



OCCUPATIONAL SAFETY RISK ASSESSMENT DURING PURSE SEINE VESSEL UNLOADING OPERATIONS AT KUTARAJA OCEANIC FISHING PORT, ACEH

PENILAIAN RISIKO KESELAMATAN KERJA PADA OPERASI BONGKAR KAPAL PURSE SEINE DI PPS KUTARAJA, ACEH

Fis Purwangka^{1*}, Okto Ijen Aritonang², Erlangga Lumbantoruan², Fani², Nabila Dinantiar Adelianoor²,
Vivi Septi Sari³, Kasman Madi⁴, Ridwan Maulana Nugraha⁵

¹Department of Fisheries Resource Utilization, Faculty of Fisheries and Marine Sciences, IPB University,
Jl. Agatis, IPB Dramaga Campus, Bogor 16680, Indonesia

²Study Program of Marine Fisheries Technology, Faculty of Fisheries and Marine Sciences, IPB University,
Jl. Agatis, IPB Dramaga Campus, Bogor 16680, Indonesia

³Study Program of Agro-Maritime Logistics, Multidisciplinary, IPB University, Jl. Agatis, IPB Dramaga Campus, Bogor 16680, Indonesia

⁴Study Program of Marine Science and Technology, Faculty of Fisheries and Marine Sciences, IPB University,
Jl. Agatis, IPB Dramaga Campus, Bogor 16680, Indonesia

⁵Study Program of Management, Universitas Bhakti Asih Tangerang, Jl. Raden Fatah No.62, Ciledug, Tangerang,
Banten 15151, Indonesia

*Corresponding author: fis@apps.ipb.ac.id

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ABSTRACT

Occupational Health and Safety (OHS) is a crucial aspect of preventing workplace accidents and illnesses, particularly during high-risk vessel unloading operations at the Kutaraja Oceanic Fishing Port (OFP) in Banda Aceh. Inadequate implementation of safety programs, such as hazard identification, risk analysis, and risk control, is a primary cause of workplace accidents in this sector. This study aimed to identify activities and analyze occupational safety risks associated with the unloading process of purse seine vessels at OFP Kutaraja over one month, focusing on seven vessels. The methodology involved direct observation, interviews with crew members, and data analysis using the Job Safety Analysis (JSA) approach. Risk assessment was conducted using a risk matrix that factored in both severity and probability. The results indicate that the unloading operation comprises three main stages: pre-unloading, the unloading process, and post-unloading. Each stage presents varying levels of risk, ranging from "Acceptable" to "Unacceptable". The highest risks were associated with handling fish-filled brail nets and transporting the catch, activities that carry the potential for serious accidents. Contributing risk factors included the lack of use of personal protective equipment (PPE), suboptimal work procedures, and unsafe working conditions. Safety during vessel unloading operations could be improved through regular training, increased PPE usage, and the implementation of a JSA-based risk control system.

Keywords: occupational safety, risk analysis, vessel unloading

ABSTRAK

Keselamatan dan Kesehatan Kerja (K3) merupakan aspek penting dalam mencegah kecelakaan dan penyakit akibat kerja, terutama pada aktivitas bongkar kapal yang memiliki tingkat risiko tinggi di Pelabuhan Perikanan Samudra (PPS) Kutaraja, Banda Aceh. Minimnya implementasi program keselamatan kerja, seperti identifikasi bahaya, analisis risiko, dan pengendalian risiko, menjadi faktor utama penyebab kecelakaan kerja di sektor ini. Penelitian ini bertujuan untuk mengidentifikasi aktivitas dan menganalisis risiko keselamatan kerja pada proses bongkar kapal *purse seine* di PPS Kutaraja selama satu bulan, dengan total tujuh kapal sebagai objek penelitian. Metode yang digunakan meliputi observasi langsung dan wawancara dengan anak buah kapal (ABK), serta analisis data menggunakan pendekatan *Job Safety Analysis* (JSA). Penilaian risiko dilakukan melalui matriks risiko yang memperhitungkan tingkat keparahan (*severity*) dan kemungkinan kejadian (*probability*). Hasil penelitian menunjukkan bahwa aktivitas bongkar terdiri atas tiga tahapan utama: prabongkar, proses bongkar, dan pascabongkar. Setiap tahap memiliki tingkat risiko yang bervariasi, mulai dari kategori "Dapat Diterima" hingga "Tidak Dapat Diterima". Risiko tertinggi terjadi pada aktivitas penanganan tangkub berisi ikan dan pengangkutan hasil tangkapan, yang berpotensi menyebabkan kecelakaan serius. Faktor penyebab risiko meliputi kurangnya penggunaan alat pelindung diri (APD), prosedur kerja yang tidak optimal, serta kondisi lingkungan kerja yang tidak aman. Upaya peningkatan keselamatan kerja dalam proses bongkar muat kapal dapat dilakukan melalui pelatihan rutin, peningkatan penggunaan APD, serta penerapan sistem pengendalian risiko berbasis JSA.

