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Ergonomic Study Using Brush Cutter Machine to Cut Weeds Grass in Coffee Farm

I Kadek Sapura  
Student of Master Program in Ergonomics-Work Physiology University of Udayana  
E-mail: kadek.sapura@yahoo.com  
IMade Krisna Dnata  
Physiology Department Medical Faculty Udayana University  
E-mail: krisna.dnata@uakms.com

ABSTRACT: Cutting weeds grass in coffee farm, traditionally use hand sickle manually but recently, appropriate technology such as brush cutter has started to be applied in individual farm. Despite it works faster and can save the number of worker, the risks on safety and health threat rise. Ergonomic study is required to maximize benefits and minimize risks of machine operation. Interview and observation were applied to collect the data. Subjects were farmer in Pajahan Village. They work for 9 hours a day and use machine for min two hours nonstop. It produced smoke, harsh voice and hard vibration entire it. Worker complained pain, stiffness, tingling on shoulder, back, upper extremity, feel decreasing of hearing ability, mild tinnitus and sleeping disturbance. Health threats can be identified were hearing loss, musculoskeletal disorder and dehydration. Although machine could increase working efficiency, it gave negative impact. We suggest to modify machine to minimize vibrations, harsh sound and smoke, short rest every 30 minutes and provide enough drinking water.

Keywords: ergonomic, weeds grass, brush cutter machine, coffee farm, risk factors

1 INTRODUCTION
Agriculture is one of important sector of Indonesian economic development. Most Indonesian people occupation is farmer mostly in rural area. They plant any variety of corps depend on geographic location (Daryanto, 2010). Coffee bean is popular commodity in area with high 500-800 M above sea level. On coffee farming process, cultivation is one of key point for successful harvest. It provides optimal nutrition, light and water for plant growth (DDPPTP, 2008). Weeds grasses which sprout around the coffee plant disturb that supply. Furthermore cutting the weeds grasses are absolutely required three times a year (Rahane, 2012). Removing them, traditionally farmers use hand sickle manually. They need to lose it and spend more effort to operate them if it comes to hunt. For one hectare farmers need 14-15 days to finish the work. Recently, appropriate technology such as brush cutter has started to be applied in individual farm. It specification are as follows: supported by 2 stroke machine, gasoline plus oil fuel, weight 5-9 kg, start blade with up to 9900 rotation per minute (Dyron, 2014). Of course it works faster than sickle. Only 4-5 days are spent to finish one hectare of farm land. During operation, machine should produce smoke, harsh voice (112 db) and vibration entire it. Consequently those become risk factors on farmer safety and threat the health status. In one side machine supports farmer job but in other hand it gives negative impact. Because of descriptions above, we were interested to make a study about machine operation with ergonomic approach. This study aimed to describe the use of brush cutter, to identify risk factors and health threats and identify problems solving with ergonomic approach. Last, the study is making farmers work more efficient and healthy.

2 METHOD
Descriptive study is chosen to assess data till make conclusions. The subjects were farmers in Pajahan Village, Pupuan district, Tabanan Region of Bali during preparation and operating machine. Interview and observation were applied to collect the data. Those activities were done on last week of September 2014.

3 RESULT
Pajahan village is town side of Tabanan Regency. Pajahan has 800 families and spread though village dan most of people are farmer and have their own land. It has hill topography of Agung mountain with high 700-800 M above sea level. The soil contain rich nutrition so make many agricultural variety growth and well producing all year. Farmer use intensification system and tumpeng sari. That mean that in one farming area farmer planting many kind
of fruit with mutual interaction such as durian, manggis, banana, duku, coffe, etc. The higher tree will growth above the other shorter tree with appropriate density. Coffee plant is positioned in bottom just above the land. Coffee is featured commodity in this village.

Figure 1. Intensification system and umbang sari. There are coffee and banana planted in area of land.

The coffee plant needs specific maintenance such as removing weeds grass. In the past all farmer use hand sickle but since 2008 they have started to use brush cutter machine. The standard blade has been modified (from metal with two of sharp side) to 25 cm of strong plastic sling. It is safer and disposable than standard blade. They said that it is more efficient because it works faster and can save the number of worker. For one hectare they need 4-5 days comparing 14-15 days using sickle to finish the work. Farmer uses their own machine, borrow from other farmer, or just pay the other farmer to cut the grass using machine. Farmer has used minimum self protective device such as boot, pants, long sleeves, hat and mosquito net to protect the face.

The machine is simple in operation. It is included preparation step; blade preparation, fuel filling, engine checking, using self protective devices and then operation step. In operation step, first turn the engine on, put it on your shoulder until you fill comfort by adjust the string pad, with your dominant hand, hold the speed control and with your non dominant hand, hold the handle stick to give the direction for the blade. Machine is ready to use to cut the weeds grass. This machine is operated in standing position. All of body parts should be coordinated and adjusted to find right target (weeds). Weeds growth in easy location or otherwise under coffee leaves or hill bed which is difficult accessed. Body accelerations is required to avoid injury.

