

Risk Analysis of Quality Decline of Mackerel by UD. Rukman Jaya during Distribution Process to Ciroyom Market, Bandung City

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Abstract—UD. Rukman Jaya is a supplier of mackerel to traditional markets in Bandung City, one of which is Ciroyom Market, Bandung City. Handling activities are the most important process considering that fish is a perishable product. The quality of mackerel greatly determines the selling price of fish and the income of UD. Rukman Jaya and also traders at Ciroyom Market, Bandung City. The research was conducted at the Asemdayong Fish Landing Place in Pemalang Regency and Ciroyom Market in Bandung City in January 2026 using risk analysis methods. The risk level is determined by the correlation between the frequency of occurrence and the severity of a potential hazard. According to the observations conducted, there are 45 types of potential hazards across 11 stages of processing mackerel intended for sale at Ciroyom Market in Bandung. A total of 23 potential hazards are classified as very high risk, while 22 are classified as high risk. 17 potential hazards can be controlled through administrative measures; 11 potential hazards can be controlled through administrative and substitution measures; 3 potential hazards can be controlled through administrative and elimination measures; 4 potential hazards can be controlled through administrative measures and the use of PPE; and 10 potential hazards can be controlled through administrative and engineering controls.

Keywords—Handling activities, mackerel, potential hazards, risk assessment, severity

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I. INTRODUCTION

Ciroyom Market is one of the largest markets in Bandung City that supplies various animal protein products, one of which is fishery products [2]. Fishery products sold at Ciroyom Market consist of various types of fish, both freshwater and saltwater fish. Based on observations, the fish sold at Ciroyom Market are fish that have high economic value. One of the most commonly sold fish at Ciroyom Market is mackerel because it is highly nutritious, easy to find, and relatively affordable. In addition to mackerel, there are many other fish sold at Ciroyom Market, such as snapper, tuna, mackerel, shrimp, lobster, and others.

However, fish is a perishable commodity. Being far from the sea also exacerbates the condition of fishery products, which are prone to spoilage. This is what makes the distribution of fish to the city of Bandung difficult because Bandung is a city located at an altitude of 1025 meters above sea level in the north, so it is surrounded by mountains and far from the sea [4]. As a result, Bandung City is dependent on food supplies from outside the city [19].

In addition to Bandung's distance from the sea, which results in longer handling times for catches, there are

several other factors that cause a decline in fish quality, such as the type and biological condition of the fish, the process of death, the handling methods, and the facilities used when handling fish [8]. According to research conducted by Salmiya et al. (2022), catch handling activities can reduce fish quality due to the occurrence of rigor mortis, or stiffness/rigidity in the fish body [14]. Mardiah et al. (2022) mentioned that rigor mortis occurs because the fish's brain control and heart function stop, so the process of glycogenesis that can produce ATP to carry out energy activities does not occur [7].

UD. Rukman Jaya is one of the largest and the oldest suppliers of mackerel in Ciroyom Market, Bandung City from 2004. During peak season, this company can supply up to 3 tons of mackerel to fishmongers at Ciroyom Market in Bandung City. The handling process carried out by this company and its partners begins when the fish are auctioned at the fish auction site in TPI Asemdayong, Pemalang Regency, and ends when they are sold to fishmongers at Ciroyom Market in Bandung. The selling price of mackerel, which is a good source of income for UD. Rukman Jaya employees and fish traders at Ciroyom Market, is largely determined by the quality of the fish sold. Therefore, the quality of mackerel handled and distributed by UD. Rukman Jaya is largely determined by the success of the company's handling. This is in line with the research conducted by Sari & Nawafil (2023), where one of the important processes that can determine the quality and selling value of fish is the handling process of the catch [18].

