

The Cost Components of Occupational Accident in Oil Palm Plantations in Malaysia

Azizah Ahmad^{*}; Mohd Rafee Baharudin^{**}; Anita Abd Rahman^{**}; Salmah Muhamed[‡]; Izreen Supa'at^{‡‡}; Aidalina Mahmud^{**}; Samsul Bahari Mohd Noor[±] and Anne Noor Sri Juwaneeta Jamaludin^{±±}

Article history:

Received: 30 Oct. 2018

Accepted: 2 Jan. 2019

Available online: 21 March 2019

^{*} Department of Health Sciences, Faculty of Engineering and Life Sciences, Universiti Selangor, 40000 Shah Alam, Selangor, Malaysia.

^{**} Department of Community Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

[‡] Department of Accounting and Finance, Faculty of Economic and Management, 43400 UPM Serdang, Selangor, Malaysia.

^{‡‡} Department of Health Sciences, Faculty of Engineering and Life Sciences, Universiti Selangor, 40000 Shah Alam, Selangor, Malaysia.

[±] Department of Electrical and Electronic Engineering, Faculty of Engineering, 43400 UPM Serdang, Selangor, Malaysia.

^{±±} Department of Epidemiology and Public Health Medicine, Perdana University-Royal College of Surgeons in Ireland, 43400 Serdang, Selangor, Malaysia.
E-mail: azizah@unisel.edu.my

ABSTRACT

The cost of accident has a major impact on the company's financial performance. This article concerns on the cost of occupational accidents incurred planters during an accident in a plantation. It proposes a method to identify the accident cost based on harvest delays by using timeline penalty. The research objective is to develop a method for identifying the accident cost by using empirical data based on case studies. The results showed that the output loss was the highest contributor to the accident cost calculation. However, the cost may vary due to the situation and condition of the injured workers, such as temporary disability (TD), permanent disability (PD) and death (D). These cost components can be useful parameters for cost benefit analysis of accident prevention plan. This research aims to help companies improve their awareness of accident prevention, develop cost of accident analysis skills, implement a future plan in managing safety risk and actively participate in global safety and health issues. This study offers to bridge the significant gaps between research knowledge in current policy and practice, the collaboration of trade unions and employer's representative, demand for public health services and other welfare agencies and increase the safety awareness of employers.

Keywords: accident cost, agriculture, palm oil plantation, timelines penalty.

INTRODUCTION

The agriculture sector plays an important role in the development of the world economic. It is also one of the most hazardous sectors in all economic sectors, and many agricultural workers suffer from occupational accidents and ill health every year. In South East Asia alone, there has been an increase

in fatality due to occupational injuries in the agricultural sector has increased from 24.0 per 100 000 to 27.5 per 100 000 employees (Hämäläinen *et al.*, 2006). This paper proposes methods to identify costs related to industrial accidents in the agriculture industry, especially in relation to production loss. The study is only for the palm oil industries, as Malaysia holds

the position as one of the biggest producers and exporters of palm oil and palm oil products in the world.

There were some difficulties and challenges in developing a reliable evaluation of cost due to the lack of detailed statistical information on Malaysian accident data. Implementation of occupational safety and health in agriculture in Malaysia is lagging behind compared to the construction sector and the manufacturing sector. According to the Ministry of Human Resources Malaysia, in year 2012, 13.3% of Malaysian population worked in the agricultural sector. Data from Abdullah *et al.* (2011) are estimated to have 446 368 workers, in which 69% (foreigner) and 31% are locals. In 2012, 2267 accident cases were reported. During the year, the number of fatal accidents was 55 and total disability of 2212 people (Department of Statistic, 2012). According to the Fatal Accident Case Report from DOSH, 39 of the 404 cases of fatal accident were from palm oil plantation (DOSH, 2018). These accidents were caused by various factors, such as plantation workers facing hazardous activities due to different types of equipment, crop/plant, animal, machinery, chemical substances and environment (the Earth's surface under widely varying geographic and climate condition).

In 2014, a comprehensive study on the cost of accidents was made by DOSH Malaysia where it introduced an accident cost calculator for agricultural, construction, manufacturing and civil society. However, this calculator was generalised without considering issues associated with each type of crop planted. This data calculated from DOSH calculation creates a gap that has not yet been explored whereas palm oil-based agriculture is the main commodity crop in Malaysia.

Accidents still happen in palm oil plantation, which leads to loss of output, equipment and vehicles damage, capacity loss and others losses. However, most plantation companies could not identify the source of the loss. In addition, to the best of the author's knowledge, there are no reports on the palm oil plantation accident costs as a reference for the respective authorities. The limitations of assessing the cost of a palm oil accident have led policymakers to limit their ability to plan for OSH management, especially when assessing the cost-benefit analysis of accident prevention planning.

