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THE EFFECT OF TRAINING AND JOB INTERRUPTIONS ON LOGGING CREWS' SAFETY IN TANZANIA'S PLANTATION FORESTS: THE CASE OF SUA TRAINING FOREST, OLMOTONYI, ARUSHA

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ABSTRACT

A study was carried out in Sokoine University of Agriculture Training Forest to assess the effect of training and job interruptions on logging crews' safety during tree cutting using chainsaw and two-man cross cut saws. For each cutting method, experienced and inexperienced crews were studied before training, after training and after break using time study techniques for nine months at intervals of three months. Results show that crews seldom use safety gears. Inexperienced crews suffered more health risks than experienced crews. Most of occupational risks encountered by inexperienced chainsaw operators were from falling objects (mostly dead branches and pods), falling trees, walking between trees with a running chainsaw as well as walking carelessly on logs and felled trees during bucking. Experienced two-man cross cut saw operators committed fewer risks and suffered about 37% fewer injuries compared to inexperienced crew. Chainsaw operators suffered relatively more injuries compared to two-man cross cut saw operators. After training, there were significant improvements in both methods, but more so for the inexperienced crews. The level of safety consciousness decreased with increased accidents and or risks after the break for both crew categories. Inexperienced crews suffered more injuries. On resuming operations after the break, inexperienced crews seemed to adhere to safety rules more than the experienced ones. It is concluded that provision of appropriate safety gears as well as delivery of on job training are important measures for improved performance and lowering accidents and injuries to logging crews.

Key words: Tree cutting, chainsaw, two-man cross cut saw, training, safety, accidents, Tanzania.

INTRODUCTION

Forestry has been identified in many countries as an industry with high rates of work-related injury (Crowe 1986; Toupin *et al*. 2007). Compared with mining disasters where several workers may be killed at the same time, accidents in forestry remain largely unnoticed and hardly ever make news (Blombäck 2002). Still, the statistics give reason to worry. In New Zealand for example, Cryer and Fleming (1987) reported that between 1975 and 1984, the average fatality rate in forestry work was 11.5 times higher than the overall work force rate. In the same country, six forestry workers died in workplace accidents in 2012 and 10 in 2013 (Pearl and Bowen 2014). Statistics from the USA for 1998 and 1999 show that forest workers employed in harvesting had the highest fatality rate (Blombäck 2002). The author noted further that high fatality rates in the USA are still much lower than in other countries, particularly in the tropics.

Due to the high rate of fatalities, forestry workers have been identified as an occupational group at high risk of work-

related injuries (Lindroos and Burström 2010; Tsioras 2012). Forest harvesting operations for example, had earlier been described as 3-D job: that is Difficult, Dirty and Dangerous (ILO 1991; Shemwetta *et al.* 2002). According to Axelsson (1998), deaths caused by falling trees have been reported to be the most common fatal accident in forestry globally. This is based on the fact that a falling tree involves high and unpredictable forces. However, increased mechanization in the logging industry in the developed world has shown a slight decrease in fatal accidents although strain and health hazards have increased in some way (Lefort Jr. *et al*. 2003). This is because mechanization has acted to shield workers from direct dangers associated with felling and trimming.

On the contrary, the situation in many developing countries such as Tanzania, manual or semi-mechanised logging operations using hand tools are favoured more due to cheap labour availability (Fue *et al*. 1999; Silayo 2004; Silayo *et al.* 2007). Tree cutting is done manually using two-man cross cut saws, axes or chainsaws. Log extraction in most forests is done using manual methods, animal power and tractors (crawler tractors, farm tractors and skidders). Manual skidding and forwarding, especially in the first and second thinning are also common in plantation forests. Loading and unloading is performed manually or semi-mechanized by means of front-end loaders. Truck-trailer, tractor-trailers of different sizes and skyline system perform secondary transportation (Ole-Meiludie *et al.* 2002). The log transport systems applied are described by Abeli and Ole-Meiludie (1991) which may be in form of short wood, log length and/or tree length.

In Tanzania, chainsaw is the most used felling device in commercial timber harvesting (Kweka *et al.* 2007). McCormack (2002) reported that in the 1950s and 1960s chainsaws were introduced in the logging industry widely in some countries. These authors noted that as chainsaws became lighter and their operation more practical, they were adopted enthusiastically by tree fellers. Chainsaws therefore made tree felling by one person possible, although in many cases the traditional practice of employing an assistant who helped to carry the backup tools and fuel supplies lingered on for some years. Axelsson (1998) contended that the chainsaw, with its unprotected chain running at a speed of some 20 m/sec, is the most dangerous tool.