UD. Rukman Jaya supplies mackerel directly from fishermen in PPP Asemdayong, Pemalang Regency after winning the auction process. According to an interview with the owner of UD. Rukman Jaya, mackerel sold at Ciroyom Market, Bandung City, with good quality reaches a price of Rp. 50,000/kg to Rp. 55,000/kg. Meanwhile, mackerel of poor quality is sold below that

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price. Therefore, it can be concluded that the income received by UD. Rukman Jaya workers and mackerel traders at Ciroyom Market, Bandung City, is largely determined by their success in maintaining the quality of the mackerel from the time it is received until it reaches the buyer. Based on information obtained from workers at UD. Rukman Jaya, mackerel of good quality is sold at a high price, while mackerel of poor quality or with damaged body parts is often sold at a low price or does not sell at all. On the other hand, Akerina & Kour (2020) stated that every fishing effort that utilizes fish resources to the maximum is certainly expected to be able to provide reasonable profits for those involved [1]. Therefore, UD. Rukman Jaya strives to maintain the quality of the mackerel it ships and minimize the potential for deterioration during handling and distribution.

Fish freshness cannot be improved but can be maintained [21]. Fish can last up to 12–18 days by being chilled during fish preservation. Proper fish handling processes are crucial to maintain quality, nutritional value, and food safety. Therefore, this study aims to identify the handling and transportation activities of mackerel, as well as to develop control measures related to the handling of mackerel carried out by UD. Rukman Jaya from the time the fish is received from the fish auction until it reaches the mackerel traders at Ciroyom Market, Bandung City. The initial stage of this study is to analyze the risk of quality deterioration from each activity, after which recommendations are formulated to prevent the deterioration of mackerel quality.

II. METHOD

This study was conducted at the Asemdayong Fish Landing Place (TPI) in Pemalang Regency and Ciroyom Market in Bandung City on January 2026. The place can be seen in Figure 1.

Tools and Materials

The equipment used in this study included writing instruments and cameras. The fish that was the object of this study was mackerel. Mackerel was chosen because it is a leading commodity from the Asemdayong Fish Landing Site in Pemalang Regency and is landed in large quantities at that location, as well as the high demand for mackerel to be sent to Bandung City because the Pemalang area is famous for its fresh, high-quality mackerel. This is evidenced by research conducted by Delisna (2022), which states that the main commodities caught at PPP Asemdayong are mackerel, Spanish mackerel, and tembang fish [3].

The type of data collected

The research began with data collection through interviews. Interviewees were selected using purposive sampling, or deliberate sampling in accordance with the research objectives. Interviews were conducted with fishermen who supply mackerel at the Asemdayong Fish Landing Place to find out about the mackerel catch that will be sent to the city of Bandung, as well as with the owners of mackerel distribution businesses and the owners of UD. Rukman Jaya regarding the distribution

and sales process to Ciroyom Market. In addition to conducting interviews, the research also involved observing the activities involved in handling mackerel catches, from the moment the fish were received by UD. Rukman Jaya's partners after the auction process until they reached the mackerel traders at Ciroyom Market. Tools and materials used in the interviews and observations were writing instruments, cameras, and questionnaires.

The types of data used in this study consisted of primary data. Primary data was obtained through direct observation of the handling of mackerel from the time it was received after the fish auction until it reached the mackerel sellers at Ciroyom Market, Bandung City. Primary data was also obtained from interviews conducted with all distribution business actors, ranging from supplier fishermen, distribution business owners, to the owner of UD. Rukman Jaya itself.

Data analysis

Data analysis was performed using risk analysis with the Hazard Identification Risk Assessment and Risk Control (HIRARC) method, which was modified in accordance with the research objectives. The risk research consisted of:

1. Identification of potential hazards

In this study, the potential hazards referred to are things in the handling of mackerel that can reduce the quality of the fish during the handling and distribution process from Pemalang Regency to Bandung City.

2. Assessing the frequency of occurrence of potential hazards

The assessment of the frequency of occurrence of potential hazards that cause a decline in the quality of mackerel refers to the AS/NZS 4360 (2004) standard [23], which has been adapted to the type of research and conditions at UD. Rukman Jaya. The assessment scale for the frequency of occurrence is presented in Table 1.