Theoretical background

In the agriculture industry, Malaysia is the second largest producer of palm oil in the world after Indonesia. However, the current scenario shows that the agricultural sector is the most hazardous sector worldwide (Ruslan *et al.*, 2016). Various studies have been conducted to identify occupational hazards in the palm oil industries where they are made to understand the current scenario of occupational hazards in formulating new policies, control measures and welfare improvement (Shamsul *et al.*, 2014). According to Nawi *et al.* (2016), their study revealed that palm oil workers are exposed to the daily hazardous work tasks of oil palm plantation, highlighting the ergonomic problems and risk of daily injuries. Meanwhile, International Labour Organisation produced Safety and Health Fact Sheet about major safety and health hazard in palm oil plantation industries in 2004.

The consequences of occupational accidents affect three main parties: employers (owner of oil palm plantation), plantation workers and society at large. The economic burden depends on the severity of accident

cases. In several studies, the costs related to these accidents are unevenly proportioned between parties. There were many different definitions of occupational accident costs; most studies define accident costs as direct and indirect costs. According to Labelle (2000), direct costs are easy to determine because they represent real expenses, and indirect costs that are difficult to determine. Definition done by Reville *et al.* (2001) states that the costs refer to the costs paid before (*ex-ante*) and after (*ex-post*) accidents. This study discusses the *ex-post* costs incurred by plantation companies after an accident. Based on previous studies, the costs involved are output losses, damage costs, medical costs, fines, insurance, investigation costs, rehabilitation costs, recruitment costs, work time and funeral costs (Gavious *et al.*, 2009; Abiuso and Figuera, 2007; Monk *et al.*, 1986). These findings are further supported by a review done by Ikpe (2009) which described the tangible cost incurred by employers including production reduction, machinery, equipment, and material damage, quality losses, recruitment and training of new staff, increase of production costs, increase of insurance premium, administrative costs, litigation costs and absenteeism.

Monk *et al.* (1986) described the output loss due to harvest delay can be estimated by four methods such as on-farm labour estimate, seasonal labour estimate, timeliness penalties and contractor cost estimates. To comply with palm oil industries, the timeliness penalty was used as the cost calculation approach. In addition, Monk *et al.* (1986) described that timeliness penalties were applied to time-sensitive farming operations, such as output loss due to critical delay during harvesting. The yield penalties is applied when the harvesting task is not completed

in the optimal time, resulting in yield loss. In the case of palm oil yield, the fresh fruit bunches (FFB) price was used on mill-gate basis as an indicator to calculate the production yield loss incurred by plantation owner. The estimation of output loss was calculated based on the scenario if a harvester is injured in an accident and withdraws from farm labour force.

The palm oil industry forms the economic backbone of Malaysia. The palm oil industry is regulated by the Malaysian Palm Oil Board (MPOB) as an agency dedicated to promoting and regulating the quality of practices in the palm oil industry provided under the Malaysian Palm Oil Board Act 1998 (Malaysian Palm Oil Board Act, 2006). Workers in oil palm plantations consist of various categories of workers, some of whom are paid daily, while others pay wages on a monthly basis. Monthly paid workers include administrative workers such as clerks and executives, while the plantation workers are paid on a daily basis. Plantation workers consist of general foreman, harvester foreman, harvesters/pruner and fresh fruit bunches (FFB) pickers, farm workers and general workers. Their salaries are calculated based on an agreement between the Agricultural Producers Association of Malaya (MAPA) and the National Union of Plantation Workers (NUPW). This agreement states that they practice piece-rate payment based on productivity such as fresh fruit bunch (FFB). In addition, they also provide a minimum monthly salary of RM 900.00 to their employees, provided they come every day and perform as directed.

According to the Malayan Agricultural Producers Association, employee wages are divided into two categories:

- Category I: wages and terms and

conditions of employment of harvesters, harvesting kanganyies, loaders and others loaders on oil palm estates, 2010. They are based on the current monthly-weighted average price of crude palm oil plus one position traded during the month. For example: RM 2722.00 per tonne. At the given price, the harvesting rates payable for the month will be those applicable to price zone “above RM 1900.00-2000.00 (inclusive)”, so the price bonus payable for the month was RM 5.30 per full day’s work employee.

- Category II: Rates of pay and terms based on minimum wages RM 900.00. The basic wage income rate for palm oil mill employees was RM 34.62 per day worked.

