areas of 50,000–400,000 ha for 25 years, to be managed for long-term sustainable timber production
Timber Sales Contract (TSCs)	for forests of 5,000 ha or less in off-reserve areas for three years that are destined for conversion to agriculture, awarded to companies having at least 51% Liberian ownership
Forest Use Permits (FUPs)	intended for non-timber forest uses (e.g., tourism and harvesting of NTFPs)
Private Use Permits (PUPs)	for regulating commercial forest activities on private land

The NFRL makes provisions for benefit sharing with regards to commercial logging revenues and requires a social agreement, which defines community benefits and access rights, to be developed for every forest contract.

Chainsaw milling is considered illegal, as it does not fall under any of the contracts and permits established by the NFRL. By extension, the collection and payment of fees related to CSM is also illegal. The FDA collects fees for the issue of official waybills, however, allowing chainsawn lumber to be transported to Monrovia and thus giving the practice a quasi-legal status. Chainsaw milling is also banned under FDA regulation No. 26.

Chainsaw milling and supply chain analysis

In Liberia people use chainsaws to convert the logs from felled trees into planks on site. The planks are then hand-carried to the roadside for packing into vehicles and transport to markets. A milling team is usually composed of one chainsaw operator and an average of two helpers and five wood carriers. Some groups also employ cooks, bush managers or tree spotters. A study of the practice (Blackett, Lebbie and Marfo 2009) indicates that 67% of the workers come from local communities, 32% are other Liberians and only 1% are foreign. Most teams operate with a single saw.³ About 76% of the operators claimed to own their chainsaws; financiers (including wholesale buyers and traders in chainsawn lumber) owned 23% and communities owned 1%.



Chainsaw millers normally operate in partnership with traders and suppliers, although timber loads may be brought to Monrovia or other markets and offered on spec to timber traders. Planks are usually carried up to five kilometres (km) to the roadside for loading, but in a few cases are carried as far as 10 km. Trucks are generally loaded with about 500 planks or 24 m³. Timber is transported for an average of 178 km to Monrovia timber markets, but transport from as far away as 700 km has been reported.

Raw material sourcing

CSM in Liberia is carried out in different types of natural forests including virgin forest, logged-over forests and farmland with isolated valuable timber species. Most CSM occurs in forests that both millers and communities regard as community forests; a limited number of millers operate on private land. Sourcing of raw materials is based on local knowledge on both the market and forest resources and on the good relationships of traders and chainsaw millers with the communities concerned.

Communities negotiate with chainsaw millers and collect and manage fees; in some instances county authorities appoint Plank/Toll Committees to do this on behalf of the communities. Typically, chainsaw millers pay several fees:

- a registration fee of US\$25–42;
- an in-kind payment of 10 to 20 pieces of lumber for every 100 planks produced (these are usually used for community development projects);
- in-kind fees such as drinks or bags of rice; and
- a token fee of US\$8–12 for a forest manager or tree finder, if one is available in the community.

Community shares may sometimes be sold back to the millers to obtain cash to purchase other materials. Commonly, one or more chainsaw millers are given access to specified areas with little apparent control by the communities over how many trees are harvested or the activity's impact on the environment. Occasionally, the removal of large trees is permitted to facilitate agricultural development.

Timber production

In logged-over forests, chainsaw millers tend to start work in easily accessible parts of the forests until the valuable timber is exhausted. They then follow less accessible logging roads. From the roads, the chainsaw millers penetrate the forest on foot. The analysis done by Blackett, Lebbie and Marfo (2009) revealed that 80 percent of FMCs and 77 percent of TSCs lie within five km of a road. In some TSCs, 100% is accessible.

Blackett, Lebbie and Marfo (2009) calculated the conversion rate from logs to planks to be about 31%, although this rose to about 35% if only 14-foot (4.27-m) logs were considered. The Liberian timber trade prefers a standard length of 14 feet. About 86% of all boards produced are 51 mm thick, which minimizes the amount of processing required afterwards.⁴

The FDA estimates that the Annual Allowable Cut (AAC)⁵ in the forest areas will initially reach 750,000 m³. The Diagnostic Trade Integration Study (Tissari, Taplah and Kamara 2008) predicted that the AAC would rise to 1.3 million m³ by 2011 once the formal logging sector was re-established. The current total volume harvested by CSM is estimated to be between 280,000 and 650,000 m³ based on a recovery rate of 31%. Blackett, Lebbie and Marfo (2009) calculated that the total CSM harvest could amount to as much as 50% of the maximum predicted AAC. CSM, if not properly regulated, is a serious threat to the environment and biodiversity and to Liberia's aspirations to develop a major timber exporting industry.

Markets

The principal market for timber is Monrovia, where 74% of Liberia's urban population resides. Smaller amounts are consumed in other urban areas and rural areas. Total annual consumption and estimated volume traded has been assessed to be in the range of 86,900–201,300 m³ of sawn timber. However, low level export of logs resumed in December, 2009, and about 3,300 m³ of logs had been exported by mid-July, 2010. Full scale formal processing of timber is yet to commence.

Prices

The average market price of chainsawn lumber is US\$152 per m³, which is well below the average export prices quoted by the International Tropical Timber Organization (ITTO 2009) for West African logs and lumber which are US\$283 and US\$575/m³ respectively.⁶ These low prices are a disincentive for the export-oriented timber industries in Liberia to supply the local market.



The CSM sector pays no formal taxes. Blackett, Lebbie and Marfo (2009) calculated that the government was missing out on US\$65 in taxes for every cubic metre sold. This “subsidization” means that cheap timber prices come at the expense of forest sector revenues. It is not surprising that the CSM trade is highly profitable (the profit margin is calculated to be about 27%) and therefore attractive for business. The straightforward nature of CSM and lack of regulations also makes it very simple for people to participate.

Traders, species and sizes/volume traded

Traders depend entirely on rough-sawn planks produced by chainsaw millers. Nearly 75% of the trade is concentrated on six species.⁷ Very limited re-sawing is done; it is normally carried out by an independent sawmill or bench saw adjacent to timber trading markets.

Employment

An estimated 1,500 people are employed in the retail chainsaw lumber business; 3,850 work in CSM. In addition, a large number of intermediaries make a livelihood from trading. This employment is important in Liberia, where cash-earning opportunities are few and far between. Each worker supports a large number of other family members.

Drivers of chainsaw milling

There are several main drivers of CSM in Liberia:

- the 2003 ban on the export of timber products — along with the cancellation of concession agreements in 2006 and the cumbersome processes involved in the competitive bidding for forest contract areas — means that domestic needs can be met only by CSM, which is widespread due to its unregulated nature;
- the practice of collecting fees and issuing waybills by the FDA and the collection of fees by the local communities for what is an illegal activity has created the impression that CSM is a legitimate practice;

- the FDA's capacity for effective law enforcement is very limited;
- apart from the collection of waybill fees, the fiscal regime established for commercial logging is not applied to CSM —immunity from fees has made CSM extremely profitable, which is a strong incentive for people to invest in the sector, resulting in its rapid expansion;
- a strong market demand exists for post-war reconstruction materials; and
- CSM generates employment.

Impacts of chainsaw milling in Liberia

Socio-economic impacts

Benefits to communities and individuals

The lack of any structured distribution or management of benefits means that inequities are common. Communities and individuals receive direct benefits from CSM in the form of cash or in-kind payments from chainsaw millers or businessmen. Individuals benefit from wages, which average about US\$189 per month per person and can be as much as US\$93,000 per year per community. Communities may benefit indirectly from the removal of large trees from agricultural land. Farms created in this manner are two or three times larger than traditional slash-and-burn areas. Purchasing power is increased through the employment of local people. This in turn results in the emergence of small businesses in the vicinity of CSM.

Community conflicts

The large flows of benefits derived from CSM by both communities and county authorities are usually accompanied by inadequate accountability, misappropriation of funds, inequities in benefit sharing and thefts of agricultural produce, planks, and bush meat from traps, which account for more than 70 percent of conflicts in the community. Additional sources of conflict include delays in or refusal by chainsaw millers to make payments; harvesting trees without community authorization and domestic disruption caused by the high incidence of relationships between women from communities and chainsaw millers.



Environmental impacts

Forest structure

The structure of the forest is being adversely affected.

Chainsaw millers harvest nearly all trees of the desired species above 35-cm diameter at breast height (DBH); the regulated minimum felling diameter is 40-cm DBH for TSC areas and 60 cm DBH for FMC areas. Blackett, Lebbie and Marfo (2009) observed that the hiring of chainsaw operators has increased the traditional farm size by about two to three times. In some high forest areas, valuable species such as Tetra, Niangon and Abura tend to occur in groups or pure stands. These three species, together with Lovoa (*Lovoa trichilioides*), account for 75% of the species harvested. CSM's low-DBH felling limits — especially in areas where pure stands of the preferred species occur — will have an adverse effect on the future growth of forests.

Biodiversity and the environment

Chainsaw millers' lack of directional felling skills leads to widespread destruction of saplings, seedlings and important non-timber forest products such as rattan (although five-year-old sites in logged forest showed profuse regeneration, largely of pioneer tree species and vines, e.g., rattan, in the large gaps opened during logging). Blackett, Lebbie and Marfo (2009) observed several fallen branches and tree trunks in streams, obstructing water flow. Some of the tracks used most frequently showed signs of soil erosion. Accidental felling of defective trees used by tree-nesting mammals and birds will reduce the number and quality of nesting sites, create competition for the sites and potentially reduce the animals' reproductive capacity. Communities blamed chainsaw noise for causing wildlife to move away from the forest. Chainsaw millers rely on local hunters to supply them with bush meat and in some cases set their own traps, severely affecting the forest fauna.

