Preparedness and Response from Government Authorities towards Pollution on Marine Ecosystem

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Abstract

Environmental pollution is affected by pollution and caused harmful to marine life and humans. Among the factors contributing to pollution are human errors, technical errors and natural disasters. This study focuses on the roles by related marine authorities towards pollution on the marine ecosystem in order to prevent the pollution on the marine ecosystem. The elements highlighted in this study are the preparedness and response that selected and straightly approach from marine authorities based on source of oil spill and effect of oil spill. The sources of the oil spills are human errors, technical errors and natural disaster. Meanwhile, the elements of effects of the oil spills are marine mammals, and economy for local community. The scope of the study is at Pangkor Island, Perak, Malaysia. This research aims to identify the main elements identified as factors of pollution that cause from oil spill sources oil spill in term of marine authorities feedbacks and survey that concisely happened at Pangkor Island. Pangkor Island is selected as research scope in this research because of its location that attracting tourists for marine ecosystem as well as important for fisherman activities. 77 respondents participated in the questionnaire survey. The data were analyzed using the Statistical Package for Social Science (SPSS) for descriptive analysis, mean analysis and pearson correlation analysis. The result indicated that technical error gives the highest mean analysis which is 4.56 from SPSS results and shows as one of the major source of oil spill which have been agreed by the marine authorities. The Pearson correlation coefficient between technical errors towards preparedness and response poor positive relationship showed a positive relationship at coefficient are 0.255 and 0.181 respectively. The both values are based on one selected element for preparedness and responses. The result of the correlation analysis has proved that the preparedness and response of the oil spill were influenced by steps and precaution measurements.

Keywords; *Marine Pollution, Oil Spill, Preparedness and Response, Marine Authorities*

I. INTRODUCTION

The marine ecosystem is important to the tourism industry and needs to be protected from extinction. The threat to the marine ecosystem such as pollution from oil spill needs to be avoided to preserve the marine ecosystem. The oil spill pollution causes a bad effect on the marine ecosystem and mostly comes from shipping activities (Fingas, 2011). Most accidents happen involved petroleum industry and caused damage to the marine ecosystem (AlKazimi& Grantham, (2015). Marine mammals are important sources of food for indigenous residents (Huntington, H. P. et al, 2016). Marine mammals associated with increasing human activities offshore which can interfere with vital life functions. Many coastal communities rely on marine mammals for food and cultural identity, and subsistence hunters have expressed strong concerns that underwater sound from human activities

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negatively affects both the animals and hunting success. Federal regulations require scientists and oil and gas operators to acquire incidental harassment authorizations for activities that may disturb marine mammals (Moore, S. E., et al, 2012). Marine debris also becomes critical issues and is known to be harmful to organisms and human health (Rochman, Hoh, Kurobe, &Teh, (2013). The amount of marine debris such as plastics in the marine environment has increased. This waste is created by humans who have discharged into marine environments (Kole, 2017).

A. Research Objectives

The objectives of this study cover:

1) To analyze the preparedness from Marine Authorities in preventing the pollution towards the marine ecosystem.

2) To determine the response from Marine Authorities towards pollution on the marine ecosystem.

B. Research Questions

Based on the problems identified, the following research questions are as follows:

1) What are preparations from Marine Authorities in combating the pollution in the marine ecosystem?

2) What are responses from Marine Authorities in preventing pollution in the marine ecosystem?

C. Scope of Research

This study focuses on government authorities on preparedness and response of pollution towards the marine ecosystem. The government authorities were from Marine Department (Mar Dep), Malaysian Maritime Enforcement Agency (MMEA), Port Authorities, and Department of Environment (DOE) located in Lumut, Perak, Malaysia.

II. LITERATURE REVIEW

This chapter review several definitions of pollution, oil spill, preparedness and response, sources of oil spills and effect of oil spills from the previous study. There are several factors caused the oil spills at an open sea which can be divided into human errors, technical errors and natural disasters (Salako, Sholeye, and Ayankoya, 2012).

