

Productivity and Cost Analysis of Felling in Indonesian Selective Cutting and Planting, North Borneo, Indonesia

Muhdi

Faculty of Forestry, University of Sumatera Utara, Medan, Indonesia

Abstract: *Semi-mechanics system by chainsaw is used to fell at the tropical natural forest, Indonesia. This research examined the productivity of felling in natural tropical forest, north Borneo. Time study of felling by chainsaw STHILL 070 is measured to every felling work elements that was using null stop method with two stop watches. Elements of work are measured in logging with chainsaws was directional felling of trees; making undercut; making backcut; and trees felled. Elements of work measurement and distribution of stem requires the long working time on conventional logging (CL) and reduced impact logging (RIL) that the total of the working time was 4.35 minutes (33.15%) and 4.22 minutes (40.41%), respectively. This research resulted that the time of felling by chainsaw STHILL 070 on conventional dan RIL plots were 13.13 minutes and 10.44 minutes, respectively. The productivity of felling by conventional logging and RIL in PT Inhutani II areas was 38.03 m³/hour and 45.56 m³/hour, respectively. Based on the calculations, the total cost of conventional logging and RIL was 1089.64 IDR/m³ (0.084 USD/m³) and 956.58 IDR/m³ (USD 0.073/m³), respectively.*

Keywords: chainsaw, cost, productivity, fell, time study

1. Introduction

The conventional cut is the older of the two and was the most common when timber was cut with the handsaw. Manual or semi-mechanised logging operations by using hand tools are more favoured due to cheap labour availability [7]. In another hand, the chainsaw Sthill cut takes the snipe from the stump rather than from the tree. A modification of both conventional and chainsaw cut utilizes two slanting cuts-one downward and one upward [2]. It is used to ease of felling, achieve by diminishing the angle of the upward or downward strokes used in the two types of faces.

Logging with a mechanical system using a chainsaw that is logging systems commonly uses in the natural tropical forests of Indonesia. Logging using chainsaws usually uses the operator and helper on logging areas of natural troical forests. Logging is a timber harvesting of trees with diameter equal to or greater than the limits diameter that is established on annual logging block of work plans. Limit diameter allowable is 50 cm up for permanent production forests and 60 cm up for limited production forest.

Event logging work consists of several elements, among others walk between trees, determines the direction of fall and weeding, making undercut and backcut, wait a tree falls and the measurement and distribution of stem. This began with loggers team went into compartment to look for felling trees ripe with attention to good quality of trees that is done by hitting or trying to pierce it with a chainsaw. If the tree is good, the operator determines the direction of fall with regard to skew tree, state and safety canopy of trees felled. Once the trees are cut and then cut off the tip and base to be skidded. When finished cutting one tree, lumberjack team to other trees to be felled, and so on.

Logging activities require a large fee in forest management because it uses a semi-mechanical equipment, namely

chainsaw and a workforce consisting of logging operators and assistants. The time study identifies the factors that affect the work productivity. Thus, the productivity in the time studies cannot be applied directly to practical work [5]. Especially on harvesting sites where there are several machines of competing machine manufacturers, there may be competition between the operators. In addition, the rather short working periods in the time study by no means represent practical working situations. Use of tools and labor is a big investment for the company. Improved performance and minimize the cost of logging is very important. The efficiency and effectiveness of logging will cut wasted time (idle time) and is expected to improve work performance logging and will cut costs. The purpose of this study was to determine the work performance logging using chainsaws STHILL 070 in natural tropical forests, North Borneo.

2. Materials and Methods

The study was conducted in concession areas of PT INHUTANI II, Malinau, North Borneo. To determine the performance measurement timber felling work time. Logging time measured is the total time of each work element in logging.

Time of each element work with chain saw logging was observed at the time of felling and measured using a stop watch two nullstop basis, meaning that each element working time is read instantly by a stop watch that at the beginning is always reset to zero (ILO, 1975). Elements of work are measured in logging with chain saw is: (1) Directional felling of trees; (2). Making undercut; (3). Making backcut; and (4) Trees collapsed.

Besides the measurement of the diameter and length of the log. The number of workers on logging plots running noted. Labor is meant here is the direct labor involved in logging. Secondary data were collected, namely: (1) the price of the tool, (2) maintenance costs, (3) the life of the appliance, (4)

wage operator and helper, (5) hours of work per day, (6) the interest rate and (7) the price of gasoline. The calculation of the volume of logs per sortimen calculated by the formula Smalian; work performance felling of timber.

3. Results and Discussion

3.1. Elements and Working Time

Logging activities in IUPHHK Inhutani II is done in teams. One team consists of two people loggers that one operator and one helper operator. Loggers been assigned to conduct logging operations, while the maid duty operator is carrying the chain saw and fuel, look for trees and cleaning up the area around the trees and clear the area of rescue, as well as cutting the base and tip of the tree.

The tools used in logging aeal IUPHHK Inhutani II in the form of chain saws. The tools used are chain saws STHIL 070 which is a privately owned operator. Supplies carried by each team logging in logging activities include a chainsaw fruit, a fruit miser, two machetes, as much as 5 liters of fuel as well as food and beverages.

Logging time measured include fixed time and time is not fixed. Time does not remain comprised of the time to make notch and notch reply and division of the stem, while the

fixed time consists of the time running between trees, determines the direction of fall and weeding as well as time lost. Measurement of working time performed on each element of the logging work. Measurement of working time logging in the area of conventional wood harvesting and RIL carried out each 30 replicates. Jensi tree species harvested in concessions areas of PT. Inhutani II Malinau is meranti (*Shorea spp.*), Lime (*Dryobalanops spp.*), Keruing (*Dipterocarpus spp.*) and nyatoh (*Palaquium spp.*) The observation of the average work time logging can be seen in Table 1.

