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Factors for Safety Sustainability in Workplace: A Case Study in Anglers

Shamsul Effendy Abdul Hamid[1], Mazdi Marzuki[1], Nik Harnida Suhainai[2], Miftachul Huda[1]

[1] Faculty of Human Sciences, Universiti Pendidikan Sultan Idris, Tanjong Malim, Malaysia

[2] Universiti Kuala Lumpur, Malaysia

Abstract: Fishing is one of the most dangerous occupations in the world. As there is an increase in the number of anglers worldwide, it is important to recognize accident factors for coastal anglers to find ways to impede any unnecessary risks. This systematic review involves studies on this topic published between 2016 until March 2020 from Web of Science and ScienceDirect. It was carried out coherently with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method. The sample of respondents embraced different populations such as anglers, incidents of accidents, health professionals involving fisheries, and administrative staff related to fisheries. The research consists of the main elements, such as the causes of accidents, accident effects, and the improved solution to the existing problems. This review found that marine accidents are not triggered by a single factor but rather by a combination of several causes that lead to a dangerous condition. Four major accident factors involving coastal anglers such as human, management, environment, and equipment were identified. In conclusion, these studies revealed different accident factors in each area. Addressing these factors would better understand anglers' safety and contribute to a safer working environment for the next generation.

Keywords: coastal anglers, accident factors, safety measures, fishery sector.

協作遊戲需求分析：將數學引入幼兒

摘要: 钓鱼是世界上最危险的职业之一。随着世界各地渔民数量的增加，重要的是要认识到沿海渔民的事故因素，以便找到阻止任何不必要风险的方法。该系统评价涉及该主题的研究，这些研究于 2016 年至 2020 3 月期间从 科學網和 科學指導 发表。它与系统评价和元分析的首选报告项目 (棱鏡) 方法相一致地进行。受访者样本包括不同的人群，例如渔民、事故事故、涉及渔业的卫生专业人员和与渔业有关的行政人员。研究内容包括事故原因、事故影响和对现有问题的改进解决方案等主要内容。从这次审查中发现，海上事故不是由单一因素引发的，而是由导致危险状况的多种原因的组合引发的。确定了涉及沿海渔民的四个主要事故因素，如人员、管理、环境和设备。总之，这些研究表明，每个地区的事故因素是不同的。解决这些因素将有助于更好地了解渔民的安全，并有助于为下一代创造更安全的工作环境。

关键词： 沿海垂釣者, 事故因素, 安全措施, 渔业部门。

1. Introduction

The global contribution of fisheries and aquacultures to Gross Domestic Product (GDP) is essential. As one of the key contributors to the world's economy, the fishery sector has been allocated an extensive fund by most governments to increase productivity and improve the income of anglers. The anglers are commonly seen as citizens from rural areas, have low income, and are uneducated. However,

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About the authors: Shamsul Effendy Abdul Hamid, Mazdi Marzuki, Faculty of Human Sciences, Universiti Pendidikan Sultan Idris, Tanjong Malim, Malaysia; Nik Harnida Suhainai, Universiti Kuala Lumpur, Malaysia; Miftachul Huda, Faculty of Human Sciences, Universiti Pendidikan Sultan Idris, Tanjong Malim, Malaysia

fishery activity has been transforming to ensure that this sector is synchronized with the changing times, especially in this new era. The steady increases in the revenue, the value of catches, and the number of anglers each year have shown a positive trend. Despite this development, the fishing sector is categorized as dangerous and has the highest number of accidents among other sectors. This study will look at the factors that cause accidents to coastal anglers, who make up most of the local anglers.

1.1. Background

Fisheries are human activities related to fisheries resources, whether at sea, river, pond, fish farming, or aquaculture. These activities produce local food and provide recreational and industrial resources to local communities. The fisheries industry is a commercial activity that provides fishery products for human consumption or as raw materials for other industries. This sector is one of the most important economic resources, and based on Food and Agriculture Organization (FAO), this industry is one of the major contributors to the Gross Domestic Product (GDP) in some countries globally.

