



Noise Level Assessment of Chainsaw during Felling and Bucking Operations in Pasoh Forests Peninsular Malaysia

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Abstract. Chainsaws are the most common piece of mechanized harvesting equipment used during logging operations, and their noise has a major negative impact on the health of the logging employees. The objectives of this study were to assess the noise level and noise effect of a chainsaw during felling and bucking operations. The investigation was done at a forest that was being harvested in the Pasoh Forests in Jelebu, Negeri Sembilan, Peninsular Malaysia. Data were collected for this investigation utilizing a sound level meter at distances of 0, 5, and 20 meters from the chainsaw during felling and bucking. The result shows the means for felling operation, 0m is 96.3333 dBA while 5m is 89.8333 dBA and 20m is 72.6222 dBA. Next, the means of bucking operation for 0m is 97.9667 dBA while 5m is 84.0333 dBA and 20m is 77.0833 dBA. There are significant differences between 0m, 5m, and 20m respectively. The result of statistical analysis (ANOVA) is a statistically significant difference in the mean of noise level between the distance during both operations. The OSHA's allowable exposure limit Permissible Exposure Limit (PEL) for all employees is 90 dBA for an 8-hour day of noise while NIOSH, Recommended Exposure Limit (REL) for occupational noise exposure is 85 decibels. The result shows the average sound level during felling operations: at 0 m, it is 96.3333 dBA, at 5 m, 89.8333 dBA, and at 20 m, 72.6222 dBA. The means of operation for bucking at 0 m is 97.9667 dBA, at 5 m it is 84.0333 dBA, and at 20 m it is 77.0833 dBA. The disparities between 0m, 5m, and 20m, respectively, are substantial. The result of statistical analysis (ANOVA) indicates a statistically significant difference in the mean of noise level between the distances during both procedures. As recommendation following health and safety policies at work for those workers who working with chainsaw need to use the hearing protective equipment (HPE), to ensure that the device is worn correctly, and at reasonable times when noise exposure occurs.

Keywords: Decibel, Noise Level Meter, Permissible Exposure Limit, Hearing Protective Equipment.

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1.0 Introduction

Hearing is one of the major senses and like vision is important for distant warning and communication. It can be used to alert, to express joy, and to indicate fear. According to the Director General of Occupational Safety and Health [1], awareness of the consequences of noise, both auditory and extra auditory, as well as rising levels of noise exposure, have led to an ongoing rise in concern about workplace noise. According to Singh & Davar [2], the word "noise" is derived from the Latin word "nausea," which means "unwanted sound" or "sound that is loud, unpleasant, or unexpected." The noise produced is an accumulation of the sounds of the machines that are already in use, which will have an impact on the entire workplace. Operators of heavy machinery may experience negative consequences such as noise and vibration, depending on the type of operation, the roughness of the job, and the machine's features [3].

The main effect of noise on humans is the loss or decline in hearing ability. The effect of excessive and prolonged noise, which is found in many industrial environments can cause permanent or permanent hearing loss that is difficult to cure [4]. Taoda et al. [5] assessed the average noise exposure level of 81 national forest employees using chainsaws, log cutters, bush cleaners, timber-collecting cable machines, and forklifts. According to NIOSHA [1], the Recommended Exposure Limit (REL) for occupational noise exposure is 85 decibels, A-weighted, as an 8-hour average time-weighted (85 dBA as an 8-hour TWA) using a 3 dB exchange rate. Exposures above or below that level are considered hazardous. Since noise has a significant impact on worker health and safety, it is crucial to take this into account when conducting industrial activities. Management must be directed by planning and organizing to prevent occupational accidents and diseases, hence decreasing expenses associated with work accidents and occupational diseases. Occupational health is one of the functions of management.

Operators of chainsaws who use them for the majority of their working hours are subject to a variety of health concerns, including the effects of noise and vibration. Particularly noise exposure may contribute to major occupational illnesses like deafness in chainsaw operators. According to Yıldırım et al. [6], the noise produced by chainsaws, the most common piece of mechanical harvesting equipment used in logging operations, causes major health issues for the workers. The felling and bucking operations are alleged to produce noise that interferes with workers' health, especially if they have hearing issues [7,8]. The most severe effects of noise on people are permanent hearing loss, respiratory issues, high blood pressure, cardiovascular issues, and slowed brain reactions [9]. According to John et al. [10], the most commonly reported is noise-induced hearing loss (NIHL), a permanent form of hearing loss resulting from acute or chronic high-level sound exposure.

Forest logging involves the use of various noise-producing equipment. Hearing Protection Equipment (HPE) is very important when handling chainsaws because effective in hindering hearing loss. But mostly workers, they did not wear HPE because feel uncomfortable. A study by Olege et al. [11] that the quality of hearing safety and its use was low among Nigerian steelworkers. Pyykko et al. [12] identified age among forest workers who handled chainsaws as one of the individual risk factors for sensory neural hearing loss (SNHL). Hearing loss was found in 48 percent of the sample aged

between 30 and 39, 76 percent of the sample aged between 40 and 49, and in all loggers aged over 50 [13]. Age also one of the factors some people having a hearing problem.

