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RESEARCH PAPER

Marine Pollution in The Maritime Zones of Pakistan: A Green Theory Perspective

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ABSTRACT

Marine pollution poses a significant threat to the maritime zones of Pakistan which is adversely affecting the marine ecosystem and human well-being. This paper aims to examine the challenges associated with marine pollution in Pakistan's maritime zones and propose strategies for countering its detrimental effects. The strategies to counter marine pollution in countries like Denmark, Norway, Indonesia, and South Africa have been discussed and how these strategies can be implemented in Pakistan. Data has been collected from primary and secondary sources. The discussion regarding countering marine pollution has been made under the theoretical lens of the green political theory, which adopts an eco-centric view instead of an anthropogenic view. To address the challenges faced due to marine pollution, this paper recommends using legislative measures, technological advancements, public awareness campaigns, and international cooperation. Enforcing stricter pollution control standards, and promoting sustainable practices in industries are important towards reducing pollution. Also, the adoption of advanced technologies for wastewater treatment and oil spill response, combined with regular monitoring and surveillance, can help to contribute to pollution prevention and control.

Keywords: Anthropogenic, Eco-centric, Eutrophication, Marine Pollution, Maritime Zones, Prevention

Introduction

The maritime zones of Pakistan are not only rich in biodiversity but are imperative for the economy of the country. Despite these facts they also face numerous threats arising from pollution from both land-based and marine sources. Oil spillage, plastic litter, eutrophication, untreated waste in the water are just examples of the problems in the maritime zones. The livelihood of the local communities, the economy, the local flora and fauna have all been negatively affected by marine pollution. Thus, in order to deal with such issues, some strategies and lessons from other countries will be discussed in this paper.

Marine pollution in Pakistan's maritime zones primarily originates from industrial discharges, untreated sewage, offshore oil exploration, shipping activities, and indiscriminate waste disposal. These contaminants, including plastics, heavy metals, oils, and chemicals are a severe risk to marine life. Degrading habitats, harming fisheries, and impacting the livelihoods of coastal communities are some of the serious effects. Furthermore, the dumping of plastic waste has led to the emergence of marine litter, has also led to endangering marine species, and contributing to the overall global plastic pollution issue.

According to the United Nations Convention on the Law of Sea (UNCLOS), marine pollution can be defined as:

"The introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities." (UN General Assembly, 1982)

Marine pollution occurs when the marine environment is exposed to pollutants primarily discharged into the water due to human activities. These pollutants cause the marine environment to undergo chemical and physical changes that threatens the biodiversity and create long-lasting negative impacts. The most common sources of such pollutants include solid waste from human activities on land and sea, and run-off from rivers. Industrial waste, sewage waste, and other domestic waste become part of the marine environment. (Wilhelmsson et al., 2013)

Marine pollution is mainly focused on the pollutants that are created as a result of human activities. Many chemicals are released in to the ocean that are mostly man-made. Plastics are the most common type of pollutants that are released in to the oceans. (Howard, 2019) The marine zones hold much significance for not only the economy of a state but also for the human development. About 80% of the pollution in the oceans comes from plastic. About 10 million metric tons of plastic waste are dumped into the oceans every year. This waste disturbs the environment by killing the local species of the water. The plastic also breaks down and becomes part of the ecosystem, where it is passed to humans through seafood. (Avakian, 2021)

In accordance with the UNCLOS, Pakistan has divided its maritime zones as:

- Territorial waters, which extends till 12 nautical miles beyond land territory and internal water from the baseline.
- Contiguous zone, which is an area adjacent to and beyond the territorial waters and extending to 24 nautical miles from the baseline. In this zone, the state has control over immigration, security, customs and pollution.
- Exclusive Economic Zone, which extends beyond and adjacent to the territorial waters and its limit is 200 nautical miles. In this zone, the state has the right of exploration, development, exploitation, conservation and management of all resources, both living and non-living.
- Continental shelf, which is the natural prolongation of the land territory of the state. In 2015, the UNCLOS accepted Pakistan's claim for extension of sea limits. The territory of 240,000sqkm expanded by another 50,000sqkm. It was increased from 200 nautical miles to 350 nautical miles.

