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Risk Assessment on Safety and Health of Workers in Oil Palm Plantation

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Abstract

The safety and health of workers in the oil palm plantation industry were of paramount importance due to the hazardous nature of agricultural work. Workers encountered multiple hazards and faced risks related to posture, chemical exposure, and physical strain during various field operations such as harvesting, weeding and pest control, manuring, and collecting and loading Fresh Fruit Bunches. Neglecting safety and health practices in oil palm plantations could result in increased rates of injuries and fatalities, significantly impacting workers and the industry's overall success. The objectives of the study were to identify the risk levels in safety and health, identify the field operation contributing to the highest risk, and determine the relationship between risks in field operations and workers' productivity. Data were collected through distributed structural questionnaires, on-site observations, and interviews. Thus, this study was conducted at oil palm plantation company in Kluang, Johor and the sample size was 132 workers using simple random sampling. Probability Impact Matrik and SPSS version 26 have been used in this study and the results indicated that weeding and pest control posed the highest risk (risk no 1), followed by harvesting (risk no 2), manuring (risk no 3), and collecting and loading (risk no 4). Only harvesting demonstrated a positive relationship with workers' productivity among these activities. The findings of this study provided valuable insights into the levels of risk of activity, the identification of high-risk field operations, and the relationship between risks and workers' productivity.

Keywords: Risk Assessment, Safety and Health, Oil Palm Plantation, Harvesting, Fresh Fruit Bunch

Introduction

According to the International Labor Organization (ILO), agricultural work is associated with over 170,000 annual deaths, making it the most hazardous occupational industry in the context of operating oil palm plantations, workers are exposed to a range of hazardous activities, including chemical and physical hazards during tasks such as harvesting, weeding and pest control, manuring, and collecting and loading Fresh Fruit Bunches (FFB). During harvesting, workers encounter various hazards and face high risks associated with posture, such as back pain, neck strain, and shoulder injuries. The use of heavy manual tools and the need to constantly look up while harvesting to avoid contact with FFB and fronds contribute

to these risks. In the case of weeding and pest control, the World Health Organization (WHO) estimates that agricultural workers experience 1-5 million cases of pesticide poisoning annually, resulting in 220,000 fatalities (Boedeker et al., 2020). Additionally, workers carrying knapsacks weighing around 15 kg during spraying operations are at risk of developing back pain and shoulder injuries. This study aims to conduct a comprehensive risk assessment to evaluate the safety and health risks faced by workers in the oil palm industry. Safety and health are rules and procedures to prevent accidents and injuries at work or in public places. By identifying and ranking the risk levels associated with core plantation tasks such as harvesting, weeding and pest control, manuring, and collecting and loading Fresh Fruit Bunches (FFB). The study provides actionable insights that can inform workplace safety policies and ergonomic interventions. The findings not only highlight the operations with the highest risks, particularly weeding and pest control, but also establish a link between occupational risk and worker productivity, emphasizing that unsafe working conditions can directly impact operational efficiency. The study's results serve as a vital reference for plantation managers, occupational health professionals, policymakers, and labor organizations in designing targeted risk mitigation strategies, enhancing worker safety, reducing injuries, and improving overall productivity and sustainability in the oil palm sector.

Effects of Harvesting in Safety and Health of Workers

Harvesting Fresh Fruit Bunches (FFB) in oil palm plantations can be tough on the health of workers (Rozadi & Fatin, 2021). The job involves awkward postures, bending, and exertion, which can lead to pain and potential injuries in the knees, back, hands, arms, neck, shoulder, and spine (Ng et al., 2014). Workers also must look up and bend while cutting tall trees, putting extra strain on their neck and trunk (Vaschalis & Suswanto, 2020). Using manual tools for this task increases the risk of injury. The combination of repetitive movements, forceful exertion, and uncomfortable postures makes FFB harvesters susceptible to musculoskeletal disorders and injuries (Ng et al., 2014).

Effects of Collecting and Loading FFB on the Safety and Health of Workers

The process of collecting and loading Fresh Fruit Bunches (FFB) in oil palm plantations can be tough on workers' safety and health. Manual methods are commonly used, and workers may experience sprained shoulders from handling loading bars and suffer back pain due to frequent bending while collecting and swinging FFB (Ng et al., 2014). Workers using the Mini Tractor Grabber (MTG) face the risk of extreme neck rotation during FFB collection. The Mechanical Buffalo (MB) used in hilly terrain exposes workers to excessive noise and vibration, leading to physical strain (Abdu, 2020). These tasks put workers at risk of musculoskeletal disorders like sprained shoulders and back pain due to the repetitive nature of the work. The noisy and vibrating conditions of machines like the MB can also contribute to discomfort and potential injuries.