Based on the findings and previous studies, it has been found that, in addition to the physiological effects, noise induces major psychological disturbances (uncomfort and irritability) on humans [14]. The most significant of these disorders is the low-performance level and reluctance to work, which can be directly related to the noise level seen in noisy environments [15].

This study was conducted to measure the noise level of a chainsaw during felling and bucking operation in Hill Dipterocarp forest. This study site was taken in Pasoh Forest, Jelebu, Negeri Sembilan. Since there is a lack of study regarding measuring noise level of a chainsaw during felling and bucking operation. The objectives of this study are to measure the noise level of a chainsaw during felling and bucking operation and to classify the noise range and noise effect of a chainsaw during felling and bucking operation.

2.0 Methods

2.1 Study site

The study site conducted in forest undergo harvesting operation in Compartment 65 and 66 Pasoh Forest, Jelebu, Negeri Sembilan. Others reserved forest located between the study sites is Triang Reserved Forest, Kenaboi Reserved Forest, Berembun Reserved Forest, and Gapau Reserved Forest.

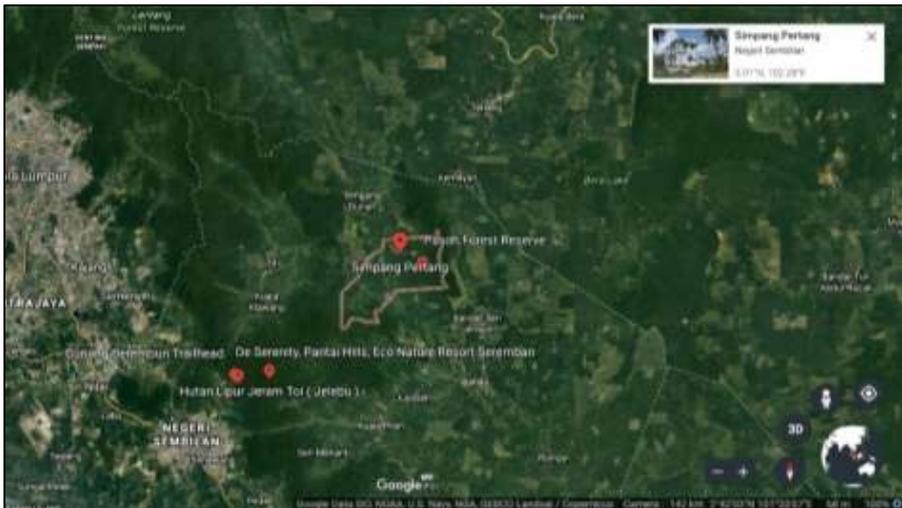


Fig. 1. Study site area in Pasoh Forest Reserved, Jelebu, Negeri Sembilan

2.2 Noise level measurement

The noise level measurement for the felling operation by using a sound level meter, data was collected in dBA starting from 0m, 5m and 20m. For 0m, focus on chainsaw operator only. In the same time, the chainsaw operator cutting the tree was recorded. Meanwhile, for bucking operation, the operator chainsaw was buck the tree after the felling operation at the temporary landing. The data was collected by a sound level meter in dBA with different distance starting from 0m, 5m and 20m, because bucking was do at temporary landing which is not only chainsaw operator but someone else around there.

2.3 Analysis data

The analysis was performed Statistical analysis (ANOVA) by using statistical software program IBM SPSS Statistics 21 to compare noise range and noise effect level during felling and bucking operation. Next, the relationship between noise level and the distance were assessed by using linear regression.

3.0 Results and Discussion

The results from this study demonstrate two things. First, the methods for determining distance and noise level during felling and bucking operations. Second, the distance between felling and bucking operations and the noise level. In Compartment 65, three measurements were made: 0 metres, 5 metres, and 20 metres. Three distances showed a substantial difference. Every distance has a unique goal for the forest operation workers. For 0m, it's focus on Chainsaw operators who use chainsaws during most operating hours are exposed to various health hazards, such as the effects of noise and vibrations [16].

3.1 Noise level during felling operation

The noise level dBA of felling operation with three different distance (m), the highest means is 96.3333 dBA for distance 0m, while the lowest means is 72.6222 dB for distance 20m. For distance 5m, the means is 89.8333 dB. Figure 2 showed in a means plot during felling operation.

Table 1. The regression of felling operation between noise level and distance.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	96.069	1.167		82.290	.000	93.665	98.474

Distance	-1.177	.098	-.923	-	.000	-1.379	-.975
				11.997			

The regression model between noise level (dB) and distance (m) can be expressed as $Y = 96.069 - 1.177X$ for felling operation, where Y is noise level and the X is distance, 96.069 is a constant. We can identify the distance that we did not taken in this study like 10m and 15m. By doing regression, distance for 10m is 81.299 dBA while 15m is 72.414 dBA. Both noise level, we can considered it safe for workers and it's does not contribute to major problems on the safety and health of workers. This classification can be use as a reference to manager of forestry to take care of safety and health of workers in felling operation.

