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Health and Safety Analysis for Fisherman in East Surabaya, Indonesia

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ABSTRACT

The number of fishermen in Indonesia has continued to decline in the last decade as reported by the Statistics of Marine and Coastal Resources 2021. In 2010 the number of fishermen was recorded at 2.16 million people. But in 2019, the number was recorded at only 1.83 million people. Thus, there was a decrease in the number of fishermen by 330,000 people in 2010-2019. The fisheries sector is one of the most dangerous industries. In contrast, the health and safety of the people, especially fishermen are too far below occupational health and safety feasibility standards. This research used job safety analysis method for hazard identification and risk assessment for fisherman activities during preparation, operation, and pasca-operation. Data were collected through observation and interview 30 fishermen in East Surabaya. Results of observations divided by three activities shows that fishermen don't prepare themselves with safety kit or safety equipment, including for personal protective equipment. The conclusion is most potential hazards could be minimized by using personal protective equipment. To minimize the risk of fatality, fishermen should carry a first aid kit, and communication devices and should be accompanied when going to sea. There are future research and program to increase fisherman awareness prior to safety.

Keywords: *job safety analysis, safety, fishermen,*

1. BACKGROUND

Indonesia has many potentials for marine and fisheries. More than 278.696.000 people with 1.270.000 fishermen live in the country known as the largest archipelago country over 5,000 km in width and 1,700 km in length, in total has an expansive 5.800.000 kilometers cubic large with 17.000 islands. The estimated number of fish reaches 12.54 million tons/year. The number of fishermen is 2.925.818 people, a small part of that, there are 291.200 people in East Java based on statistical data from The Ministry of Marine Affairs and Fisheries Republic of Indonesia in 2021. The number of fishermen in Indonesia has continued to decline in the last decade as reported by the Statistics of Marine and Coastal Resources 2021. In 2010 the number of fishermen was recorded at 2.16 million people. But in 2019, the number was recorded at only 1.83 million people. Thus, there was a decrease in the number of fishermen by 330,000 people in 2010-2019.

The decline in the number of fishermen in Indonesia was driven by two things, namely the climate crisis and extractive industrial expansion in coastal, sea, and small islands [1]. Related to the climate crisis, fishermen in various regions in Indonesia are very affected because fishing activities in the sea are very relying on friendly weather [2]. If the weather at sea is not friendly, fishermen cannot go to sea. In addition, the climate crisis makes it difficult for fishermen to predict the weather. In addition to worsening the weather, waves at sea become higher due to climate crisis [3]. This condition forces fishermen not to go to sea. As a result of the climate crisis, fishermen in Indonesia can only go to sea for 180 days or six months in one year. This worsens the social and economic life of fishermen in Indonesia [4]. This condition forces fishermen in Indonesia to switch professions. The climate crisis has also caused the death of fishermen in Indonesian waters to continue to increase [5]. In 2020, the number of fishermen who died at sea was 251 people. This figure has increased from 2010 to only 86 people. In the future, the climate crisis will continue to worsen the lives of fishermen in Indonesia. Based on the latest report from the Intergovernmental Panel on Climate Change (IPCC) published on February 28, 2022, the climate crisis will reportedly exacerbate the increase in temperature force fish to move from the tropical region and will reduce Indonesia's income from fishing by 24 percent.

In Southeast Asia, 99 percent of coral reefs will experience bleaching and die due to the climate crisis in 2030 and in 2050, 95 percent will reach the highest threat level category, impacting fisheries that depend on coral. The fisheries sector is one of the most dangerous industries [6]. Fishermen or fishing trappers have been transformed into one of the most dangerous professions in the world [7]. In contrast, the health and safety of the people, especially fishermen are too far below occupational health and safety feasibility standards [8]. Minister of Maritime Affairs and Fisheries of the Republic of Indonesia regulation number 3/permen-KP/2019 about community participation in the implementation of protection and empowerment of fishermen, fish breeders, and salt farmers states in article 11 that community participation in the health and safety of fisherman, fish breeders, and salt farmers, should provide safety equipment for fishing and aiding while fishing [10].

The opportunity for accident rate could be caused by fishermen's attitudes, fishermen's skills, and knowledge about work safety at Sea. In actual condition, there are just a few fishermen personnel who use safety tools [9]. Most fishermen choose not to use self-protection equipment hence there is no safety equipment on the boat which obligatory available for fishing, shipping, and any other at-sea activities [11]. If an incident or accident happens due to weather and water conditions, no one will be able to give assistance due to limited communication due to fishermen being more comfortable when going fishing alone [12]. This behavior could accentuate that the fisheries sector is one of the most dangerous industries in the universe [13].