TABLE 1.
FREQUENCY OF OCCURRENCE

Scale	Magnitude	Frequency
1	Never/very rarely	0-20%
2	Rarely	21-40%
3	Sometimes	41-60%
4	Often	61-80%
5	Always/very often	81-100%

3. Assess the severity of each treatment

The severity assessment scale refers to AS/NZS 4360:2004, modified based on The severity assessment scale refers to AS/NZS 4360 (2004), modified based on the number of physical changes in mackerel. Parameters for physical changes in mackerel refers to the condition of the eyes, gills, flesh, odor, texture, and mucus on the surface of the mackerel's body. The severity assessment based on the physical changes in the mackerel is presented in Table 2.

TABLE 2.
SEVERITY

Scale	Magnitude	Severity
1	Very low	1 parameter changed
2	Low	2 parameter changed
3	Moderate	3 parameter changed
	High	4-5 parameter changed
5	Very High	6 parameter changed

The data was then analyzed using a risk matrix, also referring to AS/NZS 4360 (2004). The correlation between the frequency of mackerel quality deterioration events and the severity of the resulting parameter changes can be determined from the risk matrix. References for assessing the risk level of mackerel handling during distribution from the Asemdayong Fish Farming Processing Center to Ciroyom Market, Bandung City, are presented in Table 3.

TABLE 3.
RISK MATRIX

Severity	Frequency				
	1	2	3	4	5
5	H	H	E	E	E
4	H	H	H	E	E
3	M	M	H	H	E
2	L	L	M	H	H
1	L	L	M	H	H

III. RESULTS AND DISCUSSION

Results

Fish handling activities

UD. Rukman Jaya usually picks up mackerel to be sold at Ciroyom Market, Bandung City, from fish auction sites in Pemalang Regency. One of these is TPI Asemdayong in Pemalang Regency. UD. Rukman Jaya has regular suppliers who supply mackerel from local fishermen. Typically, fishermen arrive at the Asemdayong PPP pier at 9:00 a.m. WIB. However, this depends on the weather at sea. During peak season, fishermen can land their catch at 6:00 a.m. WIB and conduct an auction at 7:00 a.m. WIB. UD. Rukman Jaya employees or partners must wait for the auction to finish before finally being able to bring the mackerel to the UD. Rukman Jaya partner depot to be able to carry out further fish handling such as weighing, washing, icing, packaging, and loading onto trucks. The mackerel distribution process from start to market at Ciroyom Market is shown in Figure 2.

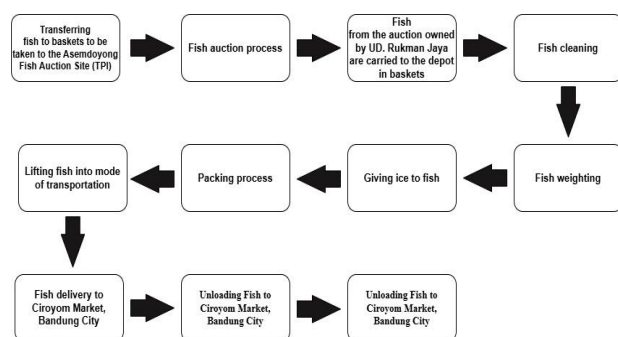


Figure 2. Distribution process of mackerel from TPI Asemdayong to Ciroyom Market in Bandung City.

Mackerel purchased from fishermen is then transported using baskets to the packing depot owned by UD. Rukman Jaya's partners. Based on interviews conducted, there are almost 7 depots that are partners of UD. Rukman Jaya in PPP Asemdayong, Pemalang Regency. Each depot has an average of one employee working on the mackerel handling stage. During the harvest season, mackerel brought to the depot can reach

20 kg per basket. However, during the lean season, the mackerel brought in by the baskets are not full. After the mackerel is brought to the packing depot, it is then washed using PDAM water from TPI Asemdayong, Pemalang Regency. The fish is washed by dousing it with a dipper or hose.

