Volume: 10 Issues: 62 [September, 2025] pp. 532 - 539
International Journal of Accounting, Finance and Business (IJAFB)
eISSN: 0128-1844
Journal website: www.academicinspired.com/ijafb
DOI: 10.55573/ IJAFB.106244

RISK ASSESSMENTS OF HARVESTING ACTIVITY IN OIL PALM PLANTATION AT KUALA KANGSAR, PERAK

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Article history
Received date : 4-9-2025
Revised date : 5-9-2025
Accepted date : 5-10-2025
Published date : 15-10-2025

To cite this document:
Mahiyuddin, M. A. M., Khairuddin, F., Aani, S. N. A., & Noor, W. N. W. M. (2025). Risk assessments of harvesting activity in oil palm plantation at Kuala Kangsar, Perak. *International Journal of Accounting, Finance and Business (IJAFB),* 10 (62), 532 – 539.

Abstract: *Malaysia's oil palm plantations contribute to the country's economic growth, but they also raise significant environmental concerns. It has become a substantial player in the oil palm industry. Harvesting activities present several risks that can significantly impact oil palm production. These risks, if not adequately managed, can lead to a decrease in production levels, adversely affecting both the company and the broader agriculture sector. Therefore, the primary objective of this study was to investigate the major impacts of oil palm harvesting activities on oil palm production. The study examined four key risk factors, which are labour risk, mechanical risk, physical risk, and ergonomic risk. Data was collected from 40 respondents at Plantation in Kuala Kangsar, Perak, using closed-end questionnaires, and the results were analysed using SPSS version 29. The analysis revealed that all four risk factors have a notable influence on technology adoption within the harvesting process. Specifically, the correlation analysis demonstrated that each risk factor is significantly related to the oil palm production. Moreover, the multiple linear regression analysis highlighted that labour risk is the dominant factor, with a strong correlation coefficient of 0.800 and a highly significant p-value of less than 0.001. This finding underscores the critical impact of labour-related issues on production efficiency. Based on these results, it is recommended that the company enhance its safety protocols by implementing stringent measures. This includes regular maintenance of harvesting equipment, conducting comprehensive ergonomic assessments to reduce physical strain on workers, and addressing labour-related challenges through improved working conditions and training. By adopting these recommendations, the company can mitigate the identified risks, improve technology adoption, and ultimately enhance oil palm production.*

Keywords: *Oil palm production, harvesting activity, labour risk, mechanical risk, physical risk and ergonomic risk.*

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Introduction

The story of Malaysia's oil palm plantations is a compelling narrative of economic growth intertwined with significant environmental challenges. In the 1960s, facing economic difficulties due to low rubber prices, the Malaysian government initiated the "Land Development Scheme," which encouraged small farmers to transition from rubber cultivation to oil palm. This strategic shift helped Malaysia emerge as a major player in the global palm oil industry, alongside Indonesia, with approximately 5.74 million hectares of plantations by 2024. However, the rapid expansion of the industry has led to serious environmental issues, including deforestation and the loss of wildlife habitats. In response to these challenges, the industry is increasingly focusing on sustainability, adhering to standards set by the Roundtable on Sustainable Palm Oil (RSPO) to promote responsible practices that minimize environmental impact. The harvesting process is critical to the industry's success and can be performed using both manual and mechanized methods. Manual harvesting, while labor-intensive and capable of producing high-quality fruit, poses significant health risks to workers, including musculoskeletal disorders from repetitive tasks and awkward postures.

Conversely, mechanized harvesting enhances efficiency but introduces mechanical risks that must be carefully managed. Moreover, the industry faces challenges related to labor, particularly a shortage of skilled workers, which can lead to inefficiencies and increased accident rates. Approximately 60% of manual harvesters report experiencing back pain and joint problems, underscoring the physical strain of the work. To address these multifaceted issues, the industry must prioritize worker safety by implementing ergonomic practices, improving working conditions, and investing in training programs. Hence, this study aims to identify the impact of harvesting activity on the workers, to investigate the major impact of oil palm harvesting activity on oil palm production, and to examine the relationship between the impact of harvesting activity and production. By focusing on these areas, the research makes a significant contribution to the development of best practices within the agricultural sector, specifically guiding oil palm companies in striking a balance between operational efficiency and the welfare of their workers.

The findings from this study are instrumental in shaping strategies that ensure both high productivity and improved worker conditions, fostering a sustainable and ethical approach to agriculture. This study plays a pivotal role in informing policy development that supports worker health and safety. It advocates the uptake of sustainable agriculture practices that not only would work to protect the environment but also augment the welfare of workers. By balancing economic success with environmental stewardship and worker well-being, Malaysia's oil palm industry can continue to thrive while ensuring a sustainable future for all stakeholders involved.