2. METHODS

Work accidents are mainly caused by human error factors based on FAO (2009) data is 43,67%. Accidents could be minimized by sustainable awareness of health and safety, increasing quality factors, and creating standard operational procedures for activities. It is necessary to identify activities, potential risks, and hazards and mitigate them. Analyzing potential hazards and potential risks for fisheries work activity could be using job safety analysis (JSA). Job safety analysis is a procedure to integrate safety and health principles and practices into task operation by identifying hazard and risk assessment method [13]. The technique it to identify existing and potential hazards of activity, assessing their risks, mitigate them by recommending and implementing effective control [14]. JSA is an integral part of safety management system with proper performance. It could provide a deeper understanding of how work should be done or shouldn't be done which one to avoid and prevent adverse outcomes [15]. Studies show that applying proper JSA is effective in preventing accidents and preventing safety behaviors [16-18]. The JSA technique is conducted in four main steps. Step 1 is decomposing the task/job into its sequential steps. Step 2 is identifying hazards threatening the health and safety of workers during each step of the task. Step 3 is risk assessment by estimating the likelihood of occurrence and potential consequences. Step 4 is discerning, recommending, and implementing risk reduction measures [17][18]. Each step of JSA is to identify potential hazards and to recommend the safest way to do the work activities. The methodology is based on the idea that safety is an integral part of all fisheries work activities. In this research, only health and safety aspects will be considered. This study is specific to traditional fishermen for a person boat capacity in Medokan Ayu district, Gunung Anyar regional, and Kenjeran district, East Surabaya, East Java, Indonesia. This study uses two types of data. Primary data obtained from direct observation of activities and operations, interview 30 fishermen in Medokan Ayu district, Gunung Anyar regional, and Kenjeran district, East Surabaya, East Java, Indonesia. Secondary data is supporting data obtained from various sources such as literature, documents, and archives. Observations to decompose the job/activities into sequential steps, then identify hazard of each step of the task. Afterwards, conducting risk assessments by estimating potential consequences and lastly to give recommendations, implementing risk reduction. Data results will be used as analysis material including descriptive and job safety analysis (JSA) [19][20].

3. JOB SAFETY ANALYSIS

Fishing activities, mainly at sea, is a high-risk activity, in consequence too, preventive measures must be taken to minimize or eliminate the potential risk of harm or accident to support the success of an arrest operation fish. Job Safety Analysis is a method to determine potential hazards in fisherman activities by identifying the whole potential source of hazards. Activities applied to this study are fishermen's activities on boats. Work steps are recorded in the left column, the potential danger is written in the middle column, and the preventive action is written in the right column. Hazard identification begins by identifying sources of hazard in the consequences area, and compiling with correct way to do activities to ensure each activity is included. All activities should be detailed by sorting the whole stages step by step [11-13]. The definition of an accident is an event unexpected and unexpected ones can cause injury, disability, or even death because of work accidents [12]. Ships a floating building in motion using the thrust of an engine at varying speeds for traversing various cruise areas within a certain period [2]. Ships can experience various problems that can be caused by several factors, such as weather, state of the shipping channel, people, ships, and others that cannot be predicted by human capabilities and finally cause disruption to sail from the ship. The sequence of work steps in each fishing operation activity will be

grouped and then potential hazards that may arise, as well as suggestions and feedback on what actions need to be taken to eliminate or minimize potential danger. Here's the breakdown of work safety analysis in each pre-operative stage, operating stage, and post-operative stage.

3.1 Pre-operation

Working on board a fishing boat, fishers are often exposed to occupational hazards. Health and safety in fisheries are complex issues with multiple aspects. Fishing is performed under unpredictable and rapidly changing weather and sea conditions, yet many fishermen are lacking any form of protection. Fishing requires working for long hours at sea, mostly at night and in rough water. Traditional fishermen will start working based on weather conditions, unlikely office hours at 09.00 to 17.00 job but at any time when the tidal is high, no heavy rain, no natural disaster. The work involved transporting equipment to handling fishing catches. The work of fisheries could have severe health consequences, and cause accidents, injuries, and fatalities.