Kata kunci: analisis risiko, bongkar kapal, keselamatan kerja

INTRODUCTION

Occupational Health and Safety (OHS) encompasses all conditions and factors that can impact the safety and health of workers and other individuals, such as contractors, suppliers, visitors, and guests, within the workplace (British Standards Institution 2007). OHS measures must be implemented across all work activities to mitigate the risk of accidents and prevent work-related injuries and illnesses by identifying potential hazards and occupational risks (Silalahi *et al.* 2018). Data from Indonesia's Social Security Agency for Employment (BPJS Ketenagakerjaan), as cited by Bria *et al.* (2024), indicate that there were 265,334 workplace accidents recorded as of November 2022, representing a 13.26% increase compared to the previous year.

Unloading operations carry the highest potential for workplace accidents because they require rapid handling and precise procedures to maintain the quality of the landed commodities (Sahniah *et al.* 2024). Consequently, loading and unloading activities involve numerous personnel and entail hazards classified as major risks (Nurbaiti *et al.* 2023). A prime example is the Kutaraja Oceanic Fishing Port (OFP) in Aceh, which has seen a natural increase in the number of vessels landing their catches and the total volume of landed catch at the facility following its upgrade from a Coastal Fishing Port (CFP). With an average of 151 vessels landing their catches at OFP Kutaraja, key operations have increased accordingly, particularly the unloading of landed catches (Rizwan *et al.* 2023). The workforce involved in unloading activities constitutes a vital component of port operations (Silalahi *et al.* 2018). This necessitates preventive measures or solutions to reduce accident rates during unloading operations (Lestari *et al.* 2017).

One of the factors that cause occupational accidents is the lack of implementation of work safety programs. Factors such as the work environment, type of work, workload, supervision, and work ability can influence the occurrence of occupational accidents (Yustikaningsih *et al.* 2020). Identifying potential hazards, assessing and controlling risks, and evaluating and monitoring risks are carried out to reduce or eliminate hazards that can cause workplace accidents (Lalenoh *et al.* 2023). Studies on the risks of loading and unloading activities at fishing ports at PPN Lempasing, Lampung (Nurbaiti *et al.* 2023), PP Paotere, Makassar (Irfaniyanti *et al.* 2019), and OFP Cilacap (Barni *et al.* 2025) have indicated a high level of risk in these activities. These

previous studies were conducted at class B, C, and D fishing ports, where the vessels landing fish are smaller than those at the present study site. Differences in work culture, facilities, and potential risks mean that loading and unloading activities at OFP Kutaraja follow their own patterns. Given the relatively high volume of loading and unloading activities, owing to the large size of the vessels and the frequent shoaling of the harbor basin, these activities are more intensive and carry a high level of risk. This research aims to identify activities and analyze the risk of occupational accidents during purse seine vessels' unloading activities at OFP Kutaraja, Aceh. Seven purse seine vessels were observed during the study period. The purse seine fleet was chosen because it lands large volumes of catch with high productivity, so the loading and unloading process involves many parties (Rosano *et al.* 2025).

METHODS

This study was conducted to identify purse seine vessel unloading activities at the Kutaraja Oceanic Fishing Port (OFP Kutaraja) and to analyze occupational safety during the unloading process. The study location is shown in Figure 1.

The data collected included activity profiles and details of unloading operations obtained from the Kutaraja Port Authority and crew members through observation and interviews. Severity and likelihood scores were assigned to each work task using evidence from direct field observation and crew interviews, following the scoring procedure described below. The collected data were processed into tables and pie charts and analyzed using the Job Safety Analysis (JSA) method. The study aimed to identify work stages and potential hazards, determine occupational safety risk levels based on consequences and likelihood, and identify risk control priorities for purse seine catch unloading activities at OFP Kutaraja. The study's output includes information on unloading operations profiles, operational details, and risk levels for each activity, serving as the basis for recommendations to improve occupational safety. Detailed research objectives are presented in Table 1.

This study was conducted at the Kutaraja Oceanic Fishing Port (OFP) in Aceh in February 2022. The equipment used included stationery, a laptop for data processing, and documentation tools. Table 2 lists the equipment used and its respective purposes.