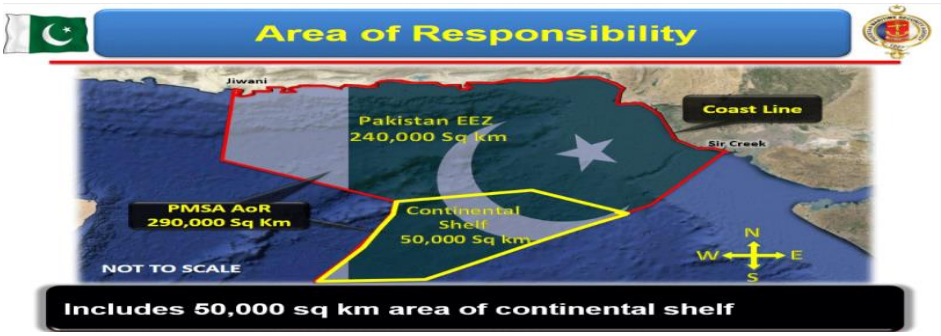

Figure 1. Pakistan's Maritime Zones. (Pakistan Maritime Security Agency, 2015)

The kinds of marine litter that are found in the maritime zones generally include medical waste, glass and plastic bottles, beverage cans, fishing lines and nets, and various types of wastes from ships. The coastal areas and harbors receive considerable amounts of waste that is carried onto the sea. For instance, Karachi Harbor receives a wide variety of pollutants from a number of sources, which are usually from the locals and tourists. The material can be thrown directly, swept, or blown off from the land or from ships. (Qaimkhani, 2018)

In the present times, marine pollution in Pakistan has affected economic activities along with human development and human health. The issue of high number of plastic debris in the marine zones has endangered the marine animals. As a result, the disturbance of the ecosystem has affected the livelihoods of the coastal communities along with creating navigation issues for the ships in the sea. The high amounts of pollutants in the water can damage machinery of the ships. Such pollution also affects tourism in the maritime zones. (Verma et al., 2020)

Despite signatory to several treaties, the lack of implementation of such treaties in Pakistan has become a major obstacle in countering marine pollution. Thus, checks and penalties are of great significance. (Gillani, 2019)

To counter and curb the negative impacts of marine pollution, sustainable practices should be encouraged. International standards and practices should be applied for waste disposal. In addition to this, systems should be brought into effect that check the disposal of waste and impose some penalties to discourage the continuing degradation of the environment. Despite being part of several international treaties, the lack of implementation of such treaties in Pakistan has become a major hindrance in countering marine pollution. Thus, checks and penalties are of great significance. In addition to this, environmentally friendly industries can be set up for long-term benefit. There is not considerable literature present that compares strategies of other countries in dealing with marine pollution and how it can be applied to Pakistan's case. Thus, this paper offers a unique perspective as to how Pakistan can deal with the waste in its maritime zones and how it can learn from other countries.

Material and Methods

This study was conducted under the qualitative research methodology within the post-positivist paradigm. Three qualitative research approaches i.e., descriptive, historical and exploratory were used to find out the answer to the research questions. Data was collected from primary and secondary sources. Primary data was taken from official reports including white papers, whereas secondary data was taken from books, research articles, and reports published on the issue under consideration.

Marine Pollution In Pakistan

Pakistan's maritime zone faces problems due to anthropogenic activities. The different types of pollutions seen in the marine waters are as:

Eutrophication means the excessive growth of algal and plant growth on water surfaces due to lack of sunlight, carbon dioxide, and also due to high levels of nitrogen and phosphorus. Human activities are mainly responsible for the high rate of eutrophication and its spread. Eutrophication is a threat to drinking water, water sources, fisheries, and recreational water bodies. Along with human health the local communities living near coastal areas affected by eutrophication affects the livelihood of the people as well. (Chislock, et al., 2013)

Eutrophication occurs when excessive algal and plant growth covers water surfaces, often caused by insufficient sunlight, carbon dioxide, and increased levels of nitrogen and phosphorus. Human activities contribute significantly to the rapid increase of eutrophication which poses threats to drinking water, fisheries, and other recreational bodies of water. Coastal communities, especially those near the areas which are affected by eutrophication, face challenges because eutrophicaton impacts both human health and livelihoods. In the Karachi coast of Pakistan, the visible signs of eutrophication include the greening of the water surface due to the development of algal growth.