Most incidences of death in harvesting sites for both tree felling crews and firewood collectors in Tanzania plantation forests are caused not only by the equipment used but also by poor practices and negligence (Shemwetta *et al.* 2002; Silayo *et al.* 2010; Mrecha, M. personal Communication 2013). Logging crews are normally engaged without professional training which in turn results into poor practices coupled with heavy workload and frequent muscle fatigue (Shemwetta *et al.* 2002). In the absence of safety regulations and training, accident rates tend to be several times higher than in industrialized countries whether work is performed manually or with machines (Blombäck 2002).

Unfortunately, there are few or no structured training programmes for logging crews in Tanzania where the working conditions are also reported to be poor (Silayo *et al.* 2010). However, technology in the logging industry is evolving from manual to semi-mechanised with increased use of chainsaws and other modern tools. The new tools come with new forms of occupational hazards which need to be addressed through training and ergonomic improvements of the logging equipment which can improve crews' performance in different forms (Giovanna and Talbot 2014).

Meanwhile, logging in most forests is performed seasonally depending on weather and availability of harvesting stock. Thus, often crews break for an average of three months before resuming operations. This study therefore was designed to determine the effect of training and job interruption on crews' safety during timber harvesting in plantation forests in Tanzania. Specifically, the study assessed the effect of on job training for two-man cross cut saw and chainsaw operators during tree cutting operations in plantation forests on crews' safety. The study also assessed the effect of job interruption on crews safety on resumption of operations due to the fact that forest harvesting occurs seasonally based on weather and available coupe. This information is important for logging planners and managers to schedule logging activities in line with professional competence of the logging crews to ensure improved safety and high productivity.

MATERIAL AND METHODS

Description of the study area

This study was carried out at the Sokoine University of Agriculture Training Forest (SUATF), Olmotonyi, in Arumeru District, Arusha region, Tanzania. The forest lies between latitudes 3' 15º – 3' 18º south and longitudes 36' 41º – 36' 42º east. It is bordered by Meru forest plantation to the east and west, Arusha National Park to the north and Timbolo and Shiboro villages to the south.

The forest covers about 840 hectares of plantation forests planted with soft and hardwood species and few patches of natural forests. SUATF is on the slopes of Mount Meru, at an altitude of between 1 740 to 2 320 m above sea level (Abeli *et al.* 2003). The seasonal climate includes a consistently dry period between June and October. Rainfall patterns vary considerably, but average annual precipitation is about 1200 mm. The mean annual temperatures range between 18°C in the morning and 23°C in the afternoon.

Experimental design

Study groups

The study was conducted on clear cutting operations using two-man cross cut saws and chain saws. The crews were divided into two groups for each cutting tool. The first group consisted of newly recruited crews which were engaged during the study while the second group consisted of experienced operators. The education of all crews was primary level, which is standard seven leavers. Medical reports showed that all crew members were in good health as there was no one suffering from either chronic or communicable diseases that could affect their performance. Each group was first studied *in situ* for up to three months, after which they were trained and studied again and then left to rest for the same period before they were studied again. This arrangement aimed at assessing the impact of production breaks on learning and forgetting behaviour of the crews. This was based on the fact that working experience accumulates as crews spend more time on the job with new skills. This in turn leads to increase in output due to learning and decrease of forgetting (Wright 1936).

Convenience sampling which is a type of non-probability sampling technique was used in this study. This was due to the fact that forest harvesting in Tanzania is carried out by few crews due to low capacity of processing facilities and low available stock. For example, it is common to find tree cutting being performed by a single chainsaw operator. When two-man cross cut saw operators are involved, hardly more than two crews of four people are engaged. Therefore, the units that were selected for inclusion in the sample were obtained by convenience.

Inexperienced crews

Crews in this category were made up of individuals without prior experience in tree cutting operations. The chainsaw operator was a man aged 29 years old. The cross-cut saw crew members were 38 and 40 years old. These individuals had occasionally been involved in different forest related activities including carrying out forest inventory, log skidding and log loading as casual labourers for over five years.

Experienced crews

Crews in this category comprised individuals who had previously been involved in tree cutting operations using the same tools for at least three years. A chainsaw operator (31 years old) had worked for over 8 years in the same forest. On the other hand, the experienced cross cut saw operators had worked in the same capacity for over 12 years. The two members/individuals of this group were 40 and 41 years old and had been working as casual labourers in the same forest. The crews had never received any formal training pertaining to their activities apart from on-the-job training.

Training plan

The training plan was structured to allow for consistent learning focusing on hands-on skills based on the recommended tree cutting practices such as directional felling, proper limbing and bucking practices, appropriate ergonomic postures during tree cutting, proper use and maintenance of cutting tools (cross cut saw and chainsaws). Accident prevention and safety precautions were also emphasized to reduce workplace accidents, risks and/or hazards. The methods of safety and health training ranged from passive, information based techniques such as lectures to learner-centred performance-based techniques such as hands on demonstrations. The hypothesis was that greater knowledge acquisition that fits well working crews to work settings would occur through training, thereby improving behaviours, safety performance and therefore reducing negative safety and health outcomes. On-site training/instructions method was adopted as it has proved to one of the most effective way of imparting crews with required skills following it wide application in the Scandinavia (ILO 1991).