Besides that, they have the following incentives:

- Attendance/ productivity incentive: Up to RM 35.00 (work for all normal days offered)
- FFB Bunch checkers = + RM 1.00 per day
- Grass cutters = + RM 2.00 per day
- Chemical sprayer = + RM 1.00 per day
- Field application of empty fruit (EFB) = RM 3.50/mt
- Loaders = RM 4.00/mt
- Special gratuitous payment RM 200.00.
- For harvester: harvesting rate are listed below:
 - a) <1.5 metric tonne = RM 19.00/mt
 - b) 1.5 – 1.7 = RM 19.50/mt
 - c) 1.71 – 1.90 = RM 20.00/mt
 - d) > 1.91 = RM 21.00/mt

Most farms in Malaysia employ a harvesting group of two workers, one of which is a fruit cutter and one is a fruit picker. The job specification of a fruit cutter includes cutting fruits and branches,

whereas the fruit picker picks loose fruits. According to the information collected from the harvester, they can obtain a minimum of 150 bunches to 300 bunches of palm fruit per day. The average bunch is 10 - 25 kg or around 3750 kg - 7500 kg @ 3.75 - 7.5 tonne per day (Nawi *et al.*, 2016; Sime Darby, 2014). The yield depends on the method of knitting with a manual sickle or mechanical sickle. Some employers pay workers according to the tonnes obtained. In 2000, one tonne of palm fruit was paid RM 33.25 (Nawi *et al.*, 2016). However, based on the information from harvesters, the payment in 2012 increased to RM 40/mt and was shared between two employees.

When an accident occurs, the company will experience a loss of output of fresh fruit bunch per day. Late harvesting of palm fruit will increase the amount of loose fruit, thereby reducing the price of fresh fruit bunches. Palm fruits contain free fatty acid (FFA). The amount of FFA depends on the harvesting time. A late harvest of one day will reduce the amount of FFA in the fruit by 9%. According to Donough *et al.* (2010), indicator for a minimum ripeness standard (MRS) is one loose fruit (LF) at harvest. Some articles described the ideal harvest time when the number of loose fruits is between 1-10 per bunch. However, Idris Omar, 2010 described the loss of 20 loose fruits can reduce the oil extraction rate (OER) by 0.37%-0.92%.

The oil extraction rate grades are described in *Table 1*.

Grade	Percent of OER (%)
A	19
B	18 - 18.9
C	17 - 17.9

In this study, OER percentage minus penalty was used as shown in Equation 1.

Rated extraction rate =
extraction rate basis - penalty

Equation (1)

So, the losses of FFB output incurred by farmers are calculated in Equations 2 and 3.

Output loss 1 (FFB output) =
Estimated selling price of fresh fruit bunches on the day of the accident minus the estimated selling price of fresh fruit bunches with late harvested penalty.

Equation (2)

In order to estimate the output loss, the two approaches were combined. A situation was created in which the replacement workers came to work the day after the accident occurred, late harvest calculation was used to calculate the output loss and multiplied with the second approach of 10%-15% FFB loss due to insufficient harvesters and loose fruit pickers. This is shown in Equation 3. According to Veloo and Hitam (2012), the plantation company experienced reduction in productivity (FFB output) due to 10%-15% knitting done by lower skilled replacement workers.

Output loss 2 (insufficient workers) =
Estimated selling price of fresh fruit bunches with late harvested penalty multiple inefficient harvester percentage.

Equation (3)

METHODOLOGY

A retrospective occupational accident data from Social Security Organisation (SOCSCO) Malaysia was accessed and appointment was made with the relevant plantation

companies. In order to obtain accurate data, an interview was set with the company and its injured workers a year after the accident whereby the case has been closed. The calculation of the accident was presented based on the selected case study. The palm oil plantation located at Pahang Darul Makmur and the case of injured person was categorised as temporary disability based on the SOCSO database.

The model

The potential accident costs in calculating accident costing were included to build the structure of the occupational accidents cost model. The cost of these accidents is the total cost incurred regardless of whether it is direct costs or indirect costs. The accident cost consists of output loss (OL), damage cost (DC), medical cost (MC), legal cost (LC), insurance premium increase (IPI), investigation cost (IC), rehabilitation cost (RC), recruitment cost (RCC) and loss work time (LWM), as shown in Equation 4.

Total cost incurred by plantation company =
output loss (OL) +
damage cost (DC) +
medical cost (MC) +
legal cost (LC) +
insurance premium increase (IPI) +
investigation cost (IC) +
rehabilitation cost (RC) +
recruitment cost (RCC) +
loss work time (LWM).

Equation (4)

The variables involved are shown in *Table 2*.

Reliability of Instrument

A pilot test was conducted on a group of people involved in the agriculture field of University Putra Malaysia (UPM) in order to test the clarity and degree of difficulty

of the questionnaire. Translation and back-translation were done to remove the linguistic boundaries. The process was carried out with expert representatives during the development of questionnaire session. It involves translating the questionnaire into another language (English version) and then translating it back into the original language version.