One common consequence of eutrophication is the formation of algal blooms. Coastal and offshore waters enriched by algal blooms experience a sudden increase in harmful phytoplankton blooms. The toxic substances from these blooms have the potential to be part of the food chain, with humans being specifically vulnerable. This increased risk includes food poisoning and infections from ingesting contaminated seafood, impacting both human health and ocean biodiversity. (Nergis et al., 2018)

Oil spills in the oceans pose a threat to the flora and fauna of the affected area. Overall, oil spills have reduced but still have severe effects when such incidents occur.

Oil which can originate from different sources is often spilt onto beaches and coasts which leads to water contamination. Increased exposure to oil spills can lead to harmful effects blindness, and organ failures in marine animals. The harmful effects on marine animals can continue for years after exposure to oil. While oil spills in Pakistan have not been very frequent, they have had significant impacts on the country's maritime zones. (National Oceanic and Atmospheric Administration, 2021)

Oil spills have been few in number in Pakistan but have had adverse effects on the maritime zones of Pakistan. In 2003 a vessel which was carrying about 67,800 tons of crude oil destined for the national refinery in Karachi suffered damage during a heavy downpour. It resulted in the Tasman Spirit splitting in two parts. This event led to almost 30,000 tons of oil being spilled in the sea. (Tasman Spirit, 2016) In 2018, an oil spill occurred along the Karachi coast, covering a substantial area and resulting in the death of animals. WWF-Pakistan's team reported discovering animals with oil-coated fur on rocky shores. The effects of oil spills on marine life is long-lasting, affecting ecosystems for years. Typically, oil blankets everything from beach sand to seabed rocks, causing harm to marine organisms. Sea birds, unable to relocate, suffer from oil-coated feathers that disrupt their ability to regulate body temperature. Dolphins and whales face breathing difficulties as oil clogs their blowholes. The most severe consequences of an oil spill are felt by fish, especially when their eggs come into contact with the oil. (WWF-Pakistan Expresses Serious Concerns over Oil Spill along Karachi Coast, 2018)

The presence of floating contaminants together with solid waste and a combination of untreated industrial and municipal wastes are major causes of marine pollution in Karachi Port. Marine vessels and commercial craft working in Karachi harbor use seawater to cool various machinery and systems, which can be frequently affected by the presence of wastes which includes plastic luggage and poisonous seawater. consequently, it considerably influences the overall performance and efficiency of the system. chemical compounds present in business effluents bring harm to ship engines in harbors because of its corroding effects. Plastic bags have a bad effect if they block the consumption of cooling water from the craft. The craft occasionally suffers from a protracted period of unavailability. The ship's delay affects other ships and provides massive monetary losses. (Tahir, 2017)

Plastic pollution poses a significant challenge in Pakistan, particularly within its maritime zones. Globally, it stands out as one of the most pressing issues of the 21st century. In 2012, an estimated amount of 165 million tons of plastic related pollution was present in

oceans around the world. Nurdles, which are small manufactured plastic pieces used in producing various plastic products, are a major concern when it comes to plastic pollution. These are mostly transported through cargo ships. It is estimated that about billions of these nurdles enter the oceans every year. While plastics in oceans usually go through partial degradation within the span of one year. Complete breakdown of these plastics is rare. Ocean-based sources contribute to 90% of the total plastic waste present in oceans. Merchant ships discharge used medical equipment, plastic-containing cargo, sewage discharge, and other types of waste into the ocean. Other vessels like research vessels also throw unnecessary waste. The ocean's main contributor to plastic pollution is discarded fishing gear, such as traps and nets, which constitute 90% of plastic waste in some areas. Pakistan grapples with similar challenges in its maritime zones. (Muhammad & Khan, 2020)