When machine is turning on, it produces vibration entire it mainly in blade stick, harsh sound and smoke. Hand must be strong to hold and resist the blade stick vibration and bounce, more you need extra power in blade cut strong grass or hard object (e.g stone, branch or twig). You will have minimal mo-
tion on your finger, wrist, lower and upper hand. Central motion is placed on shoulder to follow blade direction. Back will be vibrate by machine as well. Harsh sound and smoke is produced follow the engine speed. The faster speed, more noisy sound and thicker smoke are spread out. The sound intensity and smoke density are not measured.

Farmer worked for nine hours a day with three times period of rest. They started to work at 07.30 or 08.00 until 10.30 local time. Short resting usually take a 10.00 and 15.00 for 15 – 20 minutes. Sometimes short rest is not done when they want the work finish faster. Longer rest as lunch is done at 11.30 – 12.30 to eat provided stock. During rest man usually consume cigarette and a glass of coffee. Fresh water was drunk just at lunch for 1 glass (200cc). In a day of work farmer consume 600 – 800Cc of water. At afternoon, environment temperature rise and farmer worked in hot situation. It stimulated sweating and decreasing concentration.

Machine was turned off when fuel finish or resting time came. It means that machine operated minimum 2 hours nonstop. Effect of this are farmer stand, hold the stick, resist the vibration and bounce, minimum motion, hold machine weight, hear harsh sound, and inhale smoke for minimum 2 hours as well.

Some uncomfortable were felt during and after machine operation. Based on interview during machine operation, farmers feel stiff, tingling and pain on their hand, neck and shoulder, and feel decreasing of hearing ability. Then after finish the job complain add with tired feeling, fatigue, range of upper extremity motion restriction, mild tinnitus, and sleeping disturbances. They realize that those symptoms are caused by working for long time period.

4 DISCUSSION
Coffee becomes featured commodity in Pajahan village because the topographic is suitable for coffee plant (BBPPTF, 2008). Maintenance such as cutting weeds grass have implemented appropriate technology by using brush cutter machine (Manuaba, A. 2005). It is more efficient because it worked faster and could save the number of worker. Efficiency is supported by the machine specification (Drytrade, 2014). Farmer has realized the benefits by their experience.

Although farmer has felt benefits from machine, they don’t aware with risks factors faced. They have used self protective device and have operated machine according to their manual instructions. In the other hand, they are contact with risks factors during machine operation for long period of time. These are muscle contraction, joint movement restrictions, static position, harsh sound and smoke for more than two hours.

Over muscle contraction are caused by holding and resist cutting blade and machine vibration. When contraction continue without rest, muscle metabolism will change become anaerobic because oxygen and energy reserve finish. Thus produce more lactate acid. Muscle contraction for long time will clam blood vessel around it and make poor blood circulation. Calcium and neurotransmitter as important substance for muscle contraction decrease because of over use. Accumulate of that condition make metabolism waste will stay in muscle, decreasing muscle cell contraction ability and join inflexibility (Ganoty and Hall, 2007). Finally some complains rise such as stiffness, pain, tingling, fatigue and range of motion restriction. If these conditions remain for longer and over muscle tolerant, muscle injury is possible happen. To minimize that effect, ways to reduce vibration is required such as modify the handle stick. Temporary muscle relaxation by shutting off the engine and taking more short rest will become problems solving.

Harsh sound production about 112 db exceed normal hearing limit in working field. If sound about 112 db, worker must contact no longer than 0.95 minute (Kepmenker, 1999). Over limit sound can damage the tympanic membrane, vestibular and cochlear membrane function. Early sign of that are decreasing hearing ability and tinnitus. Symptom will disappear some time after harsh sound will disappear too. Sensory hearing loss can be suffered when ear contact with repeated, for long time and high db sound. To prevent hearing loss, it need to modify exhaust pipe to reduce voice production. Others, using voice reduction device and work against wind direction can be implemented.

Machine smoke is high possibility to inhale during machine operation. If any metal gas substances contained on the smoke diffuse in alveoli membrane to blood, hemoglobin ability to bind oxygen will decrease. Impact of that situation is decreasing oxygen saturation and blood oxygen concentration. It is aggravating poor circulation by over muscle contraction (Dealun S.C and Ladner P.K, 2002). Managing the wind direction by working against it will help farmer from smoking contact. Managing the machine speed will reduce smoke production.

Working nonstop for two hours, moreover under sun shine heat will increase body temperature. Body water will lost by sweat production and skin evaporation (Dealun S.C and Ladner P.K, 2002). In small amount, body will compensate it by increasing the heart load and decreasing urine production. Dehydration occurred when body lost lot of water without enough intake. When farmer consume approximate 800 cc of water, their body is threatened by mild to moderate dehydration. Providing minimum 1500 cc of water and take it during short rest are good way to prevent it.
5 CONCLUSION

Although application of machine could increase working efficiency, it gave negative impact and threat health worker status because inappropriate operation, precaution and prevention. Risk factors included: muscle contraction, joint movement restrictions, static position, harsh sound and smoke for more than two hours. Health threat can be identify are musculoskeletal disorder, hearing loss and dehydration. We suggest to modify handle sticks to minimize vibrations, modify smoke pipe to reduce harsh voice and smoke, work against the wind direction, short rest for 1-2 minutes every 30 minutes or every one part of land by turning off engine and do muscle relaxation and join movement. Last we suggest to provide minimum 1500 of drinking water and drink it during rest.

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