It varies mostly from 0.01 percent to 10 percent within different world regions [8]. It is economically viable and able to generate high income and have the potential to prosper. It also offers vast employment opportunities for anglers. Anglers usually live in areas close to fishing locations like rivers and beaches. This group of population's sources of income highly depend directly on sea revenue. The majority of the anglers are male, usually the family's breadwinner. They are also categorized as the low-income population. However, this should change as these anglers are the main source of the world's protein supplies and are the backbone of the fisheries industry.

Daily fishing activity usually involves anglers being exposed to the risks of accidents. Examples of accidents that commonly occur during fishing include drowning, slipping, fire, or collisions with boats. Many factors contribute to accidents among anglers. Previous studies have shown a disagreement about the major causes of accidents.

Håvold [16] stated several key factors to accidents, including attitudes towards safety and safety training, job stress, safety management, co-operation among employees, job satisfaction, and attitude towards rules and laws [16]. Ćorović and Djorovic [6] mentioned that human factors such as fatigue, lack of communication, lack of technical knowledge, and decision-making are the major contributing factors to marine accidents. At the same time, Faturachman and Mustafa [9] found that marine accidents involving fishing boats and yachts are influenced by environmental factors such as bad weather, high currents, and high tide [6, 9].

Marine accidents are not triggered by a single factor but by several causes that lead to dangerous conditions. The factors contributing to the accident commonly depend on the anglers' work environment. Monsoon winds, lack of training, laws not concerned with safety issues, loose security enforcement are major causes of accidents. Thus, it is essential to identify the factors of fishing activity accidents for coastal anglers as increasing the number of anglers might increase the risks of accidents.

1.2. Problem Statement

Fish is an important global protein source. Being the main protein source in many parts of the world, the fishing industry has seen fluctuating trends in terms of production. In 2015, the world's total marine catch faced a slight decrease from 81.2 million tons, reaching its highest with 171 million tons and 79.3 million tons in 2016. Nearly 90 percent of that production was utilized for direct human consumption. The growth of annual fish consumption had increased twice as high as population growth since 1961. This had increased the value of global fish exports in 2017 to USD 152 billion. Most of the export comes from fishing industries in China, Norway, and Vietnam [8].

Fishing is an occupation that has existed for a long time. In 2016, about 40.3 million people were involved in fisheries [8]. Besides the huge number of people engaging in this sector, fishing seems to be very risky, and it is the most dangerous occupation in the world. Its estimation for fatality rate from International Labor Organization (ILO) is at least 80 lives lost per 100 000 fishers [17]. This study focused on coastal anglers only. Coastal anglers are traditional anglers who operate within five nautical miles of the coast, operating boats (inboard/outboard engines).

The purpose of selecting coastal anglers is because most of the anglers are from this category. In 2016, about 86 percent of the motorized fishing vessels in the world were in length overall (LOA) less than 12 meters, the vast majority of which were undecked, and those small vessels dominated in all regions. Conversely, the larger vessels, classified as those with LOA greater than 24 meters, made up only 2 percent of the total fleet [8]. According to Kaplan and Kite-Powell [19], 80 percent of fishery accidents in Canada and 50 percent of fisheries accidents in Iceland are boats below 24 meters [19]. Ben-Yami [1] in Khan and Janjua [20] stated that small anglers are often overlooked in all aspects, even in industrialized countries [1, 20].

It is also noted that international law does not cover laws for coastal anglers, while local laws do not focus on their safety. Anglers on larger boats exceeding 24 meters in length and deep seas are protected by various international acts and conventions such as Torremolinos International Convention for the Safety of Fishing Vessels 1995 and International Convention on Standards of Training, Certification, and Watchkeeping for Anglers but not for coastal anglers.