Effects of Weeding and Pest Control in Safety and Health of Workers

Nag (2011) stated that the process of weeding and pest control in oil palm plantations can have serious effects on workers' safety and health. Workers use knapsack sprayers to apply pesticides, which can lead to exposure through inhalation or skin contact. This repetitive and physically demanding work can cause exhaustion, back discomfort, skin issues, and other health problems. Improper spraying procedures and inadequate pesticide disposal practices

can also contribute to worker exposure (Sukardin et al., 2013). Previous research has linked pesticide exposure to various cancers and other health issues (Vaschalis & Suswanto, 2020).

Effects of Manuring in Safety and Health of Workers

The process of manuring in oil palm plantations can be risky for workers' safety and health (Abdu, 2020). Workers usually use manual methods to load heavy fertilizer bags onto lorries and spread the fertilizer in the field. This repetitive task can lead to back pain, shoulder, arm, and hand injuries. Moreover, applying manure generates dust and fumes that can irritate workers' eyes, nose, and respiratory system. Handling heavy bags and using equipment for spreading can also increase the risk of accidents and injuries (DOSH, 2008). In summary, manual manuring in oil palm plantations poses safety and health risks, including musculoskeletal injuries and exposure to dust and fumes.

Materials and Methods

This research conducted at Plantation company which was located at Kluang, Johor, Malaysia. The company was a company that focused on oil palm production with the complete implementation of machinery to increase the productivity of Fresh Fruit Bunch. Location of the study was chosen was to determine how safety and health could affect the workers' productivity and to identify the major risks present at this location of the study.

Data Collection Method

The researcher carried out this research paper by using the primary data and a set of questionnaires to collect data for the risk assessment of workers' safety and health through a distributed structural questionnaire. The survey consisted of three parts which the first part of the questionnaire comprised demographic information such as age, height, weight, working experiences, and medical information. The second part of the questionnaire contained worker's productivity, the risk level, and pain experience while performing tasks such as harvesting, collecting, and loading, weeding and pest control, and manuring. It was to determine the risk level and which body parts experienced pain by workers as a result of their daily work routine. The final part was to assess the risk level in harvesting, collecting, loading FFB, weeding and pest control, and manuring.

Research Design

Quantitative research was used in this study to collect all the data and information from the respondent, which involved 132 workers. The analysis used for this study was descriptive analysis was used to summarize the data collected from the questionnaire to demonstrate the demographic data, workers productivity, risk faced by workers in field operations such as harvesting, collecting, and loading FFB, weeding and pest control in field operations. Descriptive analysis and correlation analysis in SPSS version 26 was used to find relationships between different variables in the data such as harvesting, collecting, and loading FFB, weeding and pest control, and manuring with workers' productivity. Probability Impact Matrix was used to classify and prioritize risks for each activity, such as harvesting, collecting, and loading FFB, weeding and pest control, and manuring. A 5x5 risk matrix was used for risk assessment and management. It involved plotting risks on a grid with two axes: one for the probability of the risk happening and the other for the impact or severity of the risk. The matrix had five levels for both probability and impact, making a total of 25 cells.

Table 1
Probability Impact Matrix

	Impact				
Probability	1	2	3	4	5
5	5	6	15	16	25
4	4	7	14	17	24
3	3	8	13	18	23
2	2	9	12	19	22
1	1	10	11	20	21

Conceptual Framework
Conceptual framework shows the dependent variable and independent variable used in this study. The dependent variable was workers' productivity and independent variables were harvesting, weeding and pest control, manuring and collecting and loading of fresh fruit bunches (FFB) as stated in the Figure 1.

