Implementation of Occupational Safety and Health Using the Hiradc Method (Hazard Identification, Risk Assessment, And Determining Control) in Palm Oil Plants: Literature Review

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Absract

The palm oil industry is one of the important sectors in Indonesia that employs a large workforce and contributes significantly to the national economy. Crude palm oil, also known as CPO, and its increasing demand worldwide, drive the growth of this industry. Behind its benefits, the process of processing fresh fruit bunches (FFB) into CPO carries very high hazard potential if not properly managed, as each stage of production involves interactions between humans, machinery, the work environment, and hazardous chemicals. The purpose of this study is to thoroughly analyze the application of the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) method in palm oil mills. Data sources were collected from 6 national journals published between 2019 and 2024 with the keywords "HIRADC, Occupational Health and Safety, Palm Oil Industry, Hazard Identification, Risk Control." The review results indicate that each work station can face various hazards, ranging from mechanical risks due to using unguarded machines, slippery work floors, exposure to hot vapors, to health threats from usage. Using the HIRADC method, risk assessment produces risk categories ranging from low, medium, high, and extreme. These categories are then used as the basis for implementing control strategies according to the hierarchy of controls, which include elimination, substitution, engineering controls, administrative controls, and the use of personal protective equipment (PPE). Nevertheless, previous research has also found that the main problem causing the risk of accidents to persist is the low level of worker compliance with occupational safety regulations and the suboptimal implementation of standard operating procedures (SOPs). Therefore, the findings of this analysis indicate that the routine and continuous application of the HIRADC method can reduce workplace accident risks, protect workers' health, and improve company productivity. Hence, the implementation of this method must be accompanied by increased supervision, regular training, promotion of a safety culture, and the development of worker discipline.

Keywords: HIRADC; Safety, Work, Risk Control

Introduction

The palm oil industry is growing rapidly, resulting in intense competition. Every company requires funding and technology, as well as attention to occupational safety and health (OSH) during the production process, because every production activity can cause accidents, either due to negligence or unsafe working conditions. PT. Beurata Subur Persada (BSP) faces various risks in the production environment, including falling at the workplace, being exposed to hot liquids, or slipping on stairs. The HIRARC method, which is used to identify, assess, and control risks, is applied to

reduce these risks. This method is expected to improve workplace safety and increase the company's productivity. (Putra & Saputra, 2022)

Every industry, including the palm oil industry, must implement occupational health and safety (OHS) standards, which are extremely important. To protect workers while ensuring the continuity of production processes, occupational safety management (OHS) is crucial across all business lines. This is because the use of unsafe machinery, equipment, and working conditions are all factors that can cause workplace accidents. (Maliza & Putri, 2024)

Indonesia contributes approximately 85–90% of global palm oil production, making it one of the largest producers in the world. Capable of absorbing a large workforce while also serving as a key commodity for the national economy, palm oil plantations have developed into a strategic sector. However, along with the increase in production and plantation area, significant challenges related to occupational health and safety (OHS) have emerged in the palm oil processing industry. The process of converting fresh fruit bunches (FFB) into crude palm oil (CPO) involves various stages that, if not properly managed, can lead to workplace accidents. Therefore, to ensure a safe working environment is maintained, hazards must be identified, risks assessed, and controls established through HIRARC risk analysis .(Ulimaz, 2022)

Occupational health and safety (OHS) is directly related to worker productivity and safety. PT. Sumber Sawit Makmur still experiences cases of workplace accidents despite having implemented an OHS management system in accordance with Government Regulation of the Republic of Indonesia No. 50 of 2012. Additional analysis is required using the Hazard Identification Risk Assessment and Risk Control (HIRARC) method and Fault Tree Analysis (FTA) because these findings indicate that the implementation of OHS is not yet optimal. This analysis must be conducted to identify potential hazards, assess risks, and provide recommendations for improvements aimed at reducing the number of workplace accidents and achieving the zero-accident target. (Syarif et al., 2023)