Data collection

The occupational safety of the crews was assessed by monitoring their performance during cutting operations. Safety was generally categorised into two scenarios which were the general risks encountered by the crews and the injuries suffered during the operations. The risks here are referred, but not limited, to all actions that crews were subjected to which led or could lead into injuries or accidents. Lilley *et al*. (2002) describe these types of risks as 'near-miss' which may include machine handling, appropriate decisions of tree felling direction, self positioning during felling, bucking and delimbing. Others included use of self protective gears and walking between trees or logs.

Injuries were all physical damages to the crew's body such as wounds, abrasion or eye impairment by saw dust and being struck by an object. Thirty observations were randomly made at intervals of between two and three days for the whole period of the operation for each experiment, that is, when crews were first studied (before training), after being trained and after the break. During these observations, risks encountered and the injuries which occurred were recorded separately. Working conditions data were collected using ergonomic checklist. Some of the information collected included the type and use of safety gears, education, health status, salaries and remunerations as well as the general safety.

Data analysis

Descriptive statistical analysis and regression analysis were performed using MINITAB 15 and SPSS (Statistical Package for the Social Sciences) software. Data from ergonomic checklist which included among other things, the working conditions, use and type of protective gears, injury and accidents history and general health were coded and analysed using SPSS. The number of injuries and accidents observed during the study were analysed using MINITAB 15 Software. Descriptive statistics and regression models were developed to establish relationships between dependent and independent variables e.g. between the number of observations and the injuries. In this study, multivariate and univariate regression were used for modelling crews risk levels in relation to the number of observations made during cutting operations.

RESULTS

Health occupational hazards

Results from the ergonomic checklist showed that experienced chainsaw operators suffered from several occupational health problems before and during the first experiment of this study as revealed by the crews. The main complaints from the operators included backaches, dizziness and finger numbness. About 80% of the surveyed crews reported to have suffered from backaches with cross cut saw operators claiming to have been affected more. However, after training the crews on basic skills pertaining to the operation of the cutting equipment (two-man cross cut saws and chainsaw), all crews admitted to have experienced less and less physical fatigue than before.

Use of safety gears/equipment

The study found that logging crews were normally provided with some basic safety gears which included jackets, gumboots, helmets and hand gloves but seldom used them. About 90% of the crews complained that they felt uncomfortable using these protective gears due to several reasons including some being oversize, excessive moisture retention and heat. However, the study noted that chainsaw operators were neither provided with eye nor ear protectives which are extremely important for protecting the crew from saw dust and excessive noise which may impair hearing. It was also learnt that over 80% of the crews do not bring the safety equipment with them on site and the rate of using protective gears decreases with the crew experience. Comparatively, during this study inexperienced crews were observed to comply with safety regulations although they equally complained of uncomfortability.

Occupational safety of the logging crews

Results showed that inexperienced crews suffered more injuries than experienced ones (Table 1). Further, it was found that generally crews of both categories were injured on different parts of the body but mainly on the head caused by falling objects, hands and legs mainly from physical contacts with the logs, stumps, branches, cutting tools as well as other objects on the forest floor.

Chainsaw operator's safety levels

Results showed that crews faced different number of occupational risks with intensities varying between experienced and inexperienced operators. Table 2 shows the average occupational risks and the actual injuries suffered by experienced and inexperienced chainsaw operators for different experiments.

Table 1: Part of the body injured during harvesting operations using the two cutting tools

Crew category	Part of the body injured							
	Head		Hand		Legs		Others	
	Number of injuries	%	Number of injuries	%	Number of injuries	%	Number of injuries	%
Chainsaw operators	81	36	54	24	70	31	21	9
Cross cut saw operators	11	22	22	44	10	21	7	13

Table 2: Occupational risks committed and the injuries suffered by chainsaw operators during different learning categories

SN	Crew Category	Study categories					
		Studied in situ		After training		After break	
		Committed risks	Injuries	Committed risks	Injuries	Committed risks	Injuries
1	Experienced	80	20	62	13	64	25
2	Inexperienced	164	22	77	36	86	41

Chainsaw operators' safety level when studied for the first time

Observations on the chainsaw operators' safety before training showed that these crews committed different types of risks although suffering of injury was nearly of the same type. The assessment of experienced crew during the first experiment at a threshold level of 0.05 for statistical significance using Pearson correlation analysis shows that there was negative but statistically insignificant correlation between the number of risks committed and the suffered injuries ($r = -0.15$, $df = 58$, $p = 0.417$). This resulted into a non predictable trend of the crew safety levels. However, there was a positive and statistically significant ($r = 0.895$, $df = 58$, $p > 0.001$) correlation between the risks committed and the number of injuries at a predictable trend for inexperienced crews (Figure 1). The number of committed risks and injuries between the two crew categories differed significantly (t-test, $df = 58$, $p = 0.001$).

