Impacts of Skill Improvement in Small-scale On-farm Timber Processing in Kenya

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Abstract

Following the logging ban in Government natural and plantation forests in Kenya, the demand for timber from farms increased but without appropriate sawing technologies. This resulted in the use of less preferred sawing methods; chain saws and mobile saw benches, which are known to be wasteful due to large saw kerfs and lack of adequate sawing skills for the operators. KEFRI initiated a programme to improve sawyers' skills through training, with about 200 sawyers benefiting in three Districts in the first two years. An evaluation study two years after training in each District showed that timber recovery increased by over 7 % and 8% for trained chain saw and mobile saw bench operators respectively. Mobile saw benches had significantly higher timber recovery than chain saws due to their differences in saw kerfs and mode of operation. It was recommended that skill improvement be incorporated in initiatives aimed at improving on-farm timber processing. The use of thinner chains and circular saws should also be encouraged. Further research should be targeted towards developing more cost effective and recovery improving sawing technologies for the small-scale on-farm timber processing.

Key Words: Timber, Chain saw, Mobile saw Bench, Recovery.

Introduction

Kenya's forestry sector has been an important contributor to the country's economy (KEFRI, 1999). Until mid 90s, soft wood plantation species were the main source of timber in Kenya meeting up to 90% of the demand, with the rest coming from indigenous forests and small amounts from the farms (KFMP 1994). After the closure of majority of the country's saw mills due to lack of materials due to the ban on timber harvesting from plantations and natural forests (Ndegwa and Kihara, 1998), the country's timber market depended on supplies from farms and import sources. Small-scale processing methods, among them chain saws, mobile saw benches and pit saws became popular on the farms.

These sawing methods were preferred because they required a relatively smaller capital investment than the conventional static sawmill. Their mobility meant that operations could take place in strategic locations because access is easier, and operators can come and go as the demand for wood supply dictates. However, unlike in other parts of Africa, especially in Papua New Guinea, where small-scale timber processing is well-developed in because it has been advocated for many years (Tolfts, 1998), in Kenya and other developing countries, they suffered lack of appropriate technologies and sawing skills (Clarke, G.C. 2005). These contributed to timber with rough surfaces, irregular sizes and very low recoveries (Muthike and Githiomi, 2003).

A number of the factors affecting timber recovery and surface quality in small-scale on-farm timber processing are associated with the sawing technologies, a number are associated with the sawyer's skills and level of experience. Chain saws used in Kenya are fitted with large kerf felling chains, which are not suitable for splitting (Kilkki (1993). Many of the mobile saw benches use very thick saws to avoid frequent maintenance. On the other hand, on-farm timber processing attracts unskilled labour from the unemployed population in the rural areas.

In Kenya, unlike some of the sawyers in the formal sector who could access training opportunities at Forest Industrial Training Centre (FITC), most of the operators in small-scale sector are trained on the job by their fellow operators. The type of training they get is therefore deficient because many of the factors affecting timber recovery and quality are not adequately learned. Most of them know only how to start and hold the machine in position. Tree farmers and timber merchants are also ignorant about timber recovery.

In an effort to improve small-scale timber processing, timber processing guidelines for small-scale timber sawyers was developed, putting emphases on factors affecting timber recovery and surface quality; proper machine and saw maintenance, log alignment for first cut, different sawing patterns and timber size determination and precision during sawing and safety precautions (Muthike, Githiomi, 2003). This document has since been improved and published (Muthike, Githiomi and Onchieku, 2006). Based on these guidelines, KEFRI started two-day training seminars for the sawyers in each of the districts where small-scale timber processing is done.

The first pilot seminar was attended by 28 sawyers; (10 chain saw and 18 mobile saw bench operators) in Meru Central district in 2002. When similar trainings were done in Embu and Kirinyaga Districts in 2003, 169 sawyers were trained in five divisions. Training involved one day of theory and one day of practical training using simulation methods. A study was therefore necessary to evaluate the effect of the training on timber recovery and surface quality. This was done two years after training in each District to give enough time for the sawyers to adjust themselves to the acquired skills i.e. 2004 in Meru central and 2005 in Embu and Kirinyaga. Some interim results were published in KEFRI conference in 2004 (Muthike, 2004). This paper reports on the combined evaluation in the three districts.

Objectives

The objective of the study was to evaluate the effect of skill improvement training of timber sawyers on timber recovery.

Materials and Methods

The study was carried out in Meru Central, Embu and Kirinyaga districts, targeting sawyers who had been trained and their counterparts in the same districts who did not attend the training. For each sawing method; chain and bench saws, five trained sawyers were randomly selected from the list of trainees from each of the five divisions in the three Districts. For chain saws, the machine operator was picked. Since mobile saw bench requires many people to operate, the lead sawyer was the most important as he is the one who determines how the log is to be cut while the rest in the team assist in pushing the logs through the saw. A similar number of those who were not trained were also randomly selected. In total, there were five sets of trained operators in each of the five divisions and similar number of untrained sawyers

Grevillea robusta wood from on-farm grown trees was used for both sawing methods. Trees were felled, cross-cut into logs. The mid diameter and length of each log were measured in meters to the nearest second decimal point. The volume of logs converted by each sawyer was then calculated as shown in equation 1. Saw bench operators used a circular saw mounted on and powered by a tractor, while chain saw operations used chain saws to convert logs into market size timber. The total volume of timber sawn by each sawyer was determined as shown in equation 3. Timber recovery was calculated as shown in equation 3.