Reliability test was used to measure the overall reliability of the relevant instruments by using the Cronbach's Alpha score. The Cronbach Alpha is used to show the homogeneity of the instrument in order to evaluate the inner reliability on average inter-item correlation. In this study, we used 17 accident cases for reliability testing. The Cronbach alpha for this questionnaire was 0.83. This shows that the reliability coefficient was above 0.70 and this result was accepted as evidence of internal consistency of the questionnaire.

RESULTS AND DISCUSSION

According to previous studies, accidents not only cause injuries to employees but also cause losses to companies through loss of production. Most accident cost studies focus more on the agricultural sector, but the impact of the cost of loss from palm oil plantation accidents remains unknown.

Empirical Evidence on the Magnitude of Accident Costs

Selection of case based on the SOCSO database using simple random sampling method. Secondary data details such as accident information, age and employee name can be obtained from Form 21 (Accident Report). The researchers have contacted the company to seek cooperation and make an appointment for the interview. Accident calculations

TABLE 2. VARIABLES OF ACCIDENT COST

Variables	Description of variables
Output loss (OL)	Output loss occurs when the harvesting process is delayed due to accident involving workers.
Damage cost (DC)	Cost incurred through the damage of raw material yields, vehicle, equipment and machinery. Some of them are insured; some of them are not insured. These studies only take the cost incurred by employers.
Medical cost (MC)	Medical costs include travelling cost to hospital via ambulance or other vehicles. It also includes the payment of medical treatment and hospitalisation. Since the plantation workers are provided with first-aids kits, the cost of consumable medical supplies is included. Some large plantation also provides treatment on site of the accident.
Legal cost (LC)	Company may be incurred to fines due to the breaking the law. Company may have to pay the legal fees is subjected to a hearing.
Insurance premium increase (IPI)	Workers are provided with welfare protection by Social Security Organisation (SOCSO) for local workers and the insurance from Department of Labour for foreign workers if any accident or occupational disease occurs. Plantation owners are required by government to bear insurance for their workers as the plantation workers are excluded from SPIKPA government policy guidelines.
Investigation cost (IC)	The costs incurred during investigation period involving the time taken by the supervisor, workers who be witness, administrative staff, assistant manager and manager. It also includes the time spent by the occupational safety and health committee to discuss this issue.
Rehabilitation cost (RC)	Cost spends on who went to the rehabilitation center or hospital to get treatment. In addition to the cost paid to the rehabilitation centre, employer also provides and bears other costs, such as counseling, training, workplace adjustments to allow the employee to return to work as usual. It also includes the travel expenses incurred by company.
Loss work time (LWM)	Lost work time refers to the loss of working time incurred by the company in order to restore working conditions. Company may or may not bear the cost from absence of injured worker, extra payment for overtime and extra time to re-organise the work. To prevent the recurrence of similar accidents, the company may provide a refreshment safety course in which this cost incurred by company.
Recruitment cost (RCC)	The recruitment costs happen when a worker dies or an injured worker is unable to return to the pre-injury job. Company has to hire new replacement workers by investing in advertisement, employment agencies and interview and training costs of new workers.

were presented based on the following conditions:

A 44-year-old healthy man suddenly slipped and fell when harvesting oil palm fruit early in the morning. His left leg was injured. He was given 29 days of medical leave. His case was categorised as temporary disablement (TD).

The cost of this situation is calculated in *Table 3*.

The total accident cost incurred by the company for this case was:

Total cost incurred by plantation company = Output loss (OL) + Damage cost (DC) + Medical cost (MC) + Legal cost (LC) + Insurance premium increase (IPI) + Investigation cost (IC) + Rehabilitation cost (RC) + Recruitment cost (RC) + Loss work time (LWT).

Total cost = RM 14 164.47 + RM 0 + RM 25 + RM 0 + RM 0 + RM 172.93 + RM 174.60 + RM 0 + RM 1505.77

Total cost = RM 16 042.77

The result showed that the main contribution to the total accident cost incurred by employers is the cost of output loss. The cost may vary according to the accident characteristics and injury pattern. It also depends on the type of work in the plantation. Increase in production loss will occur when the accident involves a group harvester. The calculation of output loss was based on the theory developed by Monk *et al.*, (1986), which described the output losses due to delay. The yield of palm oil is time-sensitive farming operations at harvest and is related to timeliness penalties.