Chainsaw operators' safety level after training

The number of occupational risks committed and the injuries after training showed different trends between the inexperienced and experienced crews (Figure 2).

Further analysis showed that the number of injuries for the experienced crew was reduced by 48% after the training. This reduction is significant (t-test, $df = 58$, $p = 0.010$) when compared with the situation before training. Injuries for the inexperienced crew were reduced by 42% which differed significantly (t–test, $df = 58$, $p = 0.001$) from the injuries before training.

Chainsaw operators' safety level after break

Results show that the injury level between the two crews did not differ significantly (t-test, $df = 58$, $p = 0.064$). Unlike for the experienced crew, there was no significant (t-test, $df = 58$, $p = 0.026$) difference between the number of injuries observed

during the period after training and after the break for the inexperienced crew.

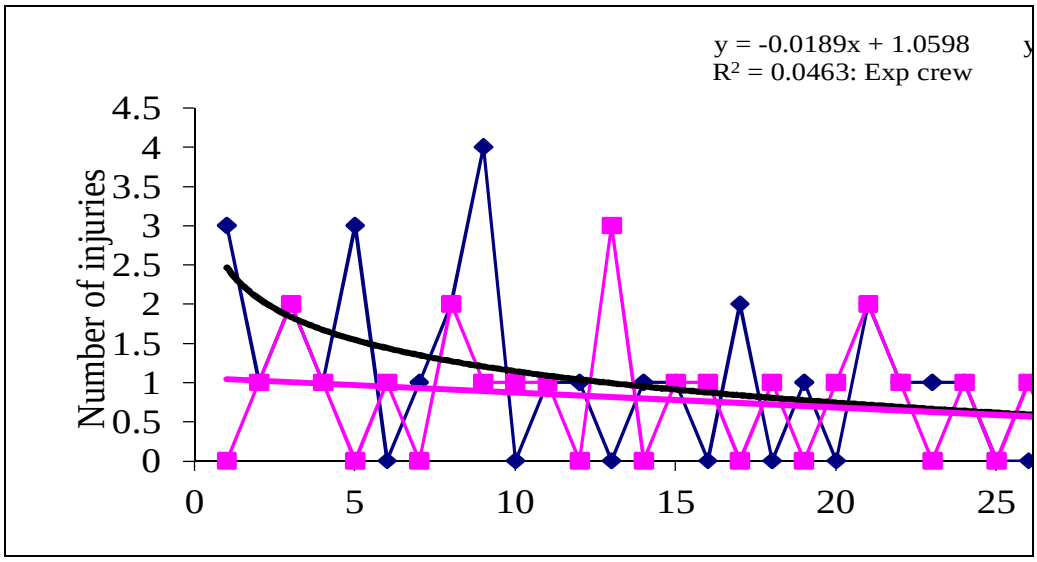

Figure 1: Relationship between the number of observations and injuries suffered by the Experienced and inexperienced chainsaw operators when studied before training

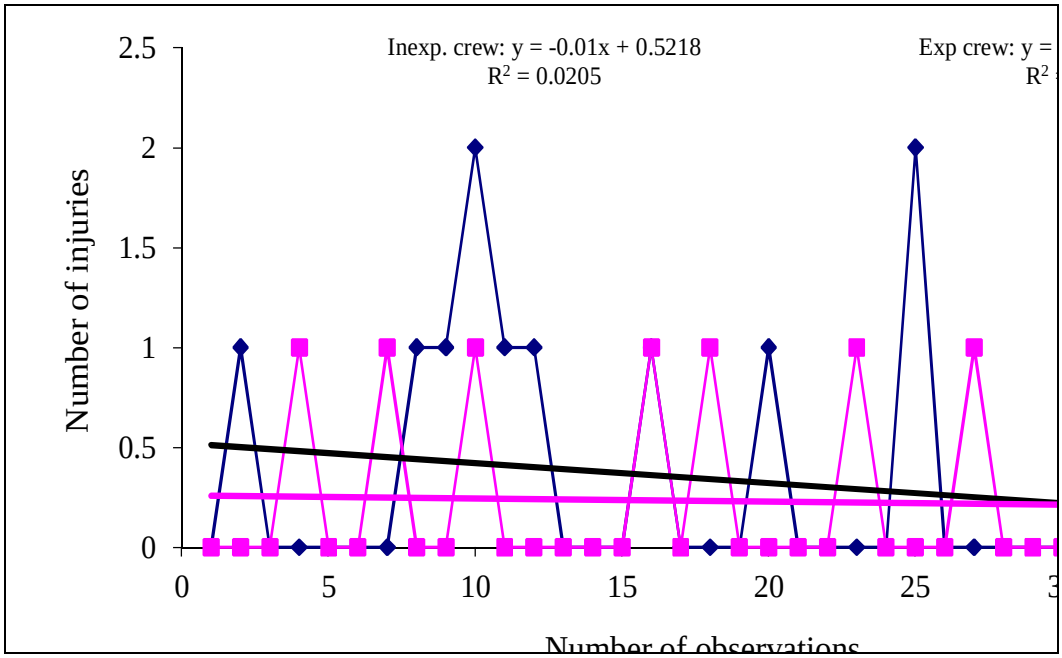

Figure 2: Chainsaw operator's safety level as measured by the number of injuries suffered after training