A. Definition of Terms

a) Oil Spill:

The oil spill is defined as the huge wellsprings of hydrocarbons entering the accepting seagoing condition. It can come from any resources which are from a vessel during onboard, small boat from a fisherman, natural disasters and more. The spillage of oil can cause a big negative impact on the marine ecosystem when occurred (Doshi et al, 2017). It is also defined as a general term used to denote liquid petroleum products which mainly consists of hydrocarbons. The spillage of oil into the natural environment is termed an oil spill (Ajide and Isaac, 2013). It is known as any kind of form of contamination that is found in any ecosystem resulting devastating harmful impact towards the organisms in the particular ecosystem and interrupting the growth rate and plant or animal reproduction or by interfering with human comfort, health, property values and amenities (Potter. S. G, 2013).

b) Preparedness and Response:

Preparedness and Response can be described as activities performed before disasters and aimed at enhancing safety and reducing impact for both people and infrastructure. These activities are important to minimize the impact when the disasters occurred in the future (Holguín-Veras. J.et al, 2012). The preparedness also is known as an efforts to design organizational structures, to organize supply chain resources, and to plan and train to ensure efficient response if preparedness is called for. The preparedness is a major phase of emergency management and is particularly valued in areas of competition (Listou. T, 2015).

B. Causes of oil spill

a) Human errors:

It is due to several reasons such as accidental leaks from ships and offshore oil platforms and it often results in exorbitant economic costs and devastating marine ecological degradation and human (Shi, Wang, Luo, & Zhang, 2019).Vessel collisions at sea or incidents relating to an oil spill at oil terminals (Speth. P.E,1988), (Garcia, K.C, 2014), (Sánchez, D., 2014), (Salako, 2012). It was also due to human factors, human error, unsafe behavior (Theophilus Stephen, et al, 2017), (Haghighi. M, et al, 2017), (W.Y. Liu, Chen, Chen, &Shu, 2017), (Mistra, 2015), (Fingas, 2011), (Jukes, P., & Singh, B, 2017).Human error of poor emergency planning response (Sutherland & Weber, 2006).Due to human activities or natural disasters (X. Liu &Wirtz, 2006). Lastly, due to both direct and indirect human factor failings (Venart, 2004).

b) Technical errors:

It covers: the vessel condition, ocean/ coast environment, human factors and emergency devices (Kang, Zhang &Bai, 2016). Pollution comes from a vessel is causes form oil discharge from ships, tanker collides, wastewater discharge, garbage, and solid waste discharge and marine machinery exhaust. When accidents occurred involves of a vessel, the vessel also discharges the pollutants like oily water, noxious liquids, sewage, garbage and contaminated ballast water released to the marine environment (UmoIduk and Nitonye Samson, 2015).

c) Natural Disaster:

It is a major case that resulting from natural processes of earth like floods, hurricanes, tornadoes, tsunami, an earthquake and it occurred with unexpected where the place, what the time and when the disaster occurred. The oil spills into the oceans and waterways from machinery transporting petroleum like pipelines and oil tanker ships are due to natural disasters. Heavy storms in ocean and earthquake caused to shake off the sea floor and resulted in oil spills (Rinkesh, 2012).

C. Effect of oil spill

Once the oil spill happened, it provides negative effects and harm to our marine environment and causes loss. It cause severe long-term environmental and social-economic impacts on marine ecosystems and the subsistence of coastal communities (Hamilton (2015), Song, Wei, Qian, & Fang (2011), Etkin (2001), Taylor (2014), Guard (2011), Weber (2010), Abdulrazaq, Zubaidah, & Kader (2014), Khalid (2013), Wheeler (1998), Ajide (2013) and Doshi, Repo, Heiskanen, Srviö, &Sillanpää, (2017).As we are aware, the oil spill occurred when liquid of petroleum which is oil is released into the environment by vehicle, vessel, pipeline or anything else. It occurred on a large scale and is mostly seen in water bodies. When the oil spill occurred in a certain place it caused a big impact either to the ecosystem, marine life, people and more in the short term or long term. It is a reason why it's important to avoid the spillage of oil towards the marine ecosystem. It also affected mangrove shoreline worldwide (Norman C. Duke, 2016).