The use of pesticides in oil palm plantations has increased along with the expansion of land and labor. This condition raises workers' exposure to active pesticides, increasing the risk of occupational health problems. Although RSPO and ISPO standards require the implementation of the Occupational Health and Safety Management System (SMK3), most previous studies have focused on workplace accidents in palm oil mills rather than pesticide exposure in plantations .(Maksuk, 2019)

With increasing competition in the palm oil industry, companies must optimize their resources, especially labor, to produce high-quality products. However, due to various potentially dangerous machines and equipment during the production process, workers often face safety and health issues. Therefore, to prevent accidents that could harm the company, a workplace safety system must be implemented. (Tarigan et al., 2023)

Method

This research is a literature review, where the data sources in this study come from literature in the form of national journals that have been published and obtained from the search engine 'Google.' The research data concerns the implementation of occupational health and safety using the HIRADC (Hazard Identification, Risk Assessment, and Determining Control) method in palm oil factories from 2019 to 2024, with the keywords 'HIRADC, Occupational Health and Safety, Palm Oil Industry, Hazard Identification, Risk Control.' A total of 6 research journals were obtained, which were then filtered again based on the suitability of the title, abstract, and content relevant to this study, resulting

in a total of 6 journals.

Result

This table presents a summary of hazard identification, risk assessment, and control measures (Table 1).

Tabel 1. Hazard Identification,Risk Assesment,Determining Control

Reference	Place/Area	Potential Hazard	Potensial Risk	DeterminingControl
(Putra & Saputra, 2022)	1. Stairs going up and down to the sterilizer.	1. Slipped on the stair step	1. Broken leg/arm, sprain, head bump	1.Enginering control.
	2. Bottom cover of the sterilizer	2. Exposed to hot liquid	2. Burns, peeled skin	2.Enginering control.
	3. Thresher oil storage floor.	3. Splashed with oil, the floor is slippery	3. Peeling skin, sprained ankle.	3. Oil spill cleanup, slippery floor warning signs, PPE.

This table presents a summary of hazard identification, risk assessment, and control measures (Table 2).

Tabel 2. Hazard Identification,Risk Assesment,Determining Control

Reference	Place/Area	Potensial Hazard	Potensial Risk	Determining Control
(Maliza & Putri, 2024)	1. Sterilizer - Boiling door.	1. Workers can get caught in the door when opening/closing or be exposed to hot steam.	1. Severe burn, amputation	1. Strict SOP for opening/closing, full PPE, safety interlock on sterilizer door.
	2.Sterilizer-Control room & tabung.	2. A faulty electrical panel/unstable voltage can explode.	2. Electric shock, burns, fire, death.	2. Routine inspection of electrical panels, calibrated safety valves & pressure gauges, operating SOP & confined work permits.
	3.Sterilizer - FFB Inspection.	3. Worker exposed to hot vapor while checking the ripeness of TBS.	3. Mild to moderate burn.	3. PPE, proper vapor ventilation, procedural training.

This table presents a summary of hazard identification, risk assessment, and control measures (Table 3).

Tabel 3. Hazard Identification,Risk Assesment,Determining Control

Reference	Place/Area	Potensial Hazard	Potensial Risk	Determining Control
(Ulimaz, 2022)	1. Loading Ramp - Work floor area.	1. Crumbs are scattered on the floor.	1. The worker slipped and fell	1. Clean the floor regularly, use anti-slip safety shoes.
	2.Loading Ramp - The process of loading Fresh Fruit Bunches (TBS) onto the truck.	2.The FFB fell/bounced onto the worker.	2. Head injury, bruise.	2. Use a safety helmet, SOP for truck loading.
	3.Loading Ramp - Pulling trucks with a capstan.	3. The sling cable snapped and hit the worker.	3.Worker was thrown and injured.	3.Use a new/usable sling cable, perform regular equipment inspections.

This table presents a summary of hazard identification, risk assessment, and control measures (Table 4).

