

# ANALYSIS OF USING EFFICIENT LOGGING TOOLS AT PT. PURWA PERMAI IN CENTRAL KALIMANTAN

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## ABSTRACT

A high log demand that often exceeds its supply capability should be overcome by using appropriate logging tools. Numerous kinds and types of logging tools require a well planning in their utilization. Number of tools which are greater or fewer than what is actually needed can be disadvantageous for a company. In relevant to these aspects, a study was carried out at a timber estate in Central Kalimantan in 2007. The aim of the study was to find out an efficient number of tools used for logging in a timber estate. The analysis was based on the target and realization of the company's log production. The result revealed that: (1) Optimum number of logging tools depended on production target, i.e. 41 units of chainsaws for felling, 42 units of farm tractors for skidding, 9 units of loaders for loading and unloading, and 36 units of trucks for transportation; (2) Number of logging tools as obtained from all activities in the field was fewer than that from the analysis based on production target and realization. This condition indicated that number of logging tools used in the company was not yet efficient.

Keywords: High log demand, production target and realization, number of logging tools.

## I. INTRODUCTION

Logging covers chain of activities that convert potential value of forest products (log and non-log) to actual value of products (wood and non-wood) (Nugroho, 2003). With the advancement of technology and increase in log demand, hence, the use of logging tools to achieve a production target at the company is required. A suitable consideration of choosing and using tool technically, economically, and ecologically is needed in logging activity (Haryanto, 1996; Suhartana *et al.*, 2006).

To achieve an efficient logging, the company should solve a problem of choosing suitable tools with appropriate number using applied method to enforce an efficient and effective production of logging activities (Purnama and Basuki, 2003; Suhartana and Yuniawati, 2007; Suhartana *et al.*, 2007). A proper number of tools is expected to achieve log production target and to eliminate

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a company's loss. The use of greater number of tools can technically assure high log production, but it may not be economically acceptable. Conversely, fewer number of tools might bring about the log production below the target. In relevant, the aim of this study was to find out an efficient number of logging tools used in a timber estate based on the company's production target as well as production realization.

## II. MATERIALS AND METHODS

### A. Location

This study was conducted in July 2007 on a working area of a timber estate named PT. Purwa Permai. The estate/company was situated in the Forestry District of North Barito, under the Forest Service of Central Kalimantan Province (Figure 1).

Topography of the location was about 8-17 %, with the elevation of 92-175 m above sea level. Based on the Schmidt and Ferguson's classification, the type of climate there was categorized as "A" type with it monthly rainfall of 346 mm. Vegetation of the area was dominated by gmelina without buttresses. The tree density was 680 stands/ha (for diameter of 10 cm and up).

The logging operation used chainsaw for felling and bucking (6 units), farm tractor for skidding (2 units), loader for loading and un-loading (3 units), and truck for transportation (6 units). Based on the decision of Minister of Forestry with the number: 931/Kpts-II/1999 dated on 14-10-1999, this company established and started their operation in 1992/1993 with the area of 20,500 ha. It was predicted that 9,083 ha of the area, was the area of productive forests, and the rests area are conservation area and area for other use. In the Company's Annual Work Plan 2007, log production target was 267,333.04 m<sup>3</sup>/year and average production realization was 146,932.48 m<sup>3</sup>/year taken from 1,071.47 ha area (PT Purwa Permai, 2007).

### B. Activities

Activities of the study/research covered the collecting of primary and secondary data. Primary data were taken from field observations like the number of logging tools, working time and productivity. Secondary data such as annual allowable cut, forest area (ha), forest potential (m<sup>3</sup>/ha) and timber estate production data, were from the company's profile and from interviewing employees.