The damage cost was zero, which means that the accident did not involve any product damage, equipment and machinery. This case study shows that the medical cost incurred by employers was only RM 25.00. This cost includes

travelling cost to the hospital, medical treatment, hospitalisation, first aid and on-site treatment. This calculation was based on the medical cost calculation method of Gavius *et al.* (2009). Meanwhile, according to Monk *et al.* (1986), medical cost consists of on farm medical treatment, ambulance services, private transport to hospital, hospital treatment (in-patient or out-patient), treatment by general practitioner and other forms of medical care. Brody, *et al.* (1990) gave a different opinion on category of medical cost by putting the cost under fixed prevention cost as ex-ante cost where the company pays to the insurer or insurance company first. Meanwhile, the Malaysian government provides subsidised medical treatment to local workers and a Hospitalisation and Surgical Scheme for Foreign Workers (SPIKPA) for foreign workers through the Ministry of Health.

However, most plantation companies in Malaysia have their own clinics or panel clinics to treat injured workers.

This case did not involve any legal prosecution. For workers, this is seen as common accident that can happen to anyone. According to Gavius *et al.* (2009), the legal expenses due to lawsuits fall under insurance cost and it is also categorised as direct cost of the company. However, the contradictory suggestion from Head and Harcourt (1998) stated that legal penalties was the indirect cost variables and it also uninsured accident cost borne by employers. Meanwhile, according to Lebeau, M and Duguay, P (2013), the legal cost borne by various parties involved consists of employers, employees and the community. This case did not involve increment of insurance premium. The welfare of the worker is protected through medical treatment and salary compensation provided by the

government through SOSCO and the Labour Department.

The investigation cost of this case was RM 172.93. This amount was calculated based on the worker's salary who was involved in the investigation of the accident. According to Gavius *et al.* (2009), this cost is included in the cost of work time. Meanwhile, Brody *et al.* (1990) noted that the investigation cost is broken down into specific cost variables, which are separated into administrative cost and production loss. However, in this study, the investigation cost stand on its own as categorised by Head and Harcourt (1997) and was included in the indirect employer cost where the investigation costs will be calculated from company's participation in official government inspections after a serious injury or death.

The amount of rehabilitation cost was RM 174.60. This cost consists of travel and medical treatment expenses, including equipment costs. In Malaysia, the cost of rehabilitation is mostly covered by government agencies (Ministry of Health and SOCSO) via subsidy and private institution company such as insurance company. However, the injured worker is paid between RM 1.00 to RM 40.00 for each visit to the hospital or clinic and it is claimable to the company. According to Lebeau and Duguay (2013), rehabilitation cost is part of the medical cost. Meanwhile, Systematic Accident Cost Analysis methodology (SACA) categorised this cost under 'others cost' category where it combines with fines incurred by the company (Rikhardsson and Impgaard, 2004). It was also supported by Head and Harcourt (1997) who stated this cost is borne by the employers.

The recruitment cost of this case study was zero. The employer claimed that for injured persons with a temporary disability case,

TABLE 3. CALCULATION OF ACCIDENT COST

Parameter (cost)	Value (RM)	Remarks
Loss output	14 164.67	Average yield of the primary harvester was 180 bunches per day. The secondary harvester takes his place. From calculation presented in Appendix A, the employer has experienced output loss of RM 488.44 per day. He got 29 days of medical leave. Total Loss of output per day X MC = RM 488.44 X 29 = RM 14 164.67
Damage	0	Damage cost of raw material yields (a) = 0 Damage cost of vehicle (b) = 0 Damage cost of equipment (c) = 0 Damage cost of machinery (d) = 0 Damage cost of cleaning the accident site (e) = 0 Total damage cost = (a) + (b) + (c) + (d) + (e) = 0
Medical	25.00	Travelling cost to hospital by car = km x RM 1.00 = 15 x RM 1.00 = RM 15.00 Medical treatment costs (deposit RM 30.00) = RM 0 Hospitalisation (wad class 3, free for citizen) = RM 0 Item in First-aids kit that had been used = RM 10.00 Treatment at the site of the accident = RM 0 Total cost : RM 25.00
Legal	0	Not applicable. None of the cases having a law suit.
Insurance	0	Not applicable. There was no increased in insurance premium payment has occurred. Monthly payment still remained based on employee's salary.
Investigation	172.93	Investigation: Time had been taken by employer and employees in investigation multiple with wage per hour. Supervisor = 4 hours X (RM 1200/26 working days/8 hours) = RM 23.00 Witness = 2 hours X (RM 900/26 working days/8 hours) X 2 person = RM 17.30 Administrative staff = 8 hours X (RM 1200/26 working days/8 hours) = RM 46.15 Assistant manager = 1 hour X (RM 2400/26 working days /8 hours) = RM 11.50 Manager = 0.5 hour X (RM 6000/26 working days /8 hours) = RM 14.40 Investigation meeting in JKKP for 1 hour (respective person) = (total wages of RM 12 600/26 days/8 hours) X 1 hour = RM 60.58 Total investigation cost = RM 172.93
Rehabilitation	174.60	Rehabilitation center = Hospital Temerloh (38 km) Number of visit multiple (to and fro) = 3 X 2 = 6 times traveling. Travelling distance = 38 km Mileage Claim Rate = RM 0.70 (referring to standard mileage claim at Malaysia) Travel cost between estate and hospital = 6 X 38 X 0.70 = RM 159.60 Hospital bill : RM 5 each section = 5 X 3 = RM 15 Travelling to Health Clinic Purun Temerloh for wound dressing: Frequency visit (return) = 6 times travelling Distance = 19 km Mileage claim rate = RM 0.70 Travelling cost = 6 X 19 X RM 0.70 = RM 79.80 Clinic fees = RM 1.00 per visit X 3 times = RM 3.00 Cost of counselling, training and workplace adjustments = 0 Total cost = RM 159.60 + RM 15.00 + RM 3.00 + RM 79.80 = RM 174.60