Tabel 4. Hazard Identification,Risk Asseesment,Determining Control

Reference	place/Area	Potensial hazard	Potensial Risk	Determining Control
(Syarif et al., 2023)	1TBS Weighbridge.	1. Hit by FFB.	1. Serious injury to a worker.	1. Use PPE (helmet, safety shoes).
	2.Capstand.	2.The capstan rope is wound up/broken.	2. Thrown, trapped, seriously injured.	2.Routine inspection, K3 sign installer, using PPE.
	3.Kernel Silo	3.Polishing drum (stuck).	3. Crushed finger, amputation	3. PPE (gloves, helmet, safety shoes), machine inspection, safe work training.

This table presents a summary of hazard identification, risk assessment, and control measures (Table 5).

Tabel 5. Hazard Identification,Risk Assement,Determining Control

Referance	Place/Activity	Potensial hazard	Potensial Risk	Determining Control

	1. Pesticide spraying - workers are not fully using PPE	1Pesticide droplets inhaled (mask not up to standard, gloves not worn)	1Red eyes, cough	1. Provision of PPE according to standards, socialization, and education on occupational health and safety culture.
(Maksuk, 2019)	2. Workers do not undergo decontamination after being exposed to pesticides.	2Pesticide residues stick to the skin and clothing	2. Itchy, red, irritated skin	2Wash your hands and change clothes after work
	3. Work environment (pesticide materials)	3. Pesticide droplets and used containers are disposed of carelessly	3. Eye irritation, dry skin, environmental pollution	3. Managing waste according to procedures, providing designated disposal areas

This table presents a summary of hazard identification, risk assessment, and control measures (Table 5)

Tabel 6. Hazard Identification,Risk Assement,Determining Control

Referance	Tempat/Area	Potensi Bahaya	Potensi Risiko	Determining Control
(Tarigan et al., 2023)	1.Sortasi	1. Dropping fruit from the top of the fork truck is not acceptable, temperature >35°C	1. Head injury, fatigue, dehydration	1. Use of PPE, technical engineering, administration
	2. Boiled (sterilizer)	2. Caught in the boiler door, hot steam, noise >85 dB	2. Burns, hearing impairment, trapped in machinery	2. Elimination, PPE (earplugs, gloves, helmet), engineering controls
	3.Digester&presser	3. Slippery floor, hot pipes, machines without protective barriers	3. Slipped, burned, hand trapped in machine	3.Rekaya engineering

Discussion

Hazard Identification,Risk Assesment,Determining Control

According to the journal by Putra & Saputra (2022), hazard identification, hazard potential, risk potential, and control determination are discussed because these four elements are integrated into the HIRARC method. Hazard identification is necessary to identify sources of hazards present in the work area, such as machinery, equipment, materials, environment, and workers. The company can identify conditions that may lead to workplace accidents and plan preventive measures from the beginning. Hazard potential and risk potential are discussed to explain the cause-

and-effect relationship of a hazardous condition to workers. For example, a slippery floor or oil splashes can pose hazards such as sprains, burns, and fractures. From this, we can assess the likelihood of occurrence and the severity of the impact. The results of this assessment produce risk levels of low, medium, high, and extreme. These values can be used to determine which type of management is most important.

Meanwhile, the determination of controls is intended to show how a business can manage or mitigate these risks to prevent greater losses. Control is carried out by following a hierarchy of controls, which includes elimination, substitution, engineering, administrative measures, and the use of personal protective equipment. Therefore, this discussion is important because it not only identifies hazards but also offers practical solutions to make the work environment safer and healthier for all employees.

Hazard Identification,Risk Assesment,Determining Control

According to Maliza & Putri (2024), each work area has different risk conditions. It is important to discuss the location, potential hazards, and potential risks in the sterilizer station. For example, workers may slip and get injured on a slippery floor; the boiling door carries risks of electric shock and fire; and the electrical panel carries risks of electric shock and fire. To clearly identify the sources of hazards, detailed identification is required. Furthermore, risk assessment is carried out based on likelihood and severity of impact. In this way, organizations can identify low, medium, high, or extreme risk levels and prioritize hazards that require immediate attention.