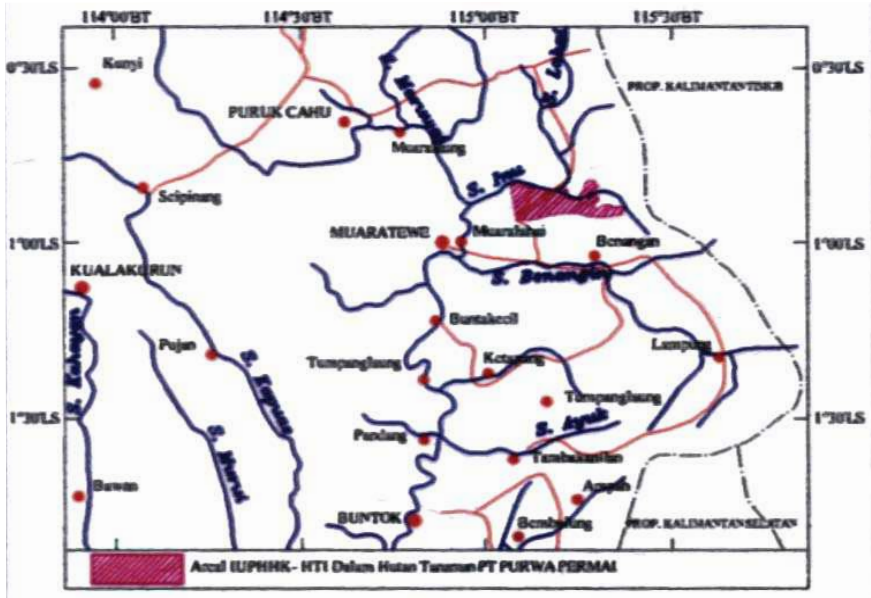


Figure 1. Study site map in PT Purwa Permai, Central Kalimantan

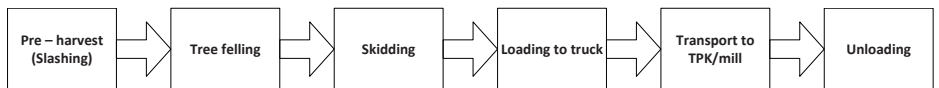


Figure 2. Flowchart-harvesting process in PT Purwa Permai, Central Kalimantan

### C. Data Analysis

Data from field such as productivity, number of tools and cost of mechanical tools, were processed into tabulation form and calculated using the following formula:

#### 1. Working productivity

$$P = \frac{V}{T}, \text{ where : } P = \text{working productivity (m}^3\text{/hour); } V = \text{logged volume (m}^3\text{); and } T = \text{working time (hour)}$$

2. Number of felling tools required (Suhartana and Yuniawati, 2006):

a. Based on production target

$$NCT = \frac{PT}{\text{Working productivity per day} \times \text{working time per year}}$$

b. Based on production realization

$$NCR = \frac{PR}{\text{Working productivity per day} \times \text{working time per year}}$$

where : NCT = number of chainsaws based on production target (units); NCR = number of chainsaws based on production realization (units); PT = production target (m<sup>3</sup>/year); and PR = production realization (m<sup>3</sup>/year).

3. Number of mechanical tools (skidding, loading and un-loading, and transportation tools) required (Keputusan Menteri Kehutanan No. 428/Kpts-II/2003):

a. Based on production target

$$NT = \frac{PT}{12 \text{ months} \times \text{working day per month} \times \text{trip per day} \times TC}$$

$$NR = \frac{PR}{12 \text{ months} \times \text{working day per month} \times \text{trip per day} \times TC}$$

where : NT = number of mechanical tools based on production target (unit); NR = number of mechanical tools based on production realization (unit); TC = tool capacity (m<sup>3</sup>/trip/unit); Effective working time = 8 hours/day, 15 days/month.

4. Cost of mechanical tools (FAO, 1992):

$$MTC = \frac{Ed + Eis + Eit + Et + Ef + Eo + Em + Ew}{MTP}; Ed = \frac{P \times 0.9}{Lh}; Eis = \frac{P \times 0.6 \times 3\%}{Ly};$$

$$Eit = \frac{P \times 0.6 \times 2\%}{Ly}; Et = \frac{P \times 0.6 \times 18\%}{Ly}; Ef1 = 0.20 \times HP \times 0.54 \times FPr;$$

$$E_{f2} = 0.12 \times HP \times FPr; \quad E_m = 1.0 \times E_d; \quad E_o = 0.1 \times E_f$$

where: MTC = cost of mechanical tools (Rp/ m<sup>3</sup>); E<sub>d</sub>=depreciation expenses (Rp/hour); E<sub>is</sub> = insurance expenses (Rp/hour); E<sub>it</sub> = interest expenses (Rp/hour); E<sub>t</sub> = tax expenses (Rp/hour); E<sub>f</sub> = fuel expenses (Rp/hour); E<sub>f1</sub> : E<sub>f</sub> for felling, skidding and loading-unloading; E<sub>f2</sub> = E<sub>f</sub> for transportation; E<sub>o</sub> = oil/lubrication expenses (Rp/hour); E<sub>m</sub> = maintenance expenses (Rp/hour); E<sub>w</sub> = wage expenses (Rp/hour); MTP = productivity of mechanical tools (m<sup>3</sup>/hour); P = tool price (Rp); FPr = fuel price (Rp/litre); L<sub>h</sub> = working time of tools (hour); L<sub>y</sub> = working time of tools (hour/year).