Field observations showed that unlike the experienced crews, the inexperienced crews followed and keenly observed safety measures after resuming operations. Consequently, experienced crews suffered more risks and injuries during the first days of resumption of the operations. Analysis of

the break effect showed that injuries for inexperienced and experienced crews increased by about 21% and 29% injuries respectively compared to the situation before and after the training. However, both crews experienced significant improvement within a short period (after 10 observations which were nearly one month of continuous operation) after resuming the operations (Figure 3).

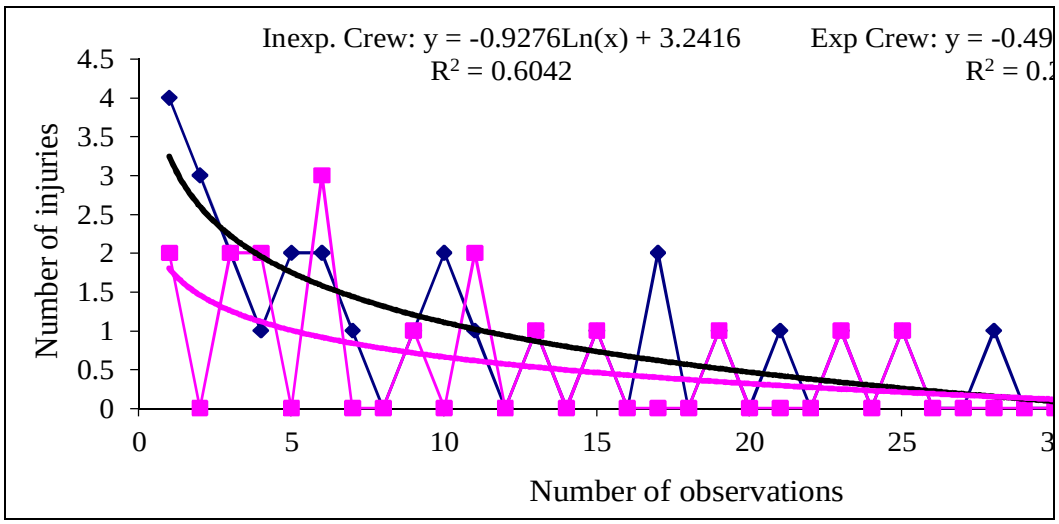

Figure 3: Chainsaw operators' safety level after resuming cutting operations

The two-man cross cut saw crew's safety
Table 3 shows number of occupational risks encountered and injuries suffered by two-man cross cut saw crews.

Table 3: Occupational risks encountered and the injuries suffered by the Two-man cross cut saw operators for different study categories

SN	Crew Category	Study categories					
		Studied in situ		After training		After break	
		Committed risks	Injuries	Committed risks	Injuries	Committed risks	Injuries
1	Experienced	28	8	12	4	19	10
2	Start up	32	14	16	4	23	9

The two-man cross cut saw operators' safety level when studied for the first time
The study found that experienced cross cut saw crew committed fewer risks and suffered about 37% fewer injuries compared to inexperienced crew. There was a close correlation ($r = 0.6514$, $df = 58$, $p = 0.001$ and $r = 0.706$, $df = 58$, $p = 0.001$) between the encountered risks and the injuries suffered by the experienced and inexperienced crews respectively. While the experienced crew showed a relatively steady trend of sufferance, there was a slight improvement on the inexperienced crews (Figure 4).

These observations show that inexperienced crews did not carefully observe safety measures at this stage. As a result, inexperienced crews suffered more injuries which differed significantly (t test, $df = 58$, $p = 0.001$) from those suffered by the experienced ones.