Theoretical Lens

The green political theory contends that ecosystems should be prioritized. It adopts an ecocentric view instead of an anthropocentric one. It is based nature centered view instead of a human centered one. Eco-centrism acknowledges and incorporates human needs and desires into a broader ecological context. It places a priority on maintaining healthy ecosystems, recognizing their crucial role in supporting human health. (Dyer, 2018). An important aspect is decentralization, involving the shift of decision-making and authority from central entities to local bodies, with features such as democratic accountability and self-determination. This approach offers ecological benefits; as smaller communities typically rely more on nearby local resources. In the light of this theory, the case studies of different states will be analyzed and to see if such examples can be applied to Pakistan's case. The other environmental theories have adopted a more anthropocentric view instead of ecocentric view. Also, the theories deal with the environmental problems by staying within the current system instead of changing structure to deal with such issues. (Arı & Gökpınar, 2019)

Case Study : European Circular Economy For Sustainable Future

In Pakistan, one of the biggest issues in the maritime zones is pollution. The causes can be attributed to the fact that there are little to no sustainable practices in within the population. There are no structural changes in how marine pollution can be countered. Public awareness is increasing but not to a level where sustainable practices can be adopted. Also, business and industries have no incentives to shift to green practices and products. Thus in order to counter these problems, the model of circular economy will be discussed.

In a circular economy, products are intentionally designed for long-lasting durability, reuse, and recyclability. Materials for new products are taken from existing ones, promoting remanufacturing, reuse, and recycling products as much as possible. As a last resort, these materials are used as a source of energy or disposed of. In late 2015, the European Union adopted the Circular Economy Package, which includes the objectives for reuse of food, water, and plastics.

The primary purpose of the circular economy is to promote sustainable growth by creating green industries through cleaner production technologies and efficient resource utilization. This involves waste management, recycling, and the implementation of multilateral environmental agreements. While developing countries may face challenges accessing the knowledge and technologies essential for the circular economy, they can also gain substantial benefits. Circular economy activities hold the potential to address a significant portion of water and resource needs, which can reverse the upward trend in resource use, and reducing issues like resource depletion, climate change, and pollution in natural areas, including maritime zones. (United Nations Industrial Development Organization, 2019)

In the past, the commitment to reduce high levels of marine pollution in European countries has been not been consistent with efficient uses of resources and goals of waste management. Public and private sector initiatives are now supporting the change to a circular economy, by laying the groundwork for increasing the efficiency of the plastic pollution by improving design, increasing resource efficiency and reducing marine pollution. Many countries have developed resource efficiency and strategies that aim to change the plastic industry and prevent ocean pollution. The Dutch strategy, "A Circular Economy in the Netherlands by 2050," labels marine pollution as a global problem. (Brink et al., 2018)

The Netherlands has developed a circular economy model that aims to improve resource efficiency, reduce waste generation and reduce environmental impact. Key elements of the circular economy approach include:

1. Sustainable production and consumption: The Netherlands promotes sustainable production practices, focusing on product design for sustainability and recycling. It encourages consumers to choose products with a longer shelf life and supports the adoption of sustainable consumption patterns.

2. Waste management and recycling: The country has invested in advanced waste management and recycling infrastructure. An effective waste separation, collection and recycling system has been implemented, ensuring the recovery and reuse of valuable resources. This helps in reducing the quantity of waste that are dumped in landfills or polluting the marine ecosystem.

3. Innovation and research: The Netherlands actively promotes innovation and research in circular practice and technology. It supports the development of new solutions and collaborates with businesses, academia and research institutions to drive technological progress that contributes to the circular economy.

4. Public awareness and engagement: The country places great emphasis on raising public awareness and engaging citizens in the circular economy. Educational programs, campaigns and initiatives are carried out to inform and inspire people to adopt sustainable behaviour, reduce waste and contribute to a cleaner environment, including marine ecosystems.

