Evaluating the Community's Perception of the Ecological and Social Consequences of Oil Spills in Algoa Bay, South Africa

Thabang Maphanga

***Abstract*—** Oil is the most important energy resource in the world, and it is transported by ships across the oceans. An oil spill may occur during the transfer of oil to vessels and its transportation or extraction from the earth. Oil contamination can negatively impact the coasts and estuaries and cause serious health problems for humans, the environment, and wildlife. The study aims to evaluate the impact of a spill on the environment and the socio-economic aspects of Algoa Bay. Algoa Bay is a large, crenulated bay on South Africa's southeast coast facing the southwest Indian Ocean. It forms one of a series of such bays along the Cape South Coast. The questionnaires were then administered using simple random sampling. This was done by asking random people who were socializing in the area, asking fish catchers, people living around the beach, and also people working along the beach. Two Garmin GPS units were used to assess the environmental sensitivity to an oil spill and also for field assessment. The results indicate that 39.8% of respondents strongly agreed that oil spills adversely affect tourism, while 28.9% agreed, and 24.7% remained neutral. Conversely, 4.5% of respondents disagreed, suggesting that oil spill incidents might attract tourists interested in observing or learning from such events. The availability of information on

coastal resources and prioritized protection areas facilitates a more efficient response and allocation of protection and clean-up efforts, thereby underscoring the recommendation for implementing an oil spill contingency plan. Nevertheless, oil spills are implicated in environmental pollution and degradation, negatively impacting economic sectors such as tourism and fisheries.

***Keywords*—** Oil spillage, Perception, Environmental Awareness, Education, Pollution

I. Introduction

Oil is the most important energy resource in the world which is transported by ships across the oceans. During the transferring of oil to vessels and its transportation or extraction from the earth an oil spill may occur. Contamination from the oil can have negative impacts on the coasts and estuaries and can cause serious health problems in human beings, environment, and wildlife [1]. According to[2], Oil spills in marine environments can have long-term impacts not only on aquatic ecosystem in general but also on human activities. Moreover, people also use the ocean and shoreline for boating, sightseeing, vacation, and other recreational activities. Therefore, the prevention of an oil spill is the top-most priority, and the responsibility lies equally on individuals as well as on governments and industries, because the sources of oil spill in the ocean are due to carelessness, rather than an accident [5].

The impact of an oil spill on the natural environment is known to have long-lasting negative effects. The consequences are further complicated when sensitive environments are impacted. [6] defines oil spill as an accidental release of oil into a body of water, as from a tanker, offshore drilling rig, or underwater pipeline, often presenting a hazard to marine life and the environment. [7] and [8] pointed out that oil pollution is widespread in marine environments as a result of inadvertent spills from refining facilities and during transportation, direct discharge from effluent treatment plants, and runoff from terrestrial sources. Oil is the most important energy resource in the world which is transported by ships across the oceans, during the transferring oil to vessels and transportation oil spill may occur [9]. That contaminates the coasts and estuaries and can cause serious health problems to human beings, environment, and wildlife, says[10][1].

An essential element of oil spill preparedness is the assessment of risk for coastlines and near-shore waters that are considered to be vulnerable to damage by oil pollution [4][7] Nonetheless, fishery industries are potential support to economic growth but then, [11] highlights that, misuse may cause species structure to change because it is selective, and because of the opposing volumes of fish populations to sustain losses. Seeming variation in species structure between a protected and an exploited site may partly reflect the effects of exploitation.

The oil spills resulting from damaged tankers and pipelines often lead to both immediate and long-term environmental damage, which can persist for decades [12][1] When oil infiltrates coastal marshes, mangrove forests, or wetlands, fibrous plants and grasses absorb the oil, potentially harming the vegetation and rendering the area unsuitable as a wildlife habitat. Moreover, as oil ceases to float on the water's surface and begins to sink into the marine environment, it can have detrimental effects on fragile underwater ecosystems, killing or contaminating fish and smaller organisms that are crucial links in the global food chain [3]. [4] assert that oil spills can

