

(RESEARCH ARTICLE)



Chainsaw part damage of harvesting teak forest in Madiun East Java, Indonesia

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Abstract

Forest harvesting has to be a concern for productivity, the operator's safety, and the environmental impact of forest harvesting. Chainsaw is commonly used for forest harvesting in Java, Indonesia. To increase the harvesting productivity, the operator has to maintain their chainsaw. Part of the chainsaw is often damaged in the harvesting process, affecting the productivity of felling the trees. This study analyzes the damage to parts from chainsaws in teak forest harvesting. The research location was in a forest area of Perhutani Company in Madiun East Java. The result shows that all ten chainsaws had damage to their parts components. The piston was the engine component which damaged in all the ten chainsaws. The body components such as the front handle, muffler, and on-off switch were damaged by all ten chainsaws. We observed that the chainsaw operator could not maintain the chainsaw well.

Keywords: Chainsaw; Engine; Perhutani; felling tree; Teak harvesting

1. Introduction

Teak forests in Java have been managed for about 200 years since the Dutch colonization. Currently, teak in Java Indonesia covers an area of more than 2.4 million hectares, and it is managed by Perhutani [1]. Perhutani is a Forest State-Owned Enterprise of Indonesia managing forest resources in Java and Madura Island. According to Perhutani, Perhutani harvests more than 650 thousand m³ of lumber each year. The lumbers mainly from Teak, Pine, Mahogany, Rosewood, Damar, Acacia, Jabon, Sengon, Gmelina, and Rasamala.

Forest harvesting has to be a concern for the operator's safety and the environmental impact of the forest harvesting. Some research showed that after harvesting forest, they determine the residual stand damage of the vegetation beside the fallen tree and the ground damage because of the movement of the bulldozer in skidding the log. Some research showed the degradation of natural regeneration after logging in Kalimantan, Indonesia [2], India [3], and Borneo [4]. The change in carbon stock [5,6,7] and ground biomass is caused by log extraction from the natural forest [8,9]. Machines such as bulldozers showed that soil compaction occurs due to heavy equipment operations in forest harvesting [10,11]. The amount of forest stand damage that occurs depends on the intensity of timber harvesting [12].

Harvesting teak and other tree species of Perhutani in Java usually use the chainsaw to fell the tree and a manual system to skid the lumber from the stump to the collecting site. Every year forest harvesting is carried out in several districts in Java. One of them is the Madiun district. Forest harvesting has begun by felling the tree. The felling tree will be cut at the branches. The operator makes a log as a result of falling the tree. The next activity is bucking. Bucking is an activity of cutting the log become some short parts, namely lumber. The activity of felling and bucking plays an essential role because it determines the work productivity of the operator. One of the harvesting tools that play an essential role is the chainsaw. Chainsaws are commonly used in forest harvesting areas, including teak harvesting. Chainsaw is often

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damaged in the harvesting process, so it affects the productivity of felling. Some research was conducted on harvesting teak in Java, but research about chainsaw damage in harvesting forests was rarely found.

This study analyzes the damage to parts from chainsaws in teak forest harvesting operations in Madiun East Java.

2. Material and methods

The research location took place in district Madiun of the Perhutani teak forest area. We identify the chainsaw part damage and analyze the cause of the part damage. Ten operators and ten chainsaws had been identified. All the operators used Stihl 070 chainsaw, and the chainsaw belonged to the operator. We identify the damage to the safety component of the chainsaw, the body, engine, transmission, chain, and guide bar. Also, we find out the damage to the system of lubrication, electricity, gasoline flow, chain cutter, and bar nose.

3. Results

This research identifies ten chainsaw operators who have experience using a chainsaw to fell the tree. On average, all operators have worked with a chainsaw with about 7.3 years of experience as a chainsaw operator. The lifetime of the chainsaw was, on average, five years, and the average operator age was 44.6 years old (**Table 1**).