III. METHODOLOGY

This study relied on both primary and secondary data in order to come up with accurate and objective findings. The reference from previous literature review related to this topic is referred to.

Pilot Test

The pilot test was conducted as a trial collection of data to detect weakness from the questionnaires and to reach the objective of the study. The pilot test were conducted among 30 respondents are come from the Marine Department, Department of Environment and MMEA. It is used to analyze the reliability value of each questionnaire. There were 20 items tested for sources and effects of the oil spills. The reliability of questionnaires is conducted by using a Cronbach's coefficient alpha for the internal consistency reliability (Gliem&Gliem,

2003). The result in Table 1 below shows the overall range of 0.749. Thus, all of the questions were acceptable and able to be used for conducting the survey.

TABLE 1. PILOT TEST TABLE

Marine Authorities	Number of Distribution
MMEA	10
DOE	10
Mar Dep	10
Total	**30**

Note: Mar Dep-Marine Department, MMEA-Maritime Malaysian Enforcement Agency, DOE-Department of Environment

TABLE 2. CRONBACH'S ALPHA VALUE

Reliability Statistics	
Cronbach'sAlpha[a]	N of Items
0.749	20

Population, Sample, and Respondents

The sampling frame of the current study consists of 90 employees from three government agencies such as Marine Department, MMEA and DOE located in Lumut, Perak, Malaysia. From this sampling frame, the sample was drawn using Gay and Airasian (2003), suggests that for descriptive research the sample should be between 10-20% of the total population. Therefore following Gay and Airasian (2003), 90 questionnaires were sent, 77 were received back and usable, so the overall response rate was 85.55% responses were collected from these government agencies. The breakdown can be seen in Table 3. In order to ensure effective distribution and collection of the questionnaire, the Human Resource Department was involved and

questionnaires were distributed through face to face session handled by the Human Resource Department and researcher. The profile of the respondents can be seen in Table 3 below.

TABLE 3. POPULATION, SAMPLE AND RESPONDENTS

Agencies	Population	Sample	Respondents
Mar Dep	30	30	28
MMEA	50	50	40
DOE	10	10	9
Total	**90**	**90**	**77**

Questionnaire and Survey Method:

77 respondents have participated in the questionnaire survey applied in this research by using closed-ended questions to acquire for the following information:

1) Section A: Respondents' background

2) Section B: Sources and effect of oil spill

3) Section C: Preparedness and Responses

A Proposed Theoretical Framework:

Thisresearch is involving of two variables for Independent Variables (IV) and Dependent Variables (DV) respectively. The independent variables covered the sources of oil spill and effect of oil spills. The sources of oil spill mainly are come from human error, technical error and natural disaster and effect of oil spill towards marine mammals and economy for local community. While for dependents variables used two variables of the preparedness and response. These variables descriptively selected in order to measure the significant towards the action from the related government authorities. Preparedness is the first process for emergency case that happened at Pangkor Island such as accidents and any related

abnormal activities reported by the citizen. Then, there will trigger for recorded and response to avoid the problems.