The next stage is weighing the fish by employees from UD. Rukman Jaya's partner company. The weighing is done using a hanging scale, which is then recorded by UD. Rukman Jaya's partner company, followed by the addition of ice to the mackerel. Ice is added to the mackerel destined for Bandung City to maintain its quality during shipping. The ice is added to the mackerel in chunks. The ice is mixed with water to keep the fish submerged in the drum or container. The ice application process begins with filling the drum or container with water, adding chunks of ice, then adding fish, then adding water mixed with ice, then adding fish.

The next stage is packaging the fish. This process is carried out simultaneously with the addition of ice. After the mackerel is iced, the container is then tightly sealed, completing the packaging process. This mackerel packaging process is carried out by UD. Rukman Jaya's partner company, who also handle the activities of transporting the fish from the TPI (Fishing Market), weighing, and adding ice. A single fish tank or drum can hold between 60 and 75 kg, typically containing the same type of fish.

After all fish auction activities are complete and there are no more fish to be processed, the blongs containing mackerel begin to be loaded onto transportation vehicles for delivery to Ciroyom Market in Bandung City. This begins at 2:00 PM WIB every west monsoon season or 4:00 PM WIB during the peak season. The mode of transportation used for this mackerel delivery is an open truck. According to an interview with the owner of a distribution business and a partner of UD. Rukman Jaya, during the peak fish season, one truck can carry around 22 drums with a load of 10-12 drums of mackerel. Meanwhile, during the lean season, the truck only carries around 15 blongs with a load of only around 3 blongs or even just one blong. Each blong contains 60 kg to 75 kg, resulting in a total load of 1.65 tons.

Around 2:00 PM to 4:00 PM WIB, trucks begin leaving TPI Asemdayong and heading to Ciroyom Market in Bandung. The journey to Bandung takes approximately 5 to 6 hours. Trucks carrying mackerel arrive in Bandung between 8:00 PM and 11:00 PM WIB. If there are no other trucks loading and unloading fish, trucks transporting mackerel from Pemalang can begin loading and unloading immediately. However, if there is a queue for loading and unloading, trucks can wait approximately 30 to 45 minutes per vehicle. After loading and unloading is complete, the mackerel is then transported by workers at Ciroyom Market in Bandung to be distributed to the respective traders who have ordered mackerel from UD. Rukman Jaya.

Risk assessment

Risk assessments are conducted for each stage of the mackerel handling process carried out by UD. Rukman Jaya. The observed mackerel handling activities begin when the fish are brought by fishermen to the fish

auction site, then transported to the depot/warehouse owned by UD. Rukman Jaya, until the fish are received by mackerel sellers at Ciroyom Market in Bandung.

Based on observations at the research site, handling activities carried out at the first point include transferring the fish to baskets for transport to the fish auction site using carts, weighing, transporting them to transportation vehicles, and then conducting the auction. The next step is for the mackerel to be taken to the fish warehouse/depot for washing, weighing, icing, and

packaging before being loaded onto transportation vehicles for shipment to Ciroyom Market in Bandung. Subsequent handling activities occur at the receiving point at Ciroyom Market in Bandung, including loading and unloading in front of Ciroyom Market, and finally, the fish are distributed and sold by traders at the market. Potential hazards and risk assessment during handling activities from TPI Asemdayong to Ciroyom Market in Bandung City can be seen in Table 4 and Table 5.