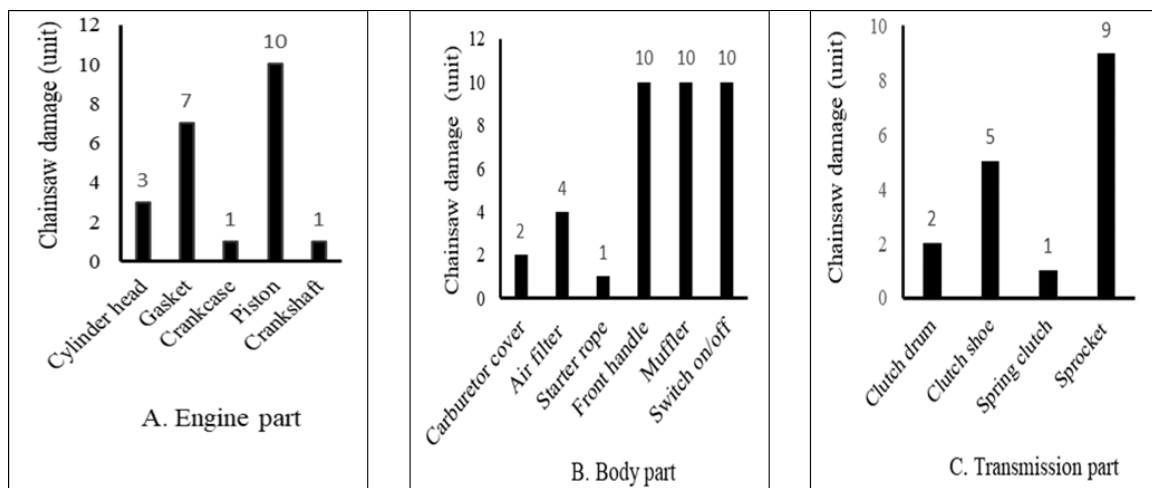


Figure 1 Several chainsaws were damaged in each component's engine, body, and transmission

Table 1 The number of chainsaws, operator ages, the lifetime of the chainsaw, and working experience

| Number of chainsaws | Operators age (years old) | Chainsaw lifetime (years) | Working experience (years) |
|---------------------|---------------------------|---------------------------|----------------------------|
| 1 | 45 | 5 | 10 |
| 2 | 52 | 4 | 4 |
| 3 | 48 | 6 | 7 |
| 4 | 40 | 5 | 7 |
| 5 | 39 | 4 | 8 |
| 6 | 44 | 5 | 6 |
| 7 | 49 | 5 | 13 |
| 8 | 43 | 5 | 5 |
| 9 | 46 | 5 | 7 |
| 10 | 40 | 5 | 6 |
| Average & Stdv | 44.6±4.3 | 4.9±0.6 | 7.3±2.6 |

Table 2 Identification type damage part of the engine, body and transmission

| Chainsaw component | The damage type of the part |
|---------------------------|------------------------------------|
| Engine part | |
| Cylinder head | sparkplug rack was broken and worn |
| Gasket | torn and ripped |
| Crankcase | broken dan cracking |
| Piston | soot, dirt and scratch |
| Crankshaft | eroded |
| Body part | |
| Carburetor cover | bolt worn |
| Air filter | torn |
| Starter rope | broken rope |
| Front handle | not stable, loose |
| Muffler | without cover |
| Switch on/off | blown and broken |
| Transmission part | |
| Clutch drum | worn |
| Clutch shoe | worn |
| Spring clutch | broken |
| Sprocket | worn |

