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Overcoming Issues of Oil Palm Plantations Manual1 Work with Ergonomic and Engineering Considerations

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ABSTRACT

This paper is an initial study by reviewing current situation and researches to determine the issues with manual works in an oil palm plantation and the need for mechanisation with consideration for the application in the smallholder plantations. The smallholder oil palm plantations in certain areas, activities of harvesting, collecting, loading and pruning are still done using manual tools. The small land size ownership means it is not economical to acquire large machineries and current harvesting technologies to reduce the burden of the plantation works. Therefore, the current practise is still in favour. With the increasing awareness and role of ergonomic in recent days, a new solution for this current situation must be taken action not only for the benefit of human in terms of wellbeing but also towards the better gain margin as human productivity increases. Reviews on this paper is based on the three job scopes that had been identified high risk for musculoskeletal disorders, the use of manual tools and equipment, mechanised option for the manual tools and equipment, and issues with both manual and some developed mechanised solution.

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INTRODUCTION

Oil palm industry is a labour dependant industry and since Malaysia is the second largest palm oil producer in the world after Indonesia (Pakiam, 2013), the number of human involved in situations with high risk of danger and injury is also significantly high, respectively. The risk in agriculture industry in general may come from various sources either the usage of farm machineries, pesticides, animals, terrain and others that varies based on the geographical and nature of the industry (Gresham, 1986). In worst case scenario, death could occur. This industry also facing the problem of shortage of labour whereby it has been one of the factors that causes a decrease in the expected production from 18.9 million tonnes to 1.4 million tonnes (Bernama, 2012). This industry is really labour dependant especially in the upstream segments comprising about 50% to 90% of the labour are foreigners, or out of 577 900 workers, 350 000 are foreigners (Adnan, 2010).

Local labours meanwhile are not interested to join because of the heavy work load and low pay. This has seen the local educated workforce to join manufacturing industry rather than agriculture (Ming & Chandramohan, 2002). For some cases of smallholders plantations, elderly are the ones to care for their plantations to cut down operation cost. But the desire were held back when the works are too physically challenging for them.

These situations could be improved by increasing productivity per person and this will reduce dependency to increasing productivity by increasing number of labour. An average plantation worker has a productivity of 1.5 ha to 2.0 ha. By introducing mechanisation, it is expected to reach about 20 ha per person (Ming & Chandramohan, 2002). Dependency on foreign does not provide a lasting solution because with neighbouring countries possessing larger land and labour reserve, our industry may be affected if some unexpected incident occur (Shuib, Yusof, Kheng, Kamisan, & Aidros, 2007); such as labour strike.

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2. Discussion:

This section will be discussing about the manual works especially the harvesters, collectors and loaders; the risks they are exposed to, the manual tools that are in use and some current technologies that had been developed for these jobs.

A. Oil palm plantation works:

Manual works in the oil palm plantations are human centred. The workers are responsible for many activities that require them to fully utilize their body strength to accomplish the tasks. Three jobs that are exposed to risk from manual material handling are the collector, harvester, and loader. In general the works involves a repetitive motion, awkward postures, and forceful exertions. More will be discussed in the next subsection.

Harvesters are the one who are doing the cutting of the fruit bunches and pruning activities. Loaders are the ones who will load the fruits from collection point onto the transport vehicle and the collectors are responsible for loading the harvested fruit bunches onto a wheelbarrow and transfer them to a collecting point.

In terms of working duration, observations done had identified that it differs based on the plantation management. For large scale plantations, the working hours can be said as fixed for 8 hours a day in general and for smallholder plantations, the works ended when the harvesting process ends.

B. Musculoskeletal Disorders (MSDs) among oil palm plantation workers:

MSDs problem involves the muscular and skeletal system of a person. The problem may be in the form of joints ache, muscle pain, hindered movements, and fatigue and for worse cases it could lead to sleeping disturbances.

Given the nature of the job, musculoskeletal disorder is something that is bound to happen among oil palm plantation workers. A previous study (Hendra & Rahardjo, 2009) had identified risks with the working postures in the three job scopes in the oil palm plantation based on REBA (Rapid Entire Body Assessment). It recorded scores of 9 – harvesters, 10 – loaders, 9 – collector (loading of fruit bunches) and 8 – collector (pushing wheelbarrow). From the results, it is clear that the risk is real.