Literature Review

Harvesting, the final stage of this production cycle, plays a crucial role in determining both the yield and economic viability of oil palm farming. Oil palm accounts for nearly 40% of global vegetable oil consumption. However, the harvesting process comes with significant risks, particularly concerning worker safety and the quality of the fruit (Murphy et al., 2021). One major concern is the potential for Musculoskeletal Disorders (MSDs) among workers, which can result from the repetitive and strenuous physical tasks involved in harvesting (Ayu et al., 2024). Factors such as a worker's age, years of experience, and the length of their daily shifts can greatly influence their risk of developing these disorders. This underscores the need for thorough assessments of these variables to evaluate safety and health risks effectively. By

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identifying workers who may be more vulnerable to MSDs, targeted interventions and preventative measures can be implemented (Santos et al., 2015). This highlights the importance of comprehensive Occupational Health and Safety (OHS) training and diligent supervision to promote a culture of safety. By fostering adherence to OHS guidelines, the industry can minimize injuries and enhance the overall well-being of its workers (Claxton et al., 2021).

Ergonomic Risk

Manual harvesting involves awkward postures, repetitive movements, and heavy lifting, leading to musculoskeletal disorders (MSDs) such as back pain, shoulder injuries, and carpal tunnel syndrome (Nuruly et al., 2019). The harvesting activities in oil palm plantations pose significant ergonomic risks to workers, with studies indicating that the manual nature of this work contributes to a higher risk of MSDs, particularly in the upper extremities (Nabila & Tri, 2023). Additionally, unsafe actions among oil palm harvesters are influenced by variables such as knowledge, attitudes, length of service, and Occupational Health and Safety (OHS) supervision. Workers lacking adequate training or with shorter service periods may be more prone to unsafe practices, increasing their risk of injury (Iskandar et al., 2023).

Mechanical Risk

The introduction of mechanized harvesting in the oil palm industry has brought significant benefits, such as increased productivity and reduced reliance on manual labor. However, these advantages come with complex mechanical risks that require careful examination and mitigation. Utilizing ergonomically designed tools and exploring safe mechanization options can help decrease physical strain on workers and minimize fruit damage (Muhamad & Firdaus, 2018). Although mechanization can be initially costly, it has been shown to enhance harvesting efficiency by covering more area, reducing labor requirements, and improving workers' quality of life. By integrating mechanical solutions, the industry can alleviate the physical burden on workers, thus reducing the incidence of pain and enhancing overall productivity (Ahmad et al., 2023).

Physical Risk

During harvesting and collection, workers face hazards such as falling fruits or branches, which can lead to cuts, bruises, and potentially serious injuries (Murphy et al., 2021). Research indicates that factors like age, years of service, work duration, and posture significantly influence the likelihood of pain among palm oil harvesters, emphasizing the need for thorough evaluations of these risk factors (Ayu et al., 2024). Additionally, unsafe actions in the field, non-compliance with personal protective equipment (PPE), and unsafe behaviors contribute to accidents during oil palm harvesting. Ensuring that workers adhere to safety protocols and consistently use PPE is crucial for reducing these risks and preventing accidents (Iskandar et al., 2023).

Labour Risk

The Malaysian palm oil sector is currently facing a shortage of around 40,000 foreign workers, which poses significant challenges for the industry (Megan, 2020). Manual palm oil harvesting has been associated with pain among workers, influenced by factors such as age, years of experience, and duration of work shifts. These factors significantly contribute to the prevalence of pain complaints, underscoring the importance of thorough risk assessments to mitigate health concerns (Ayu et al., 2024).

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Research Methodology

This study was conducted at oil palm plantation company in Kuala Kangsar, Perak, to investigate the major risks associated with harvesting activities that impact oil palm production. Simple random sampling was used to choose a representative sample of 40 workers from 50 harvesting workers using the RaoSoft calculator. A quantitative method was employed in this study, using surveys and observations conducted through a closed-ended questionnaire. All the questions used a Likert-type scale based on five (5) point (1=Strongly Disagree, 5=Strongly Agree).

On field, the respondents were first briefed about the survey and the questionnaire was then distributed to all workers, and they were guided to answer all questions to obtain the relevant information. The questionnaire is divided into three sections: Part A collects demographic information such as gender, age, and race, while Parts B and C address oil palm production and the key risks impacting harvesting activities.