Table 1 showed that the elements of work measurement and distribution of stem requires the longest working time on a plot of conventional wood harvesting and RIL respectively with the working time of 4.35 minutes (33.15%) and 4.22 minutes (40,41 %) of the total working time cutting one tree, while making undercut and making backcut to occupy both the working time, each for 3.40 minutes (25.88%) and 2.76 minutes (26.43%). Height measurement and distribution of working time due to the difficulty stems Loggers get a free position when the cut for dense stands and the topography is not flat. The high labor time manufacture notch understandable considering this activity will determine the direction of fall trees and wood quality is generated so that the necessary rigor is quite high compared with other work elements.

Table 1: Average time work of felling a tree on conventional logging and RIL.

No.	Work Element	Conventional Logging		Reduced Impact Logging	
		minute	percent	minute	percent
1	Walking to another tree	2.84	21.60	1.80	17.23
2	Determines the direction of fall and weeding	0.87	6.64	0.62	5.93
3	Making undercut and backcut	3.40	25.88	2.76	26.43
4	Waiting a tree falls	0.60	4.55	0.61	5.87
5	Measuring and bucking	4.35	33.15	4.22	40.41
6	Idle time	1.07	8.15	0.43	4.14
Total		13.13	100.00	10.44	100.00

Working time running between trees on a plot of average conventional wood harvesting and RIL respectively with the working time of 2.84 minutes (21.60%) and 1.80 minutes (17.23%). The length of time running between trees is strongly influenced by stand density, especially density of trees that have been cooked in logging. The higher the density of trees ripe harvest, the working time running between trees will be more brief. Besides, topographic factors also determine, more severe topography will further enlarge the working time running between trees. Working time running between trees can be suppressed by loggers to bring a map tree for as long as the field observations loggers are not equipped with a map tree.

Time lost encountered in logging activities are mostly caused by the breakdown of the chain or pinching of the saw blades at the time of trunks, making notch and notch reply and the running time to find a tree to be felled. The average time is lost in conventional wood harvesting plots and RIL is of 1.07 minutes (8.15%) and 0.43 minutes (4.14%) of total work time cut down a single tree. The time required for cutting one tree on a plot of average conventional wood harvesting and RIL was at 13.13 minutes and 10.44 minutes. Lost time (idle time) are common in logging activities are

mostly caused by the chain jams when making notch and notch reply or at the time of cutting the base and tip of the rod. Reference [9] resulted that analysis of delays provided the allowance time as 61.21% of effective time. In the structure of delay time the forefront was the delay due to rain, but the same, given the climatic characteristics of the study area, was recognized within allowance time.

3.2. Productivity and Cost of Felling

Based on the calculation that the value of work performance logging compartments conventional timber harvesting between 13.73 m³/hour to 64.97 m³/ hour (Average of 38.03 m³/ hour). The value of work performance logging on timber harvesting RIL plots between 22.30 m³/hour to 75.11 m³/hour (average of 45.56 m³/hour).

Cost of felling is calculated based on the cost of business chainsaws and logging work performance. Operating expenses accounted for chain saws of the constituent components of business costs are fixed costs of tools, variable costs and wages tool operator in a unit time. Business costs of logging on timber harvesting plots of conventional and RIL respectively IDR 41439.12/hour and

IDR 3581.97/hour with an average performance during the study on conventional timber harvesting plots and RIL respectively amounting to 38.03 m³/ha and 45.56 m³/hour.

Based on the calculations, the total cost of conventional logging and RIL was 1089.64 IDR/m³ (0.084 USD/m³) and 956.58 IDR/m³ (USD 0.073/m³). The fixed costs, variable costs and total cost of logging is presented in Table 2. When compared with the research [8] in the Green Heart Forest, Guyana showed similar results that conventional timber harvesting total cost per m³ is greater 9% when compared with RIL techniques.

Table 2: Cost of felling in concession areas of PT Inhutani II

Cost Component	Conventional logging	RIL
	(IDR/hour)	(IDR/hour)
A. Business costs		
1. Fixed cost	657.05	657.05
2. Variable cost	23,639.21	23,639.21
3. Salary	17,142.86	19,285.71
B. Total cost of felling	41,439.12	43,581.97
C. Total cost of pelling (IDR/m ³)	1,089.64 (0.084 USD/m ³)	956.58 (0.073 USD/m ³)

When compared with the research [4] in the tropical forests of Brazil shows the same thing, where environmentally friendly wood harvesting technique also shows the cost of timber harvesting smaller when compared to wood harvesting by conventional techniques. Similarly, the results of research [3] in the Amazon, Brazil showed that RIL lower total costs by 5% when compared to the cost of conventional wood harvesting. The unit cost considering the gross and net production rate was 1.05 USD/m³ and 0.81 USD/m³, respectively [1]. Reference [6] resulted that the productivity of felling processing was 35 m³ per effective hour and the average unit cost of processing was 0.22 USD/m³.

4. Conclusion

The time it takes to cut down a tree with a chainsaw STHILL 070 on average on a plot of conventional wood harvesting and RIL was at 13.13 minutes and 10.44 minutes. Lost time (idle time) are common in logging activities are mostly caused by the chain jams when making notch and notch reply or at the time of cutting the base and tip of the rod. The performance logging with chainsaw STHILL 070 conventional timber harvesting on plots ranging between 13.73 m³/hour to 64.97 m³/hour (average of 38.03 m³/hour). As for job performance STHILL 070 chainsaw logging on timber harvesting RIL plots ranged between 22.30 m³/hour to 75.11 m³/hour (average of 45.56 m³/hour).

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