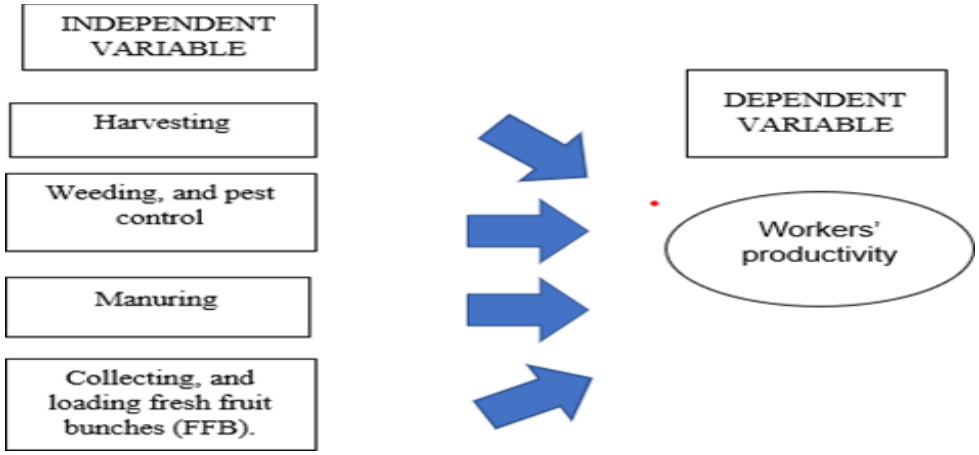


Figure 1 Dependent and independent variables

Result and Discussion
Risk Faced in Harvesting Activity
Table 2 reveals that the highest risks for workers are shoulder pain and hand/arm pain during harvesting, followed by back pain. The lowest risks were being crushed by FFB and knee pain. These findings align with previous research, indicating physical challenges during harvesting, such as postural stress and awkward postures, leading to various pains and discomforts.

Table 2
Risk faced by workers in harvesting.

Statistics

		How would rate the risk level and probability risk happen in your job in oil palm plantation?	Have get the medical leave (MC) because of accident during harvesting activities	Does hand feel any pain while doing harvesting work?	Did feel backpain while harvesting?	Have feel pain at shoulder when harvesting FFB?	Have feel pain at waist when harvesting FFB?	Have feel pain at knee when harvesting FFB?	Does faced the risk of being crushed by FFB while harvesting?
N	Valid	33	33	33	33	33	33	33	33
	Missing	0	0	0	0	0	0	0	0
Mean		2.4545	2.0606	2.3030	2.2424	2.6970	2.1212	1.6667	1.6061
Median		2.0000	2.0000	2.0000	2.0000	3.0000	2.0000	2.0000	2.0000
Minimum		1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00
Maximum		3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Risk Faced in Collecting and Loading FFB Activity
According to the table 3, workers had a moderate to high risk of back pain and a low to moderate risk of neck pain while loading FFB using machinery. The lowest risk was associated with shoulder pain and injuries resulting from repetitive motions during FFB collection and loading. Previous research also supported these findings, indicating shoulder sprains among unskilled workers and back pain due to bending during FFB collection. Workers using Mini Tractor Grabber faced a significant risk of neck rotation during FFB collection (Abdu, 2020).

Table 3
Risk faced by workers in collecting and loading FFB

Statistics

		How would rate the risk level of your job and probability of the risk happen in oil palm plantation? (Collecting and loading FFB)	Have get the medical leave (MC) if facing a pain after collecting and loading FFB into the tractor or mechanical buffalo (MB)?	Have felt waist pain when collecting and loading FFB into the tractor?	Have ever felt back pain when collecting and loading FFB into the tractor?	Does arm feel any pain when collecting and loading FFB into the tractor?	Have facing a pain at shoulder when collecting and loading FFB into the tractor?	Did face a risk of physical strain or injury due to repetitive motions in collecting and loading FFB?	Does facing a pain at neck area when performing the loading of FFB by using Mini – Tractor Grabber (MTG) or any machine that mounted to the tractor?	Does the machinery noise affect sense of hearing while/after using the mechanical buffalo (MB), Mini – Tractor Grabber (MTG) or any machine that mounted to the tractor? or tractor?	Does facing an ergonomic hazard associated with prolonged siting while using the while/after using the mechanical buffalo (MB, Mini – Tractor Grabber (MTG) or any machine that mounted to the tractor?
N	Valid	33	33	33	33	33	33	33	33	33	33
	Missing	0	0	0	0	0	0	0	0	0	0
Mean		2.5758	1.1212	1.9091	2.5758	1.6364	1.4545	1.4545	1.9697	1.9091	1.90909
Median		3.0000	1.0000	2.0000	3.0000	2.0000	1.0000	1.0000	2.0000	2.0000	2.00000
Minimum		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.000
Maximum		3.00	2.00	2.00	3.00	3.00	2.00	2.00	3.00	3.00	3.000

Risk Faced in Weeding and Pest Control
The table 4 indicated that workers faced the highest risk due to prolonged pesticide exposure without access to water for personal hygiene. Shoulder pain, back pain, and trouble breathing were also significant risks. Limited access to clean water was consistent with previous research in similar settings. The nature of the work, involving repetitive tasks and pesticide exposure, put workers at risk of various health issues (Ismail et al., 2016).