Lessons and insights

If uncontrolled, CSM will have a serious socio-economic and environmental impact that will jeopardize Liberia's intention to establish a viable timber export industry. Large portions of FMC and TSC areas are vulnerable to CSM. Harvest levels constitute a significant proportion of the AAC and CSM targets high-value species that are also preferred by the formal industry. The sustainability of remnant forests is adversely affected by overharvesting and the lack of post-milling management, including limited monitoring of logging activities by either the communities or FDA staff. In addition, there are serious inequities in the sharing of the benefits from CSM.

At the same time, CSM in Liberia is currently the only source of lumber in the domestic market for post-war reconstruction. Additionally, the activity provides direct and indirect employment for many people.

Recommendations

Several actions are needed in order to ensure the effective regulation of CSM in Liberia:

- designate specific forest areas for CSM, control harvesting intensity and limit damage by the introduction of simple felling rules;
- implement a tax regime that places chainsaw millers and formal industries on par to ensure the payment of realistic prices for timber;
- improve the law enforcement capacity of the FDA and the communities;
- facilitate the organization of chainsaw millers and traders to align their activities with forest and fiscal policy; and
- introduce appropriate mechanisms and institutional arrangements for management and equitable distribution of fees.

Any action to regulate CSM will have to consider that there is currently no realistic alternative source of local timber supply and that many people (including the forest communities) depend on CSM for at least part of their income. It will also have to account for the fact that the law enforcement capacity of the FDA is extremely limited.



Of the possible options proposed by the FDA study,⁸ the one regarded as the most promising and consistent within the current forest policy framework involves lifting the ban and allowing CSM under permit. There is no explicit provision in the National Forest Policy that prohibits CSM; hence, it is possible to amend the policy and accommodate the practice within existing contracts and permits. Permits would be issued to communities, allowing them to negotiate with chainsaw millers for the right to harvest in the traditional areas. The communities would be empowered to assist the FDA as enforcement agents.

Incentives for the communities would include greater tree tenure rights in their traditional lands and improved understanding of the value of protecting their forest; assurance of equitable distribution of benefits, including allocation of a proportion of the stumpage paid by the millers; and the right to the share of any penalties from violations.

A registration scheme would be established for chainsaw millers, with only those registered permitted milling rights to designated forest areas. The scheme would include a code of conduct and the self-policing of members.

For more information

For more information, please see www.fao.org/forestry/site/29659/en.

Endnotes

1. CSM is also referred to in Liberia as pit-sawing.
2. The study was sponsored by IUCN, FFI and the World Bank. The results of the study form the basis of this article.
3. The maximum number of saws operated by a group was nine.
4. The thicknesses produced are generally 25 mm and 51 mm and widths are 203 mm, 254 mm or 305 mm.
5. The AAC is meant for forest areas being managed under sustainable forest management practices, i.e., only for FMCs.
6. Prices are influenced by high-value species such as Bubinga and Sipo, which are rare in Liberia.
7. These are Abura (*Hallea ciliata*), Framire (*Terminalia ivorensis*), Tetra (*Tetraberlinia tubmaniana*), Ceiba (*Ceiba pentandra*), Niangon (*Heritiera utilis*) and Lova (*Lovoa trichilioides*).
8. A multi-stakeholder consultation process is underway to discuss the options recommended by the study and solicit inputs from the public sector, civil society (including the forest communities) and the private sector (including the chainsaw millers) to the formulation of a legal framework that would align CSM with existing forest policy.

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4.9 Chainsaw milling in Nigeria

LABODE POPOOLA

Context

Forests in Nigeria are being depleted at an alarming rate. A mere 5% is left after uncontrolled logging and conversion for special projects, such as offices and residential buildings and sporting complexes. With the Structural Adjustment Programme (SAP), a World Bank prescription to address economic recession in developing countries in the 1980s, the cost of major forest operation equipment increased by between 200% and 2000%. This left more than 90% of the industry operators with unserviceable or depreciating production plants and equipment. Since then, the number of new entrants into the formal milling subsector has been negligible (less than 10%) as few publicly owned concerns were either privatized or sold outright. These macro-economic problems drastically affected technical and financial efficiency and cost recovery of existing operations. Capacity utilization dropped to barely 30%. This scenario encouraged chainsaw milling (CSM). CSM is seen by many practitioners as affordable and its products, though not high quality, are affordable to the end users, who are largely resource-poor.



A THOROUGH INVESTIGATION OF CSM IS NEEDED TO BE ABLE TO OPTIMIZE ITS STRENGTHS AND MINIMIZE ITS WEAKNESSES.

Chainsaw milling in Nigeria

CSM is usually unauthorized and illegal in Nigeria. Operators illegally gain access into the forest, fell the trees, hurriedly convert them to planks of different dimensions, and hand-carry them to the nearest road, where they are transported to markets. Chainsaw millers seek legal authorization, usually by arguing that their operations can extract logs from difficult terrain where access by truck is impracticable. CSM operators frequently misuse this authorization by extending their activities to other areas of the forest.

Opinions are divided on the profitability of chainsaw operations. One study showed that the profit margin for the use of chainsaws for sawnwood production was 36% of the price per m³ on the market and 57% of the average cost of production/m³ (Udo 1994). The Food and Agriculture Organization earlier reported a similar margin (FAO 1979) and the Federal Department of Forestry of Nigeria reported a profit margin between 15 and 25% per m³ of wood converted.

The profitability of CSM operations increase with the rate of wood recovery. The mean recovery ratio for six selected species of timber in Cross River State is about 46%; the Forestry Research Institute of Nigeria (FRIN 1984) reported a rate of 47% for conventional sawmills. Factors such as log size, operator skill and log size also affect wood recovery in CSM. Log size had the greatest impact on the recovery rate; large logs allow for an efficient alignment of the saw and a higher-quality of sawnwood.

Adebagbo (1992) reported that CSM products derived from 23 species of trees were found at Bodija market in Ibadan. Of the 13 species studied by Popoola (2006) for comparison of volume recovery between conventional sawmill and chainsaw operations, seven were found to provide a higher recovery rate with chainsaws than conventional sawmills. Chainsawn planks were found to command lower prices in the market than those produced from conventional sawmills, however (Ogunsanwo, Aiyeloja and Filani 2005).

Ogunsanwo, Aiyeloja and Filani (2005) also argue that the extensive waste often associated with CSM could be reduced if the operation was legalized, better-trained operators were employed and the work was more carefully executed and monitored. The method could be less harmful to the environment as it ensures that off-cuts and other wood wastes are recycled in situ. Damages to residual stocks and untargeted species and damage by heavy equipment would also be reduced. Governments might see an increase in revenue due to issuance of permits. Farmers' incomes would also increase because they could sell stands of trees directly to chainsaw millers.

A thorough investigation of CSM is needed to be able to optimize its strengths and minimize its weaknesses. This paper reports on the Nigerian component of a study sponsored by the UK's Department For International Development (DFID) on CSM in three countries (Cameroon, Ghana and Nigeria).

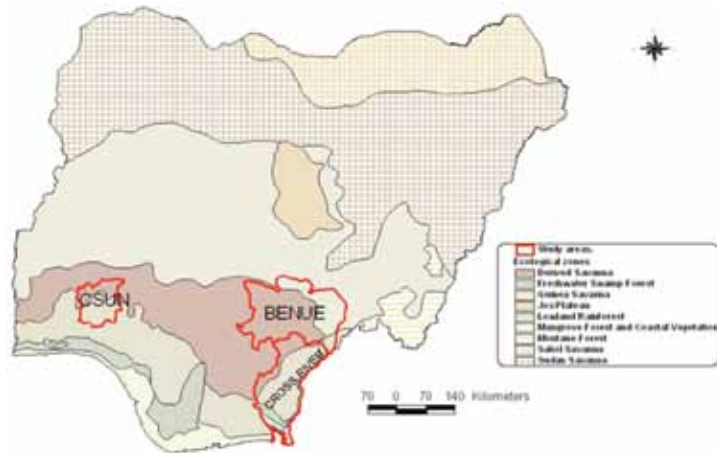
Methodology

Benue, Cross-River, and Osun States are located in three different agro-ecological zones (Figure 1). The states were selected for this study on the basis of prevailing CSM activities there:

- In Benue State, in the guinea savanna zone, CSM is rampant and dominates the timber trade.
- Cross River State (CRS) has a relatively high percentage of high forest, yet CSM is prevalent and conventional sawmilling is rarely practised.
- Osun State is a rainforest state with a high incidence of conventional sawmilling and a permissible level of CSM.

Three sets of questionnaires were used within selected study sites to obtain information from stakeholders, including forest officials, lumber marketers, chainsaw operators and households. Information included operational efficiency, availability of wood for sawing, environmental impacts of the practice, and contribution to sustainable livelihoods of operators. Data were analyzed using descriptive statistical analysis.

Figure 1.
Map of study areas



Results

Policy and legislation

CSM has grown over the years. It started with small illegal units and now includes a large number of participants, who have formed themselves into associations and unions and seek recognition from forest authorities. Most states in Nigeria still regard the activity as illegal, although some — including Akwa Ibom, Cross River, Benue, Osun, Taraba and states in the eastern part of the country — have softened their regulations to accommodate it.

Chainsaw millers hire “tree finders” to search for merchantable trees in both forest reserves and free areas (unconstituted forests). They are paid according to the number and species of trees found. The operator then obtains a forest permit for the trees intended for harvesting. Fixed stumpage rates are paid per tree in accordance with prevalent tariff schedules in the state, which vary by species. Class A species cost US\$40 per tree and Class B species cost US\$25 per tree, irrespective of tree size. The tariff comprises fees paid to government for raising and protecting the trees to maturity and royalties paid to the traditional forest owners. The forestry division also charges each permittee a tree inspection fee of US\$1.25 per tree and a regeneration fee of US\$2 per tree. There may be other unofficial payments. Operations are often carried out illegally, without a permit. After conversion, the sawn planks are hand-carried from the stump site to accessible landing points in the forest where they are loaded for transport to the market. Sawnwood is also sold at the landing points to customers, who transport it themselves.

