

WORKING CONDITIONS AND PRODUCTIVITY OF LOGGING COMPANIES IN MAFUGA FOREST PLANTATION, WESTERN UGANDA

HK Balimunsi¹*, JRS Kaboggoza¹, SW Abeli², R Cavalli³ & JG Agea¹

¹Faculty of Forestry and Nature Conservation, Makerere University, PO Box 7062, Kampala, Uganda

²Department of Forest Engineering, Faculty of Forestry and Nature Conservation, Sokoine University of Agriculture, PO Box 3000, Morogoro, Tanzania

³Department of Agro-Forestry Land Systems—Mechanisation Section, Faculty of Agriculture, University of Padova, vialle de Universita 16-35020 Legnaro, Padova, Italy

Received May 2010

BALIMUNSI HK, KABOGGOZA JRS, ABELI SW, CAVALLI R & AGEA JG. 2011. Working conditions and productivity of logging companies in Mafuga forest plantation, western Uganda. A study was carried out in Mafuga forest plantation to assess the working conditions, physical workload and productivity of logging companies. Data were collected in a clear-felled 26-year-old *Pinus patula* stand. Time studies were undertaken for tree cutting and skidding in order to determine productivity. Data on physical workload were obtained through heart rate measurement using portable electronic heart rate monitor. Data on working conditions were obtained using ergonomic checklist and field observations. Productivity in tree cutting averaged 16.5 and 9.9 m³/hour for felling and crosscutting respectively using chainsaw. Production rate in skidding was 7.2 m³/hour. These production rates were higher compared with public logging regime where past studies showed 9.6, 4.2 and 3.7 m³/hour for felling, crosscutting and skidding respectively. Working conditions were inferior compared with public logging regime. Workload produced 65% heart rate increase when chainsaw was used. This was a slight increase compared with public logging regime where physical workload was estimated at 57% heart rate increase for chainsaw use. Therefore, the increased productivity observed in this study was not due to improved working conditions but rather, workers were afraid of the employer. Supervisors were more interested in making sure that output increased irrespective of how it was obtained. Poor working conditions could be reversed by the government setting and implementing both practical rules and provisions regarding employment regulations.

Keywords: Ergonomics, forestry, forest harvesting, forestry training, time studies, forest industries

BALIMUNSI HK, KABOGGOZA JRS, ABELI SW, CAVALLI R & AGEA JG. 2011. Keadaan kerja dan produktiviti syarikat pembalakan di ladang hutan Mafuga, barat Uganda. Kajian dijalankan di ladang hutan Mafuga untuk menilai keadaan kerja, beban kerja fizikal dan produktiviti syarikat pembalakan. Data dikumpul daripada dirian *Pinus patula* berusia 26 tahun yang ditebang habis. Bagi menilai produktiviti, kajian masa dilakukan bagi penebangan pokok dan gelongsoran. Data beban kerja fizikal diperolehi daripada kadar denyutan jantung yang disukat menggunakan meter elektronik mudah alih. Data keadaan kerja diperolehi menggunakan senarai semak ergonomik dan melalui pemerhatian di lapangan. Purata produktiviti menggunakan gergaji rantai bagi penebangan pokok ialah 16.5 m³/jam manakala produktiviti pemotongan lintang ialah 9.9 m³/jam. Produktiviti gelongsoran ialah 7.2 m³/jam. Nilai produktiviti ini lebih tinggi daripada nilai yang diperolehi daripada syarikat pembalakan awam dengan nilai 9.6 m³/jam, 4.2 m³/jam dan 3.7 m³/jam masing-masing bagi penebangan, pemotongan lintang dan gelongsoran. Keadaan kerja di syarikat pembalakan swasta kurang baik berbanding syarikat pembalakan awam. Beban kerja menyebabkan kadar denyutan jantung bertambah sebanyak 65% apabila gergaji rantai digunakan. Nilai ini lebih tinggi daripada nilai yang diceraip di syarikat pembalakan awam iaitu 57%. Pertambahan produktiviti dalam syarikat pembalakan swasta bukan kerana keadaan kerja yang lebih baik tetapi pekerja berasa takut terhadap majikan. Penyelia lebih mementingkan output tinggi tanpa mengira cara ia diperolehi. Kerajaan boleh memperbaiki keadaan kerja dengan merangka dan menguat kuasa undang-undang tentang penggajian.