IV. DATA ANALYSIS AND FINDINGS

Respondents Backgrounds

TABLE 4. RESPONDENTS BACKGROUNDS

Background Respondent	Descriptions	Frequency	Percentage
Gender	**Male**	**45**	**58**
	Female	32	42
Marital Status	**Married**	**59**	**77**
	Single	18	23
Age	18-25 years	13	17
	26-33years	16	20
	34-41years	22	29
	42 years above	**26**	**34**
Education	**SPM**	**27**	**36**
	STPM	25	32
	Diploma	18	23
	Degree	4	5
	Master	3	4
	PhD	0	0
Race	**Malay**	**38**	**49**
	Chinese	22	29
	Indian	17	22

Based on Table 4 shows the demography analysis of respondent's background. The purpose of this test is to explore the respondents background towards five common variables which consist of gender, marital status, age, education and race. Ideally, this test shows the significant in this research. From the gender view shows from 77 respondents there are 45 male and 32 female respondents. There is a difference in gender as marine activities is involved in a heavy maritime industry which requires more male manpower and in general, female staff mostly are involve in administrative matters. The range of the age is between seven years, which refer to the age range of the staff of the selected government authorities. The group of the age is considering several factors such as their position and working experiences. In the age of 42 years old and above shows the highest feedback which is at 34.0%. This value is enough to represent all the samples. The majority staff who is included in this age are holding positions from middle management to top management. This category is related to the position and experience to counter the issue towards the oil spill preparedness and response. In terms of the race characteristic, the majority race of the respondents who involved in this survey is Malay stated at 49.0% as compared to other race. The location of the government authorities are located in Malay residential in Pangkor Island and Lumut, Perak. The surrounding areas are also surrounded by the Malay community in the radius of 10km to 25km near to the scope of research and this supported why the Malay population is the highest and affected this research. In terms of academic qualification among respondents 36.0% holding SPM, 32.0% holding STPM and 23.0% holding Diploma as compared to Bachelor 5.0% and Masters 4.0%. In the scope of the research required at least staff with Diploma to perform marine operation daily tasks.

Instrument

The instrument of the current study was divided into two parts. The first part of the questionnaire was regarding the Preparedness and the second part of the questionnaire inquire respondents regarding Response of the oil spills, and respondents were

asked to rate on a scale of 1-5, where 1 represent strongly disagree and 5 representing strongly agree. This measurement called Likert Scale with the purpose to measure the response rate and the typical Likert scale is a 5- or 7-point ordinal scale used by respondents to rate the degree to which the respondents are agree or disagree with a statement as mentioned by Sullivan, G. M., &ArtinoJr, A. R. (2013).

The Mean Analysis

The 77 collected data has been analyzed by using SPSS. This mean analysis is used to identify and determine the highest factors that selected and analyze by marine authorities regarding on oil spill before correlate with the preparedness and responses.

TABLE 5. MEAN ANALYSIS FOR SOURCES OF OIL SPILLS

Report			
	Natural Disaster	**Technical Errors**	**Human Errors**
Mean	4.36	**4.56**	4.49
N	77	77	77
Std. Deviation	.724	.500	.503

Table 5 shows the result of mean analysis in determining which is the most significant factors that being concluded as source of the oil spills. From three sources, technical error shows the highest mean value which is 4.56 as compared to another two sources. Respondents from marine authorities were mostly agreed that this factor is the main for any issues and problem regarding to the oil spill especially happened at Pangkor Island.

Based on the observation, the two main daily activities at this island are come from fishery activities and tourism activities.

TABLE 6. MEAN ANALYSIS FOR EFFECT OF OIL SPILLS

Report		
	Marine Mamals	**Economy**
Mean	4.52	**4.57**
N	77	77
Std. Deviation	.503	.498

1. Table 6 shows the SPSS measurement for the effect of oil spill towards Pangkor Island from marine authorities reported and analysis. These two effects are main significantly that reported by marine authorities and mostly agreed that effected in economy in local community stated the highest mean analysis of 4.57. This result concluded that the marine pollution has affected the economic at Pangkor Island by creating a problem on the tourism activities such as water sports activities, banana boats, water ski, kayaking or canoeing, diving, island hopping, snorkeling, fishing wouldn't be able to run smoothly, the beach is not clean and the amount of fish is decreasing.