Previous studies have shown that accidents are more concentrated on a small fishing boat.

The conclusion is that laws for small-scale fishing vessels are not properly regulated and controlled, which negatively affects both the fishing effort and, most importantly, safety at sea. In line with the stated problem, as a summary of this discussion, it is evident that it is necessary to study the factors that cause the accident and the safety level of the anglers on the coast during fishing operations.

1.3. Research Objectives and Research Questions

The research aims to extract previous researchers' existing knowledge and concerns using a systematic review analysis. The goal here is to understand the factors of an accident involving coastal anglers. To achieve this objective, this study has undertaken a detailed literature review by reviewing a relatively large quantity of earlier studies to answer this research question: What factors lead to accidents among coastal anglers?

2. Methodology

This systematic review involves studies on this topic that were published between 2016 up to March 2020 from Web of Science and ScienceDirect. It was undertaken in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method. The review methodology involved four steps — identification, screening, eligibility, and inclusion. Electronic databases were used to conduct literature searches using the following terms: "anglers and accident" and "anglers and safety."

The articles were included in the review only if they corresponded to the following selection criteria: (a) The study concerned about anglers and any involvement related to sea/water activities; (b) All articles were written in English and published between January 2016 until March 2020; and (c) Only article journals with empirical data are selected which means review article, book series, book, and chapter in books are all excluded. After the search of databases and the exclusion of duplications, 403 articles were identified. Using the inclusion and exclusion criteria to screen the titles and/or abstracts, 46 articles remained. Among these articles, 20 were excluded after the content was read. From this process, 26 articles were included in this review.

3. Results

This study covers 26 journals published in a 6-year duration of 2014 to 2020. Of all articles, the most studied ones have encompassed five continents which are America (9), Europe (6), South America (4), Asia (5), and Africa (2). There are eight studies conducted in the United States of America alone, meanwhile Brazil (2), Denmark (2), Malaysia (2), and Morocco (1). The sample of studies covers different populations such as anglers, incidents of accidents, health professionals involving fisheries, and administrative staff related to fisheries. The study consists of 3 main elements, i.e., the cause of accidents, accident effects, and the proposed enhancer of improvement to existing problems.

3.1. Accident Causal Factor

From previous pieces of literature, the factors can be divided into four main factors: environment, human, equipment, and management. Uğurlu *et al.* [44] and Willcox-Pidgeon *et al.* [46] stated that accidents occur as a result of double and triple combinations of these factors [44, 46].

Bad weather is a major element of environmental factors. Bad weather always negatively impacts the safety of anglers [27, 28, 32, 33, 35, 44]. Strong winds, high and low tides create unstable conditions for boats. This situation puts anglers at risk for accidents. The unpredictable topographical conditions are more likely to make the trip for fishing activities dangerous [21, 29]. This condition is made worse when it is dark and foggy, which blocks the vision. The risk of accidents is higher, especially during night and winter (shorter sunny times [18, 37]). Other dangers come from wild and dangerous animals such as sharks, catfish, freshwater stingrays, snakes, and piranhas [7, 15, 22, 40]. Accidents involving these animals are common when underwater, landing, and processing fish [7].

Behavior towards safety and the use of illicit substances and alcohol when fishing is another element of the human factor that is frequently mentioned. Recent studies show a high prevalence of alcohol use among anglers. Besides that, anglers also used illicit drugs before and during fishing operations. Studies indicate that these substances are commonly used alone and in isolated places [5, 10, 11, 24, 46]. In addition, anglers also tend to practice risky behaviors such as not wearing safety jackets [7, 36, 46]. Accidents are also associated with behavior that violates local cultural customs and lack of experience [22]. Although fatigue has been considered one of the leading causes of accidents, recent studies have found that fatigue is less associated with coastal anglers. They have less of an impact on their tiredness as they work for shorter periods and usually return to the jetty before dark [4].