In data processing: 1) for productivity, it is analyzed using formula No 1 (in previous page) according to each of logging activities, therefore the productivity of each logging tools can be obtained; 2) based on aspect 1), further can be calculated the number of efficient tools that were analyzed by production target and production realization, and then compared with the number of tools operated in the field using formula No 2 and No 3; and for cost of mechanical tools, it is analyzed using formula No 4.

### III. RESULTS AND DISCUSSION

#### A. Working Productivity

The working productivity of logging tools is presented in Table 1 and the figure of logging tools is presented in Appendix 1.

**Table 1.** Tool productivity (m<sup>3</sup>/hour)

No.	Operational aspects	Tool's name and factory specification	Productivity (m <sup>3</sup> /hour)
1.	Felling	Chainsaw Stihl 070	2.85
2.	Skidding	Farm tractor MF440	3.75
3.	Loading-unloading	Loader Caterpillar	20.00
4.	Transportation	Truck Mitsubishi PS100	1.50

Based on Table 1, number of efficient tools taking into account production target and production realization can be calculated and then compared with number of tools operated in field. The result is presented in Table 2 and Figure 3.

Table 2 shows that number of tools operated in the field is fewer than those based on analysis results by production target as well as production realization. The differences regarding the number of tools on felling in production target and production realization are -35 and -16 units, respectively; skidding -40 and -21 units; loading-unloading -6 and -2 units; meanwhile transportation -34 and -14 units.

**Table 2.** Number of logging tools (units)

No.	Operational aspects	Actual number of tools used in the field (units)	Number of tools based on analysis result using: (units)		Differences (units)	
			Production target	Production realization	Production target <sup>1)</sup>	Production realization <sup>2)</sup>
1.	Felling	6	41	22	-35	-16
2.	Skidding	2	42	23	-40	-21
3.	Loading-unloading	3	9	5	-6	-2
4.	Transportation	6	36	20	-34	-14

**Remarks :** 1) = Number of actual tools minus number of tools based on production target.

2) = Number of actual tools minus number of tools based on production realization.

In loading and unloading aspects, the difference between actual number of tools, in the field and number of tools based on production target as well as on production realization was the smallest (in absolute figure), i.e. -6 and -2, respectively (Table 2). This situation was caused by high productivity in that aspect (20 m<sup>3</sup>/hour). In other words, fewer logging tools than they should be, as indicated by negative signs (Table 2 and Figure 4) indicated that the forest company was not efficient in the use of tools. Consequently, logging activities in that company had not yet reached the efficient condition.

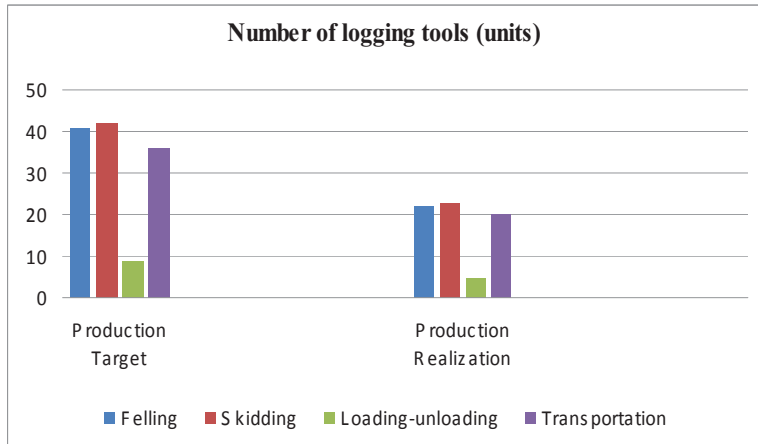


Figure 3. Number of logging tools (units)

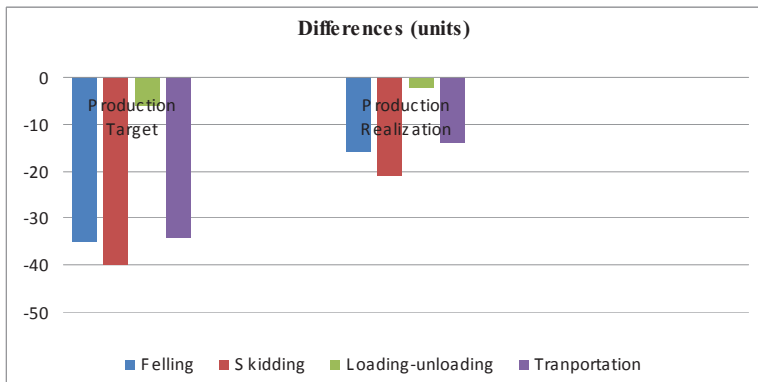


Figure 4. The differences in number of logging tools (units)

## B. Log Production

By counting the actual number of logging tools (Table 2), then an amount of log production could be calculated by comparing it with production target and production realization. The elaborated amount of log production for each operational aspects is presented in Table 3. The table shows that the actual log production for all operational aspects in the field was significantly fewer than those based on production target as well as production realization. In brief, the use of fewer logging tools in the field brought about less log production.