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be fatal to marine mammals such as whales, dolphins, seals, and sea otters. Even if marine mammals escape the immediate effects, an oil spill can contaminate their food supply. Marine mammals that consume fish or other food exposed to an oil spill may be poisoned by the oil, leading to death or other health issues [12]. Additionally, long-term damage to species, their habitats, and nesting sites is one of the far-reaching environmental consequences of oil spills. Even species that spend most of their lives at sea, such as various species of sea turtles, can be harmed by oil encountered in the water or on the beaches where they lay their eggs [13] [9[]. Nonetheless, the severity of environmental damage caused by an oil spill is contingent upon numerous factors, including the volume of oil spilled, the type and weight of the oil, the location of the spill, the species of wildlife in the area, the timing of breeding cycles and seasonal migrations, and even the weather at sea during and after the spill[3][4][8]. Furthermore, the impact of the Exxon Valdez oil spill, which occurred in Alaska on March 24, 1989, was human-induced and resulted in the release of approximately 40 million liters of oil into the sea [14]. These oil spills lead to the death of fish and other marine animals, while other effects include the damage or destruction of beneficial properties of the animals, such as damage to the feathers of birds, as well as the destruction of the mangrove habitat and other sources of ecological balance in the spill area [15].

Bunkering refers to the provision of fuel for maritime vessels, encompassing the onboard logistics of loading fuel and distributing it among available bunker tanks. The term originated during the era of steamships, when coal, the primary fuel, was stored in bunkers [16][3]. Oil spills can have detrimental effects not only on local communities but also result in widespread economic losses for the country. Moreover, oil spills pose significant long-term threats to coastal ecosystems, impacting wildlife, fisheries, coastal and marine habitats, human health, livelihoods, and recreational resources of coastal communities. Over the years, developing countries have been severely affected by natural disasters, which have proven catastrophic to livelihoods [17]. Recently, man-made disasters have also demonstrated that African countries are particularly vulnerable, as many rely on ecosystem services for their livelihoods. South Africa is no exception, with a portion of the population dependent on ecosystem services for their survival [18][6]. Oil bunkering in South Africa presents a substantial threat to the aquatic ecosystem, particularly in the eastern regions where a significant number of people rely on the ecosystem for their sustenance. As South Africa engages in oil bunkering, the critical question arises: at what cost, specifically, what are the ecological and socio-economic impacts associated with oil bunkering in South Africa?

II. Research Design and Methodology

A. Study area

Algoa Bay is a large, crenulated bay lying on the south-east coast of South Africa and facing the south-west Indian Ocean. It forms one of a series of such bays along the Cape South Coast. There are two commercial ports located with Algoa Bay. The Port of Ngqura and the Port of Port Elizabeth are critical economic drivers within the bay along with an active commercial fishing industry [10][7][6].

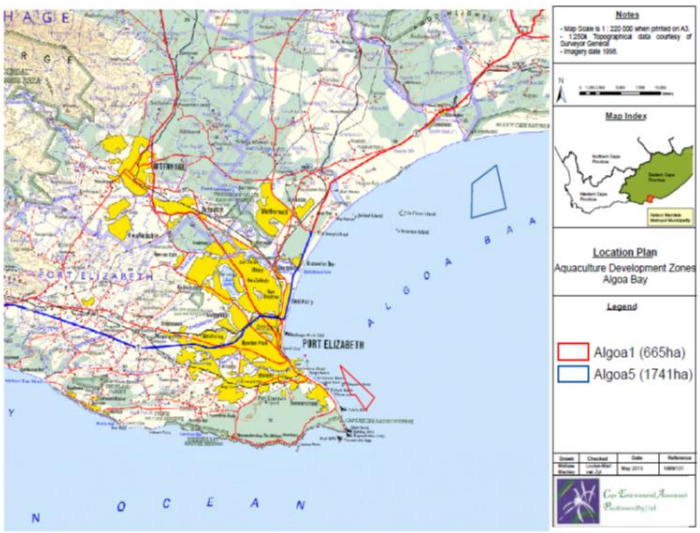

Fig. 1: Indicates the location plan of aquaculture development zones in Algoa Bay (Mackay, 2013)

B. Research Design

This research used qualitative and quantitative methods to collect primarily data in the form of questionnaires. This helped to ensure that there is enough information to collect with regards to knowing the impacts of an oil spill and help to ensure that these impacts can be managed, mitigated and prevented for future occurrence. The research was conducted at Algoa Bay, South Africa. Data was collected on the beaches in Algoa Bay, see figure 2. Sites were visited and observed to see whether the economic status is growing and also evaluate the impact of oil spill to the marine environment.