In addition, determining control measures, also referred to as control determination, is discussed as it serves as a practical approach to reduce identified risks. The established control measures include strict implementation of SOPs, use of PPE (such as helmets, safety clothing, gloves), and regular inspections of electrical panels and pressure valves. Since most accidents are caused by worker negligence or non-compliance with safety rules, these controls are considered very important. Therefore, the company must also provide regular training and briefings so that employees become more disciplined in following the established work procedures. Thus, the implementation of HIRARC through the process of risk identification, assessment, and control can help improve workplace safety and reduce the number of accidents occurring at the sterilizer station.

Hazard Identification,Risk Assesment,Determining control

According to Ulimaz (2022), discussions on hazard identification, potential hazard identification, risk potential, and control determination are carried out. To ensure that every action at the loading ramp station that could potentially cause an accident is recognized early, such as slippery floors due to loose fruit bunches, falling TBS, or broken sling cables, hazard identification is necessary. After identification, the potential hazards are determined and linked to risks, such as workers slipping, head injuries, or serious injuries from being thrown. This assessment helps the company prioritize controls by indicating low, medium, or high risk levels.

The process of determining controls is discussed because it serves to prevent identified risks from causing accidents. For example, use anti-slip safety shoes to prevent slipping, wear a safety helmet to protect the head from falling objects, and use new and suitable sling cables to prevent breakage during use. These control measures demonstrate that the HIRARC method not only assesses potential hazards but also provides practical solutions in accordance with OHS standards. Thus, the company can create a safer working environment and provide protection for workers while they work at the loading ramp station.

Hazard Identification,Risk Assesment,Determining control

According to Sharif (2023), the purpose of implementing Hazard Identification, Risk Assessment, and Determining Control (HIRADC) is to identify hazards at each workstation, assess their risk levels, and determine appropriate controls. Each workplace has different levels of hazards. At the weighbridge, for example, there is a possibility of being caught, being struck by a bunch of fresh fruit bunches (FFB), or being hit by a truck; at the boiling station, for instance, there is a risk of exposure to hot steam, being caught by a loader, and being affected by noise. This hazard identification process is very important for a company to clearly understand the potential accidents that may occur. After that, a risk assessment is conducted to determine the severity of the hazard and the likelihood of the accident occurring. The results of this assessment produce five risk categories: low, medium, high, and extreme. Based on these categories, the company can determine which types of controls are most critical for them.

The control determination stage is carried out to reduce existing risks by using strategies such as engineering controls, administrative controls, and the use of personal protective equipment (PPE). The installation of safety signs, provision of fire extinguishers, maintenance of equipment and electrical installations, and employee training are some forms of controls implemented at PT Sumber Sawit Makmur. In addition, the organization also provides PPE such as helmets, masks, gloves, earplugs, and safety shoes. However, Syarif (2023) emphasizes that because the level of employee compliance with PPE usage is still low, work accidents still occur. Therefore, the HIRADC table, which lists the location, potential hazards, potential risks, and control determination, serves as a systematic reference to prevent workplace accidents and achieve the goal of zero accidents.

Hazard Identification,Risk Assesment,Determining control

According to Maksuk (2019), pesticide spraying has a high potential danger to workers' health, indicating that the use of the Hazard Identification, Risk Assessment, and Determining Control (HIRAC) method in palm oil plantations is necessary. Hazard sources such as workers not using personal protective equipment, pesticides being inhaled or coming into contact with the skin, and the absence of decontamination facilities were identified. This identification shows that actual threats can cause problems such as red eyes, coughing, itchy skin, and even serious irritation. This stage is very important for the company to gain a clear understanding of field conditions and to identify hazards that may affect workers, materials, and work facilities.