The Pearson Correlation

The correlation analysis is used to investigate the relationship between two variables and has provided an estimation regarding the relationship between two variables. Pearson's correlation coefficient (r) is used to measure the strength of the association between these two variables. The Pearson correlation coefficient between source and effect of oil spill towards preparedness and response. Two analysis of correlation analysis are produced for preparedness and responses respectively.

TABLE 7. CORRELATION FOR PREPAREDNESS

Correlations

		Technical Error	Continuous review process of effective contingency plan	High-tech device are used for oil spill prepared ness	Effective communication	Oil spill risk assessment planning of all scales and scenario	Develop robust and detailed contingency plan
Technical Error	Pearson Correlation	1	.110	.255*	-.234*	.221	.115

*. Correlation is significant at the 0.05 level (2-tailed).

Table 7 shows the result of correlation between selected independent variables with dependent variables that consist of five variables for preparedness by marine authorities. This measurement is used to define the relationship between the most source of oil spill from the technical errors and from mean analysis constantly with the corrective plan from three different marine authorities show overall negatively relationship. Nevertheless, the result shows overall negatively relationship between the entire preparedness plan to cover-up the technical error. Only technical error shows good relationship towards high-tech device that are used for oil spill preparedness with the correlation coefficient is 0.255. This mean that technical error correlate positively with preparedness of high-tech.

TABLE 8. CORRECLATION FOR RESPONSE

Correlations

		Technical Errors	Cleaning oil methods	Management response	Marine law and regulation penalties	Prompt Action	Initial deployment for oil spill
Technical Errors	Pearson Correlation	1	-.064	.055	.023	.103	.181

**. Correlation is significant at the 0.01 level (2-tailed).

According to Table 8, the pearson correction result shows that positively relationship between technical error as main source of oil spill indicated the correlation coefficient r = 0.181 toward initial deployment by marine authorities. The result shows the prompt and correct response is essential during oil spillage or oil pollution.

V. DISCUSSION, CONCLUSION AND RECOMMENDATION

Discussion and Conclusion

The elements of preparedness and response have fulfilled the objectives of the study. It is vital for the related marine agencies to focus on the preparedness and response towards the oil spill incidents in Pangkor Island, Perak, Malaysia. The first objective has achieved on the preparedness from Marine Authorities in preventing the pollution in the marine ecosystem is very important to overcome the spread of oil spills to the other area. The study also has achieved the second objective on the response in minimizing the oil spill incidents. The marine authorities such as Marine Department, MMEA and DOE play an important role in minimizing the oil spills incidents and also responsible in the response clean-up process. The government agencies need to ensure the number of staff, equipment, facilities for the response process is sufficient at all the time. The contribution of preparedness and response of oil spill is vital in the case of oil spill incidents inthe prevention and control of the marine environment

(Montgomery &Runger, 2012).

Recommendation

Since most of the oil spill issues were from human errors, thus the awareness towards the consequences from the oil spill incidents among the crew, ship owners, ship agencies is important. Societies are responsible for the pollution issues as it comes from a human being (Al-Thani et al, 2018). The society needs to be alert on the pollution problems and to unite among each other in minimizing the pollution in the future. It is important to cultivate awareness among societies through related various a broadcast such as television, radio, flyers, billboards, telecommunication through Whats Application groups so that our environment is aware. The sense of responsibility needs to be shown by the communities to maintain the environment clean and safe for future generations. The awareness among teenagers also needs to increase by having several collaboration with the ministry of education and the ministry of higher education through introducing the environmental education subject to students at schools and universities. A special curriculum needs to be formulated for the systematic disclosure to be implemented as it is intended to instill awareness effectively among societies (An et al, 2018). The government agencies should conduct several campaigns to societies and fishermen to cultivate moral values tolove the environment and marine ecosystem (Wu, 2019), which could minimize the pollution causes from fishermen. Lastly, the other responsible parties should perform a checklist to make sure do not discharge wastes to an open sea which leads to marine pollution (Worthington et al, 2018).

VI.   ACKNOWLEDGMENT

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