C. Primary data

The questionnaires were then administered using simple random sampling. This was done by asking random people who were socializing in the area, asking fish catchers, people living around the beach, and also people working along the beach. Two Garmin GPS units were used to assess the environmental sensitivity to an oil spill and also for field assessment. Fill-up sheets were used to combine questionnaires asked by organization candidates.

D. Data analysis

Responses collected from the items on the questionnaire

formed the basis for data coding. The data collected was subjected to a largely descriptive analysis, using a simple statistical analysis, of each characteristic found in the material, as well as using a pie chat and graphs which was collected from the personal interview, and was transcribed and translated into subsections and utilized inductive reasoning as well as content analysis to determine the extent of impact. The information or data obtained from the observational procedure was also used to complement that which was obtained from both quantitative and qualitative data.

III. Results And Discussion

A. *Demographic profile*

The age distribution of the respondents in the study is presented as follows: individuals aged 16-25 constituted 27% of the sample, those aged 26-35 comprised 33%, and respondents aged 36-45 accounted for 40%. Consequently, the data indicates that the largest proportion of respondents, 40%, were within the 36-45 age range. Overall, the findings suggest that the majority of participants were mature individuals, capable of perceiving the impacts of oil spills resulting from bunkering activities.

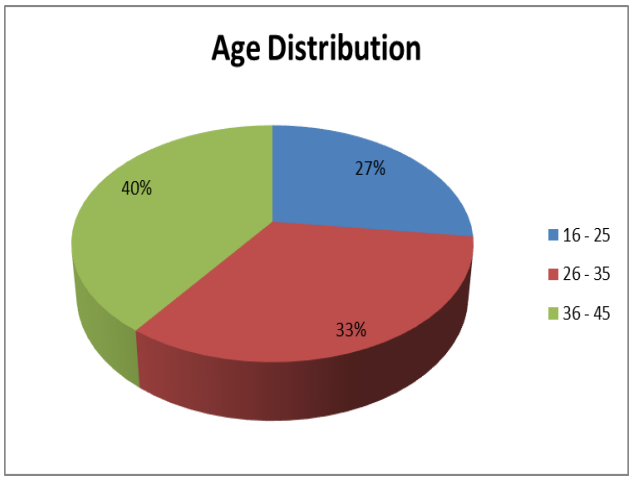

Fig. 2: The age distribution frequency of people that are more socializing in Algoa Bay, interpreted in percentage.

B. *The leisure that is taking place in algoa bay*

The data presented in Figure 1.1 indicates that leisure activities accounted for the highest proportion of respondents, at 47%. This was followed by fishing and visiting, each with 20% of respondents. In contrast, restaurant workers represented the smallest group, with only 13% of respondents. Consequently, the findings of this study suggest a high level of social interaction in this bay, which is characterized as a bathing beach.

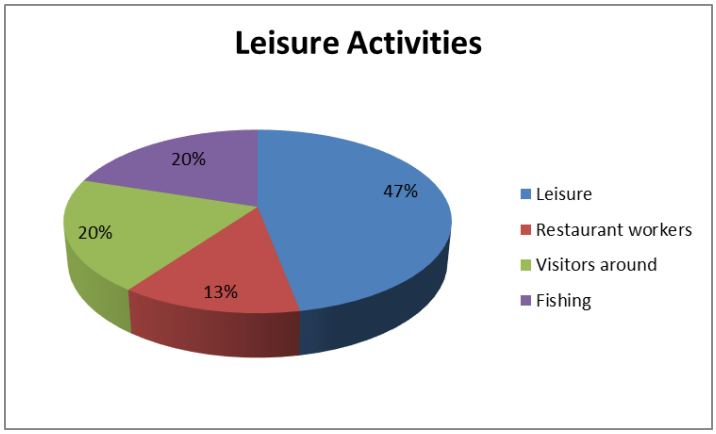

Fig. 3: Determines the leisure that is taking place in Algoa Bay and the percentage of respondents of each of those groups.