The Dutch circular economy model has a positive impact on reducing marine pollution. By focusing on waste management, recycling and sustainable consumption, the country reduces the amount of waste entering waterways and ultimately the ocean. By promoting a circular business model, the aim is to prevent the generation of waste and use resources responsibly, thereby reducing the pollution of marine ecosystems. Emphasizing public awareness and involvement strengthens the communication regarding waste management and the crucial significance of safeguarding the marine environment against pollution (Ministry of Infrastructure, 2019)

Some important steps for circular economy include:

1. Products and Eco-design: This involves finding alternative materials for products, such as choosing alternatives to microplastics in everyday items or in ships. Manufacturers should avoid creating products which ultimately end up in landfills. The extended producer responsibility (EPR) scheme can motivate better design, and voluntary commitments can lead to large scale action.

2. Choice of Materials: Special attention must be given to creating plastics without toxic substances to reduce environmental risks. Chemical regulations should be implemented and reformed within circular economy solutions to replace and

eliminate toxic substances. Plastic free materials can offer inventive, cost friendly alternatives with beneficial results. Exploring, researching, and developing such replacements and alternatives can enhance the redesign and reuse of old-generation plastic products.

3. Funding and Investment for Eco-design Promotion: Establishing funding programs, including public and private sector investments, is very important to give support to inventers and designers who are addressing ineffectiveness in the plastic industry and creating better solutions for reducing plastic waste.

4. Legislation and Legal Rules: Governments, parliamentarians should create standards and definitions to offer a clear plan to producers.

5. New Business Models: Structural waste must be avoided from across all economic and economic related sectors. Manufacturers should consider changing from selling short term products to providing services of extending product life. This change can reduce material waste throughout the production. (Brink et al., 2018)

Pakistan should invest in green industries and sustainable business practices that has positive effect on the environment. Waste management, innovation, recycling, public awareness and research are all required for adopting circular economy. The private investors should be encouraged to make a shift in the usual practices while the government should collaborate with countries that have implemented the practices of circular economy. Eco-friendly products should be invested in so as to provide better alternatives for harmful products.

Case Study: South Africa's Eutrophication Control Policy

South Africa's eutrophication policy's goal is:

"To adopt a government-wide, adaptive and systems-based management approach, in alliance with the private sector and civil society, that will improve resource water quality, prevent pollution and ecological degradation, support ecologically sustainable economic & social development and allow an informed use of the nation's water resources."

Important tools for water quality management have been adopted. Each instrument is specially designed for eutrophication. The joint and separate use of management tools to limit anthropogenic sources of eutrophication is an important aspect. To improve eutrophication management, it is necessary to improve and strengthen these instruments.

Regulatory instruments

These instruments are an integral component of environmental and water resource management, and they will remain important in addressing the issue of eutrophication. Direct regulation of land and water use plays an important role in managing this issue.

Economic management instruments

Market-based instruments are essential for eutrophication management. These instruments should be applied in addition to command-and-control measures by encouraging positive behaviour changes, encouraging innovation, addressing sources of pollution, promoting an efficient economy, and generating funds for projects related to eutrophication.

Societal participation management instruments

Participation of societal management instruments are important as well. Involving partnerships with civil society along with governmental mechanisms to enhance participation. These strategies aim to control anthropogenic eutrophication through voluntary participation. Such approaches should be consistent with governmental strategies with focus on transparency and accountability. It can create help to create substantial results, generate funding, and effectively combine with other eutrophication strategies. (Chislock, et al., 2013)

Monitoring is an important. Structures should be created in order to ensure proper monitoring of the policy being implemented. Pakistan can ensure such policies with the use of its existing channels. Education and awareness of people in schools, through media channels and campaigns can help in creating an environment of sustainability and responsible practices.