The next factor, equipment, includes the boat and inside the boat. The ship's sinking occurred due to several elements such as obsolete vessels, overloaded vessels, water leakage, unstable vessels, and strong winds. Studies also suggested that old, short, and made of steel are more likely to crash. Furthermore, a highly experienced captain can help to prevent anything worse [32, 44]. Marvasti stated that the old ship made of steel was safer than the new ship made of fiberglass [33]. Additionally, the equipment on the boat itself contributed to the increase in fishing accidents [4, 33].

Management factors include management systems and regulatory laws that affect fishery safety. The law

change has a mixed effect [33]. Introducing individual quota systems has had a positive impact on the industry. It makes anglers less likely to go to sea in bad weather [33]. Other studies suggested that it increases angler's income while anglers from lower socioeconomic conditions will potentially take more risk [22]. Anglers are also at risk for accidents due to a lack of standard procedures such as job sharing, improper lookout, and leaving the bridge unattended [44].

3.2. Accident's Effect

We found two effects from fishing accidents from the past studies: impacts on boats and/or equipment and individuals. Effects on the boat are capsizing, grounding, sinking, and fire. Grounding accidents, sinking accidents, and collision accidents occurred mostly in coastal waters [22, 37, 44].

The commonest individual injury associated with fishing is body injury such as cuts and muscle pains. Most injuries were not severe and did not result in clinical care, but approximately limited one's work. Electrical shock, solar radiation, and drowning were also identified and prioritized prevention and control. In addition to health disorders including musculoskeletal, cardiovascular, visual, and hearing problems, dermatologic and respiratory problems are risks that anglers of all ages face. Other long-term effects are health problems such as paralysis, economic burden, and traumas due to accidental falls [2, 3, 7, 12, 15, 22, 24, 29, 32].

4. Discussion

The study presented different accident factors in different areas. There is a possibility of the same factors, but every region has distinctive factors. Studies in modern countries such as Europe and America use complete data on accidents and anglers. Most likely, the process of their reporting on accidents and anglers database is more structured than in other countries. In some cases, there is also underreporting of occupational injuries that have been linked to concerns of financial and regulatory repercussions such as fear of liability and investigation that reduce the likelihood of anglers reporting non-fatal injuries [3, 21].

Financial restrictions have become the main reason why efforts to reduce accidents are difficult to do. Financial needs have made anglers go to the sea even if the weather is bad. Every effort to tackle this safety problem requires higher funds such as an allowance for safety training, purchasing modern tools to facilitate fishing operations, and insurance. Anglers also demonstrated attitudes such as the defensive ideology of their profession and addictive disorder to danger. These behaviors could cause the failure of individual or group safety measures [23].

Another perception of anglers in this literature research is that they have a high level of job satisfaction, although these coastal fishers are more exposed to occupational risks. This is related to friendship, work environment, independence, and meaningful work [39]. Injuries are perceived as an acceptable part of the job, and it happens all the time [2]. The common perception is that health concerns seem minor compared to risks faced at sea as an angler [43]. Working and safety conditions are better onboard large fishing vessels because they are less cramped than smaller ones and, above all, belong to companies with a specific safety department [4]. Some say that anglers' adaptive capacities are the source of system safety and resilience [38]. People working in the fishing industry have amongst the poorest health outcomes of all workers. Poor health outcomes among fishers extend beyond the risk of fatal accidents to general health status and illnesses or disabilities that can impede everyday life [42]. Therefore, there is an urgent and important need for new regulations to cover medical coverage and health inspection in order for anglers to be healthy and, in the long run, can reduce accidents during fishing operations. Noman *et al.* [32] found that many anglers face occupational problems, but a neglected proportion visited the registered doctor. Working time does not allow anglers to get health care. The authorities should build proper health care facilities near fish landing areas to access health facilities [32].