**Table 3.** The amount of log production for each operational aspect of logging tools

No	Operational aspects	In the field		Log production (m <sup>3</sup> /year)		Number of logging tools (units)	
		Actual log production (m <sup>3</sup> /year)	Actual number of logging tools (units)	Based on production target (m <sup>3</sup> /year)	Based on production realization (m <sup>3</sup> /year)	Based on production target	Based on production realization
1	Felling	39,398.4	6	269,222.4	144,460.8	41	22
2	Skidding	10,800.0	2	226,800.0	124,200.0	42	23
3	Loading and unloading	194,400.0	3	583,200.0	324,000.0	9	5
4	Transportation	11,340.0	6	68,040.0	37,800.0	36	20
Total		255,938.4	17	1,147,262.4	630,460.8	128	70

In total (Table 3), the amount of log production in the field (255,938.4 m<sup>3</sup>/year) is less than those based on production target (1,147,262.4 m<sup>3</sup>/year) and based on production realization (630,460.8 m<sup>3</sup>/year). The differences for each operational aspects were consecutively -229,824.0 m<sup>3</sup>/year and -105,062.4 m<sup>3</sup>/year (felling); -216,000.0 m<sup>3</sup>/year and -113,400.0 m<sup>3</sup>/year (skidding); -388,800.0 m<sup>3</sup>/year and -129,600.0 m<sup>3</sup>/year (loading-unloading); -56,700.0 m<sup>3</sup>/year and -26,460.0 m<sup>3</sup>/year (transportation).

Loading-unloading work brought out actual log production in the field greater than that based on the company's production target as well as production realization (Table 3). This situation was brought about by high loading-unloading productivity (20 m<sup>3</sup>/hour). Besides, it was also caused by longer working hours per day in loading-unloading work than those based on production target or production realization (Table 4).

If we look into performance of logging tools with respect to log production, especially based on production target, we should not feel worried about negative/positive sign (Table 2). This was brought about by well planned work that further improved log production.

### C. Production Time

Using Tables 1, 2, and 3, production time could be calculated for each operational aspects of the logging tools (Table 4).



**Table 4.** Production time (months) for each operational aspects of logging tools

No	Operational aspects	Actual number of	Log production (m <sup>3</sup> /year)		Production time (months)		
		logging tools in the field	Based on production target	Based on production realization	Actual time in the field	Based on production target	Based on production realization
1	Felling	6	269,222.4	144,460.8	81.4	11.9	22.2
2	Skidding	2	226,800.0	124,200.0	297.0	14.1	25.83
3	Loading-unloading	3	583,200.0	324,000.0	16.5	5.5	9.9
4	Transportation	6	68,040.0	37,800.0	282.89	47.15	84.87
Total		17	1,147,262.4	630,460.8	677.79	78.65	142.80

Table 4 indicated that actual production time of logging tools in the field (677.79 months) was longer than those based on production target (78.65 months) as well as production realization (142.80 months). This situation was caused by fewer available logging tools (17 units) compared to those based on production target and production realization i.e. 128 and 70 units, respectively (Table 3).

#### D. Machinery Cost

Costs of logging tool were calculated based on productivity, depreciation, purchasing, and operation cost. The cost components of logging tools were presented on Table 5.

**Table 5.** Cost components of logging tools

Cost components	Operational aspects			
	Felling	Skidding	Loading-Unloading	Transportation
Price (Rp) per unit	7,500,000	350,000,000	475,000,000	170,000,000
Working time of tools (hours)	1,000	10,000	10,000	15,000
Working hours of tools (hour/year)	1,000	1,000	1,000	1,500
Insurance (%/year)	3	3	3	3
Interest (%/year)	18	18	18	18
Tax (%/year)	2	2	2	2
Cost of gasoline fuel (Rp/litre)	6,000	-	-	-
Cost of diesel fuel (Rp/litre)	-	6,000	6,000	6,000
Wages of operators and assistants (Rp/day)	96,000	80,000	90,000	35,000
Working hour (hour/day)	8	8	18	7
Machine power (HP)	15	82	138	100

Table 5 was used for calculating machinery cost for each operational aspects of logging tools calculated (Table 6).