Table 4
Risk Faced by Workers in Weeding and Pest Control

Statistics

		How would rate the risk level of your job and probability the risk happens in oil palm plantation? (Weeding and pest control)	Have get the medical leave (MC) if facing a pain after spraying process	Have facing a trouble in breathing during application of spraying process	Have facing headache after spraying process?	Have experiencing skin itching during/after spraying process?	Did face a risk of physical strain or injury due to repetitive motions in weeding and pest control operations?	Did facing a back pain when carrying the conventional knapsack (CKS) due to repetitive motion?	When drinkleat, does make sure to clean yourself out after spraying process?	Have facing a shoulder pain during carrying the conventional knapsack?	Did expose to pesticides for prolonged periods without access to clean drinking water or facilities for personal hygiene?
N	Valid	33	33	33	33	33	33	33	33	33	33
	Missing	0	0	0	0	0	0	0	0	0	0
Mean		2.4848	1.5152	2.5152	2.1515	2.1818	2.2727	2.5455	2.8485	2.6667	2.9091
Minimum		2.00	1.00	2.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00
Maximum		3.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Risk Faced in Manuring Activity

According to the table 5, the highest risk for workers was back pain, followed by physical strain or injury during manuring operations and shoulder pain. This aligns with prior research, which highlighted the risks associated with carrying heavy bags of fertilizer and repetitive movements involved in spreading it. Preventive measures and ergonomic considerations are essential to minimize musculoskeletal injuries. Additionally, the handling of manure could generate dust and fumes, emphasizing the need for safety protocols and training to reduce accidents and promote worker well-being.

Table 5
Risk faced by workers in manuring

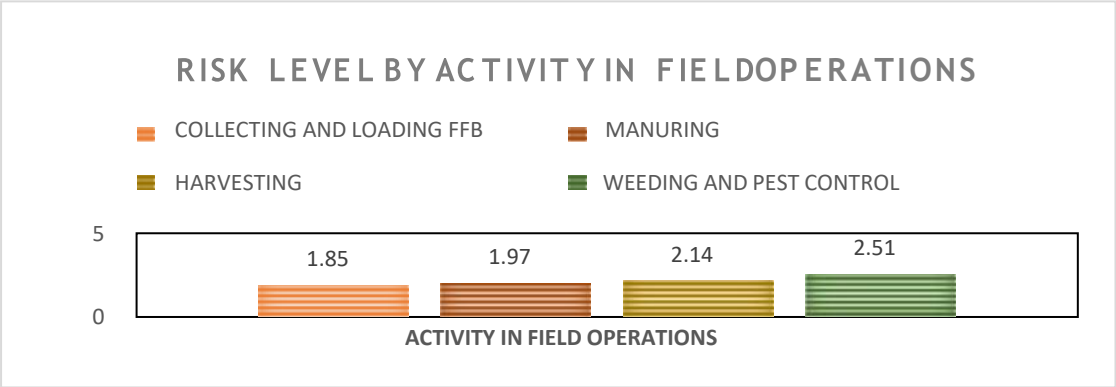
Statistics

		How would rate the risk level of impact and probability the risk happens in oil palm plantation?	Have get the medical leave (MC) if facing a pain after applying fertilizer manuring?	Does facing a trouble breathing during manuring process?	Have feel back pain while in manuring process?	Have experiencing skin itching during/after manuring process	Have experiencing shoulder pain when carrying manure during manuring process?	Did facing a risk of physical strain or injury due to repetitive motions in manuring operations?
N	Valid	33	33	33	33	33	33	33
	Missing	0	0	0	0	0	0	0
Mean		2.0000	1.7273	1.7273	2.3333	1.7576	2.0000	2.2424
Median		2.0000	2.0000	2.0000	2.0000	2.0000	2.0000	2.0000
Minimum		2.00	1.00	1.00	1.00	1.00	2.00	2.00
Maximum		2.00	2.00	2.00	3.00	2.00	2.00	3.00

Risk Level by Activity in Field Operations

The Bars chart in Figure 2 shows that weeding and pest control activities have the highest risk (2.5084) in an oil palm plantation due to handling pesticides and potential exposure to hazardous chemicals. Harvesting follows with a moderate to high risk (2.1439) due to handling sharp tools and exposure to falling fronds. Manuring is ranked third with a low to moderate risk (1.9697) due to handling fertilizers and potential exposure to dust or chemicals. Collecting and loading FFB have the lowest risk (1.8515) due to physical strain from lifting and navigating uneven terrain.