* E-mail: balimunsi@forest.mak.ac.ug

INTRODUCTION

Harvesting of plantation forests in Uganda started in the 1970s. Logging operations were solely performed by public agencies (Aluma 1976). Most of the logging operations were labour-intensive and semi-mechanised (Ndemere 1991). Production rates were low (Aluma 1976, Ndemere 1991) due to poor working conditions, high energy demand and low pay (Balimunsi 2007). Since 1986, Uganda has been undergoing a number of economic and market reforms to raise the economic growth and hence improve the performance of different sectors. One of the reforms is the privatisation of production sectors, including the forest sector. Through privatisation, some of the wood-based public industries have been liquidated or sold and some have entered into joint ventures or leased to private investors (Karan 2001, McCaughan & Carvalho 2003). Privatisation of wood industries, which depend largely on logging operations for supply of wood raw material, was expected to bring higher operation efficiency (ILO 1996, Mahenge 2001, Phillip 2001). Studies have shown 28.5% increase in logging productivity in private logging and 25% decrease in costs when tree cutting is done by crosscut saw and 32.6% increase in productivity and 17.5% decrease in costs when cutting is done by chainsaw (Balimunsi 2007). The higher productivity in private companies suggests that forest workers are well motivated, properly trained and adequately remunerated (Ole-Meiludie & Fue 1990). However, facts are lacking on whether the perceived increase in productivity in the private regime is hand in hand with improved working conditions. Therefore, a study was carried out to assess working conditions, physical workload and productivity in logging operations under private logging companies in Mafuga forest plantations.

MATERIALS AND METHODS

Study area

Mafuga plantation is a forest reserve situated in Kabale District, in the south-western part of Uganda. It is about 30 km north of Kabale town on the Kabale–Kanungu road. The total gazetted area of Mafuga Forest Reserve is 3699 ha while the plantations cover a total area of 2670.3 ha. The main tree species grown in Mafuga forest plantations are *Pinus patula*, *Pinus taeda* and

Cupressus lusitanica. *Eucalyptus grandis* is mainly confined to fire lines and along the border. The plantation lies from 1850 to 2800 m asl. The hills are steep and severely dissected. The main valley bottoms are poorly drained and slightly swampy. The major streams are tributaries of Ishasha River, which drains to Lake Bunyonyi situated in the south-western part of the plantation. Rainfall pattern is bimodal, with maximum around April and November but generally well distributed. The mean annual rainfall is about 1264 mm. April rains are generally heavier than November although the latter usually have longer duration. The months of July and August tend to be dry, thus, posing the risk of forest fires. The average daily temperatures for Kabale town from 1960 till 2000 ranged from 10.7 to 23.9 °C.

Methodology

The data were collected in a 26-year-old *P. patula* stand, which was clear-felled using chainsaw. Logging operations were performed by five private companies. Each company had two operators, one for felling and one for cross-cutting. Each operator had one assistant. Skidding (log rolling) operation was carried out by eight crew members on average per company. Time study was undertaken for tree felling, crosscutting and skidding in order to determine work productivity. It involved recording productive and non-productive work element times in centiminutes (100 centiminutes in 1 minute) using continuous snap-back timing. Measurements were taken for ground slope in percentage using a clinometer. Skidding distances were taken using measuring tape. Log mid-diameter and length were measured using callipers and measuring tape respectively. Heart rate of the workers was measured using Polar Sport Tester in order to determine physical workload. Heart rate of the workers was recorded by measuring the average value in resting condition and maximum reading of a continuous observation during field operation.

Data on working conditions were obtained through field observations and an ergonomic checklist. The information assessed through the ergonomic checklist concerned length of service and training of the workers, quality and availability of working tools, supervision, working time and break, general safety and health aspects, social security, worker welfare and food.

Data on workload and time were analysed using MiniTab spreadsheet and were reported as mean, maximum and minimum values. Descriptive statistics for working conditions were obtained using Statistical Package for Social Sciences (SPSS) computer software. Workloads were classified according to Grandjean (1980) into very low, low, moderate, high, very high and extremely high based on the percentage heart rate increase (Table 1). The percentage heart rate increase was calculated as shown in equation 1.

$$PHRI = \left(\frac{WHR - RHR}{RHR} \right) \times 100 \quad (1)$$

where

PHRI = percentage heart rate increase (%)

WHR = heart rate during working operation (beats/min)

RHR = heart rate during resting (beats/min)

Log volumes with respective productive time data collected in the field were used to compute productivity in m³/hour as shown in equation 2.

$$P = \frac{Tvol \times F \times 60}{T} \quad (2)$$

where

P = productivity for a given logging operation (m³/hour)