Based on findings from various researches up to date, pushing activities affects arm, shoulder and low back areas(Hoozemans, Slaghuis, Faber, & van Dieën, 2007; Kotowski, Davis, & Waters, 2009a; Lin, Chen, Wei, & Wang, 2010). These researches can be related to the collectors of harvested fruit bunches. For pushing, factors that determine how much force will be exerted are handle orientation, handles height, tyre diameter and the posture while pushing (Hoozemans *et al*., 2007; Kotowski, Davis, & Waters, 2009b; Lin *et al*., 2010). With worse conditions in the oil palm plantations, results can be expected to be of a greater magnitude for force exerted by muscles, Electromyogram (EMG) readings, moment on the L4/L5 section of the spine and other variables that are studied.

The other two jobs also show the same problem in the low back areas where the works of harvesters especially for low and young trees requires frequent bending and also loaders whereby the job is about bending and lifting heavy weight. Repetition or frequency of the movements is also a factor for all the three jobs.

C. Conventional working tools and equipment:

Conventional tools are still in practise. The tools and equipment used by the three main jobs mentioned earlier are sickle, chisel, hook, loading spike and wheelbarrow. Main attraction of manual tools and equipment is that anybody could use it. There are no specific training needed for workers to use. Sickles and chisels are attached to a pole. Sickles are usually used for trees higher trees and usually retractable poles are used for greater reach. Loading spikes area steel rods with sharpened end and the wheelbarrow is the normal wheelbarrow.

D. Current technologies of mechanisation:

It can be seen that there are efforts made by stakeholders such as Malaysian Palm Oil Berhad (MPOB), Federal Land Development Authority (FELDA), local universities and private sectors to overcome the issues of mechanization in the oil palm plantation sector. The main reasons for the mechanization was to increase labour productivity, reduce dependency on foreign labour, better quality of harvested fruit bunches, faster harvesting and collection process. Mechanisation had been seen in many stages in the cycle for extracting the oil from the fruits. To quote some are, detection of ripeness for the oil palm fruits (Hazir, Shariff, Amiruddin, Ramli, & Iqbal Saripan, 2012), motorized sickle and chisel for harvesting and pruning of oil palm fronds (Jelani *et al*., 2008; Jelani, Maji, Shuib, Mohamed, & Din, 2010), power assist wheelbarrows to transport fresh fruit bunch (FFB) and transport vehicles(Shuib *et al*., 2007).

To focus on the available technologies based on the three job scopes of oil palm plantation works with issues of ergonomics; harvesters, collectors and loaders, we are going to look into some technologies of mechanisation regarding the job scopes.

For an alternative to the current manual tool for harvesters using sickle and chisel, the industry had seen the introduction of motorized sickle and chisel. Both of the innovations are powered by 2-stroke petrol engine (Jelani *et al*., 2008)which will move the cutting mechanism. This innovation is suited for harvesting and pruning purposes for trees below the height of 5m. As a result, the use of these new tools had eliminated the need for harvesters to use force to cut fronds and fruit bunches. Fig. 1 shows the look for the motorized cutters.

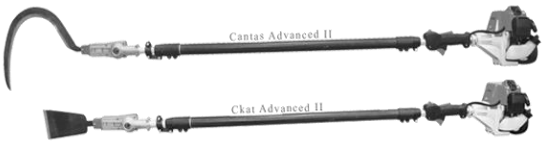

Fig. 1: The motorized cutters.

The collectors and loader meanwhile had seen quite a number of innovations to target this section. The technologies used for this section are basically to make the process of collecting faster and increase human labour capability. A few that had been developed took the form of powered wheelbarrows and transport vehicles.

Powered wheelbarrows had seen the conventional wheelbarrow had been equipped with diesel or petrol engine to facilitate the mobility and capability of carrying more load in comparison to the conventional. Vehicles with various capacities were also developed. Integrating a vehicle with mechanisms such as lifting and mechanical grabber, the use of these vehicles can eliminate human interaction with the high risk jobs (Shuib *et al*., 2007).