Participants in chainsaw milling

Ownership and uses of chainsaws

An average of 70% of operators owned their chainsaw (44.4% in CRS, 100% in Benue State and 68.5% in Osun). Ownership enables the operator to better understand how the chainsaw works and better manage resources for optimum productivity and efficiency. The reverse is also true. Chainsaws are used in logging operations, crosscutting and clearing; they are also rented to other users. CSM generates incomes ranging between US\$2.50 and US\$80 per day.

Foremen

Most (75%) CSM entrepreneurs work with foremen, tree markers, chainsaw operators and other categories of hired labour. A foreman's income ranges between US\$10 and US\$20 per day. Some of them also have other jobs, most important of which are driving and farming, artisanship, sales and porter. These alternative jobs bring in an additional income ranging from US\$6–9.

Chainsaw operators

An operator's income ranges between US\$18 and US\$40 per day. This compares favourably with what the average skilled worker such as vehicle driver or electrician could earn. This provides an incentive for young able-bodied people to take up chainsaw operation. Operators usually work with assistants, referred to in Nigeria as a partner. Assistants earn from US\$6–12 per day.

Lumber porters

Lumber porters carry the sawnwood from the stump site to the landing site for loading onto trucks. The porters are usually engaged only when there is work to be done. Their average daily income ranges from US\$2.50–12.50.

Loading gang

Also referred to as loaders, they move planks from the gantry or landing site to the truck. They are unskilled labourers; women and young adults sometimes do this work temporarily to earn income for immediate needs. The daily income for a loader ranges from US\$2.50–12.50; most earn about US\$4. Earnings depend on the number of planks carried. They also have alternative jobs such as commercial motorcycle riding (*okada*), farming and working as security guards, labourers, porters and shop assistants.

Changes in production methods

In the late 1970s and early 1980s, CSM was completely outlawed in several states of Nigeria. Since SAP years, however, which led to the removal of subsidies on petroleum products and equipment, and to massive currency devaluation, many sawmills and logging companies ceased operations or operated with obsolete and inefficient plants. This led to the rise of chainsaw operations in many localities. The gradual growth and acceptance of CSM products in the timber market have encouraged a refinement of the processes and the products. Chainsaw operators now line and measure logs preparatory to flitching. In some places CSM products are so high quality that it takes a discerning eye to spot the difference between it and mill-sawn wood.

Resource ownership

One of the major problems of valuation in forestry is that ownership of the resource is not well defined. This underlies the erroneous notion that forestry is not a major contributor to national income. Chainsaw milling suffers from this perception. If CSM is not considered a major contributor to national income, then it is necessary to consider how important it is to resource owners and to what extent they are prepared to invest in managing them sustainably.

According to the FAO (2004) three key factors influence the ability of resource owners to fully appropriate values and transform them to economic benefits:

- resource characteristics;
- ownership of resources, including policies and legislation that define ownership, the social and economic conditions of the owners and more importantly their entrepreneurial ability (including the ability to understand changing opportunities and to move up the value chain); and
- the nature of markets served.

These factors interact with each other, altering the ability to capture the different values derived from chainsaw milling.

Unfortunately, stakeholders in the forestry sector display less and less interest in understanding the intricacies of its management. This is compounded by the common-property characteristic of most natural forests where CSM usually takes place. In such circumstance, pricing is inappropriate, and efficiency and transparency in resource extraction are not guaranteed. CSM is largely a private enterprise made up of individual owners with varied interests. In this situation, standards are not assured; nor do ethics and professionalism come into play. Maximum profit is the common aim. In recent times, however, some of the operators have organized themselves into cooperatives or associations, with the common goal of resisting the formal sector's effort to get government to outlaw CSM.

Markets

The market is a key determinant in any enterprise. Before the 1980s, lumber from chainsaw operations was found mainly in rural and peri-urban markets. The market consisted mainly of people who required wood for rough construction work. With the economic downturn of the mid-1980s, however, CSM lumber began to appear in urban markets, partly because it was cheaper than mill-sawn wood. A drop in personal incomes encouraged buyers to settle for cheaper sawnwood from CSM, thus creating a huge market for it. A survey by Popoola (2006) of selected markets showed significant disparities in prices of chainsawn and mill-sawn planks in Nigeria, ranging from US\$0.16–3.6 per m³. By 2009 the difference ranged from US\$0.8–9.0 per m³. This becomes significant when large consignments are involved. The lower cost of chainsawn wood can defray the costs of labour and other materials. This is a major driving force in the continuing importance of CSM in the economy. Another driver is the improvement in the quality of the output.



Policy response

Until recently CSM was outlawed in many states in Nigeria. It continues to be practised, however, and more states are relaxing their legislation, for several reasons:

- depleted timber resources, making investment in formal sawmills unattractive;
- a huge capital requirement for the establishment of sawmills (band saw, trucks,

skilled and unskilled labour, etc.) — these have increased by 1,000 and 5,000% since 1985;

- ageing, inefficient and obsolete plants;
- an unreliable power supply from the national grid and the ever-increasing prices of diesel and petrol;
- increasing fees and charges in the formal sector without commensurate returns; and
- corruption among forestry officials.

These factors have led to poor returns on investments in the formal sector. Many operators in the formal sector have sold off their plants to invest in chainsaws. In light of this reality some states now licence more chainsaw operators. This has created conflict between the formal sector and chainsaw operators. The formal sector wants CSM to be completely banned as a result of its own dwindling fortune. The reality on the ground, however, favours the continued existence of CSM in several localities.

The future of chainsaw lumber production

Threats

Illegal CSM is still rampant in some localities, although the level of waste tends to be high. Existing laws must be strengthened and sanctions applied to corrupt officials and colluders.

Opportunities

Since most of the trees felled for CSM are obtained outside forest reserves, strategies are needed to increase the number of trees outside forests. Chainsaw operators are now organizing themselves into associations, which establish private plantations in some places. This should be encouraged. Most chainsaw entrepreneurs in Nigeria borrow their working capital and are able to repay their loans with ease. This suggests that the chainsaw enterprise is profitable and dependable. Increasing the capital base would increase the possibility for returns on investments and consequently contribute to poverty reduction.

Conclusions

Chainsaw milling is a major source of sawnwood in Nigeria. It also provides employment for both families and hired labour, thereby improving household and social well-being. Furthermore, the wages earned compare favourably with those of the average skilled worker, and are far higher than the less than US\$1 on which more than 60% of Nigerians subsist. These are clear indications of the social and economic importance of the chainsaw business in Nigeria. There is a need to address policy and governance issues that will make CSM in Nigeria officially recognized and sustainable in terms of social acceptance, economic viability and environmental impact.

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4.10 Chainsaw milling and rainforest dynamics in southern Nigeria

EKEOBA MATTHEW ISIKHUEMEN

Introduction

The Nigerian rainforest is located between latitude 4° and 9° N (Figure 1). It stretches east-west across the country, extending about 250 km inland from the coast (Ojo and Ola-Adams 1996). The biome is a continuation of the western block of the African rainforest formation.¹

Redhead (1971) arranged Nigerian rainforest trees into three utilization classes: Class I includes species of major economic timber importance (e.g., *Milicia* and *Baillonella*); Class II includes species of lesser timber importance (e.g., *Lophira* and *Mitragyna*); Class III includes species of possible timber importance (e.g., *Alstonia* and *Celtis*); and Class IV includes species likely to be of use only for fuel, charcoal or industrial use.

The population of southern Nigeria is almost 65 million on a total land area of 20 million hectares (NPC 2006). The south, where the rainforest is found, is the most densely populated part of the country, with an average population density of 324 persons/km² (the national average is 150 people/km²).

Nigerian Forest Policy

The Nigerian Forest Department (FD) was created in 1902 (Dawkins and Philip 1998). According to Okali and Fasehun (1995), the timber rules of 1906 and the forest ordinance of 1916 were the earliest management regulations introduced after the FD was created. These were directed at conservation and improvement: the 1906 rules mandated loggers to plant new or tend existing seedlings to replace trees that were felled; and the 1916 ordinance favoured planting of 24 economic timber trees to replace each tree felled. Forest reserve constitution and silvicultural experimentation dominated the period 1910 through 1940. The management of forests was devolved from national to regional control in 1952.



CHAINSAW MILLING WILL
EASILY DISRUPT THE FOREST'S
REGENERATIVE CAPABILITY
WHEN DISTURBANCE GOES
BEYOND THE ECOSYSTEM'S LIMITS.

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The post-independence military incursion into political governance significantly altered the structure of the state and private sector cooperation towards sustainable forest management through long-term forest concessions. The 100-year rotation that operated in what was the midwest region (now Edo and Delta States) and western region (Lagos, Oyo, Ogun, Ekiti, Ondo and Osun States) was replaced with a 25-year felling cycle; it was subsequently reduced again to five-year and then three-year rotations respectively. The primary objective of long-term concessions was to maintain the ecological integrity of production forests through sustained yield management by encouraging partnerships between concessionaires and the state. To achieve this goal, concessionaires had the mandate to prepare working plans and carry out forest inventories and a few development activities within the concessions; the state performed monitoring and advisory work.

The 1999 constitution of the Federal Republic of Nigeria places the protection of the environment and of air, water and land — including forests and wildlife — under state governments. The 2006 National Forestry Policy was the first stand-alone document to be produced through a participatory process.