Recruitment cost	0	The cost incurred for hiring (advertisement, interview, employment agency and training the new workers). Cost for recruitment = 0
Work time	1505.77	Refreshment course of safety training after the accident. Cost per worker = RM 10.00 Number of workers : 150 Total refreshment course = RM 10.00 X 150 = RM 1500 Employer covers the salary of the absence worker = RM 0 Extra pay for overtime work = RM 0 Extra Time to re-organise the work: Supervisor wages per day = RM 46.15 Time taken to re-organise the work = 1 hour Total cost involved = 46.15/8 hour X 1 hour = RM 5.77 Total cost of work time = RM 1500 + RM 5.77

they implemented the temporary adjustment work schedule to cover the worker's task. The calculation of this cost is based on work done by Gavius *et al.* (2009), in which the recruitment cost was the hiring cost which included advertising, interview, manpower agencies and also training. They also categorised this cost as an indirect cost (Head and Harcourt, 1997; Gavius, *et al.*, 2009; Brody, *et al.*, 1990). However, Brody *et al.* (1990) categorised recruitment cost under administrative cost.

The total amount of this loss work time cost was RM 1505.77. This cost includes training cost, injured worker's salary (during medical leave), overtime payment for other workers and the time for workers to reorganise the work. According to Gavius *et al.* (2009), loss work time cost is the cost of wasted time, but it is borne by employers. In the Accident Consequence Tree method (ACT) published by Aaltonen *et al.* (1996), the authors described that the lost working time consists of sick pay to the injured worker for which the company gets no work value in return and the lost working time

leads to production disruption.

The study result supports the objective of this study, which is to identify reliable variables where it will be used to build the domain for accident cost calculation. This is very important to help the employer in calculating the real cost of an accident.

CONCLUSION

Most accident cases do not develop into court cases because the welfare of the workers is fully protected. However, in this study, shows that two variables which were legal cost and increase in insurance premium were not applied in the current situation (temporary disablement cases) in Malaysia. From literature, most of the costs borne by the insurance company and the government are medical costs and living expenses, especially in the accident cases involving permanent injury or death. Commitment from the top management also plays an important role in preventing accidents. As mentioned by Reville *et al.* (2001), employers always bear the costs before the accident such as workers' compensation

insurance premiums, injury-prevention programs, costs of compliance, compensating higher wages to workers for job risks, redundant hiring to insure against workplace injury. In addition, accident prevention costs such as the cost of personal protective equipment, safety personnel (SHO) salary, training, promotion and first aids facilities are also involved (Ikpe, 2009).

The method has included detailed sources contributing to the cost of the accident. Thus, it provided a good calculation of accident costs to bring added value to the occupational safety and health prevention decision making at the company level. Supporting safety practices is also a good business investment.

ACKNOWLEDGEMENT

The authors thank SOSCO Malaysia and DOSH Malaysia for all the information and financial assistance provided in this project. The authors also wish to thank the Director-General of MPOB for allowing this article to be published.