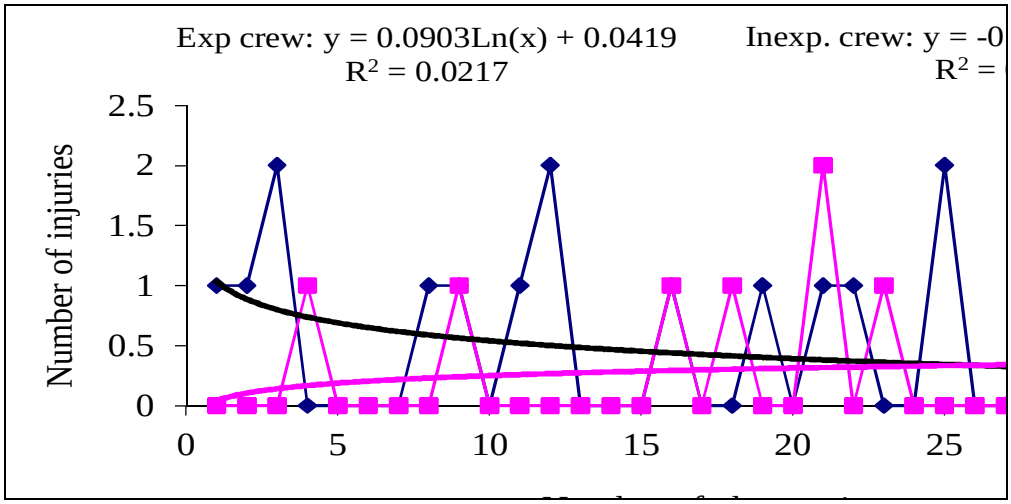

Figure 4: Relationship between the number of observations and injuries suffered by the Experienced and Start up two-man cross cut saw crews when studied before training.

The safety level of two-man cross cut saw operators' training

Results showed that there was a significant (t-test, df = 58, p = 0.009) improvement in safety level for both crew categories (experienced and inexperienced) after the training. However, injury level attained a normal distribution curve for both crews (Figure 5). There was no significant ($p \leq 0.05$) relationship between committed risks and injuries suffered by both crews after training.

The two-man cross cut saw operators' safety level after break

Figure 6 shows crews' responses to work injuries level in relation to the number of observations after resuming cutting operations.

Results show that there were no significant (t test, df = 58, p = 0.134) differences in the number of committed risks or injuries suffered by either group. Despite these similarities, the number of injuries increased by about 10% and 5% for the experienced and inexperienced respectively as compared to the situation before the break.

DISCUSSION

Health occupational hazards

The crew complaints on different body pains and heavy workload could be a result of poor working postures during felling, delimbing and bucking operations that required the operator to work continuously while in a bent position over the stems lying on the ground during bucking. According to Shemwetta *et al.* (2002), tree bucking activity forces a posture that can exert great strain on the operators' lower back.

Occasionally, poor postures of the two-man cross cut saw crew during tree felling and saw-pinching were a result of poor felling techniques. Consequently, crews faced higher workload because extra effort was often required to free the saw from the kerfs. With the same crew being responsible for all cutting sub-operations, the job becomes less varied and hence exposes the worker to increasingly static and repetitive work which can lead to occupational diseases.

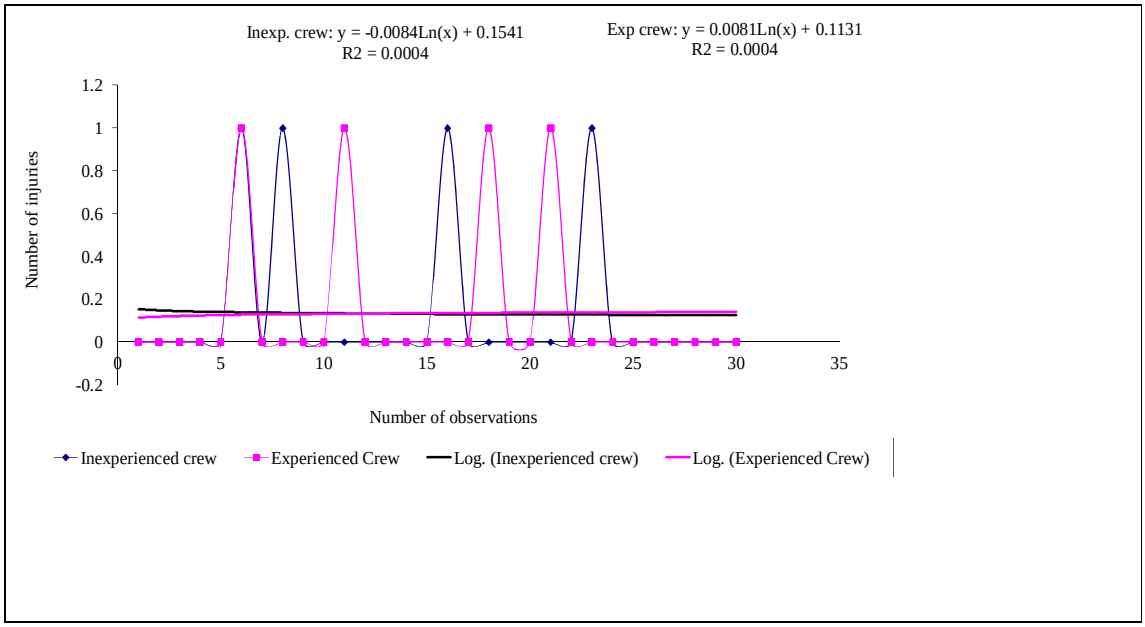

Figure 5: Relationship between the number of observations and injuries suffered by the experienced and start up two-man cross cut saw crews after training.