3.1.1. Personal fit and health check

It's compulsory to ensure fishermen's health before fishermen go to work. Check their fitness for work by conducting visual check-ups, conduct medical check-ups (check blood pressure, check up their temperature, ask for their condition). In contrast to that, the fisherman in East Surabaya rarely checks their condition due to financial problem. Local fishermen in East Surabaya don't have medical check-up tools to check their condition. Local fishermen also don't have enough income to ask for help from medical facilities and rarely have health insurance. Therefore, if there is a health issue, fishermen will force themselves to continue working.

3.1.2. Tools preparation

To ensure safe fishing activities, it's important to be well prepared. Accidents at sea could have been prevented by good preparation. Based on SOLAS (1974), all equipment used by an individual must protect from risk to health and safety. Equipment and materials must be considered for feasibility and maintenance and could be used as personal protective equipment to support fish catching activities and minimize the risk of accidents. In contrast with that, traditional fishermen don't prioritize their health and safety due to financial problems, thus they prioritize tools to catch fish first. There are many potential dangers in this equipment such as being injured, punctured by rusty items, wrapped in nets, bleeding, followed by health diseases. These potential health hazards could be prevented by bringing a first aid kit. A first aid kit is compulsory on board, including minimum items such as adhesive bandages, band-aids, sterile gauze, adhesive tape, scissors, safety pin, antiseptic cream, tweezers, thermometer, hand sanitizer, medical gloves, antiseptic, and antibiotic. Include a medicine kit for pain-killing tablets such as paracetamol or ibuprofen, eyewash, sunscreen, antihistamine for allergies, antidiarrheals for diarrhea, cough and cold medications, hydrocortisone cream, ointment, or lotion for itching, calamine lotion for stings or poison ivy, etc.

3.1.3. Manual handling

Transport equipment from post to boats, all fishermen assigned to load or unload, lifting and transfer equipment by manual handling. This activity could affect suffering back injuries and other injuries. To decrease back injuries due to manual handling, fishermen should be given training about how to do proper manual handling and provide protective personal equipment to decrease possibility to other injuries.

3.1.4. Slips and Trips

Working nearshore, which is watery, muddy, and slippery is likely to slip and trips. Injuries due to slips and trips could be cuts, bruises, muscle strains sprains, or even broken bones. These injuries could be caused by tripping over tools or equipment. These injuries are likely to happen; therefore, first aid kits should be provided at fishermen's posts, on board, and on shore nearby. Fishermen should be using protective personal equipment by procuring safety shoes with a good grip or special shoe for mud and watery area (boots).

3.1.5. Machinery check

Potential hazard while machine check and preparation are minor injuries due to friction with objects and machine tools. These accidents could be prevented by using personal protective equipment (PPE) such as face masks, boots, gloves, etc. Moreover, excessive noise from the processing machine due to Continuous exposure to noise above 80 dB can result in reduced hearing ability and hearing loss diseases. Fishermen should be provided with hearing protection, used it effectively when working, and maintained it.

3.1.6. Fueling

Potential hazard while filling diesel fuel such as burning, slipping, exposure to hazardous chemicals. It could be prevented by using kinds of transportation such as wheeled carts or special iron baskets for carrying affixes on the motor thus reducing the potential dropped and spilled. Fishermen should provide personal protective equipment (long sleeve shirt, mask, hat) and provide fire extinguishers at boats, shore area, post area.

3.1.7. Embarkation

Rough weather is a fisherman's nemesis, if fishermen are still forced to go sailing, it could be risking their lives. By continuously checking the weather before sailing by visual check, checking wind direction using a windsock, and checking forecasting weather using a smartphone application it could be used as a forecast weather. If it

announces that potential bad weather, it is forbidden to do activities at sea including swimming, fishing, and sailing.

3.2. Operation

The most dangerous and the longest of fishing activities are operational activities at sea. There are several potential risk hazards, from likely to happen to unlikely but lead to fatality. One of the activities that local fishermen do is spreading and pulling nets.