Figure 1 illustrates that oil palm production is the main outcome as dependent variable. Oil palm production is influenced by several factors, known as independent variables. These include mechanical risks, such as equipment failure and safety hazards associated with machinery used in the production process. Ergonomic risks are also significant, involving issues related to worker posture, repetitive tasks, and workstation design, all of which can contribute to discomfort or injury. Labour risk is tied to labour, such as the availability of workers and absenteeism. Physical risk arises from environmental conditions such as excessive noise, extreme temperatures, inadequate lighting, and exposure to hazardous materials.

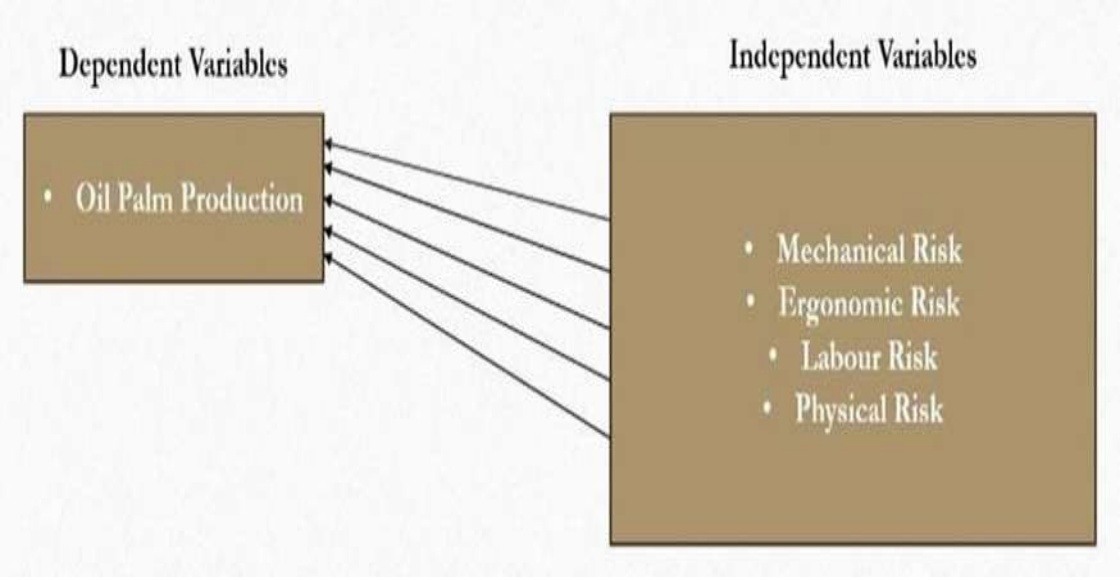

Figure 1: The Conceptual Framework Consists of Dependent and Independent Variables

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Results and Discussions

Risk Faced in Harvesting Activity

Figure 2 shows the proportion of risks that influenced oil palm production, which involved mechanical, ergonomic, physical, and labour risks. The major risks faced by the workers during harvesting activity are ergonomic risks reported by over 50% of respondents. Labour risk follows, at around 22.5%, indicating that issues like worker availability, skills, and reliability also play a substantial role. Mechanical risk is the least significant, with only about 10% of responses, suggesting that machinery-related issues are not as pressing as the other risks. These findings align with Abdullah et al. (2023), who reported that palm oil harvesters are at a high risk of developing work-related musculoskeletal disorders due to poor postures, high physical exertion, and excessive spinal loads.