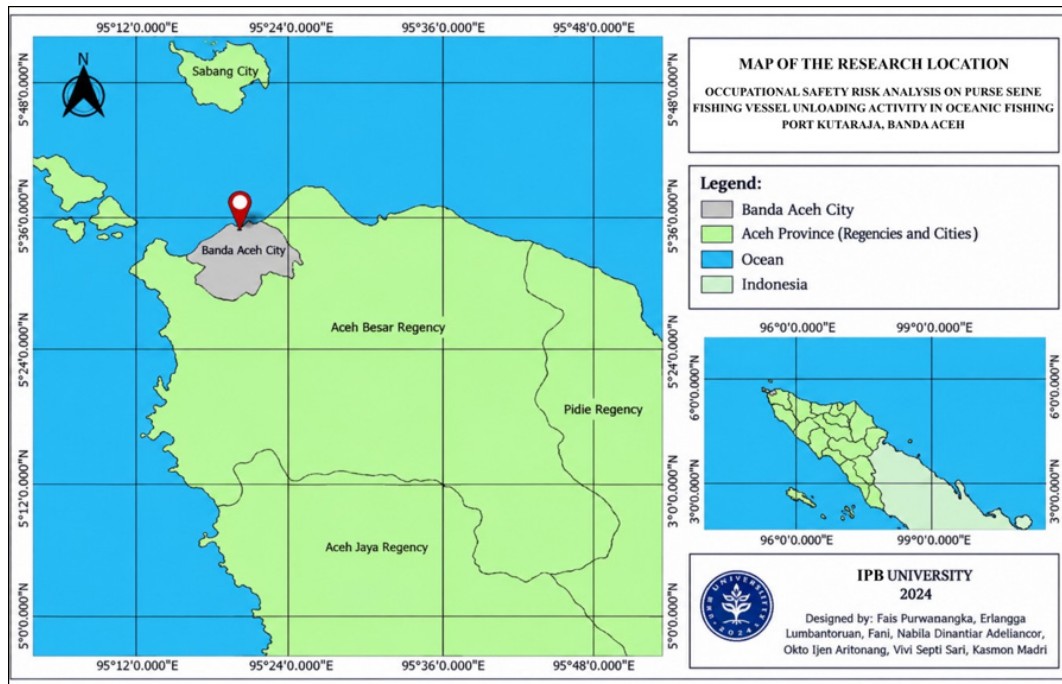


Figure 1. Map of the research location at the Kutaraja Oceanic Fishing Port, Banda Aceh City.

Table 1. Research objectives for the risk analysis of purse seine vessel unloading activities at Kutaraja Oceanic Fishing Port, Aceh.

No.	Purpose	Data Kind	Data Source	Data Collecting	Data Processing	Data Analysis	Output
1	Identifying unloading activities of purse seine vessels docked at OFP Kutaraja, Banda Aceh.	1. Unloading operation profile 2. Details of unloading activities	1. Harbour Master of Kutaraja Oceanic Fishing Port (OFP) 2. Purse seiner crew members	Observation and interviews	The data is processed and tabulated in the form of diagrams.	Descriptive analysis	1. Unloading operations profile information 2. Unloading operations details table
2	Occupational safety analysis of purse seine vessels unloading activities.	1. Hazard consequence value 2. Likelihood value	Fishermen unloading a purse seiner	Observation and interviews	The data is processed and tabulated in the form of diagrams.	Analysis using JSA (Job Safety Analysis)	Risk score for each unloading operation

Table 2. Equipment used in the study of purse seine vessel unloading activities at Kutaraja Oceanic Fishing Port, Aceh.

Tool	Note
Writing instruments	Recording various information during field data collection
Laptop	Writing up and processing data throughout the research process
Camera	Documenting all activities while in the field

The study employed a quantitative descriptive approach focusing on the activities of crew members during the purse seine vessel

unloading process. Data collection relied on two primary techniques: direct observation and interviews with crew members regarding the

work stages involved, resulting in photographic and video documentation of the unloading activities. The sample was selected using the accidental sampling method, an approach based on the incidental availability of respondents. This method was chosen due to the relatively high number of unloading workers and purse seine vessels docking at OFP Kutaraja, as well as the fact that the unloading process follows a similar work pattern across all vessels.