The principles underlying the 2006 forest policy are designed to address forest decline, streamline the contribution of forests to economic development, mobilize community and civil society toward forestry development, address transparency in the tendering of forest concessions, promote partnership with the private sector, seek international cooperation, engender forest policy initiatives, and mainstream forestry into the Millennium Development Goals. As laudable as the policy is, however, it has not yet been put into effect because the *National Forestry Act*, which is supposed to harmonize/streamline the different state's forestry laws and edicts, has not been passed by the National Assembly. In the absence of the *Forestry Act*, the 1988 National Agricultural Policy — which subordinates forestry and allied matters — is still operational. The 1988 policy considers the forestry sector an appendage of the larger agricultural sector, making its valuation and overall contribution to GDP difficult to capture.

In a few rainforest states, such as Ondo, Osun and Cross River (where the government is involved in collaborative arrangements with local communities in the management of forest resources), chainsaw milling (CSM) is backed by law in off-reserve areas and permits are issued on a stumpage or single-tree basis. Generally, there is pervasive abuse of the single permit process: chainsaw millers surreptitiously obtain multiple owner's consent from traditional institutions as well as permits/licences from the forestry departments for use by the same or different millers in the same or adjoining areas. This offers

Figure 1.
Administrative map of Nigeria



easy shortcuts for contractors or permit holders to substitute owner's/traditional ruler's royalties with licences/permits from the forestry department.

In other rainforest states, e.g., Edo, diverse interest groups (largely made up of rent-captors) find their way through political appointments onto extra-departmental forest/log monitoring committees and engage cronies to carry out the same statutory functions as government officials. Unlike paid government officials, however, they handle offences detected in both the forest reserves and off-reserve areas with subversive intent and in tacit defiance of the law. Interestingly, offenders are charged outrageous fines but only a paltry sum makes it to the government purse. Citing the dearth of trained staff in Edo State (where only 101 forest guards are deployed to protect forest reserves covering 6,000 km²), the World Bank (2005, 78) identified “weak and obsolete laws, poor work environment and lack of security for personnel as plausible disincentives” as requiring urgent attention.

Historical perspective

CSM was scarcely practised before the 1960s, but it gradually succeeded pit-sawing and later gained prominence as quick conversion apparatus in southern Nigeria. While the political exigency of the post-war 1970s and compelling socio-economic demands — which increased the demand for timber — could be responsible for the abolishment of the concessions, the instability they caused negatively affected the economic fortunes of most wood-based companies. Many companies were compelled to fold up while the remaining few survivors scaled back their operations.

Against the backdrop of mounting governance costs, some state military governments (with large tracts of production forests) exploited their forests to shore up revenue, under the mistaken premise that timber was a renewable natural capital capable of generating steady returns. This phenomenon created free entry for a large number of small concessionaires, who explored cheaper and faster options of milling.

CSM received widespread attention in areas where customary tree tenure systems permit revenue from the timber resource to be shared by the government and the traditional ruler. This was particularly the case in off-reserve areas or community-managed forests governed by traditional institutions. The system involves the issuance of felling permits on a stumpage (per tree) basis by the state forestry department, which collects the revenue and pays royalties as a lump sum to the traditional ruler in the locality. The system was fraught with abuses, however, and land owners who grew trees on farmlands had to obtain permits before cutting them down.

Chainsaw milling and livelihoods

CSM provides ample opportunities for sustaining rural and family incomes. Rural youth and women are mostly engaged in carrying lumber products to gantries or loading bays and timber sheds.

The diffuse and aggressive nature of the market for chainsawn timber products (billets, boards and rafters) in many parts of Nigeria is partly due to the relative ease with which the product is converted and transported, and partly to the prices, which are lower than those of timber from conventional sawmills. Another advantage is that chainsawn timber products can be made to the buyer specifications, while the species and selection of products for commerce or distant markets is largely dictated by forces of demand and supply. Pagiola, Lindell-Mills and Bishop (2005) argue that market-based approaches can provide powerful incentives and efficient means of conserving forest and the public goods they provide while at the same time offering new sources of income to support livelihood needs.

Impact on the rainforest ecosystem

As mature timber trees became scarce due to harvesting pressure chainsaw milling developed into a full blown commercial business and extended to planted forests as well as forests in inaccessible terrain (undulating landscapes, gorges/valleys and other marginal areas).

Timber harvesting in the fragile moist rainforest increases diversity, but the quality of species that make up the residual forest that follows depend on the intensity of removal, availability, age and quality of key species as well as the phase of succession (Whitmore 1996; Kio 1978; Bruenig 1996). According to Peters (1996, 40), "uncontrolled selective logging can reduce the local abundance of certain valuable timber trees, particularly among the climax species."

On-site CSM does not only encourage systematic selection and excessive harvesting, it could lead to serious ecosystem damage, genetic erosion and/or scarcity of endemic species population in a fragile rainforest ecosystem. According to Serageldin (1992, 338) "most of these species are not found in any other type of ecosystems; many are so restricted that in their geographic ranges - they are only found within one forest or only a small part of the forest." The current paucity of most endemic climax species (particularly among the *Meliaceae*, *Leguminosae*, *Myristicaceae*, *Rubiaceae* and *Samidaceae* families) with small geographic ranges in the rainforest ecosystem in southern Nigeria is attributable to the impact of indiscriminate on-site milling.

Linhart (1995) observed that species within small geographic ranges tend to have less genetic variability than widespread species and are therefore more vulnerable to abrupt environmental changes. Most Nigerian rainforest tree species, e.g., *Alanblackia floribunda*, are poorly adapted to recovering from bole damage due to logging.² *Alanblackia* and similar species carrying monopodial crowns face the greatest threat of extinction.

Generally, logging of any type in the fragile rainforest of Nigeria has become less attractive because the resources have been depleted beyond the limits of the ecosystem. It is no longer feasible to carry out commercial logging because of the high percentage of immature trees and juveniles.



Conclusion

Mature timber trees are in increasingly short supply in both forest reserves and off-reserve areas in southern Nigeria. The surge in population in southern Nigeria will exert enormous pressure on the rainforest and its resources in the coming decades. More tree species will be lost — and replaced by timber of lesser value — and the ecosystem will be rendered more ecologically fragile.

CSM will easily disrupt the forest's regenerative capability when disturbance goes beyond the ecosystem's limits. The argument that on-site CSM is less damaging to the forest ecosystem than other forms of logging does not apply in all forest situations, particularly in the current Nigerian context.

A national forest policy supported by the *Forestry Act* is essential for the planning and implementation of all national forest and biodiversity programmes, including climate change issues. The three tiers of government must act in concert and pool resources to drive the process of change. The current arrangement, whereby a fund set aside for the control and management of all forms of ecological degradation in the country is domiciled in the presidency and managed on behalf of states and local governments, is not only regressive but creates room for corruption and mismanagement of scarce resources.



The fragile nature of the ecosystems and the frightening state of degradation across the nation's landscape demand concerted efforts by all stakeholders — government, civil

society, NGOs and CBOs, communities and the private sector — in order to reverse the overwhelming ecological ravages across the land and the ensuing erosion of biodiversity and loss of ecosystems. Chainsaw milling should be adequately accommodated in national and state forest policies and in biodiversity action plans and laws.

Finally, an autonomous ministry with a support department and agency should be created at the state level with replicate functions at the local government level to handle forestry and allied matters, including management of special ecological funds.

Endnotes

1. This extends west from Ghana to Sierra Leone and the Guinea Highlands, and to the eastern extension of the forest of Cross River State into Cameroon and Gabon, and southeast to the tropical rainforest of Zaire and Central Africa (Onochie 1979).
2. The species produces recalcitrant seeds that are poorly represented in the seed and seedling banks in the forest floor and understorey. It also has a single apical shoot which is ill-equipped to re-enact or grow through buds if the tree bole/crown is snapped by wind or falling trees.

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4.11 Chainsaw milling in Uganda

ROBERT K. KAMBUGU, ABWOLI Y. BANANA and GEOFFREY ODOKONYERO

Status of forests in Uganda¹

Forests in Uganda cover an area of about 4.9 million hectares (24% of the country's total land area) making them an important element of land use (MWLE 2002). They are categorized as tropical high forests, woodlands and plantations. Their ownership falls into two broad categories: government reserves and private or community forests; 30% of the forests are in protected areas and 70% are on private land (Table 1).

Government reserves constitute the Permanent Forest Estate (PFE), which is set aside permanently for forestry activities and held in trust by the government (MWLE 2002). The National Forestry Authority (NFA) manages the bulk (60.9%) of these forest reserves. District Forestry Services (DFS) manages the local forest reserves (0.3%) while the Uganda Wildlife Authority manages national parks (38.8%) (Turyahabwe and Banana 2008).

No production is allowed in strict nature reserves, which comprise 20% of the forest reserves, but non-timber utilization activities are allowed in buffer zones, which comprise 30%. The remaining 50% are production zones set aside for the production of hardwood timber (Odokonyero 2005a).

Tropical high forests and plantations produce more than 80% of the country's timber; plantations supply about 20% (MWLE 2002; NFA 2005). Most of the plantations have been harvested and are almost exhausted. The supply of timber from natural forests is declining as well and forest cover continues to disappear at an alarming rate (Figure 1). Uganda was projected to face a timber deficit by 2010 (Odokonyero 2005a).



CSM CAN HELP INCREASE
TIMBER PRODUCTION OUTSIDE
CONVENTIONAL FORESTS,
WHICH CAN REDUCE THE
PRESSURE ON THESE FORESTS.

