

The potential of chainsaw milling outside forests

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Introduction

Common opinions concerning the sawing of logs into boards with a chainsaw include: it is not possible, hardly anyone does it, it is very wasteful, it produces curved boards, and the finish is very rough. A new book (Pasiecznik et al., 2006) may overturn these misconceptions, and allow the reader to see milling with chainsaws in a new light, as an increasingly common method of producing timber, being cheap and efficiency, available to most people, producing quality timber, with appropriate technology already available and just waiting to be applied. Most chainsaw milling today is, however, carried out 'freehand', i.e. without the use of any guides, frames or rails that would otherwise help sawyers produce even better quality boards with less chance of accidents. The few studies on chainsaw milling that do exist highlight the need for further training.

Trees, timber and livelihoods outside forests

The importance of timber production from outside forests is attracting increasing attention, to help meet growing demand and reduce pressure on natural forests and plantations. There is a corresponding and increasing body of literature to support this, notably regarding timber from agroforestry systems (Arancon, 1997; Hanson and Stewart, 1997; Pasiecznik, 1999; ASB, 2001; Holding et al., 2001; Holding-Anyonge and Roshetko, 2003; Holding-Anyonge et al., 2003, Russell and Franzel, 2004; Scherr, 2004; World Agroforestry Centre, 2005) and specifically from drylands (Rogers, 1984; El Fadl et al., 1989; FAO, 1989, Brennan and Newby, 1992; Felker, 2000; Pasiecznik, 2000; Blackwell and Stewart, 2003; Felker and Guevara, 2003).

In the 1990s, there was much emphasis in research and development on non-timber forest products (NTFPs), including from trees outside forests such as in farm agroforestry and dryland. This was, however, to the detriment of considerations relating to the production of sawn timber (e.g. Pasiecznik, 1999), which finally gave way to an understanding of the role of timber as a product from farms (e.g. Scherr, 2004; World Agroforestry Centre, 2005). However, recent literature surrounding 'small-holder timber' often concentrates on marketing and commercialisation, acknowledging the importance of value addition to tree products. While this is appropriate to the current emphasis on policy and livelihood impacts, practical problems on the ground are rarely addressed. This is especially true of primary timber processing, and the increase in revenues that on-farm milling could achieve have been largely overlooked. One exception to this has been in Australia, where there is an increasing wealth of knowledge on the role of portable sawmilling in timber production from farm forestry (e.g. Hanson and Stewart, 1997; Stewart and Hanson, 1998; Smorfitt et al., 1999; 2001; 2004), with potential application to other countries.

The role of trees as savings banks has been emphasised in agricultural and agroforestry systems (e.g. Chambers and Leach, 1989), especially important in low-income years, during droughts or if prices of commodity crops or livestock products fall, or when cash is required such as for hospital or school fees, marriages or funerals. Shade trees in plantation crops, e.g. *Cordia alliodora* in Central America, *Grevillea robusta* in East Africa and numerous species elsewhere are typical in this regard, and many studies have assessed the production, value and importance of such trees as a source of timber in supporting rural livelihoods. If trees are indeed acting as a 'savings bank' for farmers, then inexpensive portable sawmills could greatly increase the value of their withdrawals from the bank, by adding significantly to the price of the sawn timber sold, way above the prices paid for standing trees.

A greater quantity, quality and diversity of timber products produced locally is also likely to have secondary effects, possibly stimulating further processing or artisanal activities such as furniture or craft making, transport and the associated trade in tools, materials and equipment. More money to tree owners from the sale of value added timber products and to timber processors will increase local cash flow, the chances for re-investment, and other aspects that would benefit the local economy. Adding value to trees will also improve the chances for more trees to be planted and better managed on farms, with the knowledge of the increased returns that can be gained. There are, however, numerous constraints that may prevent such an ideal vision for rural development taking place, though with careful insight, assistance and a suitable policy environment, advances can surely be made.

Appropriate timber processing technologies

Important aspects to be considered when selecting mill types must take into account: access, productivity, available capital, availability of mills, labour considerations and end products. When timber is in plentiful supply, static sawmills are likely to be most viable, with a highly mechanised and efficient operation able to process tens or hundreds of cubic metres of timber per day. Other mills may be 'semi-static', i.e. can be dismantled and moved with some effort, but the time required means that a certain amount of timber has to be milled to ensure profit before changing location again. Then there are the truly portable mills, generally considered the most appropriate outside forests where trees are scattered, standing timber volumes are low and access may be limiting. It might also be not a straightforward question of 'either or', but of how to best mix several mill types in a single operation. Chainsaw mills are, for example, sometimes used to cut slabs in the forest or other less accessible locations, for transport to a site where the timber is resawn by a bandsaw or circular saw.