Identification of potential hazards

Potential hazards that may arise during loading and unloading activities are identified using Job Safety Analysis (JSA). This analysis helps identify job-specific risks and develop appropriate control measures to minimize these risks (Nurbaiti *et al.* 2023). The JSA process begins after the stages of loading and unloading activities have been identified in detail. The details of the JSA are presented in Table 3. The purpose of the JSA is to detect possible dangers that may occur during unloading activities (Abbasalipour 2017). This method was considered the most suitable for addressing the research problem. The JSA steps are as follows:

1. Selecting jobs;
2. Dividing work into several parts;
3. Identifying potential hazards that may arise;
4. Developing preventive measures to eliminate potential hazards and prevent possible accidents.

Risk level assessment

According to Acquah *et al.* (2021), risk is defined as the likelihood or chance of an individual suffering harm or experiencing health issues upon exposure to a hazard. Preliminary observations at OFP Kutaraja revealed significant potential hazards that could threaten the health and safety of unloading workers.

Risk assessment in this study was conducted by identifying potential hazards or the risk of hazard occurrence in the workplace

using the Job Safety Analysis (JSA) method, following the risk management process of AS/NZS 4360:2004 (risk identification, risk analysis, risk evaluation, and risk treatment). As part of the risk assessment, the level of consequence was evaluated. Consequence refers to the severity of the effects resulting from an incident associated with workplace hazards. Consequence levels range from 1 to 6; the highest level (6) signifies a major disaster, while the lowest (1) indicates a minor injury. Detailed consequence levels are presented in Table 4.

It should be noted that AS/NZS 4360:2004 does not prescribe a fixed numerical scoring system; the standard provides qualitative example scales (five levels of consequence and five levels of likelihood) and requires each organization to define consequence, likelihood, and risk criteria appropriate to its own context. Therefore, the six-level consequence and likelihood scales used in this study (Tables 4 and 5) were adapted from the semi-quantitative approach of Fine (1971) and Kinney and Wiruth (1976), which remains widely applied in recent occupational risk studies, including maritime operations (Gül *et al.* 2021; Dogan *et al.* 2022; Öztürk 2024), whose six descriptive categories (ranging from noticeable to catastrophic for consequence and from practically impossible to almost certain for likelihood) were converted into ordinal scores of 1 to 6. The four acceptability categories in Table 6 were defined for the purpose of this study. AS/NZS 4360:2004 has since been superseded by AS/NZS ISO 31000:2009 and ISO 31000:2018; the risk assessment process applied here remains consistent with the principles of the current standard (ISO 2018).

Probability refers to the likelihood of a specific unwanted event occurring, measured as the ratio of the event's occurrence to the total number of possible occurrences at each stage of the work. Probability levels range from 1 to 6, where 1 indicates an event that is highly unlikely to occur, and 6 indicates frequent occurrence. Probability levels are presented in Table 5.

Table 3. Job Safety Analysis (JSA) for loading and unloading activities.

No.	Sequence of Activity	Potential Hazard	Risk Control Measure (Further Steps If Desired)
1	...	...	...
2	...	...	...
...	...	...	...

Source: Canadian Centre for Occupational Health and Safety (2008)

Table 4. Risk consequence levels and their corresponding definitions used in this study.

Level	Designation	Definition/Criteria
6	Major Disaster	Catastrophic damage to various facilities; operations halted.
5	Disaster	Incidents involving fatalities; minor permanent environmental damage.
4	Very Serious	Permanent disability or severe illness; non-permanent environmental damage.
3	Serious	Serious impact (but not permanent severe injury or illness); minor adverse environmental effect.
2	Significant	Requires medical attention; off-site emissions occur but cause no damage.
1	Apparent	Minor injury or illness (e.g., bruising); minor damage; temporary work stoppage.

Source: Adapted from Standards Australia/Standards New Zealand (2004), Fine (1971), and Kinney and Wiruth (1976)

Table 5. Risk likelihood levels and their corresponding definitions used in this study.

Level	Designation	Definition/Criteria
6	Very Likely	The most frequently occurring event.
5	Likely	The probability of an accident occurring is 50:50.
4	Unusual	Uncommon but possible.
3	Unlikely	A small chance of an incident occurring.
2	Rare	There has never been an accident during the years of exposure, but it could happen.
1	Extremely Unlikely	Very unlikely to happen.

Source: Adapted from Standards Australia/Standards New Zealand (2004), Fine (1971), and Kinney and Wiruth (1976)

Table 6. Risk assessment matrix showing risk scores and acceptability categories based on likelihood and severity levels.