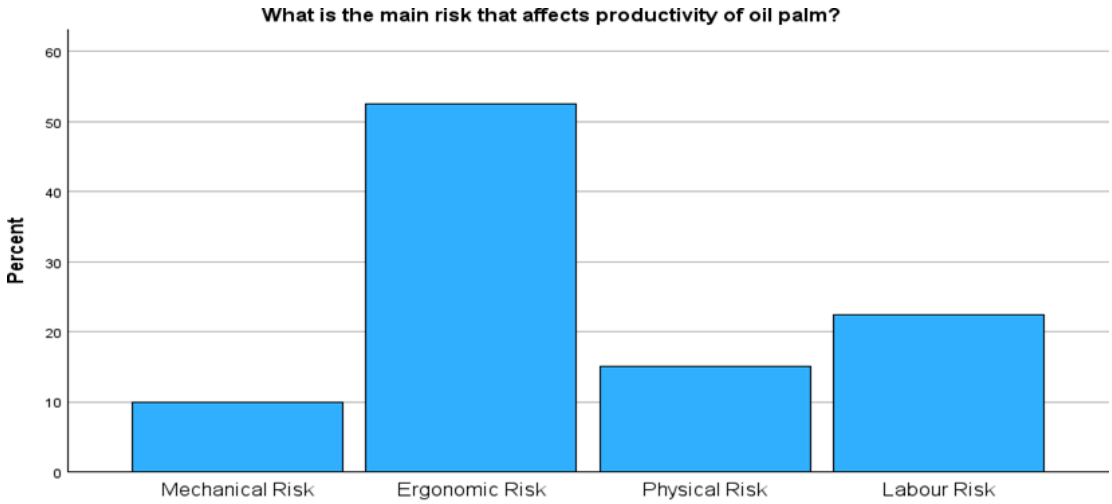

Figure 2: The main Risk that Affects the Oil Palm Production

Major Risks Influencing Oil Palm Production

This report presents the results of a multiple regression analysis conducted to examine the influence of four independent variables (mean_iv, mean_iv2, mean_iv3, mean_iv4) on the dependent variable (mean_dv). The findings provide insights into the significance of these variables. Based on the results shown in Table 1 found that mean_iv4, which is labour risk, is the strongest positive effect on oil palm production with a larger standardized Beta (0.800) and a highly significant p-value (<0.001). The result demonstrates that labour risk has a strong positive effect on oil palm production. Improving labour conditions can significantly boost productivity. Research indicates that a shortage of foreign workers has greatly reduced yields and caused revenue losses due to lower production (Lin & Wei, 2018).

Table 1: Major Risks Influence Oil Palm Production

Model	B	Beta	t	Sig
Constant	-0.802	–	-1.033	0.308
Mechanical Risk (Mean_Iv)	0.178	0.144	0.876	0.387
Ergonomic Risk (Mean_Iv2)	0.433	0.295	2.295	0.028
Physical Risk (Mean_Iv3)	-0.451	-0.435	-2.767	0.009
Labour Risk (Mean_Iv4)	1.045	0.800	6.269	<0.001

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Table 2 presents the Pearson correlation analysis conducted to examine the relationships between the dependent variable (Mean_Dv) and four independent variables (Mean_Iv, Mean_Iv2, Mean_Iv3, Mean_Iv4). Oil palm production (Mean_Dv) and Labour risk (Mean_Iv4) demonstrated a strong, highly significant positive correlation ($r = 0.681$, $p < 0.001$), identifying Labour risk as the most impactful independent variable related to oil palm production. It has been shown that delays or inadequacies in maintenance and harvesting practices directly reduce both productivity and output. This is consistent with the observation by Mohamad Fadli (2023), who noted that the shortage of foreign labour has significantly reduced palm oil yields in Malaysia. Mean_Iv and Mean_Iv2 also show moderate, positive, and statistically significant correlations with oil palm production ($r = 0.365$, $p = 0.021$ and $r = 0.353$, $p = 0.026$, respectively). This indicates that these variables also have a meaningful, though less pronounced, effect on production. In contrast, Mean_Iv3 shows a weak and non-significant correlation with oil palm production ($r = 0.216$, $p = 0.181$), suggesting it does not play a significant role in influencing production outcomes in this dataset.

Table 2: Correlation analysis between dependent variable and independent variables.

		Mean Dv	Mean_Iv	Mean_Iv2	Mean_Iv3	Mean_Iv4
Mean DV	Pearson Correlation	1	.365*	.353*	.216	.681**
	Sig. (2-tailed)		.021	.026	.181	<.001
	N	40	40	40	40	40

Conclusion

This study provides critical insights into the major risks affecting harvesting activities and their impact on oil palm production at a plantation in Kuala Kangsar, Perak. The findings clearly show that among the four risk factors analyzed are mechanical, ergonomic, physical, and labour risks. Labour risk emerges as the most dominant and influential factor, with a strong positive effect on oil palm production. This aligns with the multiple regression and correlation analyses, which identified labour-related challenges, such as worker shortages and working conditions, as key determinants of production efficiency. Additionally, ergonomic and mechanical risks were shown to have notable effects, underscoring the importance of addressing physical strain and equipment reliability to enhance operational performance. The study highlights the need for the industry to implement robust safety protocols, regular equipment maintenance, ergonomic assessments, and comprehensive training to mitigate these risks. By focusing on these areas, companies can not only improve productivity but also promote the well-being and safety of their workforce.

Acknowledgements

The authors would like to extend their sincere gratitude to all employees who participated in the survey, with special thanks to the workers at the oil palm company in Kuala Kangsar, Perak. Deep appreciation is also extended to all individuals who contributed directly or indirectly to this study and provided encouragement throughout its completion. The authors are especially grateful to the Faculty of Plantation and Agrotechnology, UiTM, for their continuous support and assistance.

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