Circular saws, band saws and chainsaw are the three alternative sawing systems employed in commercial portable mills. Band saws have the lowest kerf (around 3 mm), and high output, quality and efficiency, but require much expert resharpening especially with hardwoods. Circular saws have a wider kerf (around 6 mm), are more durable and require less expert resharpening, but as they come in so many designs, swing blades, double blades, etc., it is difficult to generalise on their output and efficiency, though hitting nails or stones is costly as blades are expensive. Chainsaws and chainsaw mills are the cheapest, but have the widest kerf (around 9 mm), lowest output and efficiency, with variable quality. Low kerf chains and bars exist, however, reducing kerf to 6 mm, ripping chains improve quality equivalent to that from bandsaws, and chains are also cheap and easy to sharpen.

Wyatt (1996) assessed whether chainsaw milling or portable circular saw mills (the 'walkabout') were most appropriate in the natural forests of Vanuatu, but his conclusions also

have relevance outside forests elsewhere in the world. “It should also be acknowledged that chainsaw mills are not generally a suitable tool for production of significant quantities of timber, or for a full-time sawmilling business. This should rightly be the role of a walkabout sawmill, with a more efficient engine and sawing system. Chainsaw mill operators who have expanded to a larger sawmill have found that their chainsaw mill was a valuable learning tool, the experience from which significantly contributed to the success of the larger business. However, in Vanuatu, most chainsaw mill operators have not expanded to walkabouts, while some of those who started with walkabouts have ‘downsized’ to chainsaw mills. This could be due to lack of resources, to absence of facilities or technical support, or it may simply be because operators feel that their needs are being met by the smaller machine.”

What has become increasingly clear over the past decade is that chainsaw milled timber is making up an increasingly significant proportion of locally available timber in many tropical countries. Milling attachments are very rarely used, however, and the ‘technology’ employed is the most basic, being a hand held chainsaw with a ‘chalk line’ as the only accessory. This method does have inherent problems related to a high risk of accidents, operator fatigue and poor board finish when using the standard techniques of removing depth gauges and using only the tip of the bar. Milling attachments are becoming more widespread though, and the technology will surely evolve, with further novel adaptations likely which should be identified and assessed in their appropriateness in tropical non-forest situations.

Outside of forests, low tree densities and volumes mean many common forestry practices are not viable. Farmers with trees on their land are presently likely to sell them standing, rather than becoming involved in harvesting and processing, and thus receive only a fraction of the value of the tree as sawn timber, with the trader (middleman) and sawmill owner making most of the profit. Sawmilling machinery suitable in situations with such low production must be very portable, able to efficiently cut small diameter, short and sometimes crooked logs, and of low enough capital cost to be economical if milling only a few cubic metres a week. Chainsaws with milling attachments are routinely used by a small number of people in some tropical moist forest and commercial temperate forest situations, and an increasing number of different types are becoming available. They have certain characteristics and requirements that make them suitable for only a limited number of operations in forestry, but show enormous potential for low volume farm forestry, agroforestry and dryland applications (Pasicznik, 2000).

The evolution of chainsaw mills

The development of the modern petrol chainsaw is generally acknowledged to have been by Andreas Stihl in 1929, though prototypes had existed since 1830. Chainsaws were, however, principally designed and used for felling and cross-cutting and not intended for rip sawing or milling, and it was to be decades later still before adaptations were made to convert chainsaws to a milling machines. However, it appears evident that freehand milling and the use of home made frames and guides have been used ever since chainsaws have been available, and a more detailed review would likely reveal such early developments. The Granberg Alaskan Mill (Granberg, USA) may have been the first in 1955 and others such as the Gruminette (Zimmer, France) followed soon after, but it is clear that chainsaws were already being used in less portable milling systems in the 1950s (Chardin, 1955) and probably before.