Severity Level	Likelihood Level					
	1	2	3	4	5	6
6	1	2	3	4	5	6
5	2	4	6	8	10	12
4	3	6	9	12	15	18
3	4	8	12	16	20	24
2	5	10	15	20	25	30
1	6	12	18	24	30	36

Source: Adapted from Standards Australia/Standards New Zealand (2004), Fine (1971), and Kinney and Wiruth (1976)

Criteria:

Unacceptable = 18–36

Undesirable = 10–16

Acceptable with Controls = 5–9

Acceptable = 1–4

Risk assessment is conducted by multiplying the likelihood level and the severity level derived from the risk identification process. The risk level is determined based on a scale of 36 possible scores. Four distinct colors indicate the acceptability criteria for

the risk; for instance, scores of 1–4 signify an acceptable risk, while scores of 18–36 indicate an unacceptable risk (Table 6).

This risk assessment matrix evaluates risk levels based on two primary parameters: severity and likelihood. The values in the

table are derived by multiplying these two parameters, each of which ranges from 1 to 6. This calculation results in a matrix with values ranging from a minimum of 1 to a maximum of 36. Risk assessment criteria are divided into four categories: "Acceptable" (scores 1–4), "Acceptable with Controls" (scores 5–9), "Undesirable" (scores 10–16), and "Unacceptable" (scores 18–36). However, since the product of two integers between 1 and 6 does not encompass every number within that range, certain values, such as 7, 11, 13, 14, 17, and others, do not appear in the matrix table.

Some numerical values do not appear in the table; however, the risk assessment relies on value ranges rather than solely on the specific figures generated within the matrix to determine categories. For instance, the value 7 falls into the "Acceptable with Controls" category because it lies within the 5–9 range, even though it is not explicitly listed in the matrix. By contrast, the value 17 falls between the "Undesirable" and "Unacceptable" categories, creating a gap in the assessment range. This demonstrates that risk interpretation is not limited to the specific numbers appearing in the matrix but is also based on established value ranges designed to guide decision-making in risk management.

Scoring procedure for severity and likelihood

The unit of assessment was each work task identified through the JSA (11 pre-unloading, 8 unloading, and 8 post-unloading tasks). For each task, the hazard and its most credible adverse outcome were first recorded from direct observation of the unloading of the seven purse seine vessels, supported by photographic and video documentation. Observations focused on unsafe acts (e.g., not wearing gloves or boots, or jumping between the dock and the vessel), unsafe conditions (e.g., the slippery FAF floor, scattered ropes, the absence of a gangway, and shoaling of the harbor basin), and any incidents or near misses occurring during the observation period.

Severity was scored on the 1–6 scale in Table 4 according to the most credible consequence of the hazard to workers, based on the type of injury observed in the field or reported by the crew, rather than the worst conceivable outcome. Hazards that mainly caused equipment damage, financial loss, or operational delay without direct injury to workers were assigned to the lower consequence levels.

Likelihood was scored on the 1–6 scale in Table 5 by combining two sources of evidence: (i) how often the hazardous event, unsafe act,

or near miss was observed across the seven vessels during the study period; and (ii) crew members' reports of how often such events had occurred during their experience of unloading operations, obtained through interviews with crew members using guiding questions on the type, frequency, and consequences of incidents they had experienced or witnessed. Events observed on most vessels or reported as occurring routinely were scored 5–6; events observed occasionally or reported as having occurred several times were scored 3–4; and events not observed but reported as possible or rare were scored 1–2.

Scores were assigned by the researchers for each task after the observation sessions and cross-checked against the interview data where the two sources differed. The risk score of each task was then calculated as severity $\times$ likelihood (Table 6) and classified into the four acceptability categories.

RESULTS AND DISCUSSION

The unloading of catches from purse seine vessels at the Kutaraja Oceanic Fishing Port (OFP Kutaraja) takes place at the fish auction facility (FAF) wharf. OFP Kutaraja features two wharves with separate areas designated for unloading and loading operations. Purse seine vessels approach the FAF wharf following a single-stage, dual-lane queuing pattern, where the entire process, from unloading to the sale of the catch, is conducted at the same facility (Akmal *et al.* 2017). Unloading operations can be carried out at any time, as there are no time restrictions for vessels entering the port area. Docking vessels may occupy vacant sections of the wharf or moor alongside other vessels if the wharf is full. On Fridays, operations commence at 14:00 WIB out of respect for Acehese customs.

The number of purse seine vessels operating in January 2022 reached 100. During the research process, seven vessels were selected for observation of activities during the unloading process. The unloading process is divided into three stages: pre-unloading preparation, the unloading operation itself, and post-unloading activities. Pre-unloading preparation begins before the vessel docks at the FAF. Purse seine vessels at OFP Kutaraja typically make fishing trips of 7 to 15 days with a crew of 16–25 people. There are three main stages of activity involved in unloading purse seine vessels at OFP Kutaraja, as outlined in Table 7.