REFERENCES

- Aaltonen, M V P; Uusi-Rauva, E; Saari, J; Antti-Poika, M; Räsänen, T and Vinni, K (1996). The accident consequence tree method and its application by real-time data collection in the Finnish furniture industry. *Safety Science*, 23(1): 11-26. [http://doi.org/10.1016/0925-7535\(96\)00021-5](http://doi.org/10.1016/0925-7535(96)00021-5).
- Abdullah, R; Ismail, A; Khomeini, A and Rahman, A (2011). Labour Requirements in the Malaysian Oil Palm Industry in 2010. *Oil Palm Industry Economic J.*, 11(2): 1-12.
- Abiuso, F L and Figuera, D S (2007). An analysis of the costs of work-related accidents and illnesses in Catalonia. Government of Catalonia. Catalonia.
- Brody, B; Letourneau, Y and Poirier, A (1990). An indirect cost theory of work accident prevention. *J. Occupational Accidents*, 13: 255-270.
- Department of Statistic, M (2012). Selected Agricultural Indicator, Malaysia, 2012. Putrajaya, Malaysia.
- Donough, C R; Witt, C and Fairhurst, T H (2010). Yield Intensification in Oil Palm Using Bmp as a Management Tool. *International Oil Palm Conference*. Yogyakarta, Indonesia.
- DOSH (2018). Fatal Accident Case. Retrieved 1 November 2018, from <http://www.dosh.gov.my/index.php/en/component/content/article/352-osh-info/accident-case/955-accident-case>.
- Gavious, A; Mizrahi, S; Shani, Y and Minchuk, Y (2009). The costs of industrial accidents for the organisation: Developing methods and tools for evaluation and cost-benefit analysis of investment in safety. *J. Loss Prevention in the Process Industries*, 22(4): 434-438. <http://doi.org/10.1016/j.jlp.2009.02.008>.
- Hämäläinen, P; Takala, J and Saarela, K L (2006). Global estimates of occupational accidents. *Safety Science*, 44(2): 137-156. <http://doi.org/10.1016/j.ssci.2005.08.017>.
- Head, L and Harcourt, M (1997). The direct and indirect costs of workplace accidents in New Zealand. *AIRAANZ Conference, Brisbane, AU*, 36(2): 46-58. <http://doi.org/10.1177/103841119803600205>.
- Head, L and Harcourt, M (1998). The Direct and Indirect Costs of Work Injuries and Diseases in New Zealand. *Asia Pacific J. Human Resources*, 36(2): 466-474. <http://doi.org/10.1177/103841119803600205>.
- Idris Omar (2010). Anggaran hasil buah tandan segar di ladang. *Perusahaan Kelapa Sawit di Malaysia - Satu Panduan*. Kuala Lumpur. Lembaga Minyak Sawit Malaysia.
- Ikpe, E O (2009). Development of cost benefit analysis model of accident prevention on construction projects. University of

Wolverhampton. Retrieved from https://wlv.openrepository.com/wlv/bitstream/2436/98842/1/lkpe_PhD+thesis.pdf.

Labelle, J E (2000). What do accidents truly cost? *J. American Society of Safety Engineers (Profesional Safety)*, 45(4): 38-42.

Lebeau, M and Duguay, P (2013). The Costs of Occupational Injuries A Review of the Literature. Institut de recherche Robert-Sauve. Retrieved from <https://www.irsst.qc.ca/media/documents/PubIRSST/R-787.pdf>

Malaysian Palm Oil Board Act (2006). *Malaysian Palm Oil Board Act 1998*.

Ministry of Human Resources (2012). Statistik Perburuhan dan Sumber Manusia 2012, 2. Retrieved from <http://www.mohr.gov.my/docz/StatistikPerburuhan2012latest.pdf>.

Monk, A S; Morgan, D D V; Morris, J and Radley, R W (1986). The cost of accidents in agriculture. *J. Agricultural Engineering Research*, 35(4): 245-257. [http://doi.org/10.1016/S0021-8634\(86\)80062-2](http://doi.org/10.1016/S0021-8634(86)80062-2).

Nawi, N S M; Deros, B M; Rahman, M N A; Sukadarin, E H and Nordin, N (2016). Malaysian oil palm workers are in pain: Hazards identification and ergonomics related problems. *Malaysian J. Public Health Medicine*, 16: 50-57.

Reville, R; Bhattacharya, J and Sager Weinstein, L (2001). New Methods and Data Sources for Measuring Economic Consequences of Workplace Injuries. *American J. Industrial Medicine*, 40: 452-463.

Rikhardsson, P M and Impgaard, M (2004). Corporate cost of occupational accidents: An activity-based analysis. *Accident Analysis and Prevention*, 36(2): 173-182. [http://doi.org/10.1016/S0001-4575\(02\)00147-1](http://doi.org/10.1016/S0001-4575(02)00147-1).

Ruslan, R; Baba, I; Leman, A M and Wai, T L (2016). A framework of non-fatal occupational injury surveillance in palm oil mill - a proposed study. *ARPN J. Engineering and Applied Sciences*, 11(11): 7322-7330.