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Table 1. Forest types and their ownership in Uganda (in hectares)

forest type	government reserves		private and community	total
	forest reserves	wildlife reserves		
tropical high forests	306,000	267,000	351,000	924,000
woodland	411,000	462,000	3,102,000	3,975,000
plantation	20,000	2,000	11,000	33,000
total	737,000	731,000	3,464,000	4,932,000

Source: Adapted from National Forest Plan, 2002

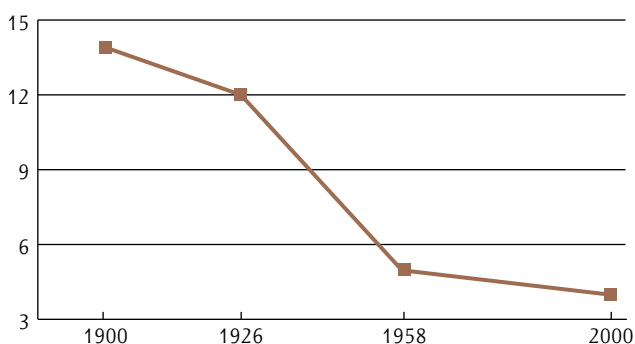
The imbalance between demand and supply of timber is increasing. This encourages illegal activities, such as the production and trade of chainsawn timber and illegal imports from the Democratic Republic of Congo (Odokonyero 2005a).

Forestry and the wood industry in Uganda

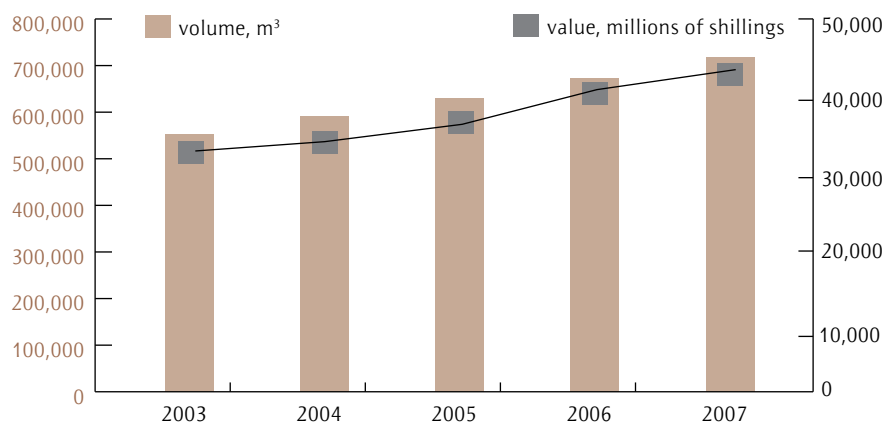
Forests are an important economic resource in Uganda. They support livelihoods by providing energy, forest products, employment and government revenue (MWLE 2002). The forest sector officially contributes about 2% to the country's Gross Domestic Product (GDP). This, however, does not include the value from wood processing, transportation and trade or the non-traded consumptive and non-consumptive benefits provided by forests (MWLE 2002). A more realistic estimate puts the contribution of the forest sector to GDP at about 6%.

Figure 1. Forest cover in Uganda (%), 1900–2000

Source: Kazoora 2007



Wood-based industries are an important part of economic development, both in employment and value addition (MWLE 2002; Plumptre and Carvalho 1988). According to the MWLE (2002), forest-based industries provide the equivalent of 3,200 formal jobs annually. The importance of the wood sector to Uganda's economy is expected to rise with the expected increased demand for wood and wood products (MWLE 2002). Figure 2 shows the timber value and volume output for five years since 2003, based on 2008 prices. Chainsawn timber is estimated to account for a third of total timber output.

Figure 2. Timber volume (m³) and value (millions of shillings), 2003–07

Source: UBOS 2008; 1750 shillings = US\$1

Timber production in Uganda is still a relatively simple process. The timber industry is highly fragmented, consisting of small-scale, labour-intensive production units that reflect the small local markets, cheap but limited raw material and low labour costs. Industrial processing of wood is not well developed.

Primary processing comprises of timber and plywood production, with only one major plywood manufacturer in the country (Auren and Krassowska 2004; UFSCS 2001). The primary wood industry in Uganda generally produces only timber. It includes three categories of producers: sawmillers, pit-sawyers and chainsaw millers. Table 2 summarizes their distribution, areas of operation and estimated output. As Auren and Krassowska (2004) noted, however, many millers operate illegally and official statistics represent only a small percentage of the actual number.

Table 2. Categories of licensed timber producers

category	licences issued	licensed volume (m ³)	estimated recovery (%)	location of operations
sawmillers	24	31,830	30–40	plantation (CFR)
pit-sawyers	183	97,000	25–30	natural (private)
chainsaw millers	—	—	20–25	on-farm/natural
others	—	—	—	urban/natural

Source: NFA and FID 2007

Pit-sawyers harvest in the natural forests and woodlands, where they are licensed as individuals or associations (Odokonyero 2005a; MWLE 2002). Their activities are restricted, especially in reserves, because they are difficult to control and regulate; the majority of pit-sawyers work on private land. They may damage the forests and their tools are inadequate for hardwood logs (Odokonyero 2005a). They produce most of the timber on the market.

The sawmill industry in Uganda is mobile and plantation-based. Odokonyero (2005a) noted that the conservation sentiment in Uganda does not favour large static sawmills since forests are small and scattered and the use of them is restricted. Moreover, the current Annual Allowable Cut (150,000–200,000 m³) can sustain only small mobile sawmills and pit-sawing.

Until recently, there has been a standing ban on the use of chainsaws in timber processing. Their use has been limited to felling and cross-cutting operations; they are considered wasteful when used for ripping. The chainsaw is an important tool for timber production on private lands, however, especially on farmland and woodlands where control is limited. In addition, some operators now transport billets, disguised as firewood, to urban centres, where they convert them to timber using chainsaws and bench sawmills.



Chainsaw lumber production

Policy and legislative framework

The policy and regulatory framework for the forest sector in Uganda is contained in the Uganda Forest Policy, the National Forest Plan and in the *National Forestry and Tree Planting Act*. This framework enables the Government of Uganda to promote a modern, competitive, efficient and well-regulated forest industry (MWLE 2002).

The forest sector is coordinated by the Forest Inspection Division (FID), which supervises the NFA and the DFS. Regulations for timber production are set by the FID and implemented by the DFS and NFA within their areas of jurisdiction. Timber production regulations restrict the use of chainsaws to felling and cross-cutting operations. It is illegal to use them for freehand ripping operations. Chainsaws are permitted if the owner uses milling attachments, registers with the NFA and pays the relevant fees. Criteria for permitting improved chainsaw milling (CSM) are evenness and smoothness of cut and limited waste.

Distribution and marketing

Timber is marketed in Uganda through formal and informal channels. The formal market is controlled and regulated through taxes on harvest, movement permits and market taxes. This regulation is difficult to apply to the informal market, which mainly comprises illegal timber producers. Most of the timber in the informal market originates in forests on private land. Forest regulations are not strictly enforced when it comes to

private forests due to corruption and a shortage of staff. Consequently, freehand chain-sawn timber does find its way to the formal market; it is easy to identify due to the distinctive marks made by chainsaws.

The key players in timber markets are the suppliers of trees, primary processors, secondary processors and consumers (Kazoora and Carvalho 2005). The timber producers are also involved in trading and so control the timber production and marketing chain (Auren and Krassowska 2004; UFSCS 2001).

Most of the timber produced is used by the building and construction sectors. Board length is predominantly 4.2 m, a major cause of inefficiency in timber production (MWLE 2001). Timber is marketed on the basis of species, size and quality, although the grading system is not fully entrenched. Due to the poor awareness of quality, there is little incentive for quality control.



Evolution of production methods

Commercial timber exploitation in Uganda can be traced back to the introduction of pit-sawing at the beginning of the 20th century (Odokonyero 2005a). Pit-sawing remained the predominant method of timber production until the 1930s, it was discouraged and sawmilling commenced.

The high demand for timber during World War II attracted many firms to the forest industry, most with little if any knowledge of sawmilling. They used very inefficient locally made or second-hand machinery and had no interest in maintaining stable conditions or high standards. After the war, a number of these firms continued operating and continued to sell timber in a non-sustainable way with low timber prices for many years (Tack 1962).

In the mid-1960s, the Ministry of Agriculture introduced the chainsaw in Uganda to facilitate pruning of coffee trees and bush clearing for planting coffee seedlings. The first chainsaws were small models with short bars and were mainly used for felling and cross-cutting small trees. Following the nationalization of sawmill industries in the 1970s, skilled workers dispersed. The industry deteriorated due to a lack of maintenance, spare parts and trained personnel (Carvalho and Pickles 1994). Most sawmills shut down and the few that remained were in a very poor condition (Windhorst 2005; Carvalho and Pickles 1994). Timber harvesting for export increased, creating a gap in the local timber market.

In the mid-1970s chainsaws and pit-saws were widely used by encroachers in Central Forest Reserves (CFRs). Since pit-sawing was considered a slow process, more and larger models of chainsaws with long bars were imported and used.

The 1980s saw the beginning of massive illegal CSM to meet the increasing demand for timber for building construction. In 1988, the European Union funded the Forest Resources Management and Conservation Program (FRMCP) of the Forest Department (FD), which emphasized biodiversity conservation. The FD had no option but to lobby for the ban on chainsaws and to licence but restrict pit-sawing. While this led to a decline in the number of pit-sawyers, the method continued to be the dominant form of timber production in natural forests and plantations until the mid-1990s. At that time, it was gradually phased out in plantations because of its inefficiency in converting small plantation logs and the difficulties associated with control of pit-sawyers (Odokonyero 2005a; McCaughan and Carvalho 2003).

CSM and pit-sawing, along with other illegal activities, peaked in the early 1990s. A ministerial ban was imposed on CSM in 1996; it restricted use to small chainsaws or agricultural tools with a bar no longer than 30 cm. In 2004, the Minister issued another public notice declaring that chainsawn timber was contraband and would be confiscated on site, together with the chainsaw and any vehicle used for transportation. This was in addition to heavy fines and prosecution.

Most chainsaw millers use the machines freehand. Almost no one uses milling attachments such as guides, frames or rails. Operators who use a chainsaw without the help of a guiding frame cannot make accurate and straight cuts. Moreover, only the rounded tip of the bar is used in cutting, leaving very rough marks of the saw teeth on the timber and increasing the risk of accidents. Freehand operation is also the reason for the waste associated with CSM.