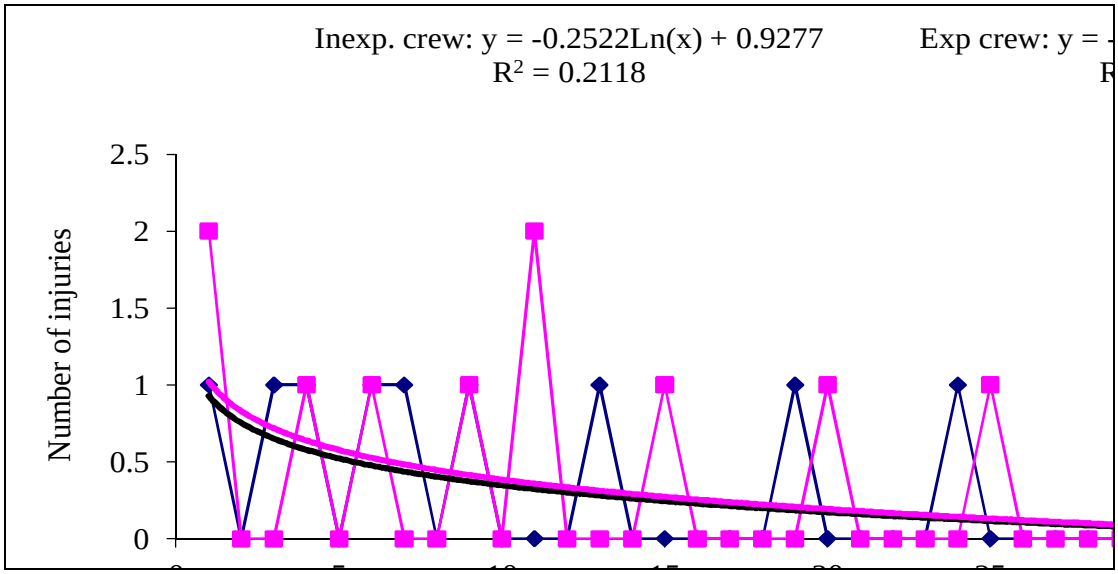

Figure 6: Relationship between the number of observations and injuries suffered by the experienced and start up crews after break

For example, chainsaw operators suffer more of such diseases such as dizziness and finger numbness (white finger diseases) due to vibrations from the chainsaw during tree cutting operations.

Use of safety gears

The provision of insufficient and inappropriate safety gears and inefficient of the few provided observed at SUATF has also been observed in many other plantation forests in the tropics and in Tanzania in particular. For example, a study by Silayo *et*

al. (2010) and Kaniki (2014) found that managers in most plantation forests in Tanzania do not provide crews with adequate safety gears despite their awareness of the importance of the gears to the workers' safety. Even those few crews provided with safety gears don't often use them because they claim it is uncomfortably hot, which they argue increases their fatigue and creates a greater safety hazard. Some of the gears which crews complained as uncomfortable to put on or work with included helmets, hand gloves and gumboots. To ensure crews safety, logging industries must observe the 'Reduced Impact Logging' (RIL) guidelines which require use of standard safety gears which include, among others, hardhats and appropriate footwear for all forest workers. Sawyers and machine operators must also use ear and eye protection. Further, sawyers must also use safety gloves and leg protection.

Occupational safety of the logging crews

The higher rate of injury incidences observed for the inexperienced crews when studied before training could be attributed to lack of experience and insufficient knowledge and skills in tree cutting. Studies in the USA (Gardner *et al*. 1999) showed that high rates of injuries in workers with shorter duration of employment have sometimes been attributed to the healthy worker selection effect, whereby workers not suited for a particular type of work may quit or change jobs, leaving behind a healthier group of 'survivors' as duration of employment increases. In China, where there is less opportunity for workers to leave their jobs in search of other occupations, workers not suited for logging may remain on the job and continue experiencing injuries (Jingxin *et al.* 2003). A similar situation faces logging crews in Tanzania.

Chainsaw operator's safety levels

The observed injury trends for the chainsaw crews were a result of combined factors. For example while some could result from low experience and poor skills, some were a result of not wearing protective gears. This is because most of the most of occupational risks encountered by inexperienced crew were from falling objects (mostly dead branches and pods) which affect the head mostly. Other areas where the crew faced serious risks was on failure to pre-determine felling directions of trees, delimbing of the tree while standing on the leaning side where logs could easily roll over. Therefore, falling trees and poor use of the machine subjected crews into serious risks. For example it was common for the crews to walk carelessly between trees or on logs and felled trees with a running chainsaw. . With respect to inexperienced crew the observed results could be mostly due to poor skills and knowledge over the machine. The crew was more scared by the running chainsaw. As a result, a crew could concentrate on the machine ignoring other possible occupational risks like rolling logs and other obstacles which in turn resulted into him being injured.