TABEL 4.
POTENTIAL HAZARDS DURING HANDLING ACTIVITIES FROM TPI ASEMDYONG TO CIROYOM MARKET IN BANDUNG CITY

Point	Handling activities	Code	Potential hazards
Transferring catch from fisherman	Moving mackerel to the TPI using a cart	1	Catch fall
		2	Overloading capacity
		3	Dirty basket
		4	Dirty card
	Fish auction	5	Smoking workers
		6	Dirty floor
		7	Slippery floor
		8	Workers slipped
Process in fish depot	The mackerel is brought to the fish depot using a basket	9	The road to the depot is slippery
		10	Workers slipped
		11	Dirty basket
		12	Dirty water hose
	Fish washing	13	Dirty water dipper
		14	Contaminated water
		15	Dirty weighing scale
		16	Uneven ice distribution
	Fish weighing	17	Sharp ice shape
		18	Dirty drum cover
		19	Drum is not closed tightly
		20	The road is slippery
	Giving ice to mackerel	21	Workers slipped
		22	Smoking workers
		23	Shaking fish on drum
		24	Dirty mode condition
	Fish packaging	25	Drum fall
		26	Fish fall
		27	Accident
		28	Melting ice
	Lifting fish to truck	29	Time of delivery
		30	Sun exposure
		31	Heat from vehicle maccine
		32	Drum cover open
		33	Fish fall
		34	Crushed fish
		35	Time of unloading fish
Fish arrived in Ciroyom Market, Bandung City	Unloading fish in Ciroyom Market, Bandung City	36	Smoking workers
		37	The road to the market was slippery
		38	The road tp the market was dirty
		39	Workers slipped
		40	Drum fall
		41	Fish fall
		42	The road on market was slippery
		43	The road on market was dirty
	Sending fish to fish traders on Ciroyom Market	44	Dirty fish table
		45	Fish table flooded

TABLE 5.
RISK ASSESSMENT

Code	Potential Hazards	Frequency	Severity
1	Catch fall	1	5
2	Overloading capacity	2	4
3	Dirty basket	5	3
4	Dirty card	4	3
5	Smoking workers	5	3
6	Dirty floor	5	5
7	Slippery floor	5	4
8	Workers slipped	1	4
9	The road to the depot is slippery	3	5
10	Workers slipped	1	5
11	Dirty basket	4	3
12	Dirty water hose	3	3
13	Dirty water dipper	3	3
14	Contaminated water	3	5
15	Dirty weighing scale	4	4
16	Uneven ice distribution	1	5
17	Sharp ice shape	3	4
18	Dirty drum cover	1	5
19	Drum is not closed tightly	1	5
20	The road is slippery	3	5
21	Workers slipped	1	5
22	Smoking workers	5	3
23	Shaking fish on drum	5	4
24	Dirty mode condition	5	5
25	Drum fall	1	5
26	Fish fall	1	5
27	Accident	1	5
28	Melting ice	3	5
29	Time of delivery	3	5
30	Sun exposure	5	5
31	Heat from vehicle machine	5	5
32	Drum cover open	1	5
33	Fish fall	1	5
34	Crushed fish	1	5
35	Time of unloading fish	4	5
36	Smoking workers	5	4
37	The road to the market was slippery	5	5
38	The road to the market was dirty	5	5
39	Workers slipped	1	5
40	Drum fall	1	5
41	Fish fall	1	5
42	The road on market was slippery	5	5
43	The road on market was dirty	5	5
44	Dirty fish table	5	5
45	Fish table flooded	5	5

Descriptions:

Frequency value:

1 = Never/Very rarely

2 = Rarely

3 = Sometimes

4 = Often

5 = Very often

Severity:

1 = 1 parameter changed

2 = 2 parameter changed

3 = 3 parameter changed

4 = 4-5 parameter changed

5 = 6 parameter changed

In Table 4, there are potential hazards that occur during the fish handling process, starting from TPI Asemdayong to Ciroyom Market by UD. Rukman Jaya. Table 4 shows that there are 45 potential hazards across 11 stages of fish handling activities carried out by UD. Rukman Jaya.. Meanwhile, in Table 5 it can be seen that there are 23 very high-risk hazard potentials and 22 high-risk hazard potentials.

The correlation between the frequency of occurrence and the severity level of potential hazards in mackerel handling activities during the distribution process from

TPI Asemdayong in Pemalang Regency to Ciroyom Market in Bandung City is shown in Table 6.

Potential hazard codes are indicated by the colors in the table. The risk level results provide detailed information regarding potential hazard codes with very high and high risk values.

There are 23 potential hazards with very high risk values, namely those with codes 3, 5, 6, 7, 9, 14, 15, 20, 22, 23, 24, 28, 29, 30, 31, 35, 36, 37, 38, 42, 43, 44, and 45. Meanwhile, there are 22 hazards with high risk levels, coded as 1, 2, 4, 8, 10, 11, 12, 13, 16, 17, 18, 19, 21, 25, 26, 27, 32, 33, 34, 39, 40, and 41.