The early basic models have changed little in half a century, though there are now many additional attachments and accessories that improve mill versatility and efficiency. The first ripping chain, specially designed for use in chainsaw milling, was invented and patented by Will Malloff in the early 1960s (Malloff, 1982), and has since been much modified and improved, and different types are now made by a number of different companies, notably Granberg, Oregon and Stihl. Frame mills were followed soon after by rail mills such as the Mini Mill in 1973 (Granberg, USA) and the Beam Machine in 1982 (Quadra Tools, Canada). More recently, specially designed carriage mills have been added to the range available, such as the M7 (Logosol, Sweden) and the J100 (Jobber, Canada).

Contemporary chainsaw milling equipment

The following is a description of equipment currently commercially available, classified into rail mills, frame mills and carriage mills. For more information refer to Pasiecznik et al. (2006) or the company websites in Table 1 below.

Frame mills are probably the best known, original and most commonly available of chainsaw milling attachments. Often called ‘alaskan’ mills or ‘slabbing’ mills, they are also sometimes referred to by a manufacturer’s name, especially in countries where that make is used exclusively, such as ‘Granberg’, ‘Logosol’ or ‘Stihl’ mills or frames. These are simple frames or guides that are fixed to the chainsaw bar, and can be adjusted to be set at differing distances from the bar thus allowing for various cutting depths. They are used almost entirely, and most efficiently, with the bar and frame horizontal for ‘live’, ‘slab’ or ‘through and through’ sawing, producing boards, slabs or beams of various dimensions. They are made of square tubular steel or aluminium, with or without rollers, and some makes have various sizes to accommodate different chainsaw bar lengths, and thus corresponding log diameters. When using a frame mill, slabbing rails, slabbing boards or similar attachments are essential for making the first cut.

Rail mills, with some variation, comprise of a small attachment that fixes onto the bar that rides along a ‘rail’ fixed onto the length of the log. They may have been developed by innovative freehand chainsaw millers to aid them in making straight vertical cuts through a log. Some attachments require the pre-drilling of the bar for the attachment to be bolted on to, others simply clamp on. Rails may be specially supplied metal units (strips, bars, angle iron, etc.) or pieces of wood, typically in common sizes such as 10 x 5 cm or 15 x 5 cm (4 x 2” or 6 x 2”), for nailing or screwing on to the log. Several rail mills have additional features such as an ability to set the chainsaw at angles other than 90 degree (vertical), cut mitres, control the depth of cut, or cut curved lines. As well as their advantage for producing custom timbers, many have been designed especially for the log cabin and timber frame housing market.

Carriage mills differ in that the chainsaw is fixed onto or into a carriage, which rides along a frame or set of rails. Most make horizontal cuts, though a few models make a vertical (or near-vertical) cut. These are all larger, heavier, more expensive, and require more setting up time than the simpler alternatives already mentioned. However, they do then generally allow the user to cut more timber in a given time, reduce muscular stress and strain and eliminate almost entirely the risk of accidents. Carriage systems cannot be carried by a single person, requiring a team or vehicle, and share many similarities with existing portable bandsaw and circular saw mills. In fact, several carriage mills can be upgraded to a bandsaw mill, i.e. the same frame can be used with a range of carriages and saw types. Saw types can be

differentiated in a number of ways, including the maximum log length and diameter log that can be cut, the height the log has to be raised, and whether the cut is horizontal or vertical.

Potential for chainsaw milling

Chainsaw milling is peculiar amongst sawmilling techniques due to its high portability, low cost, and suitability for milling logs that might otherwise become firewood or left to rot. There are many types of tree or log that fit into this category, all of which are already milled by chainsaws at least somewhere in the world. The following is a miscellaneous list of potential and actual sources of sawn timber that have been identified as having some potential as an increased source of sawn timber for local markets with appropriate conversion techniques such as chainsaw milling.

- Farm trees
- Street and city trees
- Dryland trees
- Weedy trees
- River side and rail side trees
- Firewood and fodder trees
- Forest and woodland thinnings
- Trees of poor form
- Wind blown or fallen trees
- Diseased or damaged standing trees
- Washed up trees
- Small diameter logs
- Short logs
- Branches/prunings
- Oversized trunks
- Logging residues
- Sawmill waste
- Reclaimed timbers

Some of these are of particular interest for increased exploitation as sawn timber in farm, urban or dryland situations. Others may also be found in farm woodlands, near farms or drylands or on forest margins, with the potential as a source of timber and money from what would otherwise be a low value or valueless resource, as they may be unsuitable for milling using other methods, or are not yet considered as marketable species or timber sizes.