The safety level trends observed in Figure 2 lead into mixed interpretations. For example, while experienced crew shows some improvement with nearly a constant injury trend curve the inexperienced crew shows unpredictable trends. However, the improvement for the inexperienced crew was significant. These improvements could be a result of training which imparted crews with some basic skills and knowledge. Apart from training the inexperienced crew must have now acquired some experience which cannot be excluded in this improvement trend. Despite these improvements, field observations showed that experienced crew tends to ignore some of the necessary safety measures which in turn put them into

constant risks. On job training must be scheduled frequently to emphasise the importance of observing safety despite having experiences. Tools such as the chainsaw must not be underestimated in terms of danger and risk to forest workers. Not only the chain itself or the kickback of the chainsaw, but also flying splinters, sawdust and whipping branches.

Observations after the break show the effect of job interruptions for the tree cutting crews. The trend show that that crews had forgotten some of the safety measures they had either learned during training and/or through experience before were sent off. On comparison, the inexperienced crews followed and keenly observed safety measures after resuming operations unlike the experienced one. This situation was simply from negligence and complacency where experienced crews felt they have nothing extra to learn. In areas where protective gears are provided also this kind of negligence may occur to all crew categories on assumption that they are protected from hazards and risks, which may not be completely true. In a study by Klen (1997) on personal protectors and working behaviour of loggers, two issues were observed. First, 90% of the test persons had noted that the use of personal protectors enhances the feeling of safety and that use of protectors reduced accident injuries. Second, nearly half of the loggers reported that their work behaviour changed when they wore personal protectors; they became more careless, faster, bolder, and they anticipated less dangers. Therefore from this kind of observation it is obvious that change in behaviour when using protectors does not entirely nullify the protecting effect of protectors.

The two-man cross cut saw crews' safety

The higher risks committed by the inexperienced crews were a result of low skills coupled with low experience in tree cutting operations. Studies by Paulozzi (1987) and West *et al.* (1996) showed that less experienced workers in logging face more occupational risks than experienced ones. On the other hand, a study by Rodriguez-Acosta and Loomis (1997) on accidents rates between young and old loggers found out that logging-related fatalities involve more of the older rather than younger workers. However, this study did not compare age categories of the logging crews. However, the results on two man cross cut saw crews' safety are in agreement with the finding by Dinges (1995) who reported that chainsaw operators face more fatigues and hence increase risks of more human error and accidents.

After training all crews observed some improvement as there were fewer injury incidences as compare to the situation before training. When compared, the two categories the experienced crews suffered nearly equal injuries as before training although the risks were fewer as compared to the inexperienced ones. This was probably due to the fact that experienced crews were or have been much used to their ways of doing things that, training could not change the crews' approach quickly.

On the other hand, the findings after the break indicated that all crew categories had forgotten some codes of conduct which resulted into committing a number of occupational risks and so the injuries sufferance at the beginning of the operations. Crews suffered more injuries from tree kick backs, falling branches among others. The observations made in these experiments for the chainsaw operations signify the importance of institutionalising a training schedule before crews resume tree cutting operations. Experience has shown that tree felling is the riskiest job. Therefore, where manual felling is required, the primary

concern must be the safety of the feller. According to Blombäck (2002), chainsaw operators are by far the most accident-prone group. In most cases of serious or fatal accidents, the worker is injured by falling trees, branches and logs. Accidents usually occur during felling and high risk operations such as bringing down hung-ups or taking care of windthrows.

CONCLUSION AND RECOMMENDATIONS

Conclusions

The study concludes that logging crews are not provided with appropriate and adequate safety gears. Where a few gears are made available seldom crews wear them complaining for uncomfortability. It has been observed that training has a positive effect of improving crews' skills and knowledge on logging operations. The crews' safety levels were improved for both crew categories signifying the importance of on-the-site training. Further, the study observed the impact of job interruption on crew's safety levels. A tree month job interruption which was experimented in this study as an ideal period of job interruption in forest harvesting operations in Tanzania may lead to knowledge depreciation of the crews which may negatively impact their safety levels. Further concluded that well trained crews, while avoiding accidents and using appropriate tools and machines with less effort through proper working techniques will likewise reduce wood wastage in felling of trees but also reduce environmental damage in forests.

Recommendations

Most crews have their concern on uncomfortability of the safety gears/equipment. It is recommended that crews be provided with appropriate safety gears designed for tropical environment. This study has demonstrated the importance of training (on site instructions) tree cutting crews on different situations of forest harvesting. On the job training of the crews is therefore recommended despite their experience. Training should be provided by professional technicians to avoid crews learning skills haphazardly from more experienced workers, who may not be using the best one. With the fact that job interruptions lead to knowledge depreciation, on-site instructions for crews are also recommended on resumption of operations to ensure for crews safety and improved productivity.

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