3.2 Noise level during bucking operation

The noise level dBA of bucking operation with three different distance (m), the highest means is 97.9667 dBa for distance 0m, while the lowest means is 77.0833 dB for distance 20m. For distance 5m, the means is 84.0333 dB. Table 2 showed in a means plot during bucking operation.

Table 2. The regression of bucking operation between noise level and distance.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		
	B	Std. Error	Beta			Lower Bound	Upper Bound	
1	(Constant)	93.946	1.580		59.477	.000	90.597	97.294
	Distance	-.910	.133	-.864	-6.858	.000	-1.191	-.629

The regression model between noise level (dB) and distance (m) can be expressed as $Y = 93.946 - 0.91X$ for bucking operation, where Y is noise level and the X is distance, 93.946 is a constant. Based on the regression, the noise level in desible for distance 10m in average 84.846 dBA that means it's approaching to warning limit and not really safe for workers while noise level in desible for 15m average in 80.296 dBA so, we can considered as a safe distance for workers and it's does not contribute to major problems on the safety and health of workers. This classification can be use as a reference to manager of forestry to take care of safety and health of workers in bucking operation.

From the the above result of 0m for felling is 96.3333 dB and 97.9667 dB for bucking where is the highest for both operations. According to recommended NIOSH [1], Exposure Limit (REL) for occupational noise exposure is 85 dBA. A-weighted, as an 8-hour time-weighted average (85 dBA as an 8-hr TWA) using a 3 dBA exchange rate. Exposures at or above this level are considered hazardous. While according to

OSHA, they sets legal limits on noise exposure in the workplace [17]. These limits are based on the weighted average time of a worker over an eight-hour day. With noise, OSHA's allowable exposure limit (PEL) is 90 dBA for all workers on an eight hour day. The results of this study show hazard limit that can affect the health of worker. Permanent hearing loss, respiratory conditions, high blood pressure, cardiovascular problems, and slowing neural responses are the most significant effects of noise on people [9].

Next, for distance 5m, the means for felling is 89.8333 dBA and bucking 84.0333 dBA. This result may be explained that this distance quiet not safe for the workers. For this distance, we focus on helper or assistant chainsaw operator who is a skilled person who will assist in tree location, tree cleaning, wedging and the transport of materials. The finding shows for felling operation considered hazardous by NIOSH [1] while bucking it's considered in between warning limit and possible for workers to get problems health. For distance 20 m, the maximum distance for this study. The aims for this distance for worker other than chainsaw operator and helper such as driver Bulldozer and others. The result 72.6222 dBA for felling operation and 77.0833 dBA for bucking operation. From this study, it's shows that this distance are very safe for workers because previous research on the impact of noise level showed that the noise level of 80 dBA and less does not contribute to major problems on the safety and noise effect of the worker by using personal protective equipment [18].

Finally, the regression analysis both for felling and bucking operations indicated that the difference between the noise levels recorded felling and bucking operation with three distances. With different distances, we know the safe distance for workers in forest operations. The results also indicated that the maximum noise levels in both operations were over the hazard limit of 85 dBA for both operations in 0m distance while others are still can be accepted. The hearing of exposed workers should be protected by reducing the amount of noise reaching their ears if the noise level reaches the danger limit by using Hearing Protection Equipment (HPE), it is very important when handling chainsaws because effective in hindering hearing loss [19]. Thus, the average value of the average noise level was also above the 85 dBA warning limit, which can lead to serious hearing loss issues from a lifetime of exposure [20]. Properly fitted earmuffs and earplugs can reduce noise by 15 to 30 dB [21]. They have almost the same noise reduction abilities, although earmuffs are better suited to high-frequency noise while earplugs work better for low-frequency noise. This is why noise level analysis is important to the safety and health of workers.

4.0 Conclusion

This study determined that 0 m from a chainsaw is within the NIOSH and OSHA hazard limits. If they take no action or do not wear hearing protection equipment (HPE) while working, this will have an effect on the chainsaw operators' health and may result in difficulties with irreversible hearing loss. It demonstrates that 0 m is not safe for workers, especially for chainsaw operators and assistants, as the average for both is above 90 dBA and is potentially dangerous to their health. Thus, the chainsaw operators must wear an earplug to protect themselves from potentially dangerous noise.

Recommendation. It is recommended for workers of forest operations, especially when a chainsaw or other noisy tool is used. Earmuffs and earplugs should be worn by chainsaw operators to reduce the amount of noise in their ears as a precaution because chainsaws can frequently create dangerous noises. In addition to adhering to health and safety regulations at work, workers who use hearing protection equipment (HPE) should make sure the device is worn correctly and at appropriate periods when noise exposure occurs. Mostly, chainsaw operators do not use complete personal protective equipment (PPE) and they rarely use hearing protective equipment (HPE). So, it need some practice or training for chainsaw operators especially to make them comfortable when using hearing protection. Last but not least, this research serves as a reference regarding the range of noise that can be used by managers of forestry to take care of the safety and health of workers in forest operations.

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