Next, a risk assessment is carried out to determine the severity and probability. The assessment results indicate risks ranging from moderate to high. For example, inhaling pesticides can cause red eyes and coughing, while pesticide residues that remain on the skin can lead to itching and redness. Based on these findings, various control measures are implemented, including standard personal protective equipment, sanctions for non-compliant workers, awareness campaigns on occupational health and safety culture, and the provision of designated decontamination areas. As a result, the HIRAC table, consisting of components such as location, hazard potential, risk potential, and control determination, serves as a systematic reference to prevent occupational diseases, reduce pesticide exposure, and protect the health of workers in oil palm plantations.

Hazard Identification,Risk Assesment,Determining control

According to Tarigan et al. (2023), the objective of implementing the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method is to provide a comprehensive overview of potential hazards in the production area, the level of risk they pose, and appropriate control methods. Location analysis is crucial because each station in the palm oil processing process—ranging from sorting, boiling, thresher, digester, clarification, kernel, to boiler—has different working conditions. Based on direct field observations, hazards can arise from workers (such as fatigue or improper use of personal protective equipment), the work environment (such as high temperatures, noise, and slippery floors), and equipment (such as unguarded machines, broken ropes, or hot steam leaks). Without identifying the sources of hazards, risks cannot be effectively controlled; thus, hazard identification serves as the basis for preventing workplace accidents.

In addition, risk assessment is conducted to determine the severity and likelihood of occupational accidents. Tarigan et al. (2023) found that there are risks in the categories of high, medium, low, and very low, indicating different levels of risk at each station. The results of this assessment lead to the implementation of control measures in accordance with the hierarchy of controls: elimination, substitution, engineering controls, administrative controls, and the use of PPE. For example, at the boiling station, it is necessary to eliminate the habit of smoking in the production area and implement engineering controls such as installing machine guards, while at stations with high noise levels, the use of earplugs is required as part of PPE. Therefore, the application of HIRARC, which encompasses the location, potential hazards, potential risks, and controls, not only provides a systematic risk map but also ensures concrete actions to reduce the number of occupational accidents and improve worker safety.

Conclusion

Based on a literature review on the application of the hazard identification, risk assessment, and determining control methods in palm oil processing, each work station has different hazard potentials, risk levels, and control methods influenced by work conditions, equipment characteristics, environment, and worker activities. Based on research in the literature regarding the application of the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) method in the palm oil industry, it can be concluded that each work station has its own hazard potentials, risk levels, and control methods. The HIRADC method has been proven capable of providing a systematic overview of various hazards that may arise. This includes mechanical factors such as unguarded machinery, slippery floors, and broken sling cables, chemical factors such as exposure to pesticides and steam, and environmental factors such as high temperatures and noise above the threshold. After thoroughly identifying the risks, the organization can assess the risks based on the likelihood of occurrence (probability) and the intensity of impact (severity), resulting in low, medium, high, and extreme risk categories.

Additionally, HIRADC provides practical guidance for determining control measures in accordance with the principles of the hierarchy of controls, which include administrative controls, elimination, substitution, engineering controls, and the use of personal protective equipment (PPE). The HIRADC control method has been proven to improve worker safety and enhance the efficiency, productivity, and operational sustainability of the company. In other words, the implementation of this method not only focuses on worker safety issues but also helps achieve broader company objectives, such as maintaining the competitiveness of the palm oil industry and reducing workplace accident rates.

Nevertheless, the analysis findings also indicate that there are several obstacles that continue to hinder the use of this method. These include workers who do not comply with personal protective equipment (PPE) requirements, lack discipline in implementing standard operating procedures (SOPs), and a lack of an internalized occupational health and safety (OHS) culture in the workplace. These conditions suggest that the implementation of the HIRADC method requires support through increased management supervision, ongoing training and education, as well as the company's commitment to building a strong OHS culture across all business lines. With the HIRADC system working in conjunction with workforce development, it is expected that occupational accident and disease risks can be minimized. Overall, it can be concluded that the HIRADC method is an important and effective strategy in efforts to create a safe, healthy, and productive work environment in the palm oil industry. The zero-accident target can be achieved if it is applied consistently, comprehensively, and supported by increased worker awareness and compliance.

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