The NFA, with FRMCP and FAO, has piloted the use of a complete chainsaw mill in two CFRs: Kalinzu and Budongo (FRMCP 2004; Odokonyero 2005b). A marked improvement in efficiency was seen: recovery increased from 25 to 55%, productivity increased from 0.02 to 0.25 m³ per effective hour, and better quality sawn timber was produced from poorly formed trees and branches.

Impact of chainsaw milling

The use of chainsaws without attachments is wasteful and contributes to deforestation and forest degradation. Chainsaws are principally designed for felling and crosscutting and not intended for rip-sawing or sawmilling.

The conventional crosscut chain has wide kerfs (about 9 mm) and wastes large quantities of wood in terms of long splitters and flakes compared to normal sawdust. Wood is also wasted to make the rough-sawn boards smooth, straight and parallel. For every three boards produced, the sawyers waste one board. Because of the relatively low recovery rates, more trees have to be harvested.

The quality of freehand chainsawn timber does not conform to market specification or standards for grading. Rough-sawn timbers are priced low, even if they are from valuable Ugandan hardwood species. Unfortunately, the low price is its major attraction in the local market where buyers have little concern for quality. Due to the high production

speed associated with chainsaws, there is also a danger of timber being dumped on the market, which suppresses prices further. This distortion makes legally produced timber uncompetitive. CSM is associated with illegal forest harvesting activities and is difficult to regulate and monitor due to its mobility, low cost and high speed. Moreover, chainsaw millers harvest selectively, searching for the best trees around, which can lead to genetic depletion.

CSM has some positive impacts as well. Chainsaws are useful in the conversion of isolated trees, especially on-farm trees, trees in difficult terrain and deformed logs. The chainsaw could have fewer ecological impacts than pit-sawing since the tree is milled at the stump; in sawmilling and pit-sawing activities logs have to be rolled, damaging young trees.

Poor households can harvest their forest resource to improve household income in the short run or add value to on-farm trees instead of selling standing trees. Data from ongoing research on the sawnwood commodity chain in Uganda indicate that tree owners get now as little as 10% of the timber value from the standing trees they sell (Muhumuza, Kutegeka and Wolimba 2007).

Conflicts associated with chainsaw milling

Most of the conflicts associated with chainsaw timber production arise because of the ban on CSM. CSM activities — from production to marketing — are usually unregulated and carried out illegally. The chainsawn timber is contraband and the timber and the chainsaw and vehicles used are confiscated in addition to heavy fines, arrests and prosecution of persons involved. This leads to loss of assets and income. This situation has resulted in a very poor working relationship between the regulatory authorities and timber producers/traders, who see themselves as victims of mistreatment.

Conflicts also arise because CSM activities involve a multiplicity of overlapping interests and a complex network that links the wide range of participants in the CSM and marketing chain.

Chainsaw timber production is closely linked to conflict. Trees are stolen by chainsaw operators and cut and converted at night. Because production is carried out illegally, exploitative business relations develop and proceeds are not shared fairly; most of them go to the timber dealers. The owners of trees or farmers are paid too little for the trees or the chainsaw operators evade payment, leading to conflict. Timber dealers often fail to compensate the farmers for crop damage caused by their unskilled felling methods.

The ban on the use of chainsaws in timber production also represents a policy conflict. The Uganda Forest Policy envisions an “integrated forest sector that achieves sustainable increases in the economic, social and environmental benefits from forests and trees by all the people of Uganda, especially the poor and vulnerable.” (MWLE 2001). Poor and vulnerable people cannot afford the technology recommended by regulations. Moreover, as trees are small and scattered they can only be profitably harvested using simple technologies such as chainsaws.

Policy response to chainsaw milling

Over the last two decades policy response to CSM has focused on the ban and on making chainsawn timber contraband. The success of this policy has varied across forest types. In plantations, the policy has been effective in locking out chainsaw operators due to the existence of licensed mobile sawmills, whose concession agreements commit them to the protection of the forest estate. In natural forest reserves, the policy has been largely successful because NFA monitors and enforces the regulation against CSM. There are, however, cases of encroachers harvesting from reserves using chainsaws.

The policy has not been successful for trees on private land. The use of chainsaws is widespread due to corruption, political interference and the inability of both NFA and DFS to effectively monitor timber production and trade. The use of chainsaws is particularly rampant on farms because the small volume of trees per unit area makes mechanized logging and pit-sawing unprofitable.

The future of chainsaw milling

Chainsaw milling is responsible for processing significant and increasing amounts of timber. The demand for timber and timber products in Uganda is increasing and cannot be met solely from remaining natural and plantation forests.

In the short term, the demand can be met from on-farm trees and other sources outside conventional forests. These sources have low timber volumes and diversity of tree size, shape and quality, however, making them of less interest to sawmillers. CSM has high portability and low cost and is suitable for milling low quality logs that would otherwise be wasted. This can help meet the increasing timber demand outside conventional forests and reduce pressure on natural forests and plantations.

Effort will be required to ensure that chainsaws are used appropriately to minimize the waste generated through freehand milling. Enforcement of existing regulations, especially on private land, is inadequate; this encourages illegal cutting, which may lead to over-exploitation. Chainsaw frame attachments are now permitted, provided the owner registers with the NFA and pays the requisite fees. This makes it necessary to streamline regulations, sensitize stakeholders and promote appropriate CSM technology.

Endnote

1. This article has been adapted from a paper presented during the Africa regional meeting on chainsaw milling in Ghana, May 25–26, 2009.

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Section 5

Chainsaw milling and legality regimes

Photo credits

p.203 Chainsawn lumber, Democratic Republic of Congo. Charlotte Benneker

p.205 Honey tree, Indonesia. Jan van der Ploeg

p.206 Abandoned chainsawn lumber, Tano Offin Reserve, Ghana. Roderick Zagt



5.1 Developing timber legality regimes

FREERK WIERSUM

Introduction

Since the 1980s much attention has been given to developing decentralized forest management systems in the form of social and community forestry. This development was based on the notion, that a dual forestry economy should be created, and that the development of the commercial forestry sector should be matched by efforts to develop forestry for rural development and provision of basic needs (Wiersum 1999; Arnold 2001). This notion was quickly accepted and resulted in the gradual development of a variety of decentralized forest management systems.

Small-scale, artisanal timber harvesting and manufacturing systems also got attention within this context (Forestry Department 1987; De la Cruz 1989).

Chainsaw milling (CSM) is a typical example of artisanal timber production. Many people are involved in this system for providing timber to local markets; they mostly operate under informal and location-specific arrangements. This is in strong contrast to the legal context of the formal timber sector. As a result of the recent international emphasis on timber legality, the legal duality between the formal timber sector and the artisanal timber sector is becoming more pronounced. Whereas the formal timber sector has to comply with legal requirements, the artisanal timber sector mostly continues to operate under informal, and sometimes even illegal, arrangements. As a result, existing programmes to stimulate legality in the formal forestry sector may have negative consequences on artisanal timber production.



THERE IS A LEGAL DUALITY BETWEEN THE FORMAL TIMBER SECTOR AND THE ARTISANAL TIMBER SECTOR, BUT THIS DUALITY IS NOT USUALLY RECOGNIZED IN TIMBER LEGALITY PROGRAMMES.

Changing forestry regimes

Forestry regimes comprise the convergent principles, norms, rules, procedures and programmes that govern the interaction between people and forest resources (Kant and Berry 2001). Traditionally, a basic tenet of tropical forestry was that governments formulated the norms and rules and implemented the procedures for exploiting forests; the timber industry was responsible for timber exploitation and trade. Consequently, the

forestry sector was characterized by a closed corporate structure, consisting of a tightly defined group of professionals from the government and the timber industry. Within this structure, the legal procedures for timber exploitation focused mainly on technical norms for contractually agreed timber production, and on financial norms regarding payments of duties to the government for exploitation of national forest resources.



The past decades saw changes in forestry regimes in many tropical countries as decentralized forms of forest management developed. The basic principle underlying this development was that civil and grassroots organizations — not just government and the timber industry — should be involved in forestry policies. This new approach is often referred to by the term “forest governance.” It involves a multi-stakeholder process of decision-making on and

implementation of forest use and management, with specific attention to the purposes for which forests are managed and to the equitable access of different stakeholders to decision-making and implementation processes (Lemos and Agrawal 2006).

This decentralized forest governance regime is based on several considerations:

- sustainable forest use and management involve the reconciliation of different ecological, economic and social forest values held by different stakeholder groups;
- forest values are expressed at different levels of society, represented by global environmental concerns (such as biodiversity conservation and climate change mitigation), national economic and environmental concerns, and local livelihood needs;
- profiting from forest resources and services must be just and fair, reflected in norms such as participation, empowerment and equity;
- efficient management is assured if people who are directly dependent on forest resources are involved in the management; and
- the combination of a participatory approach and effective management allows for transparency and accountability in implementing governance rules and regulations.

At first, a dual forestry regime — consisting of the traditional forestry sector and a social forestry sector — seemed to be the best approach. But with the gradual development of a variety of decentralized forest management systems, this notion has been replaced by the notion of forestry regimes that are characterized by a variety of multi-actor partnerships (Lemos and Agrawal 2006). Although the need to recognize different forestry regimes is now well accepted in respect to forest management, the notion has received much less attention in respect to timber trade and manufacturing. Programmes on stimulating timber legality are still based mostly on concepts related to the traditional forestry regime, and give little attention to the presence of small-scale, artisanal timber harvesting and manufacturing systems.