Table 7. Stages of purse seine vessel unloading activities at Kutaraja Oceanic Fishing Port.

No.	Activity Stage
1	Pre-unloading operation
2	Unloading operation
3	Post-unloading operation

The results of the risk level assessment for each unloading operation are shown in Figure 2. Each activity has a distinct risk level rating, with categories comprising "Acceptable," "Acceptable with Controls," "Undesirable," and "Unacceptable."

Risk level assessments for pre-unloading, unloading, and post-unloading activities at the Kutaraja Oceanic Fishing Port (OFP) are presented in Tables 8, 9, and 10. The assessments were conducted by determining the consequences and likelihood associated with each activity. These evaluations were based on observations of activities performed during the unloading process and scored according to the criteria in Tables 4–6 and the scoring procedure described in the Methods.

Based on the analysis of Table 8 and Figure 2 regarding risk assessment for unloading activities, 11 specific tasks were evaluated within the pre-unloading phase. Of these, one task fell into the "Acceptable" category, five were "Acceptable with Controls," and five were classified as "Undesirable." This indicates a high likelihood of risk and high severity in pre-unloading activities; however, these risks can be managed through administrative controls (SOP implementation, harbor basin development), technical controls (using assistive tools to facilitate the process and personal protective equipment), and procedural training and supervision to streamline operations and minimize financial loss. No tasks were identified

as having "Unacceptable" risk during this phase, signifying that critical risk levels had not yet emerged prior to the start of the actual unloading process.

Subsequently, eight tasks were assessed for risk within the unloading phase itself. No tasks fell into the "Acceptable" category, while two were classified as "Acceptable with Controls." Conversely, three tasks were categorized as "Undesirable," and another three were classified as "Unacceptable." This indicates that the risks encountered during the unloading process tend to be higher than those in the preceding phase. The presence of tasks with unacceptable risk levels highlights potential hazards requiring immediate mitigation to prevent losses or accidents; these hazards stem from issues such as inadequate or insufficient PPE, high physical workloads leading to fatigue and injury, and operational support equipment designs that compromise worker health and safety due to poor ergonomics. During the unloading stage, risks also increase due to the direct impact on economic aspects; therefore, it is necessary to implement administrative controls (such as SOP application and task rotation), technical controls (using aids to facilitate unloading, e.g., capstan automation and trolleys, as well as personal protective equipment like non-slip gear and helmets), training, procedural supervision, and routine audits to streamline operations and minimize financial losses.

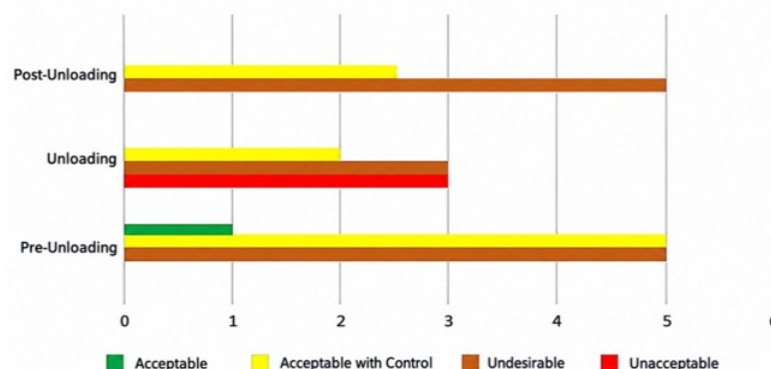


Figure 2. Risk level assessment of unloading activities at Kutaraja Oceanic Fishing Port.

Table 8. Risk level assessment for pre-unloading activities at Kutaraja Oceanic Fishing Port.

No.	Activity	Potential Hazard	Consequence or Severity	Value	Likelihood	Value	Risk Level
1	The purse seiner approaches the Lampulo FAF wharf	The shoaling of the harbor basin prevents vessels from entering the area, and improper vessel positioning increases the risk of hull collisions with other vessels or the dock wall.	Serious	3	Unusual	4	12 (Undesirable)
2	Throwing the mooring line to the wharf	Crew members risk becoming entangled in ropes or falling into the water while throwing the mooring line, and uncontrolled ropes may drop into the water.	Apparent	1	Unusual	4	4 (Acceptable)
3	Securing the line to the bollard	Crew members risk hand injuries from not wearing protective gloves while securing the line, as well as risks associated with ropes coming loose due to insecure knots.	Apparent	1	Likely	5	5 (Acceptable with controls)
4	Shutting down the ship's engine	Errors in engine shutdown procedures can increase the risk of engine damage and prevent unloading operations from taking place.	Serious	3	Unusual	4	12 (Undesirable)
5	Having a meal (if unloading takes place during the day)	Crew members who rush while eating risk choking. Additionally, engaging in strenuous physical activity immediately after a meal can increase health and safety risks.	Serious	3	Rare	2	6 (Acceptable with controls)
6	Crew members disembark onto the wharf	The absence of a connecting gangway increases the risk of crew members falling while disembarking onto the wharf, particularly because the floor at the FAF is often slippery; such falls can result in head injuries, lacerations, or concussions.	Very Serious	4	Rare	2	8 (Acceptable with controls)