Farm trees includes trees in hedgerows, shelterbelts or windbreaks, single trees in or around fields, shade trees, border trees, orchard or plantation trees, or small woodland blocks. These make up an often underestimated percentage of a region's standing timber, and are being increasingly looked at to help meet the increasing demand for timber. But farmers are farmers, expert in growing crops and raising livestock, but generally less skilled in growing trees for quality sawn timber. Tree planting, weeding, pruning, etc. are all important but commonly overlooked. In some countries, farm trees are being harvested for timber but the volumes produced can be greatly increased with the proper management, and the returns to the farmer can be greatly increased if the farmer mills them, or has them milled, where they are felled. Realising most of the value of the tree may then inspire farmers to plant more.

Dryland trees include trees mostly thought of only as sources of firewood or fodder but which often have very hard wood and yield valuable timber, including many acacia species for example. 'Recovery' in all these cases is not an issue as all the wood would have become firewood anyway and even if only 10% of the wood could be converted to boards or beams, with a minimum 10-fold increase in value per volume from fuel wood to sawn timber, milling of the at least the larger logs is likely to make good economic sense assuming a market can be found.

Fallen trees do not require felling obviously, saving time and resources. They may also require immediate removal because they block roads for example, and not only may they be free, someone may even be willing to pay to have them removed. However, such trees require extra care in cross-cutting into sawable logs because of the tensions and compressions caused by the storm winds and the need to separate the tree stem from the root plate. Standing storm-damaged or diseased trees can also fall into this category, as they will fall down anyway and it may be better to fell them in a controlled manner. Logs may also be found washed up on beaches or riversides.

Farm woodlands and forests offer a valuable source of free or low-cost timber. In plantations, thinning is usually essential but often cost the forest owner money unless the sale of trees cut covers the cost of the operation, and if there is no ready market for pulp or poles they are sometimes just cut and left to rot, but should be considered as a possible source of sawn timber. In natural forests, chainsaw millers are already buying cheap concessions on logged over land, finding enough suitable logs left by the original fellers as 'logging residues', logs not the right length, tops, below the minimum diameter, branches, split or hollow logs, or even perfect logs that could not be extracted or were one too much for the last lorry, all providing a ready source of usable timber already on the ground with no felling required.

Old timbers, beams, telegraph poles, sleepers, sawmill waste, etc. can also provide a cheap or free source of wood for resawing into desired dimensions. The chainsaw miller may just offer his services as a contractor, or try to sell the wood produced. Pasiiecznik et al. (2006) detail the ways in which otherwise unmillable logs and 'firewood' can be converted to marketable timber using chainsaw mills.

The way forward

The technology for low-cost wood conversion exists, some of it over 50 years old, and their availability and use is spreading rapidly now their wider potential is being shown. Markets exist, and will adapt as soon as supplies increase, but skills need to be taught, with training identified as the single most important need. This is the greatest challenge, and one not for extension workers alone, but also in convincing machinery manufacturers and dealers, who will gain from the developing enterprises, that it is their best interest to invest in such knowledge sharing also. Also, training is not just required in the use of milling attachments, but importantly also in basic chainsaw safety, use and maintenance, and also timber drying and marketing.

In agroforestry, the timber from trees have rarely played significant role in rural incomes, though the need for diversification and the indirect benefits of trees are increasingly encouraging tree production. Turning farmlands and drylands into timber producing areas is realistic, if equipped with the appropriate skills and tools. This will in turn reduce the

pressure on natural forests and reduce illegal harvesting. To achieve this though, needs the efforts of many committed individuals at all levels to raise awareness and provide training to ensure that chainsaw milling makes a positive – rather than a negative – contribution to rural livelihoods and the sustainability of farm and forest land alike.

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Further information

This article is drawn from the following manual and related publications:

Pasiecznik NM, Brewer MCM, Fehr C, Samuel JH. 2006. Turning Trees to Timber: A Chainsaw Milling Manual. HDRA, Coventry, UK.