C. *Oil spills social impact*

The results revealed that some of the responses from the question asked, "does oil spill deteriorate the standard of living". Evidence from the data reported in bar graph revealed that 69.3 % of the respondents strongly agreed that the oil spill deteriorate the standard of living, as well as 22.6 % of the respondents agreed that the oil spill deteriorate the standard of living caused by oil spillage and 8% were neutral. Some of the additional factors mentioned by the respondents included that oil spill causes a disturbance in their recreational activities, negatively affect the community and agricultural production. Refereeing to the study in Niger Delta it is aligned to the study made in South Africa, Algoa Bay stating that, contaminated coastal amenity areas has also led to interference and loss of recreational activities such as diving, angling, sport, fishing activities, bathing and boating. Small restaurant owners and many others who gain their livelihood from the tourist trade have also suffered temporary losses. Another negative effect caused by oil spills in this community includes the loss of tourism.

The social impacts heavily affect people, community and industries, it goes without saying that contamination of the shoreline with oils is a common characteristic of many oil spills, and when attractive coastal beaches and resorts are affected, the costs could be high as it may seriously restrict such recreational activities as bathing, boating, angling and diving for shorter or longer periods of time. As a result, hotel and restaurant owners, and others who have their income from recreational activities in the coastal zone for example, boat renters, diving tour operators, angling tour operators and many more, may suffer significant economic losses.

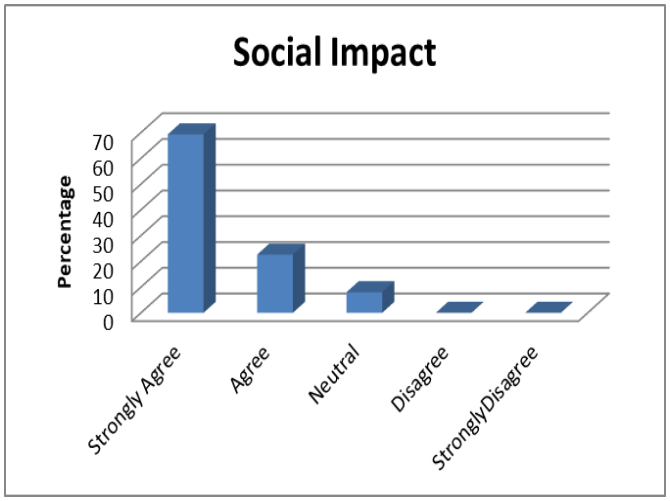

Fig. 4: Indicate how social impacts of oil spill affect people and community in Algoa Bay.

D. Oil spills economic impact

The economic assessment results demonstrate that oil spills adversely affect the forestry sector and sustainable coastal tourism, as well as the fishing and agricultural industries, ultimately leading to a decline in the economy. In response to the question, "Do oil spills affect tourism?" the data presented in the graph below indicates that 39.8% of respondents strongly agreed that oil spills impact tourism, while 28.9% agreed, and 24.7% remained neutral. Conversely, 4.5% of respondents disagreed, suggesting that some tourists may be drawn to visit affected areas out of interest or for educational purposes during oil spill incidents.