Denmark's Policies For Eutrophication

A 2015 study found that household waste containing high organic matter, untreated waste rich in ammonia, nitrate and phosphate, and untreated industrial waste containing various nutrients through the Lyari River and Malir River are discharged into seawater. The coastal belt of Karachi contributes to the increased availability of nutrients in seawater. Untreated metropolitan sewage and industrial effluents have been identified as major sources of coastal water pollution in Pakistan. Untreated sewage from more than six thousand industrial facilities in six major industrial estates, along with 300 Mgd of municipal sewage, is discharged into Karachi's coastal waters via the Malir and Lyari rivers. Specifically, the Layari River releases 130,000 tons, 160,000 tons, 800 tons, 90 tons, and 12,000 tons of solid nitrogen, organic matter, nitrogen compounds, phosphate compounds, and suspended solids, respectively, annually. (United Nations Environmental Program, 2014)

Denmark's maritime zones have been recognized officially as having dangerous levels of eutrophication. Eutrophication sets off an increase of harmful algal blooms, hypoxia in bottom waters. It results in fish kills, and a decline in species number in areas impacted by oxygen, alongside modifications in biogeochemical pathways. (Riemann et al., 2015). An approximate land area of 64,135 km is discharged directly into the Danish straits, with Denmark, Sweden, and Germany contributing 47%, 37%, and 16%, respectively. In the past 20 years, coastal eutrophication in Danish marine waters has raised a lot of concerns, leading to significant nutrient reductions in eutrophication. This achievement is credited to various policies, including national plans, compliance of international marine related treaties, and compliance with European Union laws. These achievements are linked to various policies, including national action plans, compliance with international maritime conventions and compliance with European Union legislation.

An agenda was launched in 1986 after a widespread hypoxia incident in the Denmark Strait and was adopted and required the government to reduce nitrogen emissions by 50% and phosphorus emissions by 80% from agriculture, municipal wastewater treatment plants and industrial effluents. This goal is a special target to reduce (1) agricultural emissions, (2) urban waste water treatment facilities, and (3) industrial waste. By 1995, reduction targets for sewage treatment plants and industries had been successfully met. However, it is difficult to achieve certain targets for agriculture in the specified period of time.

To address this problem, the Sustainable Agriculture Action Plan was adopted in 1991 to reduce the loss of agricultural land. Thereafter, the second Water Environment Action Plan was implemented in 1998, which included additional measures with the

European Union Nitrates Directive. This effort has led to a significant reduction in eutrophication in the Baltic Sea.

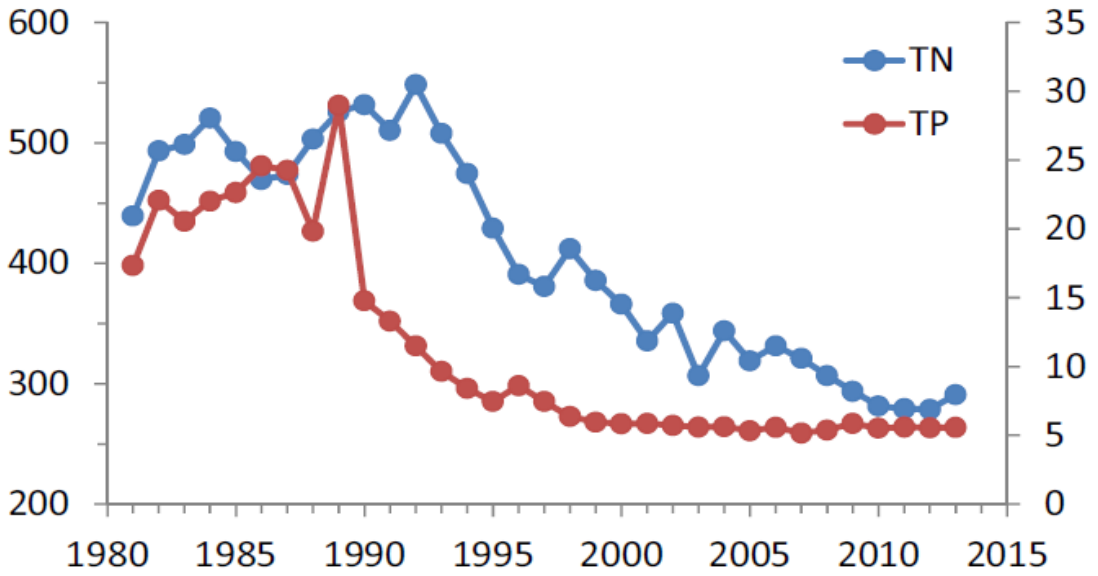

Figure 3 Reduction in nitrogen and phosphorus in Danish straits. (Riemann et al., 2015)