Mechanization is one of the methods used in this industry to reduce labour dependency. With increased mechanization, less human directly involved with high risk activities thus reducing the occurrences of injury and MSDs problems.

Even so, full scale mechanization cannot be fully utilized with conditions that are unavoidable such as rough terrain in the hills, swampy areas and valleys which are common geographical conditions for this industry. In this situation, human has the best mobility in comparison to trucks and other machineries.

Economic factor was also a factor especially for smallholders where small income from a small plantation does not favour the use of expensive machineries and tools. The next subsection will continue to discuss issues within the scope of manual and mechanised tools and equipment.

E. Issues with current manual tools and equipment:

A collector pushing the wheelbarrow needs to balance the weight of the load while at the same time lifting and pushing it towards the desired direction.

This situation can lead to fall while pushing the wheelbarrow especially during full load. The situation balancing the heavy load while pushing it will also resulting in straining the muscles in the lower back, shoulder and forearm areas (Chaffin, 1987; Macfarlane, Hunt, & Silman, 2000). Fig. 2 shows the situation of a worker pushing a wheelbarrow with harvested fruit bunches.

Fig. 2: Worker pushing a wheelbrrow with full load.

While for loading the FFB from the ground onto the wheelbarrow the use of hooks or loading spike too have issues. The handles are small in compared to the grip of the workers. This can cause slip and blisters to the palm. The action of lifting the FFB that can weigh up to more than 30kg in a fast pace will lead to overexertion of the muscles and cause injury to the low back (Kwon, Lee, & Jeong, 2012)Fig. 3 depict a worker lifting harvested fruit bunches into a wheelbarrow.

The same working procedure is applied for loaders but the difference is that the height for them to load the FFB is greater when they are required to load the FFB onto a truck or lorry.

Fig. 3: Activity of loading fuit bunches into wheelbarrow using loading spikes.

F. Issues with current motorized tools and transport vehicles:

Even the mechanisation does improves the productivity and in cases does eliminates human and dangerous working situation interactions, there are room for improvements could be done. A few downsides could be identified for the current products. Technologies for harvesting for an instance, harvesters are exposed to vibrations where the mechanism will have about 600rpm during working conditions and the weight of the tool that weighs about 5kg (Jelani *et al*., 2008) could lead to muscle fatigue. Long working hours added with difficult terrain will make the tool less favourable in comparison to conventional tools.

Powered wheelbarrow or powered cart had greatly reduced the need for pushing activity. So does the transport vehicles. For powered wheelbarrows there are room for improvement in order to get faster mobility. For the time being by using powered wheelbarrows the speed to transport the FFB are still bound to the speed of walking, which is about 3 m/s.

To gain faster pace, the concept of vehicle can be considered for future development. But again, there are considerations that must be made. A more complex vehicle with more than one mechanism will surely increase its owning cost. Increasing the size and horse power too will increase the price. For large scale oil palm plantation such as FELDA, the pricing should not become a problem with high profit turnout. The cost paid for owning advance machineries to increase productivity can be cover-up just after a few collections.

Conclusion:

As a conclusion, tools and equipment replacement should be considered for the current manual tools and equipment since the current practice does gives real health risks and threats. For mechanised tools and vehicles, consideration of ergonomic and economic factors must be made in order to provide best capability with the most affordable cost for smallholders.

In terms of design for a manual cart, based on the findings from [8], design of a hand cart should be as the followings. Handle height at 85% of shoulder height for minimum effort for pushing or pulling. Total cart weight should not exceed the carrying limit based on number of wheels and with or without mechanisation.

Development of power assist machine and vehicle concept should also be considered other than manual powered cart in consideration of the rough surface with high coefficient of friction, heavy weight to be carried, to achieve better mobility and productivity.

Manual lifting of the fruit bunches meanwhile should be eliminated or the intensity of the activity should be reduced. A new technique for lifting or tool needs to be developed with consideration of inaccessibility of readily available large machineries.

Finally, this paper may not accurately reflect the current situations of current technologies. There are still many developments that are on-going from various organizations working independently. The purpose of this paper was only to compile and convey information about the various variables that influences the process of overcoming issues related with manual works in the oil palm plantations.

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