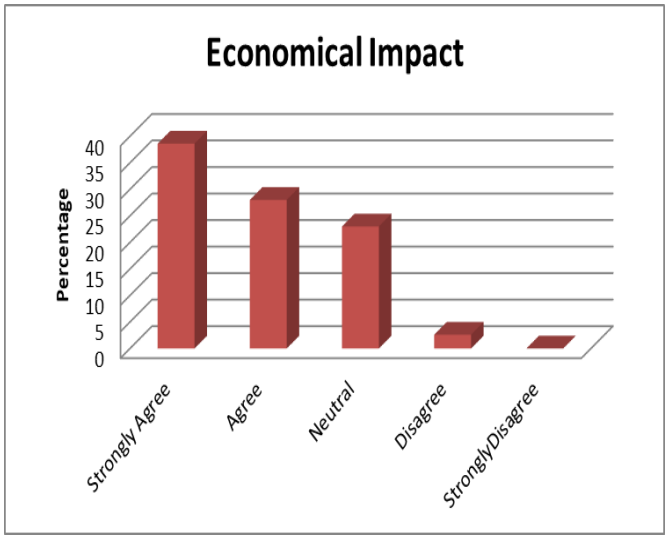

Fig. 5: indicate how oil spill affect the economy of Algoa Bay

E. Oil Spills environmental impact

Oil spills have long-term environmental impacts that can persist for decades. Responses to the question regarding the effects of oil and chemical spills in the marine environment indicate widespread and enduring consequences for wildlife, fisheries, coastal and marine habitats, human health and livelihoods, as well as recreational resources of coastal communities. Data presented in a bar graph reveal that 73.3% of respondents strongly agreed that oil and chemical spills in the marine environment have widespread and long-term consequences on these areas, 10.8% agreed, and 16% were neutral. Notably, 0% of respondents disagreed, suggesting a consensus on the negative environmental impact of oil spills.

Algoa Bay, characterized by its rich biodiversity and diverse natural environment, is particularly sensitive to anthropogenic activities. The bay also holds significant economic potential due to its active fishing and tourism industries. While the economy of Algoa Bay has benefited from the establishment of offshore bunkering activities, these activities pose risks, particularly concerning oil spills. The risk is exacerbated by the presence of a large percentage of endemic bird species within the bay. Oil spills have long-lasting negative impacts on the South African populations of penguins and other coastal birds, contingent on the volume and type of oil spilled.

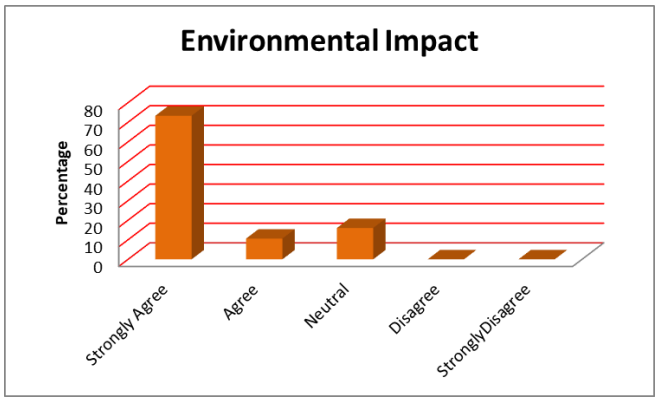

Fig. 6: Reveals how oil spill affects the environment in Algoa Bay.

It is imperative that this assessment underscores the impacts of oil spills on the community, people, and industries to raise awareness. The economic impact could be substantial, particularly affecting the two commercial ports in the area, followed by the fishery industry and tourism. The extent of economic loss would depend on the severity and duration of the impact. However, the costs have not yet been assessed. It is recommended that an economic study be conducted in Algoa Bay to evaluate potential losses due to a spill.

The impact of the Exxon Valdez oil spill, which occurred in Alaska on March 24, 1989, aligns with the study conducted in Algoa Bay, demonstrating that oil spill effects include damage or destruction of beneficial properties of animals, such as damage to bird feathers, as well as the destruction of mangrove habitats and other sources of ecological balance in the spill area.

IV. Conclusion

Access to information regarding coastal resources and prioritized protection areas facilitates a more efficient response and allocation of protection and cleanup efforts. Consequently, the implementation of an oil spill contingency plan is advisable. Oil spills contribute to environmental pollution and degradation, adversely affecting economic sectors such as tourism and fisheries. Therefore, this study is crucial for the economic benefit of the country, necessitating improved collaboration between government bodies and industry stakeholders. The economic repercussions would be particularly severe for the two commercial ports in the region, followed by the fisheries and tourism sectors. The extent of economic loss would be contingent upon the severity and duration of the impact, although the costs have yet to be assessed. It is recommended that an economic study be conducted in Algoa Bay to evaluate potential losses resulting from a spill. The economy of Algoa Bay has experienced some growth due to the establishment of offshore bunkering activities; however, these activities pose risks related to oil spills. The risk is further complicated by the presence of a significant proportion of endemic bird species within the bay. Oil spills have long-lasting detrimental effects on the South African populations of penguins and other coastal birds, depending on the volume and type of oil spilled. It is imperative that this assessment underscores the impacts of oil spills on the community, individuals, and industries to raise awareness.

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