Table 3 Identification type damage part of the electricity system, gasoline tank, lubrication, chain and guide bar

| Chainsaw component | The damage type of the part |
|-------------------------------------|------------------------------------|
| Electricity part | |
| Flywheel | broken inner side |
| Stator | concave |
| Sparkplug cable | blown and broken |
| Condenser | loose from the rack |
| Circuit breaker | worn |
| Spark plug | soot and dirt |
| Gasoline tank and carburetor | |
| Carburetor | membrane torn |
| Filter gasoline | blocked |
| Lubrication part | |
| Lubricant tank | leak |
| Lubricant filter | blocked |
| Pump | membrane torn |
| Chain and guide bar | |
| Cutter | sharpening angel is not uniform |
| Bar nose | dirty and worn |

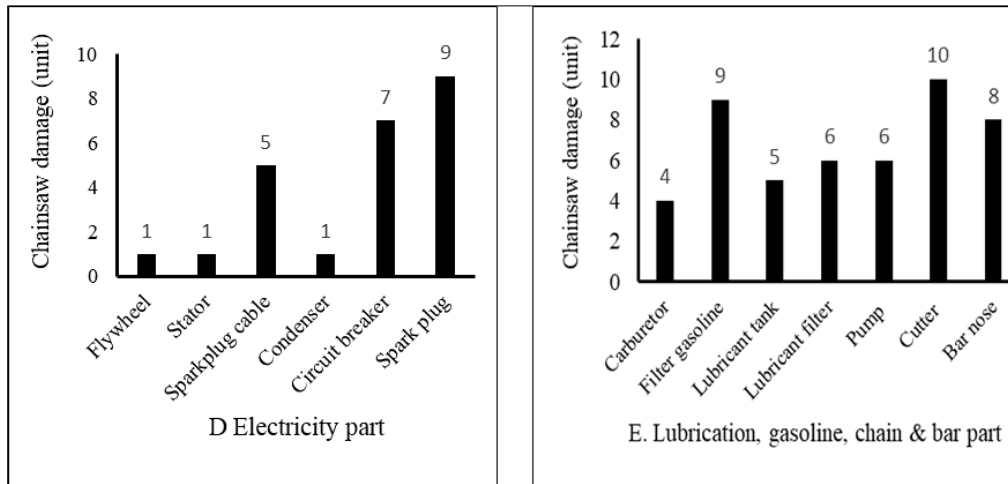


Figure 2 Several chainsaws were damaged in electricity, lubrication system, chain and guide bar in each component

4. Discussion

The chainsaw components damaged in the engine were five parts, namely the cylinder head, gasket, crankcase, piston and crankshaft. There is six damage to the body components: the carburetor cover, air filter, starter rope, front handle, muffler, and switch on-off. The transmission component contained four damaged parts: the clutch drum, clutch shoe, spring clutch, and sprocket (Table 2). Damaged components of the electricity, lubrication system and chain and guide bar components can be seen in Table 3. Types of damage to each part can be seen in Table 2 and Table 3.

In this study, we observed 10 (ten) chainsaws. Of all ten chainsaws, the damaged engine parts were ten chainsaws, all of which had damaged piston parts. There is damage to the front handle, muffler and on-off switch in the body, and all ten chainsaws. Damage to the crankcase, starter rope, and spring clutch was found only in 1 (one) chainsaw (Figure 1). Only cutter damage was found in all ten chainsaws in the electricity and other parts. The flywheel, condenser, and stator damage were found in only one chainsaw (Figure 2). The type of damage in each part of the engine, body, transmission, electrical system and other parts can be found in Table 2 and Table 3.

Research on chainsaw damage has been carried out in Romania [13], and research about felling productivity [14,15], felling productivity and cost estimation [16,17,18]. Hinge shape on chainsaw felling direction [19]. Several factors influence forest harvesting: cutting tools in chainsaws, skid distance, operator skills, and field slope conditions [20].

5. Conclusion

We conclude that the highest part of the damage was found in the engine component. The piston is the engine component of all ten chainsaws which damage type scratch soot, and dirty. Also, we found that all ten chainsaws damaged the front handle, muffler and on-off switch. We observed that the operator could not maintain the chainsaw well.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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