Pakistan can learn from Denmark's experiences by implementing the use of waste treatment strategies in its industries and by introducing policies for reducing the use of nitrogen used in fertilizers. Effective waste treatment has played an important role while policy and institution reforms are necessary. Promoting transparency, continuous monitoring and evaluation, and adaptable responses to changing factors are important elements. Sharing experiences and aligning relevant policies across nations and regions will help in overcoming issues related to the adoption of new technologies. Local governments can play an important role in keeping track of the levels of eutrophication and monitoring on the flora and fauna that are being affected by eutrophication. International organizations can also play an important role as experiences regarding policies and strategies can be shared, along with skills and technology.

Case Study: Norway's Oil Spill Response

Pakistan has encountered both large-scale and small-scale oil spills, and its response involves specialized equipment for oil spill response, including dispersants, sprayers, and skimmers, on patrol vessels located at Karachi Port Trust (KPT). These resources are available for deployment and operation by the Pakistan Maritime Security Agency (PMSA), and there is a helicopter dispersant application system used in emergency situations. Numerous KPT, PMSA, and military personnel have received training in oil spill response code.

After the Tasman Spirit spill, the establishment of the Mutual Oil Spill Assistance Committee (MOSAC) was an important response. MOSAC consists of oil refining companies that were given the task of having a stockpile of oil spill response equipment, including booms, skimmers, and sorbents. This stockpile is designed to handle spills involving a few tons of oil. While MOSAC is reported to have been dissolved, detailed information about its replacement remains to be unavailable at present.

It is an important point to note that Pakistan lacks a considerable private investment in response equipment or specialized spill response contractors. However, mechanical equipment and labor for sea cleaning are available through provincial governments and private sources. In cases of major spills, Pakistan may seek assistance from external

organizations, such as the Oil Spill Response Limited (OSRL) in Singapore. (International Tanker Owners Pollution Federation Limited, 2018)

The Norwegian Coastal Administration (NCA) provides strategic support in oil spill response facilities with different response equipment which are essential to deal with oil spills. In addition to this, NCA has capacity for 9 Coast Guard ships and 4 special recovery ships. Coast Guard vessels as well as other maritime vessels are capable of oil recovery, transportation, or serving as command vessels. Offshore patrol vessels and fishing vessels which are operated by Norwegian Maritime Rescue can be called to help and to deal with oil spills.

The Norwegian Clean Sea Association (NOFO) is an operating company which plays an important role in incidents involving oil spills. It has access to large vessels that can be quickly turned around for oil recovery operations. NOFO has 5 warehouses with related equipment, including heavy load storage and recovery systems. NOFO also has contracts with helicopters for infrared imaging in along with response vessels, day and night monitoring of oil movement and its recovery. If a spill is detected, NOFO then quickly notifies the operating company. (International Tanker Owners Pollution Federation Limited, 2018)

Pakistan should invest in oil spill response equipment and learn from countries like Norway and the US, which have an industry of oil spill response. Present structures, like the use of satellites can provide help in understanding the extent of the oil spill. New and updated response policy is required, while creating an agency especially for this purpose.