5. Recommendation

To mitigate these accidents, changes need to be made. Significant changes such as conducting safety training and expanding awareness through community culture in the form of visual and written safety messages can influence attitudes, beliefs, and behavior in a better way [26]. Organizational change, use of personal protective equipment, manual labor reduction, and employee training are some of the options that enhance anglers' health and safety [14]. Safety equipment is essential to protect against any accident risk from an angler's perspective. These risks vary at every level and are also influenced by many factors such as knowledge and how to do the job. Anglers are less interested in theoretical knowledge but are more likely to consult professionals. They also consider anglers' association as the catalyst for addressing safety concerns [41].

Research stated that two-thirds of seamen were current smokers during fishing activities, nearly half of them drinking excessive alcohol, more than a quarter of anglers had a positive urine test for cannabis, and some had a positive urine test for cocaine. Therefore, rules for fitness at sea have to be modified by introducing urinary tests before they return to the sea [10]. Turner *et al.* [42] stated that people working in the fishing industry have the poorest health outcomes of all workers in England and Wales [42]. On the other hand, medical coverage is still insufficient. Therefore, the main suggestions for anglers were to improve income, social welfare, health insurance, safety on board, quality of lifestyle, sport and

leisure activities, information and awareness campaign of occupational stress, and fight against addictive behaviors [25].

Although Lucas *et al.* [27] stated that having access to well-maintained, serviceable lifesaving equipment and the knowledge and skills to use it properly are critical factors for survival, but De Aquino *et al.* [7] stated that most anglers did not wear PPE [10, 27]. Therefore, there is a need to raise awareness of the correct use of personal protective equipment and to carry out adequate health surveillance of workers exposed to these occupational risks [30]. Increased lifejacket wear among coastal and marine users would dramatically reduce the number of drowning-related deaths each year. However, the regulation does not appear to be a promising approach for compulsorily encouraging Floating Protective Device (FPD). Fears of entanglement, discomfort, and interference with work are the primary reasons for not wearing an FPD. For FPD designs to be attractive to anglers, they must consider functionality with minimal interference in work [36, 45].

The other recommendation that has shown a positive impact is the introduction of quota restrictions with private ownership of share allocations without seasonal closures, which has reduced the need to make risky trip decisions and improve safety [33]. Another idea for accident reduction is developing a network of fishing vessels located within a ten nautical miles range. This network can be used to develop a rapid rescue force that can arrive at the location of a maritime accident well before professional Search and Rescue (SAR) vessels. The most probable accident occurrences in bad weather conditions reveal that this environmental factor is an important problem, and this network should be considered to prevent accidents in fishing vessels [47]. NIOSH also has recommended that vessel owners and operators review their vessel's stability and watertight integrity in a schedule survey. A simpler tool must be compulsory to help the skippers evaluate the ship's stability easily and understandably to reduce the number of stability-related accidents [13].

6. Conclusion

This systematic review has highlighted the importance of safety to anglers. This review focuses on the context of coastal or small-scale anglers, which comprise most anglers' groups in this industry. This recent literature shows various areas of research involved, such as the cause of accidents, accident effects, and the proposed improvement to existing problems. We have identified four major accident factors involving coastal anglers: human, management, environment, and equipment. Firstly, environmental factors include bad weather, dangerous animals, and unpredictable topographical elements. Then human factors consist of behavior towards safety and illicit substances and alcohol. Next is the equipment factor, which comprises elements such as the material of boats, overloaded vessels, and unstable vessels. Lastly, the management factor involves management systems and regulatory laws. The systematic review provides insightful information on the impact of these accidents on boats, equipment, and individuals. Effects such as capsizing, grounding, sinking, fire, and body injury affect anglers in terms of time and finances. All these studies also provide recommendations such as safety training, quota restriction, and fitness test to help other anglers to live in safe and better working conditions. Overall, these studies show that accident factors were different in each area. Addressing these factors would better understand anglers' safety and hopefully a safer working environment for the next generation.

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