Linking timber legality and governance

The FLEGT/VPA programme

The need to change from government control over the forestry sector to decentralized forest governance is reflected in several programmes to stimulate timber legality. One example is the EU Forest Law Enforcement, Governance, and Trade (FLEGT) Action Programme. In order to eliminate the import of illegal timber into Europe, the programme stimulates the formulation of a Voluntary Partnership Agreement (VPA) between the EU and selected tropical countries that provide timber to the European market. The VPA identifies the national legal framework and compliance monitoring system that ensure that all timber exports from the country to the EU have been legally acquired, harvested, transported and exported.

The FLEGT programme explicitly aims to combine legal and governance principles (van Bodegom et al. 2008). In order to stimulate good forest governance, the programme supports the formation of multi-stakeholder platforms to define national criteria for timber legality and for monitoring the implementation of legality schemes (European Commission 2007). This is expected to result in greater transparency and accountability in forest exploitation and trade.

Different categories of legal principles for forest exploitation

Although the FLEGT programme supports both timber legality and good forest governance, it is not clearly defined whether it is intended to stimulate good governance of the traditional corporate forestry regime or of the newly emerging decentralized forestry regime. This becomes clear when considering the different types of legal norms for forest exploitation, which fall into four main categories:

- timber exploitation as an ecologically sustainable practice. Important issues include the cutting of officially assigned timber species and quotas in assigned exploitation blocks and meeting requirements for damage-controlled logging. Requirements regarding timber tracking throughout the marketing chain are also important in order to prove that the marketed timber has been legally exploited;
- payments of different types of timber duties, including fees for exploitation rights, stumpage fees, transport fees and export fees;
- fulfillment of social obligations by timber exploitation companies, which traditionally mainly focus on safe and socially responsible labour conditions. Increasingly, they also concern the social responsibilities of timber exploitation groups with respect to local communities — examples are benefit-sharing schemes or reimbursement of damages to community forest resources; and
- forest access rights and benefit sharing by local communities. During the past decades, new policies have been developed for assuring equitable access to forest resources and schemes for forest benefit sharing. These schemes aim not only to encourage better forest management, but to support more equitable use of forests and improve the livelihoods of forest-dependent people.

These norms play different roles in the traditional corporate forestry regime and the decentralized forest governance regime. The traditional regime mainly focuses on the first two categories of legal principles, and, in some cases, the labour rights of timber industry workers. But this regime does not include regulations on benefit sharing with local communities or on recognizing forest access rights of local people. These issues are the focus of decentralized forest governance regimes. They also provide a basis for explicitly incorporating artisanal timber production systems in legality schemes.

The FLEGT programme mainly considers norms that relate to formal exploitation rights for cutting specified quantities of formally recognized timber species in designated forest locations, and to payment of forest exploitation and timber trade duties. This interpretation of timber legality is rather narrow and basically refers to norms considered under the traditional corporate forestry regime. FLEGT pays scant attention to the emergence of new norms as reflected in the development of the decentralized forest governance regimes. Hence, no explicit attention is paid to the legality of artisanal timber production.

Different approaches to law enforcement

The different interpretations of the norms to be considered in linking timber legality and governance are reflected not only in the types of norms to be considered, but also in how they should be enforced. Colchester et al. (2006) distinguish two types of law enforcement:

- hard enforcement in the form of legal enforcement of existing forestry laws, including criminalization of violators through arrests, the filing of charges, court judgments and the imposition of punishments; and
- soft enforcement in the form of providing incentives for law adherence or administering symbolic penalties.

The first approach is based on strict legal considerations; the second on social considerations. For instance, the second approach addresses the need to develop appropriate and accountable systems in respect to juridical services for dealing with legal infringements. Such systems concern arrangements for access to legal courts and arbitration services, and attention to social safeguards that prevent legal requirements from having undesired social effects. They also include effective governance arrangements that enable inadequate legal regulations to be improved.

Soft approaches to law enforcement are particularly relevant in decentralized forest governance regimes, since explicit attention is given to improving the livelihoods of forest dependent people. To accomplish this, law enforcement should focus not only on adherence to official regulations on benefit-sharing, but on social safeguards in the form of measures to minimize possible adverse impacts on forest fringe communities and labourers in timber industry (Kaimowitz 2003; Owusu et al. 2010).

Linking timber legality and social norms on legality

Although the different norms on timber legality and law enforcement are recognized in international agreements and national laws, they are not systematically considered in the emerging programmes on timber legality. This is demonstrated in the first legally ratified FLEGT/VPA agreement between the EU and Ghana. The preamble states that “the Parties shall seek to minimize any adverse impacts on indigenous and local communities and poor people which may arise as a direct consequence of implementing this Agreement.” Article 17 indicates that the parties “agree to develop a better understanding of the livelihoods of potentially affected indigenous and local communities as well as the timber industry, including those engaged in illegal logging” and that they will monitor these impacts and take reasonable steps to mitigate any adverse impacts. These principles are not further elaborated, however, nor is there reference to the fact that CSM is illegal in Ghana. This limited attention to social issues stands in contrast to the extensive elaboration of the articles defining the various technical issues regarding timber legality (Owusu et al. 2010).

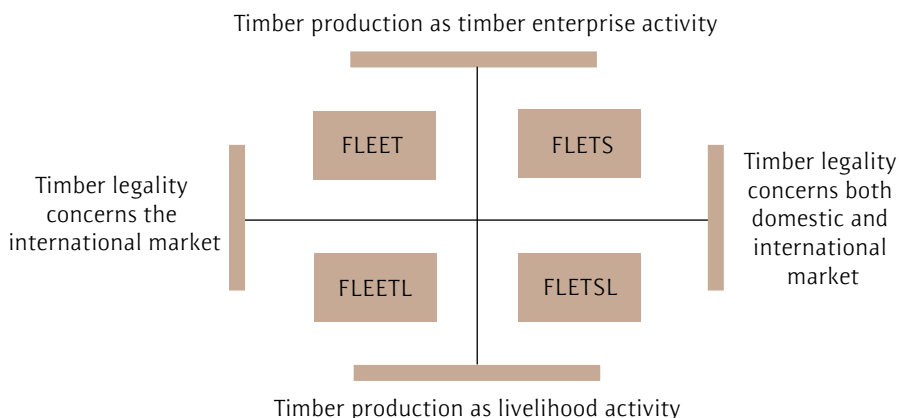
Scenarios for stimulating timber legality and governance

In view of the different governance regimes for timber production, an important question is whether timber legality programmes are focused on governing the traditional forestry sector (characterized by timber exploitation by forest business enterprises), or whether they also include artisanal forestry activities (characterized by timber production forming a livelihood activity of mostly rural people). Two sets of competing principles underlie the basic foundation of timber legality programmes:

- Should the programme have a legality focus or a livelihood improvement focus?
- Should the programme focus on legal timber production for the export market or on legal timber for both the international and domestic market?

On the basis of these competing principles, four policy scenarios on how to link timber legality and governance can be distinguished (Figure 1).

Figure 1. Policy scenarios for timber legality and forest governance



The main characteristics of each of these four scenarios are elaborated in Table 1.

Table 1. Policy scenarios for timber legality and forest governance

scenario		characteristics
FLEET	Forest Law Enforcement for Export Timber	<ul style="list-style-type: none"> ▪ mainly international trade agreement with focus on improved governance and control on timber production laws and regulations for formal forest sector ▪ policy implementation based mostly on hard law enforcement in respect to fulfilling criteria for sustained yield and other contractual agreements for timber harvesting, timber tracking and payments of export duties
FLETS	Forest Law Enforcement in integrated Timber Sector	<ul style="list-style-type: none"> ▪ mainly sustainable timber production agreement with a focus on the need to include legal recognition of diversity in small, medium and large forest enterprises ▪ policy implementation based mostly on hard law enforcement in respect to legal criteria for sustained yield, payments of duties and organization of business enterprises ▪ attention to development of artisanal forest enterprises
FLEETL	Forest Law Enforcement for Export Timber and forest-related Livelihoods	<ul style="list-style-type: none"> ▪ combined international trade and forest governance agreement with focus on improved control of regulations on timber production and trade and on benefit sharing by local communities ▪ policy implementation focused mainly on hard law enforcement in respect to fulfilling criteria on sustainable export timber production and commercial timber tracking, and on contractual agreements for benefit sharing at local and national level ▪ attention to social safeguards for forest fringe communities
FLETSL	Forest Law Enforcement in integrated Timber Sector and for forest-related Livelihoods	<ul style="list-style-type: none"> ▪ combined timber sector development and forest governance agreement with livelihood considerations integrated in timber legality norms ▪ focus on improved control over existing timber production regulations, and on further adaptation of forest laws, giving explicit attention to artisanal timber enterprises and benefit sharing by local communities ▪ policy implementation based on combination of hard and soft law enforcement with attention to criteria for sustainable timber production and timber tracking, and for benefit sharing at the local and national level ▪ attention to social safeguards for groups that are unduly disadvantaged by legal norms

The EU-FLEGT programme is intended to be the first step in achieving sustainable forest management (European Commission 2007). This could be interpreted as signifying a gradual change from the FLEET scenario to the FLETSL scenario. Trajectories for such a change may either include the FLETS or the FLEETL scenario. The gradual change from a FLEET to a FLETSL scenario will involve the adaptation from the present, mostly hard law enforcement approach towards a more soft law enforcement approach. This requires changes in the legal assurance systems of the timber producing countries, with more attention to social safeguards. At present, the discussions on FLEGT legal assurance systems are dominated by the need for stakeholder access to legal courts and juridical arbitration services for dealing with legal infringements. But under the FLETSL scenario, legal assurance systems should also include governance conditions that enable the necessary improvements of inadequate legal regulations.

Conclusion

Chainsaw milling is a major example of artisanal timber production. There is a legal duality between the formal timber sector and the artisanal timber sector, but this duality is not usually recognized in timber legality programmes. In order to regularize chainsaw milling, international programmes stimulating timber legality need to adapt their interpretation of what is involved in good forest governance. The currently dominating focus on stimulating better governance of the formal timber sector should be further developed into a focus on better governance of all timber resources.