Case Study: Indonesia's Marine Litter Solution

According to a report published by the United Nations Development Programme (UNDP), an amount of approximately 20 million tons of waste is produced annually in Pakistan, out of which almost 10 percent is plastic waste. According to a study conducted by WWF in 2018, Pakistan was identified as one of the top 10 countries with a significant amount of plastic waste. The study estimated that almost 90% of plastic waste in Pakistan is not disposed of through proper ways. (Salih Hussain, 2023)

Indonesia has some of the most important and diverse coral reef systems in the world. However, this habitat has faced a variety of challenges in the past few years, with plastic pollution being one of the main concerns. The United Nations has reported that almost 8 million tons of plastic is dumped in the ocean every year. Also, Indonesia is a major contributor, with the addition of more than 600,000 tons to this dangerous figure. The COVID-19 pandemic has made this situation worse, as the disposed and discarded masks, and other related equipment has added a large number of wastes to Indonesia's waste management system. (Shahab, 2021)

Indonesia has implemented several measures to deal with the issue of plastic pollution which includes the introducing a tax and banning single-use plastics. Some cities have taken more firm actions by completely banning plastic bags. Jakarta has forbidden the single-use plastic bags, more specifically clear bags made of different plastics like polyethylene, etc. Bali put in place a ban on single-use plastic bags in 2019, and Bogor City has also prohibited their use. An important point is that Banjarmasin's first plastic bag ban caused an 80% reduction of plastic bags in production.

Many cleanup initiatives which specifically targeted marine debris were undertaken. For example, between the years 2017 and 2020, the One Island, One Voice program in Bali involving 57,000 people collected approximately 155 tons of plastic. Indonesia is also investing in projects of research, innovation to counter marine plastic pollution. The national plan dictates the use biodegradable plastics from alternatives such as seaweed and coconut. as well as innovation to implement the circular economy. Research

on marine plastic is promoted in universities and in the Indonesian Institute of Science. Collaborative efforts which involved local government, civil society, and communities have proven to be effective in waste disposal. These initiatives can serve as learning examples for Pakistan to address waste issues in its marine zones. (Organisation for Economic Co-operation and Development, 2020)

Pakistan has already placed a ban on single use plastic bags in major cities. This ban can be implemented especially in the coastal areas. Clean up projects can be organized at community level by the local governments to encourage the citizens to adopt sustainable practices. Research needs to be carried out regarding the various methods of reducing waste and using it for producing energy. Thus, Indonesia's strategies can be carried out in Pakistan.

Findings

- Pakistan's maritime zones have been vastly affected by untreated sewerage, plastic waste, oil spills and eutrophication.
- Presently, the existing laws have not been able to change the trends of pollution in the maritime zones.
- Pakistan can learn from other countries in countering pollution by changing the structure of the current mechanisms for marine pollution.
- Marine pollution has had adverse impacts on the biodiversity of the maritime zones.
- The lack of implementation of laws and effective monitoring of the pollution has made it difficult to study and create effective policies for countering the issues.
- Plastic waste, untreated waste, run-off from fertilizers and oil from various sources are a grave threat to human health as well as to the local flora and fauna.
- Using the model of circular economy can have positive effects for the maritime zones.

Conclusion

In conclusion, countering marine pollution in the maritime zones of Pakistan is an urgent task that requires the immediate attention and collective efforts. The well-being of marine ecosystems and the sustainability of the maritime industry depend on addressing this issue effectively.

Pakistan's vast coastline and rich marine biodiversity is threatened by marine pollution. The presence of pollutants such as oil spills, untreated sewage, and plastic waste are significant threats to the of marine life and ecosystems. Also, it has negative impacts on the livelihoods of the coastal communities and the economic development of the country. For this purpose, the government, international organizations, and the local population has to join hands to counter this issue.

Recommendations

- An efficient system of monitoring is required to understand the issues to figure out effective policies.
- There is need for increasing the capabilities government agencies for enforcing environmental regulations. There should be implementation of regular inspections, and penalties for law-breaking of marine pollution laws.

- Sustainable policies should be pursued. The model of circular economy can be implemented in this regard.

- There should be increased efforts for raising awareness and education. The public, coastal communities, and school students should be taught about the impacts of marine pollution. Responsible behavior should be promoted such as proper waste disposal, reducing plastic usage, and supporting conservation efforts.

- Collaboration with other countries and international organizations should take place to address the marine pollution issues. Exchange of practices, information, and coordinating efforts to combat marine pollution can help counter the issues.

- Research and innovation should be prioritized so effective policies can be made and sustainable alternatives can be worked on.

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