$$V_L = \Sigma \frac{(\pi D^2 L)}{4} \quad \text{.....(Equation 1)}$$

Where: V_L = Total log volume

D = Log mid diameter

L = Log length

$\overline{\pi}$ = A constant value of 3.142

$V_T = \Sigma (bdl)$ ……(Equation 2)

Where: V_T = Total timber volume

b = Timber breadth

d = Timber depth

l = Timber length

$$R\% = \frac{100V_T}{V_L}$$ ……(Equation 3)

The two experimental factors were training effect and sawing method. Each factor was assigned identification numbers for ease of data organization and analysis as follows:

Training Effect

1. Before training
2. After training

Sawing Methods

1. Chain saw
2. Bench saw

Data from all the sites was collected and statistically analyzed for the effect of training and sawing method on timber recovery using SPSS version 10, with confidence level, p =0.05.

Results and Discussions

Results on sawing methods and sawyers' skills are shown in Table 1. There was a significant difference in timber recovery between the sawing methods and among the sawyers within each sawing method before and after training.

Chain saws had a mean timber recovery of 26.8 percent, which was significantly lower than 31.3 percent for mobile saw benches (Table 2). The differences between sawing methods were attributed to mechanical differences associated with the cutting tools used in the respective sawing method.

Table 1. Analyses of Variations

Source of Variation	**Sum of Squares**	**(df)**	**Mean Square**	**F-value**	**Significance (p value)**
Sawing method	119.26	1	119.26	57.85	2.52×10^{-7}
Training	316.10	1	316.10	153.34	0.00
Saw × Training	0.92	1	0.92	0.45	0.511642
Error	41.23	20	2.06		
Total	20655.71	24			

Chain saws use chains with a mean saw kerf of 7mm compared to 3mm for most circular saws used in bench saw method (Muthike and Githiomi, 2003, Clarke, 2005 and Kilkki, 1993). Due to the large kerf, sawing by chain saws result into higher wood losses in form of sawdust than circular saws. Similar conclusions were drawn from studies involving a variety of sawing tools in Zimbabwe (Eeronheimo, 1990) and Guyana (Clarke, 2005). Saw kerf of any sawing tool is determined at the design level of the tool. This was therefore not possible to minimize during the training. There was no significant interaction between sawing methods and training.

Table 2. Mean timber recoveries for sawing methods before and after training.

Sawing Method	Recovery Before Training	Recovery After Training	Mean
Chain saw	23.3	30.2	26.8
Mobile saw Bench	27.4	35.1	31.3

Timber recovery for sawyers using chain saw method increased by 7% and that of bench operators by over 8% after training (Table 2). This increase could be attributed to better servicing as well as improved handling of the sawing tools and log alignment during sawing. Secondly, the sawyers were able to minimize wastes due to effects of log taper and bends during log cross cutting and by reducing the size of side slabs during sawing. These are some of the major contributors of timber wastes in timber sawing.

Studies in Mozambique showed that log alignment for the first cut affected timber recovery due to effects of log taper and shape (Fath, 2002). Alignment of the log for the first cut is a key decision that the lead sawyer (in bench operations) and chain saw operator have to make since it determines to a large extent the sizes and volume of timber obtainable from that particular log. An operator without adequate sawing skills can waste the log at this stage.

While timber sawn using chain saws are known for irregular sizes and rough surfaces, trained sawyers were able to produce regular sized timber with smoother surfaces. This could be attributed to improved handling of the chain saw, reducing the movement of the chain during sawing while accurately cutting along the marked line. Chain saw vibration during sawing has been shown to increase wood losses along the cutting line in free hand chain sawing method (Salafsky, *et al*, 1995.).

Bench saw operators on the other hand had a recovery rate of 27.4 percent before training, which was higher than that for power saw operators (23.3). After training, the recovery increased to 35.1 percent, which was still higher than for chain saws (30.2). This consistent difference could be attributed to smaller saw kerf and sawing patterns employed during sawing. Increase in timber recovery for mobile saw bench was highly attributed to improved skills in sawing.

The tendency of untrained sawyers to produce oversized timber and leaving out large side slabs was the major contributor to wastes.

These were minimized through training and operators were able to produce timber pieces while making use of almost all the available logs. Improvements were observed in terms of saw sharpening and general maintenance, which reduced, saw warbling, which causes uneven sawing and irregular sized timber.

Conclusions and Recommendations

That training increased timber recovery for the two sawing methods due to improved sawing skills. Better machine handling and servicing has greatly improved as well as general knowledge in timber harvesting and processing. However, training did not change other factors like size of saw kerf that make sawing methods different from one another hence the differences among the sawing methods was maintained. It was therefore recommended that:

- Training of small-scale timber sawyers should be integrated in the initiatives to improve timber recovery.
- Research is needed to develop technologies to deal with factors like saw kerf especially for the chain saws. Smaller chain saws with thinner chains are now available in the market and sawyers should also be encouraged to try them. Chain saw frame attachments developed in USA and Canada and used in various countries in Europe could be tried in Kenya. Their timber recovery should also be determined.

- Bench operators should be encouraged to use thinner saws, which could greatly increase their timber recovery.
- On the overall, research and development should focus on more cost effective methods for on-farm timber processing sector.

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