Table 8. Risk level assessment for pre-unloading activities (Lanjutan).

No.	Activity	Potential Hazard	Consequence or Severity	Value	Likelihood	Value	Risk Level
7	Fish quality inspection by the vessel owner, involving the examination of samples from each hold (not always performed)	Vessel owners risk falling when jumping from the dock to the vessel to inspect the holds, especially if the dock or vessel surfaces are slippery and unstable.	Very Serious	4	Rare	2	8 (Acceptable with controls)
8	Lowering the trough locally known as *kapal cewek* (not always performed)	Crew members face a high risk of falling into the water due to the large size and weight of the fish trough. Furthermore, technical errors during trough lowering can scratch the vessel's hull, potentially causing financial loss.	Disaster	5	Extremely Unlikely	1	5 (Acceptable with controls)
9	Spreading out a tarpaulin as a base for fish sorting	Crew members risk slipping on the slippery floor of the FAF while spreading the tarpaulin if they do not wear protective boots, potentially leading to head impacts and bodily bruising.	Very Serious	4	Unusual	4	16 (Undesirable)
10	Preparing fish baskets and scales for sorting	Baskets pose a risk of striking other crew members if the person handling them fails to pay attention to their surroundings while lifting or moving them.	Serious	3	Unusual	4	12 (Undesirable)
11	Preparing the capstan and its motor, and turning on the water to wet the capstan line	Crew members risk hand injuries from not wearing protective gloves while handling the capstan line, while engine breakdowns can hinder unloading processes and slow down vessel operations.	Very Serious	4	Unusual	4	16 (Undesirable)

Table 9. Risk level assessment for unloading activities at Kutaraja Oceanic Fishing Port.

No.	Activity	Potential Hazard	Consequence or Severity	Value	Likelihood	Value	Risk Level
1	Opening the fish hold	Crew members risk having their fingers crushed by the hatch cover if care is not taken during the opening or closing process.	Apparent	1	Likely	5	5 (Acceptable with controls)
2	Removing ice from the hold	Crew members' hands are at risk of cold-related injury from direct contact with large quantities of ice, especially if protective gloves are not worn.	Apparent	1	Very Likely	6	6 (Acceptable with controls)
3	Lowering the brail net into the fish hold	The brail net may strike the operator or other crew members if it is not handled carefully; striking the eye could cause blindness. Additionally, swinging the brail net inside the fish hold can damage the quality of the catch. Crew members also risk slipping due to the cramped workspace and scattered ropes on the deck, particularly if appropriate personal protective equipment (PPE) is not used.	Very Serious	4	Unlikely	3	12 (Undesirable)
4	Hauling the fish-filled brail net using a capstan	Crew members handling capstan ropes risk hand injuries if protective gloves are not worn. Furthermore, they may slip on the wet deck. Difficulty in pulling the capstan rope can hinder loading and unloading processes and slow down vessel operations.	Very Serious	4	Unusual	4	16 (Undesirable)
5	Moving the fish-filled brail net toward the FAF	The brail net may strike crew members on deck if not handled carefully. Additionally, crew members on deck risk slipping and falling while pushing heavy loads, especially if protective boots are not worn.	Very Serious	4	Unusual	4	16 (Undesirable)

Table 9. Risk level assessment for unloading activities (Lanjutan).