The manual, training posters, policy briefs, summary report and other project outputs are accessible and available for downloading from: <http://chainsaw.gwork.org/> and http://www.gardenorganic.org.uk/international_programme/ip_publications.php, following links to Research Outputs. Limited printed copies are also available by writing to the Overseas Programme, HDRA, Coventry CV8 3LG, UK. Copyright restrictions exist on the

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Chainsaws are dangerous and misuse or poor training can lead to potentially fatal accidents and this must be acknowledged by all users. Project outputs contain information and best practice recommendations based on sources believed to be reliable. This is supplied without obligation and on the understanding that any person who acts on it, or otherwise changes their position in reliance thereon, does so entirely at their own risk.

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Table 1. Chainsaw mills and their manufacturers, arranged in approximate retail price order by mill type, but without any indication of quality, technical characteristics or maximum log size sawn.

Model	Manufacturer	Cost US\$	Website
Rail Mills			
1. Beam Machine	Quadra Tools, Canada	40	www.beammachine.com
2. Boardmaster	Hud-son, USA	40	www.hud-son.com
3. Mini Mill II	Granberg, USA	80	www.granberg.com
4. Lumbermaker	Haddon Tools, USA	90	www.haddontools.com
5. TimberJig	Logosol, Sweden	170	www.logosol.com
6. Micro-Mill	Accutech, Canada	200	www.accutechinovations.com
7. Headcutter	Big Foot Tools, USA	210	www.bigfoottools.com
8. EDM Tracer	Schroeder, USA	240	www.loghelp.com
9. Miter Mill	Accutech, Canada	600	www.accutechinovations.com
10. Big Mill Basic	Logosol, Sweden	750	www.logosol.com
Frame Mills			
11. Alaskan Small Log Mill	Granberg, USA	140	www.granberg.com
12. Alaskan Mark III 24"	Granberg, USA	180	www.granberg.com
13. Slabbing Mill 24"	Westford, Australia	290	www.eftelcorporate.com.au/~jema1
14. Stihl LSG 450	Logosol, Sweden	360	www.logosol.com
15. Alaskan Mark III 84"	Granberg, USA	390	www.granberg.com
16. La Grumnette	Zimmer, France	420	www.zimmersa.com
17. Slabbing Mill 66"	Westford, Australia	430	www.eftelcorporate.com.au/~jema1
18. Big Mill LSG Pro	Logosol, Sweden	500	www.logosol.com
19. Stihl LSG 600	Logosol, Sweden	520	www.logosol.com
20. Alaskan Mark III C2	Granberg, USA	640	www.granberg.com
Carriage Mills			
21. 'Make your own'	Procut, Canada	1000	www.procutsawmills.com
22. Rail Mill	Westford, Australia	1140	www.eftelcorporate.com.au/~jema1
23. J100 Jobber	Jobber, Canada	1500	www.jobber.qc.ca
24. Baby Bug 10XB	Wood Bug, Canada	1560	www.woodbug.com
25. Chain Saw Mill	Hud-son, USA	1800	www.hud-son.com
26. Woodworkers' Sawmill	Logosol, Sweden	2000	www.logosol.com
27. Woodbug 20XB	Wood Bug, Canada	2260	www.woodbug.com
28. SM2186 Chainsaw Mill	Lennartsfors, Sweden	2310	www.lennartsfors.com
29. M7 Sawmill	Logosol, Sweden	2400	www.logosol.com
30. Chainsaw mill	EcoSaw, Australia	3500	www.ecosaw.com
Milling accessories			
31. Winch	Westford, Australia	30	www.eftelcorporate.com.au/~jema1
32. Supplemental oiler	Granberg, USA	50	www.granberg.com
33. Helper handle	Granberg, USA	50	www.granberg.com
34. EZ slabbing rails	Granberg, USA	140	www.granberg.com
35. Bar Stinger (handle)	Schroeder, USA	170	www.loghelp.com
36. Double-ended bars	Granberg, USA	230	www.granberg.com
37. Weatherboard guide	Westford, Australia	180	www.eftelcorporate.com.au/~jema1
38. Log Wizard debarker	Log Wizard, Canada	290	www.logwizard.com
39. Log House molder	Logosol, Sweden	1450	www.logosol.com
40. The Ripsaw	SIR, USA	1590	www.ripsaw.com
Ripping chains			
41. 'Granberg chain'	Granberg, USA	-	www.granberg.com
42. Granberg-type chain	Laser, Canada	-	www.lasersales.org
43. Various, + Micro-Lite	Oregon, USA	-	www.oregonchain.com
44. Various, + PMX	Stihl, Germany	-	www.stihl.com