Tvol = total volume of all logs for a given logging operation (m³)

60 = number of minutes per work place hour

F = proportion of productive time to work place time

T = total productive time (min)

Table 1 Workload classification

Workload	Heart rate increase (%)
Very low (resting)	0
Low	0–36
Moderate	36–78
High	78–114
Very high	114–150
Extremely high	Over 150

RESULTS AND DISCUSSION

Age, experience and training of workers

Most of the crew were young with an average age of 25 years. None of the crew had formal training in logging operations (Table 2). Compared with public logging companies, where experience and age of the workers were 3 and 26 years respectively (Aluma 1976, Ndemere 1991, Balimunsi 2007), the workers in this study had two years of experience. The short period of experience could be an indication of high labour turnover due to the fact that in logging jobs payment was assured but not adequate. In addition, replacement of workers is easy because of availability of manpower and there is no strict observation on technical know-how. The young age of the logging crew is an indication of difficult and heavy forest work which is unfit for the old. Younger workers tend to work faster because they are more energetic compared with older workers (Fue et al. 1996). However, young workers are less experienced and are therefore more vulnerable to accidents.

Lack of formal (vocational) training in forestry has an effect on productivity and physical workload due to poor working methods, postures and inappropriate tool maintenance procedures (Ole-Meiludie & Fue 1990, Malisa 1992, Fue et al. 1999, Balimunsi 2007). Furthermore, untrained forest workers are more exposed to hazards because their ability to take quick and rational decisions in relation to hazards is limited (Fue et al. 1996). Lack of basic training also affected the ability of the logging crew in properly maintaining the working tools. For instance, most of the forest workers were not able to perform even minor cutting tool maintenance such as sharpening of crosscut saws and/or axes in the field. Sharpening of these tools was done at the workshop only.

Quality and availability of working tools

It was observed that the logging crew were not provided with any protective gears, felling levers, wedges or lifting devices, exposing them to excessive stress and accidents (Table 2). This was different from that of public logging regime where workers were provided with and used protective gears such as helmets, boots and gloves to some extent (Ndemere 1991). A total of 70% of the private logging crew complained that the quality

Table 2 Response of workers on working conditions across logging operations in Mafuga forest plantation

Question	Response (%)	
	No	Yes
Formal training in logging/forestry	100	0
Protective gears and auxiliary tools	100	0
Safety regulations	80	20
First aid services	100	0
Exposed to any obvious accident risk	0	100
Workers encountered accident on job	48	52
Prescribed breaks at work	100	0
Compensation against accidents and sickness	100	0
Presence of close supervision	79	21
Poor quality of food (posho and beans)	0	100
Long working time (starts at 7 a.m. ends at 2 p.m.)	20	80
Tool handles not appropriate and liable to break	30	70
Blunt crosscut saws and axes	46	54
Workers having health problem (e.g. backache)	24	76
Late payment (at least a month waiting)	6	94
Payment not adequate and needs improvement	0	100

Age of the worker (years) range: 18–42, mean = 25; working experience (years) range: 0.1–11, mean = 2

of cutting tool handles was not appropriate and experienced breakage, while 54% revealed that crosscut saws and axes were blunt and handles were not properly maintained.

General safety

Assessment of safety at work showed that half of workers had experienced some form of accident and none of the workers were given first aid services. Only 20% of the workers acknowledged the presence of safety regulations (Table 2). Similar observations were made in public logging regime (Ndemere 1991). In tree felling, the minimum safe working distance from any other person is the equivalent of twice the height of the tree being felled (Accident Compensation Corporation 2007). In Mafuga forest plantation, a hectare for felling was allocated to at least five crew. In such condition, although the average tree height was 14 m, the crew worked too close to one another and this could easily result in accidents. To reduce this risk, companies should engage safe number of workers in close quarters according to the actual requirements of safe working distance and provide an effective

supervision during forest operations. Very little effort (21%) was geared towards effective/close supervision (Table 2).

Working time and break

Working continuously without breaks has been reported to result in fatigue which increases accident, illness, discomfort and consequently reduced productivity (Axelsson 1998). In this study, 80% of the workers complained that the working time was long without prescribed breaks, resulting in increased tiredness and exposing them to the risk of accidents (Table 2). The unfavourable working conditions might have contributed to the high labour turnover.