3.2.1. Spreading and pulling nets

Where local fisherman spreading and pulling nets, there are several potential risk hazards such as:

a. Injuries

Injuries due to punctuation by rusty items wrapped in nets, friction with objects and tools, slips and trips (cuts, bruises, muscle strains or sprains, broken bones) caused by tripping over tools or equipment. It is likely to happen but affect minor injuries. To mitigate, fishermen should provide personal protective equipment (long sleeve shirt, shoes with a good grip, mask, hat, sunscreen) and always bring first aid kit while fishing.

b. Sunburn

Surabaya has an estimated outdoor temperature between 28°C to 33°C, extreme heat that occurs from October to November is 37°C to 43°C. The higher the UV Index, the greater the rate of skin-damaging and eye-damaging UV radiation. To minimize the risk of sunburn, fishermen who work in daylight should provide personal protective equipment (long sleeve shirt, shoes with a good grip, mask, hat, sunscreen) and always bring a first aid kit while fishing.

c. Catch a cold.

Most of local fishermen in East Surabaya experience health issues, particularly colds, due to working at night when temperatures are lower and conditions are less favorable for human activity. To reduce health risks, fishermen should be provided with appropriate personal protective equipment, such as windproof and waterproof clothing, adequate lighting, and support from fellow workers during night operations..

d. Sting of jellyfish or other poisonous animals

Potential stings of jellyfish and other poisonous animals are likely to happen. It should be immediate action to reduce spreading poison by using a first aid kit, then should immediately go to health facility/hospital. Thus, it is mandatory to have first aid kits and medicine on boats. Training for how to reduce effect of injuries caused by poisonous sea animals should be given to local fishermen.

e. Fall from boat.

Potential fall from boats or man overboard then drowned and could lead to fishermen's fatality. This event is unlikely to happen but has the biggest risk or extremely dangerous. Fishermen should provide lifebuoy and communication equipment that connect to fishermen's posts the search and rescue team. Bring assistance or company while fishing at the ocean to help directly or ask for help if it inevitably happens.

f. Drag out from fishing route.

Boats could be dragged out of fishing routes due to strong currents, and if there are no sufficient supplies and life support on board, this could lead to fishermen's fatality. Fishermen should provide boat anchors, lifebuoys, and communication equipment that connect to fishermen's posts, Search & Rescue teams. Bring assistance or company while fishing at the ocean to direct help or ask for help if inevitable happens. Bring a minimum of one week's food & supplies if it is inevitable.

3.3. Pasca-operation

Catches that have been collected are then sorted by type of fish and fish sizes. This activity wouldn't cause major accidents but still has hazard potential such as injured hands, bumps, and slips. This accident could be prevented by using gloves and boots or anti-slip shoes. The location of sorting should be clean, not muddy, and cleaned simultaneously to prevent health hazard possibility. Furthermore, contacting dead animals could cause contamination and spread a variety of diseases, for example, COVID-19, anthrax, parasites, and other zoonosis diseases.

3.3.1. Housekeeping

Back from fishing or sailing, most fishermen have no energy left. Therefore, they rarely clean their equipment after going back from fishing. It could be risking potential sea-wombs, sand-wombs, bacteria, and virus contamination due to unclean equipment. To minimize this contamination, Fishermen should bathe with fresh water after sailing to clean themselves. After that, clean fishhooks, nets, boats, and any other supporting equipment after fishing or sailing is stored in a safe and clean place (out of reach of children, away from landfills).

3.3.2. Environmental Cleanliness

Marine pollution is a major environmental issue in Indonesia, including East Surabaya, affecting fisheries, fish markets, storage facilities, and coastal areas. Poor environmental cleanliness can compromise food hygiene and the sustainability of fishing activities. To address this issue, coastal clean-up programs involving local communities should be conducted regularly, supported by proper waste management facilities and continuous public education from local authorities..