No.	Activity	Potential Hazard	Consequence or Severity	Value	Likelihood	Value	Risk Level
6	Pulling the brail net and emptying the fish onto the wharf	Crew members at the FAF risk slipping or falling into the water while pulling heavy loads. In some instances, human error involving brail nets equipped with drawstring mechanisms can cause the catch to fall back into the water.	Disaster	5	Likely	5	25 (Unacceptable)
7	Sorting the fish by species, size, and quality	Crew members sorting the catch risk cold-related hand injuries from handling cold fish for 3–4 hours without personal protective equipment (PPE). This condition can also affect the quality of the fish being processed.	Serious	3	Very Likely	6	18 (Unacceptable)
8	Weighing the fish and transporting them via pedicab	Crew members risk back pain from repeatedly lifting baskets of approximately 30 kg onto the scales and pedicabs, a practice that can lead to muscle fatigue and musculoskeletal injuries. Workers may also slip on the wet FAF floor while carrying the baskets.	Very Serious	4	Very Likely	6	24 (Unacceptable)

Table 10. Risk level assessment of post-unloading activities at Kutaraja Oceanic Fishing Port.

No.	Activity	Potential Hazard	Consequence or Severity	Value	Likelihood	Value	Risk Level
1	Stowing fish-sorting equipment such as baskets, scales, tarpaulins, etc.	Crew members are at risk of fatigue following prolonged unloading operations, which can impair focus and increase the likelihood of accidents. Baskets risk damage if thrown, while crew members may slip at the FAF due to slippery floors or disorganized piles of cargo.	Apparent	1	Very Likely	6	6 (Acceptable with controls)

Table 10. Risk level assessment of post-unloading activities (Lanjutan).

No.	Activity	Potential Hazard	Consequence or Severity	Value	Likelihood	Value	Risk Level
2	Hoisting the trough	Crew members risk falling into the water if they are not cautious while working near the vessel or the dock.	Disaster	5	Extremely Unlikely	1	5 (Acceptable with controls)
3	Stowing the brail nets and capstan	Crew members risk slipping on board due to slippery decks or scattered objects, such as ropes or spilled water.	Very Serious	4	Unusual	4	16 (Undesirable)
4	Closing the hatch	Crew members risk having their hands crushed by hatch covers if they are not careful when opening or closing the ship's hatches.	Apparent	1	Likely	5	5 (Acceptable with controls)
5	Cleaning the vessel	Crew members risk slipping while cleaning the vessel after unloading, particularly if the deck remains slippery or there are spills of water or other materials.	Very Serious	4	Unusual	4	16 (Undesirable)
6	Casting off lines from the bollards	Crew members risk entanglement in ropes or slipping if they are not cautious when working around scattered ropes or on slippery surfaces.	Very Serious	4	Unusual	4	16 (Undesirable)
7	Starting the vessel's engine	Engine damage may occur due to operational errors, improper maintenance, or failure to follow operating procedures, potentially disrupting vessel operations and causing financial loss.	Serious	3	Unusual	4	12 (Undesirable)
8	The vessel moves away from the FAF wharf toward the loading dock	The vessel's hull risks colliding with other vessels when moving from the FAF dock to the loading dock.	Serious	3	Unusual	4	12 (Undesirable)

Eight activities were evaluated during the post-unloading phase; none fell into the "Acceptable" category. However, three activities were classified as "Acceptable with Controls," and most notably, five were categorized as

"Undesirable." This indicates that the post-unloading phase still harbors significant potential risks, even though some activities can be managed through the implementation of appropriate controls. Key risk factors include

cumulative fatigue, environmental conditions, and vessel operations that are not conducive to a safe working environment. Mitigation efforts involve administrative controls (implementing Standard Operating Procedures [SOPs] and developing harbor basins and shipping lanes), technical controls (using aids such as anti-slip surfaces, vessel drainage systems, and personal protective equipment for crew members), as well as training and procedural supervision to ensure smooth operations.

Most of the identified potential risks stem from unfavorable environmental conditions, such as slippery floors and cramped workspaces. The work activities lack SOPs that account for the potential risks associated with the tasks being performed. Furthermore, a low level of awareness regarding the importance of occupational health and safety, which impacts both operations and financial outcomes, contributes to the high level of potential risk in these activities.

CONCLUSION

A risk analysis of purse seine vessel unloading activities at Kutaraja Oceanic Fishing Port (OFP Kutaraja) revealed that the unloading process comprises three main stages: pre-unloading, the unloading process itself, and post-unloading. Each stage presents varying levels of risk, ranging from "Acceptable" to "Unacceptable". The highest risks were identified during the actual unloading process, specifically tasks such as handling fish-filled brail nets and transporting the catch, which carry the potential for serious accidents. Key factors contributing to these risks include the lack of use of personal protective equipment (PPE), suboptimal work procedures, and unsafe working conditions. Efforts to enhance safety through training, improved PPE utilization, and the implementation of risk control systems based on Job Safety Analysis (JSA) are essential to mitigating the risk of workplace accidents. Implementing these measures is expected to support workplace safety and improve operational efficiency at OFP Kutaraja.

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