Motivation, social security and food for the workers

Studies on motivational aspects revealed that workers in tree felling, crosscutting and loading were paid by piece rate, while a basic salary was paid to the skidding crew. However, in tree felling, it was observed that since the same amount of payment per tree felled was given, smaller trees

were mostly felled along the forest boundaries. This indicated that payment of wages was not adequate to the efficiency of the operation because the size of the tree greatly affected productivity. Therefore, to encourage felling of larger trees, payment should be given according to the size of a tree felled, measured at breast height. With regard to social security, there was no compensation against accident and sickness (Table 2). This was similar to public logging regime where no compensations in the case of accident, sickness, invalidity and retirement and housing benefits were provided (Ndemere 1991). Workers were given lunch which was posho (maize flour) and beans daily. The quantity itself was not enough to match their energy requirement and worst of all there was no drinking water given to the workers. Therefore, the government must set practical rules and regulations through which the rights of the forest workers can be safeguarded.

Workload

Tree felling using chainsaw showed that the overall workload caused 65% heart rate increase (Table 3). This figure is higher compared with public logging regime where workload has been estimated at 57%. High workload in tree cutting, apart from productive work, was caused by saw pinch and resin. Felling and crosscutting involved frequent saw pinching. Since there were no wedges, pinched saws were released by manually pulling or lifting the log/tree. The presence of resins on saw blades needed more effort during cutting. In skidding operations, a pole was used to turn the log so that it rolled down a steep terrain due to gravity. This was done manually without using any lifting tools, thus, increased workload. The high workload in skidding was due to inappropriate tree felling that could not form a pattern for easier rolling. Felling was carried out without considering the extraction directions. The work organisation should, therefore, consider increasing the size of

bunching crew and trained workers in directional felling and bunching techniques in order to reduce the workload.

Based on the workload classification by Grandjean (1980) (Table 1), the workload in this study ranged from moderate to high, while that of the public logging regime, moderate. In principle, high workload should reflect low productivity. Despite higher workload in this study, productivity was still higher than the public logging regime. Lack of alternative jobs and union for workers as well as fear of losing employment provided opportunities for the company to exploit the logging crew.

Logging productivity

Logging operations were performed both manually and in a semi-mechanised way. Tree felling and crosscutting were done using chainsaw, delimiting was done using axe, while skidding was done manually using a log rolling method. The crew for tree felling, crosscutting and delimiting was made up of two to three men, while for skidding, three to five men. Productivity in private companies was higher than in public ones (past studies: 9.6 vs. 4.2 m³/hour, current studies: 16.5 vs. 9.9 m³/hour) (Figure 1). In skidding, productivity was 7.2 m³/hour for private companies, higher than the productivity measured for the public companies (3.7 m³/hour) (Table 4). Since working conditions were poor and workload was high, the increased productivity observed in this study could be explained by the workers' strong will to keep their job. The management emphasised increased output rather than improvement of the working conditions and availability of effective tools.

CONCLUSIONS AND RECOMMENDATIONS

Working and living conditions in the studied private companies were poor and workloads were

Table 3 Workload in logging operations at Mafuga forest plantation

Logging operation	Heart rate at rest (beats/min)	Workload (% heart rate increase)
Tree felling and crosscutting—chainsaw	75	65
Delimiting—axe		71
Skidding—manually		70

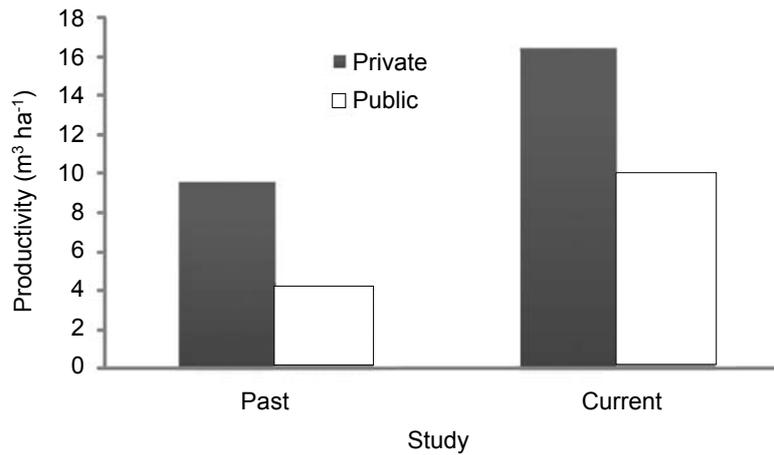


Figure 1 Productivity of past and current studies in logging operations using chainsaw

Table 4 Productivity in logging operations

Logging operation	Productivity (m ³ /hour)	
	Public	Private
Tree cutting—felling	9.6	16.5
Crosscutting	4.2	9.9
Skidding	3.7	7.2

higher compared with public logging regime. The increased productivity observed in this study was not due to improved working conditions but rather due to the workers being anxious to keep their job.