Table 1. Job Safety Analysis for Fisherman's Activities

Job Step & Activities	Potential Hazard	Control Statement
3.1 Pre-Operation		
3.1.1 Personnel fit and health condition check	Fishermen unfit but forced to keep working	Ensure fishermen health before embarkation by medical check-up (check blood pressure, check up their temperature, ask for their condition) and continuously educate that health comes first.
3.1.2 Tools transfer and preparation (from fishermen post to boat)	Injuries due to punctured by rusty items, wrapped in nets, friction with objects and tools, slips and trips (cuts, bruises, muscle strains or sprains, broken bones) caused by tripping over tools or equipment	Provide personal protective equipment (long sleeve shirt, shoes with a good grip, mask, hat, sunscreen) and always bring first aid kit while sailing
3.1.3 Manual handling	All fishermen assigned to load and unload, lift and transfer equipment are likely to suffer back injuries or other injuries due their manual handling to moving object	Provide personal protective equipment (long sleeve shirt, shoes with a good grip, mask, hat, sunscreen) and always bring first aid kit while sailing
3.1.4 Slips and trips	Injuries due to slips and trips (cuts, bruises, muscle strains or sprains, broken bones) caused by tripping over tools or equipment	Procuring safety shoes with a good grip or special shoe for mud and watery area (boots) for all fishermen
3.1.5 Machinery check	Excessive noise from the processing machine due to Continuous exposure to noise above 80 dB can result in reduced hearing ability and hearing loss diseases.	All fishermen should be provided with hearing protection, used it effectively when working, and maintained it.
3.1.6 Fueling	Exposure to hazardous chemichal, slipping due to fuel fluid, burning due to inflammable fluid	Provide personal protective equipment (long sleeve shirt, mask, hat). Provide fire extinguishers at boats, shore area, post area.
3.1.7 Embarkation	Rough weather is a fishermen's nemesis. If fishermen still want to go sailing, it could be potential hazard led to fatality	Continuously check weather before sailing by visual check, check wind direction using windsock, check forecasting weather using smartphone's application.
3.2 Operation		
3.2.1 Spreading and pulling nets (fishing)	Injuries due to punctured by rusty items, wrapped in nets, friction with objects and tools, slips and trips (cuts, bruises, muscle strains or sprains, broken bones) caused by tripping over tools or equipment	Provide personal protective equipment (long sleeve shirt, shoes with a good grip, mask, hat, sunscreen) and always bring first aid kit while fishing
	Potential sun burns due to exposure to extreme heat (31˚- 42˚ Celsius)	Provide personal protective equipment (hat, mask, long-sleeved shirt, using sunscreen), bring drinkable water while fishing.
	Potential cold due to sea wind, and working at night	Provide personal protective equipment by using anti-wind and waterproof long-sleeved shirt to minimize effect of sea wind and cold weather affecting fishermen's health
	Potential sting of jellyfish and other poisonous animals	Provide first aid kit and medicine on board, then immediately go to health facility/hospital

	Potential fall from boats or man overboard thus drowned and could be led to fishermen's fatality	Provide lifebuoy and communication equipment which connect to fishermen's post, Search & Rescue team. Bring assistance or company while fishing at ocean to direct help or ask for help if inevitable happened
	Boats could be dragged out of fishing routes due to strong currents, if there is no sufficient supplies and life support on board, then could be led to fishermen's fatality.	Provide boats anchor, lifebuoy and communication equipment which connect to fishermen's post, Search & Rescue team. Bring assistance or company while fishing at ocean to direct help or ask for help if inevitable happened. Bring a minimum of one week's food & supplies if inevitable happened
3.3 Pasca-operation		
3.3.1 Housekeeping	Potential sea-wombs, sand-wombs, bacteria, and virus contamination due to unclean equipment	Cleaning fishhooks, nets, boats, and any other supporting equipment after fishing or sailing store in a safe and clean place (out of reach of children, away from landfill). Fishermen should bath with fresh water after sailing to clean themselves and decrease potential contamination from bacteria, viruses, poisonous animal
3.3.2 Nearshore and Environment cleanliness	Potential sea-wombs, sand-wombs, bacteria, and virus contamination due to unclean equipment	By doing coastal cleaning day by all the affected people near the coastal environment (not only fishermen) and continuously maintain it shore by keeping it clean. Local government should provide landfill for waste management.

4. CONCLUSIONS

This study indicated that job safety analysis, a comprehensive health, safety, and environment method to identify risk and hazard. This study revealed a comprehensive detail assessment of the hazard that could be used to help identify minor and major risks during fishermen activities to developing reasonable practical precautions. Results of observations of overall activity using job safety analysis (JSA) of the table above identified potential hazards in every activity divided into three steps (pre-operation, operation, and pasca-operation). Events like drowning, man falling from ship to sea or man overboard, fire, falling objects, slippery and muddy workplace, have a higher risk of occurring and cause injuries or fatality for fishermen. Most potential hazards could be minimized by using personal protective equipment. Based on this study, to minimize the risk of fatality fishermen should carry a first aid kit, and communication devices and should be accompanied when going to sea. This study suggest that health and safety education programs should be continuously sounding to fishermen to increase awareness of safety. Safety equipment grants such as safety shoes, special suits with long-sleeved anti-water and anti-wind for operational works, lifebuoy, and other personal protective equipment. Emergency system supposed to be giving to mitigate and reduce risk of fisherman fatality due to man overboard/falling.

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