TABLE 6.
CORRELATION BETWEEN THE FREQUENCY OF OCCURRENCE AND THE SEVERITY

Severity	Frequency				
	1	2	3	4	5
5	1,10,16,18,19,21,25, 26,27,32,33,34,39,40, 41		9,14,20,28,29	35	6,24,30,31,37, 38,42,43,44,45
4	8	2	17	15,23	7,36
3			12,13	4,11	3,5,22
2					
1					

Description:

Extreme risk = 3,5,6,7,9,14,15,20,22,23,24,28,29,30,31,35,36,37,38,42,43,44,45

High risk = 1,2,4,8,10,11,12,13,16,17,18,19,21,25,26,27,32,33,34,39,40,41

Moderate risk = 0

Low risk = 0

Discussion

During the handling of mackerel in distribution process from TPI Asemdayong in Pemalang Regency to Ciroyom Market in Bandung City which begins with the transport of the fish to the fish auction using carts, there are several potential hazards, such as dirty carts, dirty baskets, and workers' behavior that fails to prioritize cleanliness and hygiene, such as smoking. Also when fish are auctioned at TPI Asemdayong in Pemalang Regency. The dirty and slippery floor of the auction area, combined with the presence of wild animals that have entered the site, has the potential to compromise the quality of the mackerel.

This can be seen in Table 4, which shows that at every stage of handling, there are potential hazards such as workers who continue to smoke and slippery, dirty floors. According to a study conducted by Nindi et al. (2021), both frozen and fresh fishery products are highly susceptible to bacterial contamination due to cross-contamination [10]. Cross-contamination can result from handling fish without proper attention to cleanliness and hygiene [9]. Purwanto et al. (2024) stated that a decline in fish quality can occur due to poor hygiene and a lack of attention to fish quality during handling [12].

Table 5 shows that environmental conditions in the form of dirty and slippery floors have the highest frequency and severity scores, namely 5. This means that this incident occurs very frequently. Based on observations, the partner UD. Rukman Jaya, which works mainly in fish depots, pays less attention to cleanliness and hygiene, which can lead to a risk of declining fish quality apart from the uneven use of ice and the absence of a salting process. According to a study by Setyowidodo (2016), the addition of salt can lower the temperature during the cooling process [20]. The freezing point of salted ice is lower than that of unsalted ice, so unsalted ice melts faster than salted ice [13]. However, as is well known, the shipping process carries a high risk of degrading fish quality. This is because the shipping process can cause the ice to melt, and the resulting meltwater can contaminate the fish [15].

Potential hazards with score of 4 (often) occur due to dirty carts, dirty weighing scales, and dirty baskets during transport to the depot, as well as lengthy loading and unloading times at Ciroyom Market. Long shipping times and extended waiting periods for loading and

unloading at the market can lead to a decline in fish quality. This is due to melting ice, which can lower the body temperature of mackerel, making them more prone to spoilage—especially if the transport vehicle's engine runs hot.

Potential hazards with the highest severity include dirty transport vehicles, contaminated water, fish falling out of drums, drums falling over, wet, dirty, and slippery market conditions, accidents during shipping, melting ice, and others. The tools and materials used in the mackerel handling process can also cause contamination. Drums falling due to slippery and dirty floors can cause fish to fall, potentially damaging the fish physically and contaminating them. Meanwhile, melting ice can contaminate the fish by mixing with fish mucus and blood, causing the fish to lose their freshness. The freshness of fish can be preserved through refrigeration [11]. Sitakar et al. (2016) also explain that chilling is a fish preservation method that can extend the shelf life of fish.

There are several ways to manage risk. The first is elimination, or removing a material, tool, or process that causes a hazard. Second is substitution, or replacing a material, tool, or process that causes a hazard. Third is engineering controls, which involve using protective equipment or devices that can reduce risk. Fourth, administrative controls related to SOPs (Standard Operating Procedures) or other administrative measures. Fifth is risk control through the use of personal protective equipment [5].