Shamsul, B M T; Manohar, A; Karmegam, K; Baba, M D; Azmin, S R and Shahrman, A B (2014). *Occupational Safety and Health in Commodity Agriculture: Case Studies From Malaysian Agricultural Perspective* (Khairunnisa Saliman and S B M Tamrin eds.). (First Edit). Selangor, Malaysia.

Sime Darby (2014). Palm oil facts and figures. Retrieved 20 September 2017, from http://www.simedarby.com/upload/Palm_Oil_Facts_and_Figures.pdf.

Veloo, R and Hitam, M F (2012). Plantation Labour: Need for management strategy. *The Planter : Magazine of the Incorporated Society of Planters.*, 88(1031): 125-137.

APPENDIX

The formula of Loss of output:

Loss of Output cost	= (FFB1 – FFB2) + (FFB2 X inefficient harvester percentage) X FFB3
FFB1	= CPO - (SES + CPO Traveling cost) * OER1 + (PK * KER) - FFB processing cost)
FFB2	= CPO - (SES + CPO Traveling cost) * (OER1 – OER Penalty) + (PK * KER) – FFB processing cost)
FFB3	= Number of FFB are sold (in tonne)
IHP	= Inefficient harvester percentage

The loss of output based on late harvest calculation as follows:

LO cost	= Loss of output of fresh fruit bunches.
FFB1	= Estimated selling price of fresh fruit bunches on the day of the accident.
FFB2	= Estimated selling price of fresh fruit bunches with late harvested penalty.

A step in calculation of fresh fruit bunches price.

Based on Palm Oil MPOB data 2012	
Crude Palm Oil Price (CPO) local delivered	RM 2764.00 / tonne
Palm Kernel (PK) local (ex-mill)	RM 1522 / tonne
Oil Extraction Rate (OER)	20.35%
Kernel Extraction Rate (KER)	5.1%
The weight of fresh fruit bunches (FFB) sold (tonne)	1
*SES CPO / Cess rate	RM 26
CPO Transportation costs	RM 35
CPO processing cost	RM 45
**Penalty of oil extraction rate (POER)	0.92

Note: *refer to schedule 1 for CESS calculation.

SCHEDULE 1. OIL PALM FRUIT CESS RATE

OIL PALM FRUIT CESS RATE	
Monthly Average Price of Crude Palm Oil* (MYR/t)	Oil Palm Fruit Cess Rate (MYR/t)
Less than or equivalent to 1500	0
Above 1 500 until 1 600	2.00
Above 1 600 until 1 700	4.00
Above 1 700 until 1 800	6.00
Above 1 800 until 1 900	8.00
Above 1 900 until 2 000	10.00
Above 2 000 until 2 100	12.00
Above 2 100 until 2 200	14.00

Above 2 200 until 2 300	16.00
Above 2 300 until 2 400	18.00
Above 2 400 until 2 500	20.00
Above 2 500 until 2 600	22.00
Above 2 600 until 2 700	24.00
Above 2 700 until 2 800	26.00
Above 2 800 until 2 900	28.00
Above 2 900 until 3 000	30.00

Note: *Based on Malaysian monthly average price of crude palm oil published by Malaysian Palm Oil Board (MPOB).

STEP 1. PRICE OF CRUDE PALM OIL (CPO) IN TONNE

	FFB1	FFB2
Price of Crude Palm Oil (local)	RM 2764	RM 2764
Minus expenditure		
- Ses CPO 26		
- Travelling cost CPO 35	61	61
Net price CPO at mill gate (a)	2703	2703
Multiple OER (b)	20.35%	
Multiple (OER – POER)		19.43%
Sale value of CPO on the FFB (a x b)	RM 550.06	RM 525.19

STEP 2. PRICE OF PALM KERNEL (PK) IN TONNE

Price of Palm Kernel (a)	RM 1522
Multiple KER (b)	5.1%
Sale value of Palm Kernel (PK) (a x b)	RM 77.62

STEP 3. PRICE OF FRESH FRUIT BUNCH (FFB) IN TONNE

	FFB1	FFB2
Sale value of CPO & PK on the FFB	627.68	602.81
Minus FFB processing cost (tonne)	RM 45	RM 45
Net value CPO & PK on the FFB	RM 582.68	RM 557.81

STEP 4. SALES VALUE OF FRESH FRUIT BUNCH (FFB)

	FFB1	FFB2
FFB price at mill gate (tonne) (a)	582.68	557.81
Multiple total sale of FFB (tonne) (b)	1	1
Sale Value of FFB at mill gate (a x b)	RM 582.68	RM 557.81

Output loss cost = (FFB1 – FFB2) + (FFB2*0.15) X 1

Output loss cost = (582.68 – 557.81) + (557.81 X 0.15) X 1 = 24.87 +83.67 = RM 108.54 per tonne.