Figure 2
Risk Level by Activity in Field



Correlations Analysis between Workers Productivity with Field Operations
The results in the table 6 showed a weak positive correlation (r = 0.404) between harvesting and workers' productivity, supported by a p-value of 0.020. This implies that as the risk of harvesting increased, workers' productivity decreased. The rejection of the null hypothesis confirmed a significant relationship between harvesting and productivity, aligning with the result from Nalini, (2023). Workers facing higher risks in harvesting exhibited lower daily harvest quantities compared to healthier counterparts. The analysis for collecting and loading FFB showed a non-statistically significant correlation (r = -0.328) between collecting and loading FFB and workers' productivity (p-value = 0.06). Therefore, there was no significant relationship between the two. Contrary to some prior research, this result suggested that decreasing the risk in collecting and loading FFB might not have a substantial impact on workers' productivity.

Factors such as automation and standardized procedures could have contributed to this finding. The analysis found a non-statistically significant correlation (r = 0.013) between weeding and pest control and workers' productivity (p-value = 0.94). Therefore, there was no significant relationship between the two. Decreasing the risk in weeding and pest control did not have a significant impact on workers' productivity. This result differed from prior research, possibly due to confounding variables such as worker experience, training, and management practices on the plantation. The efficiency of pest control methods might have also influenced workers' productivity. The analysis showed a non-statistically significant correlation (r = -0.163, p-value = 0.37) between weeding and pest control and workers' productivity. Decreasing the risk in manuring appeared to increase workers' productivity. Prior research contradicted this finding, as manuring activities involve handling fertilizers and exposure to dust or chemicals. However, effective safety protocols, proper training, and standardized procedures might have minimized the risks and indirectly contributed to workers' productivity. Other factors, such as overall management practices and worker motivation, could also have influenced productivity in agricultural settings.

Table 6

Correlations Analysis between Workers Productivity with Field Operations

Correlations

		MEAN_DV_4	MEAN_IV_HARVESTING	MEAN_IV_COLLECTING	MEAN_IV_SPRAYING	MEAN_IV_MANURING
MEAN_DV_4	Pearson Correlation	1	.404*	-.328	.013	-.163
	Sig. (2-tailed)		.020	.063	.942	.365
	N	33	33	33	33	33
MEAN_IV_HARVESTING	Pearson Correlation	.404*	1	-.321	-.132	-.094
	Sig. (2-tailed)	.020		.069	.464	.602
	N	33	33	33	33	33
MEAN_IV_COLLECTING	Pearson Correlation	-.328	-.321	1	.089	.061
	Sig. (2-tailed)	.063	.069		.623	.737
	N	33	33	33	33	33
MEAN_IV_SPRAYING	Pearson Correlation	.013	-.132	.089	1	-.119
	Sig. (2-tailed)	.942	.464	.623		.510
	N	33	33	33	33	33
MEAN_IV_MANURING	Pearson Correlation	-.163	-.094	.061	-.119	1
	Sig. (2-tailed)	.365	.602	.737	.510	
	N	33	33	33	33	33

*. Correlation is significant at the 0.05 level (2-tailed).

Conclusion

In this case study, the results indicate that weeding and pest control pose the highest risk (no 1), followed by harvesting (no 2), manuring (no 3), and collecting and loading FFB (no 4). Among these activities, only harvesting demonstrated a weak positive relationship with workers' productivity. Meanwhile, collecting and loading FFB, manuring and weeding and pest control does not show any significant relationship with workers' productivity. The study found that harvesting can cause back pain, neck strain, and shoulder injuries due to poor posture. Weeding and pest control expose workers to pesticide poisoning and musculoskeletal issues from heavy knapsacks. Manuring poses chemical and physical hazards, leading to eye irritation and asthma. Collecting and loading FFB tasks increase the risk of shoulder sprains and back pain due to manual labour and repetitive movements

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