The working conditions in the studied companies could be outlined as follows:

- (1) Worker experience averaged only two years. This is an indication of high labour turnover.
- (2) Workers had no formal training in forestry or logging techniques. Therefore, they were exposed to poor working methods, posture and inappropriate tool maintenance procedures.
- (3) Working tools (e.g. crosscut saws, axes) were not well maintained, thus posing high workload to the workers.
- (4) Workers were not given protective gears, no safety regulations, prescribed breaks and they were young about 25 years old. Thus, they were exposed to accidents.
- (5) Payment was not adequate. Workers were given a common lunch which was posho and beans only and were not compensated against accidents and sickness. This reduced workers morale.

- (6) There were no union for workers and industrial rules governing logging operations in Uganda. This was indicated by experienced workers who complained that working conditions in logging companies had been declining.

Declining working conditions in logging operations could be halted and improved by the government setting and implementing both practical rules and provisions regarding employment regulations and improved working conditions. The grievances of forest workers could be managed by establishing forest worker union. Working techniques and use of working tools could be improved by training forest workers in logging techniques through forest industry training institutes such as Nyabyeya Forestry College in Masindi (central Uganda). Well-trained forest workers could adopt a safer behaviour and ability in evaluating risk situations. Furthermore, they could use tools effectively by undertaking appropriate tool maintenance procedures such as sharpening of saws/axes, thereby reducing workload. Training institutes should develop educational awareness on the importance of training among logging companies.

REFERENCES

- ACCIDENT COMPENSATION CORPORATION. 2007. *Tree Felling Sites*. [Http://www.acc.org.nz/tree-felling-site](http://www.acc.org.nz/tree-felling-site). Accessed on 26 April 2008.
- ALUMA JLW. 1976. Productivity of manual and semi-mechanised logging and transport methods in Uganda. MSc thesis, Makerere University, Kampala.
- AXELSSON SÅ. 1998. The mechanization of logging operations in Sweden and its effect on occupational safety and health. *International Journal of Forest Engineering* 9: 25–31.
- BALIMUNSI HK. 2007. Productivity, cost, wood waste and environmental impact of the current and improved logging operations in Ugandan forest plantations. PhD thesis, Sokoine University of Agriculture, Morogoro.
- FUE GE, MIGUNGA GA & NGORORABANGA J. 1996. Accident and safety in logging operations at Sokoine University of Agriculture Training Forest, Olmotonyi-Arusha. *Faculty of Forestry Record* 65: 23–28.
- FUE GE, OLE-MEILUDIE REL, MIGUNGA GA & SHEMWETTA DTK. 1999. Working and living conditions in a Tanzanian forest plantation logging company. *Faculty of Forestry and Nature Conservation Record* 72: 66–74.
- GRANDJEAN E. 1980. *Fitting the Task to the Man: An Ergonomic Approach*. Taylor and Francis Ltd., London.
- ILO. 1996. *Improving Working Conditions and Increasing Profits in Forestry*. International Labour Office, Geneva.
- KARAN PK. 2001. *Current Timber Harvesting in Conifer Plantations of Western Uganda*. Forest Department, Kampala.
- MAHENGE P. 2001. *A System Balance in Harvesting Operations by a Private Company: A Case Study of Escarpment Forestry Company Ltd.* Sokoine University of Agriculture, Morogoro.
- MALISA EJ. 1992. Production and physical workload of cutting crew in Sao Hill Soft wood plantations. MSc thesis, Sokoine University of Agriculture, Morogoro.
- MCCAUGHAN R & CARVALHO J. 2003. *Plantation Harvesting and Sawmilling*. Ministry of Water, Lands and Environment, Kampala.
- NDEMERE P. 1991. Development of tropical timber harvesting systems in Uganda. An evaluation based on production rates and costs. MSc thesis, University of Helsinki, Helsinki.
- OLE-MEILUDIE REL & FUE GE. 1990. Working conditions in natural forests. *Tanzania Forest Record* 43: 93–96.
- PHILLIP E. 2001. Comparison of efficiency and working conditions between privately and past publicly controlled logging operations: a case of Sao Hill. MSc thesis, Sokoine University of Agriculture, Morogoro.