Elimination methods can be implemented by discouraging workers from smoking or failing to wear protective clothing while handling fish. This can also be achieved through administrative controls by implementing standard operating procedures. According to interviews conducted with workers from UD. Rukman Jaya's partner company, elimination methods are indeed difficult to implement because certain tools, materials, and processes are necessary during the fish-handling process. The same applies to unavoidable environmental conditions. Therefore, the potential hazards listed in Table 4 can be controlled in several ways, one of which is through administrative controls. Potential hazards such as contaminated water, dirty scales, dirty baskets or drums, dirty and muddy floors, uneven distribution of ice, the absence of additional salting processes, overloading, as well as prolonged shipping and loading/unloading times can be controlled by

establishing cargo handling regulations, improving work systems, creating work procedures, developing needs planning, and setting limits on the amount of materials (ice and salt) used. The effective fish-to-ice ratio is 1:1 [22]

In addition to administrative controls alone, there are administrative and substitution controls, specifically regarding the temperature of the mode of transport and shipments that cannot be delivered on time. The mode of transport may use refrigerated trucks [16]. In addition, fish shipments are typically made in the afternoon or early evening, from 2:00 PM to 4:00 PM, so that they can arrive in Bandung by nightfall. However, sometimes deliveries are made at night, so mackerel from Pemalang Regency can arrive at Ciroyom Market in the early morning—a time when fish sales are typically scarce—meaning the fish must be stored in the cold storage facility owned by UD. Rukman Jaya, located in front of Ciroyom Market in Bandung. In this regard, UD. Rukman Jaya has been able to manage risk through substitution. Saraswati et al. (2025) stated that storing fish in cold storage is essential for maintaining fish quality. Fish must indeed be handled quickly, properly, and kept cold at all times [17].

There are also administrative controls that involve substitution, such as replacing all equipment at risk of cross-contamination with catch-up equipment on a regular basis or performing routine maintenance. Similarly, for engineering controls, if the wash water is not clean, the water source can be changed and filters can be installed in the water lines. Additionally, to address the potential hazard of ice melting easily, UD. Rukman Jaya can bring a supply of ice and store it in a cooler box, especially if the delivery time exceeds the scheduled duration.

The final risk control measure involves the use of personal protective equipment (PPE). Potential hazards, such as employees slipping or fish being directly contaminated by employees of UD. Rukman Jaya, can be prevented by using PPE such as boots or gloves. This requires strict discipline and enforcement of regulations to ensure that all workers are required to use PPE to safeguard both the workers and the mackerel being handled. In addition to using PPE, administrative measures can also be implemented to reduce the risk of accidents that could result in losses for both workers and the catch.

IV. CONCLUSION

Based on the results of the study, it was concluded that: (1) There are three transfer points in the transportation and handling of mackerel carried out by UD. Rukman Jaya. First, when the fish are received directly from the fishermen, they are transferred by basket to the fish auction site using cart, followed by the auction at the Fish Market (TPI). Second, the handling process moves to the fish depot owned by UD. Rukman Jaya's partners, where the fish are transferred to baskets from the fish auction site, washed, weighed, iced, packaged, transported onto transportation, and then shipped to Ciroyom Market in Bandung City. Third, at Ciroyom Market, the fish are loaded and unloaded at the market and shipped to

mackerel traders who have ordered the fish from UD. Rukman Jaya. (2) Based on the risk assessment, there are 45 potential hazards across 11 stages of the mackerel handling activities carried out. There are 23 potential hazards with very high risk and 22 potential hazards with high risk. Meanwhile, there are no potential hazards with medium or low risk. (3). A total of 17 potential hazards can be controlled through administrative measures; 11 potential hazards can be controlled through administrative and substitution measures; 3 potential hazards can be controlled through administrative and elimination measures; 4 potential hazards can be controlled through administrative measures and the use of PPE; and 10 potential hazards can be controlled through administrative and engineering controls.

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