Such a change requires the recognition of a wider range of principles and norms for timber legality. Social norms in respect to benefit-sharing and social safeguards need particular attention. These norms have been formalized in programmes for stimulating decentralized forms of forest management, but still receive scant attention in timber legality initiatives. A change in focus from legality as involving technical and economic issues to an approach that also involves social issues requires major changes in the hard law enforcement processes that currently dominate the discussion.

There is a need to mitigate potential adverse social impacts when enforcing the existing laws that ban chainsaw milling. This requires structural innovations in the forest sector, with specific attention to equitable rights on timber resources and legalization of artisanal timber production. Moreover, the strict law enforcement approach should be complemented by a soft law enforcement approach that provides incentives for developing alternative labour and income earning opportunities for local people involved in illegal harvesting and manufacturing, and for rural communities that are involved in illegal timber harvesting.

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Appendix 1. Overview of chainsaw milling

CSM statistics from articles in this issue of *ETFRN News*

country	est. lumber production for local market (m ³ /year)	means of production	CSM policy	est. forest estate (ha)*	population*	article
Asia						
Indonesia	10 million RWE	Most lumber in the local market is illegally produced by small, unlicensed and unregulated mills and CSM; combination of CSM and further processing by sawmills	No regulatory framework addressing domestic timber demand; 100% focus on export. CSM authorized for personal use: harvesting maximum of 20 m ³ ; AAC: from 20 million m ³ in 2000 to 5.74 million m ³ in 2004 (not for CSM)	94.4 million (52%) natural production forests (in article): 43.9 million ha (24%)	227.3 million	2.1; 2.2
Lao PDR	n/a	n/a	CSM is allowed, but cumbersome: owner needs to register chainsaw; Dept. of Forests keeps the chainsaw, which is released only on request of the owner and after payment of considerable fees	15.8 million (68%)	6.2 million	2.4
PNG	n/a	Portable sawmills and chainsaw mills with a slabber attachment	n/a	28.7 million (63%)	6.6 million	2.5
Philippines	n/a	n/a	Community-based forest management provides a legal framework for CSM	7.7 million (26%)	90.3 million	2.6

* FAO. 2010. *Global Forest Resources Assessment 2010*. Main report, FAO Forestry Paper 163. Rome: FAO, 340 pp.

country	est. lumber production for local market (m ³ /year)	means of production	CSM policy	est. forest estate (ha)*	popula-tion*	article
South America and Caribbean						
Bolivia	n/a	“semi-industrial” extraction techniques developed in response to the 1996 law, which significantly reduced illegal CSM CSM (inaccessible areas) or in PAs (illegal)	CSM is prohibited for commercial purposes but allowed for domestic use CSM sometimes permitted in areas that are difficult to reach	57.2 million (53%)	9.7 million	3.1; 3.2
Colombia	n/a	n/a	CSM is permitted if products it produces are included in the permission provided by the environmental authority	60.5 million (55%)	45 million	3.3
Ecuador	n/a	main production of sawn timber comes from CSM	CSM is allowed — legal regulation does not consider situation of small-scale producers who cut only few trees a year	9.9 million (36%)	13.4 million	3.4
Guyana	67,931	mainly freehand CSM	CSM is allowed and included in regulatory framework	15.2 million (77%)	763,000	3.5; 3.6
Caribbean islands	n/a	mostly freehand CSM	CSM is allowed in most countries	68 million (53%)	28.8 million	3.7
Peru	1 million m ³ (timber); eight times the quantity of exported sawnwood	formal sawmill industry (low-quality timber) and CSM	CSM is prohibited with exceptions: a) harvest areas with difficult access b) relevant constraints mentioned in management plan c) forests owned by native communities or allocated to qualified loggers. CSM equipment has to be registered.	14.6 million (95%)		3.8

APPENDIX 1: OVERVIEW OF CHAINSAW MILLING

country	est. lumber production for local market (m ³ /year)	means of production	CSM policy	est. forest estate (ha)*	popula-tion*	article
Suriname	10,787 (total roundwood production: 206,970 m ³).	mobile mills and CSM (20–30%)	CSM is permitted but no guidelines are in place		515,000	3.9
Africa						
Cameroon	662,000: more than 2 million m ³ RWE (almost twice the industrial exports of sawn timber)	mainly freehand CSM; aside from informal sawn-wood, part of the domestic demand is provided by industrial timber wastes and community forests	CSM is mentioned in the forestry law but permits are difficult to acquire	19.9 million (42%)	19.1 million	4.1; 4.2; 4.3
Gabon	70,000 m ³ (23% of the industrial export of sawn wood)	mainly freehand CSM	the law allows CSM operators to apply for legal logging authorizations, but granting has been very slow	22 million ha (85%)	1.5 million	4.1
Republic of Congo	78,000 (35% of industrial sawn wood production)	mainly freehand CSM	CSM is mentioned in the forestry law but but permits are difficult to acquire	22.4 million (66%)	3.6 million	4.1
DRC	1.5–2.4 million (35% of industrial production)	mainly freehand CSM	CSM activities are not adequately covered in legislation — the law allows for a special permit for small-scale loggers, but in practice it is difficult to acquire this permit	154.1 million ha (68%)	64.3 million	4.1; 4.4
Ghana	2.2–2.9 million (RWE)	mainly freehand CSM	CSM is banned for commercial purposes; 20% of sawmill production is reserved for domestic market; AAC: 2 million m ³ per year (not for CSM)	4.9 million ha (22%) In article 4.5: 2 million ha (9%)	23.4 million	4.5; 4.6

country	est. lumber production for local market (m ³ /year)	means of production	CSM policy	est. forest estate (ha)*	popula-tion*	article
Kenya	n/a	on-farm sawing using CSM (most preferred), mobile saw bench and pit saws	Chainsaws are considered legal tools; no licences or levies are imposed on chainsaw operators	3.5 million ha (6%)	38.8 million	4.7
Liberia	280,000–650,000 m ³ (RWE, based on 31% recovery rate)	freehand CSM	CSM is illegal, but by collecting fees, the government gives it a quasi-legal status; predicted AAC: 750,000–1.3 million m ³	4.3 million ha (45%)	3.8 million	4.8
Nigeria	n/a	mainly freehand CSM, particularly from off-reserve areas and community forests	Most states regard CSM as illegal; some have softened their regulations to accommodate CSM	9 million ha (10%)	151.2 million	4.9; 4.10
Uganda	240,000 (30% of total timber output)	90% CSM, 10% sawmills	CSM has recently been permitted provided that the chainsaw is registered, milling attachments are used, and relevant fees are paid; predicted AAC: 150,000–200,000 m ³	3 million ha (15%)	31.7 million	4.11

* FAO. 2010. *Global Forest Resources Assessment 2010*. Main report, FAO Forestry Paper 163. Rome: FAO, 340 pp.

Appendix 2. Production costs, market prices and profitability of CSM

CSM statistics from articles in this issue of *ETFRN News*

country	item	production costs (US\$/m ³)	price, local market (US\$/m ³)	profit margin (%)	article
Asia					
Indonesia	Rough-sawn lumber: meranti, bankirai, kerouing	n/a cost at formal sawmill: 273/m ³	127 (2002: port of Jakarta)	n/a	2.1
Indonesia: Tanimbar Archipelago	CSM timber: different wood species	74–126	90–158 (2004)	18–20	2.3
PNG	Portable sawmill production	n/a	148–740 (2009: depending on species, quality and value added)	5–15	2.5
Philippines	CSM timber	47–131		20–56	2.6
South America and Caribbean					
Bolivia	CSM timber: softwood, semi-hard wood and hardwood	75–117	210–255	production cost not complete	3.2
Ecuador	CSM timber	n/a	74–112 (forest road), 160–240 in Quito	n/a	3.4
Caribbean Islands (Dominica)	CSM timber	55.2 (excluding transportation costs)	424	production cost not complete	3.7
Suriname	CSM timber	30–35 (felling and transport)	n/a	n/a	3.9
Africa					
Cameroon	CSM timber: ayous	44.3	34 (per m ³ RWE) (compared to 183.4 per m ³ RWE for the export market)	26	4.1
Cameroon (northern trail)	CSM timber	70–200 (depending on distance to market)	127–296 (depending on season and distance to market)	25–40	4.2
Gabon	CSM timber	48.6	n/a	35	4.1
DRC	CSM timber	n/a	150–250	n/a	4.4
Ghana	CSM timber	n/a	105 (log price 2009); CSM prices 12–74% cheaper than formal lumber	15–22	4.5; 4.6
Liberia	CSM timber	n/a	152 (export price: 575)	27	4.8
Nigeria	CSM timber	n/a	n/a	36	4.9



Established in 1991, the European Tropical Forest Research Network (ETFRN) aims to ensure that European research contributes to conservation and sustainable use of forest and tree resources in tropical and subtropical countries.

ETFRN promotes a dialogue between researchers, policy-makers and forest users, the increased coherence of European tropical forest research, and increased collaboration with researchers in developing countries through partnerships and other forms of capacity building.

ETFRN provides a range of services, including *ETFRN News*, which comprises theme-based issues on research relevant to the international development agenda. This issue of *ETFRN News* provides an overview of the opportunities and challenges of chainsaw milling as supplier to domestic markets worldwide.

The mission of Tropenbos International (TBI) is to improve tropical forest management for the benefit of people, conservation and sustainable development. By making knowledge work for forests and people, TBI contributes to well-informed decision making for improved management and governance of tropical forests. TBI's longstanding local presence and ability to bring together local, national and international partners make it a trusted partner in sustainable development. TBI is ETFRN's coordinating member and national focal point in the Netherlands.

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