**Table 6.** Machinery cost of logging tools

No	Operational aspects	Number of logging tools (units)			Machinery cost (Rp/hour)		
		Actual number in the field	Based on production target	Based on production realization	Actual number in the field	Based on production target	Based on production realization
1	Felling	6	41	22	223,362.0	1,526,307.0	818,994.0
2	Skidding	2	42	23	359,499.2	7,549,483.2	4,134,240.8
3	Loading-unloading	3	9	5	763,249.2	2,289,747.6	1,272,082.0
4	Transportation	6	36	20	721,440.0	4,328,640.0	2,404,800.0

Table 6 shows that machinery cost for each of the logging tools (operational aspects) in the field was fewer than those based on production target and production realization. This situation occurred due to fewer number of logging tools needed. Although the fewer logging tools caused the lower machinery costs, this situation brought about inefficiency in logging operations thereby lowering log production. This condition was disadvantageous for the forest company for not reaching production target. For the information, according to the Forest Company's Annual Work Plan in 2007, the company operated in 1,071.47 ha area in that log production target was 267,333.04 m<sup>3</sup>/year, while its production realization was 146,932.48 m<sup>3</sup>/year.

#### IV. CONCLUSIONS

1. Efficient operation of the Forest Company depended on number of logging tools based on log-production target, i.e. 41 units of chainsaws for felling operation, 42 units of farm tractors for skidding, 9 units of loaders for loading and unloading, and 36 units of trucks for transportation.
2. Actual number of logging tools operating in the field is fewer than it should be based on analysis of log production target as well as production realization. This situation indicated that operation and available number of logging tools in the field are not yet efficient.
3. Actual machinery cost of logging tools in the field is less than those based on log production target and log production realization. This situation is disadvantageous for the company implying that it does not yet achieve log production target.

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## REFERENCES

- FAO. 1992. Cost control in forest harvesting and road construction. FAO forestry paper No.99. FAO of the UN. Rome.
- PT. Purwa Permai. 2007. Rencana Karya Tahunan Tahun 2007. Palangkaraya.
- Haryanto. 1996. Pemanenan Hasil Hutan Buku 2: Penebangan. Yayasan Pembina Fakultas Kehutanan. Universitas Gajah Mada. Yogyakarta.
- Keputusan Menteri Kehutanan No.428/Kpts-II/2003 tentang Pedoman Perhitungan Kebutuhan Alat-Alat Berat. Tanggal 18 Desember 2003.
- Nugroho, B. 2003. Kajian institusi pelibatan usaha kecil menengah industri pemanenan hutan untuk mendukung pengelolaan hutan produksi lestari. Disertasi Program Pasca Sarjana. Institut Pertanian Bogor. Bogor. Tidak diterbitkan.
- Purnama, B. M and M. Basuki. 2003. Masalah penebangan liar dan perspektif pemerintah. PT. Inhutani II. Direktorat Pengembangan. Jakarta.
- Suhartana, S., Dulsalam, and D. Tinambunan. 2006. Peningkatan produksi hasil hutan melalui implementasi pemanenan hutan berwawasan lingkungan. Prosiding Seminar Hasil Litbang Hasil Hutan, tanggal 30 Nopember 2005 di Bogor. Hlm. 65-77. Pusat Penelitian dan Pengembangan Hasil Hutan. Bogor.
- Suhartana, S. and Yuniawati. 2006. Effisiensi penggunaan chainsaw pada kegiatan penebangan: studi kasus di PT. Surya Hutani Jaya, Kalimantan Timur. Jurnal Penelitian Hasil Hutan 24(1):63-76, Februari 2006. Pusat Penelitian dan Pengembangan Hasil Hutan. Bogor.
- Suhartana, S. and Yuniawati. 2007. Penggunaan alat pemanenan kayu yang efisien: studi kasus di satu perusahaan hutan di Kalimantan Timur. Jurnal Wahana Foresta 1:1-12, Januari 2007. Fakultas Kehutanan, Universitas Lancang Kuning. Pekanbaru.
- Suhartana, S., Yuniawati, and Rahmat. 2007. Penggunaan jumlah chainsaw yang tepat dan efisien pada penebangan: studi kasus di satu perusahaan hutan di Kalimantan Timur. Jurnal Rimba Kalimantan 12:62-66, Juni 2007. Fakultas Kehutanan, Universitas Mulawarman. Samarinda.

**APPENDIX. Logging tools**



**Figure 5.** Chainsaw Stihl 070 for Felling and Bucking



**Figure 6.** Farm tractor as a skidder



**Figure 7.** Loader Caterpillar



**Figure 8.** Truck Mitsubishi PS 100