

Marine Pollution and Waste Management

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Abstract

Water covers more than 70% of the surface of the globe. The ocean, which is amazing and significantly controls the world's climate, also has a hidden crisis, namely marine pollution. In the modern world, marine pollution is becoming a bigger issue. *Article 1 (1) (4) of UNCLOS* : says that “Pollution of the marine environment” means 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, a hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of seawater and reduction of amenities”. Chemicals and garbage, most of which originate on land and are blown or carried into the water, are the two main components of marine pollution. Marine pollution, caused by human activities like improper disposal, shipping, and overfishing, harms ecology, health, and global economic institutions. Solutions include international agreements, sustainable fishing, improved waste disposal, and raising awareness. Education-based campaigns have the power to inspire citizens, groups, and governments to action. The legislative reforms and sustainable practices are significantly aided by environmental organizations and advocacy groups. The government has made several notable efforts, such as the plastic ban, marine protected areas, clean-up programs, and environmentally friendly fishing. Several countries have enacted plastic bags, which have significantly reduced the amount of plastic pollution, while the ocean may not be affected. Creating marine protected zones helps safeguard biodiversity and gives damaged ecosystems a place to recover. This article gives a general overview of the complex issue of marine pollution and shows how important it is to have efficient waste management plans. It investigates diverse marine pollution types and causes, emphasizing the dangers it poses, such as biodiversity loss, potential health hazards for humans, and significant financial expenses.

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1. INTRODUCTION

Aquatic habitats with high quantities of dissolved salt make up marine ecosystems. These comprise the deep ocean, the open ocean, and the coastal marine ecosystems, each of which has unique biological and physical properties. Aquatic settings with high concentrations of dissolved salt, such as those in or near the ocean, are known as marine ecosystems. The distinctive biotic (living) and abiotic (non-living) components that make up marine ecosystems are what distinguish them. The ecosystem's exposure to sunlight, the quantity of oxygen and nutrients that are dissolved

in the water, the distance from land, the depth, and the temperature are all significant abiotic variables. Biotic factors include plants, animals, and bacteria. Marine pollution is the introduction of materials or energy from humans into the marine environment, which has harmful effects on the marine environment, including harm to living resources, risks to human health, impediments to marine activities like fishing, deterioration of seawater quality, and loss of amenities¹.

¹ Lal's Commentary on Water And Air Pollution And Environment (Protection) Laws, fourth edition, Vol.-II, Delhi Law House, Delhi 2005, p.185

2. TYPES OF MARINE POLLUTION

- I) Chemical Pollution
- II) Plastic pollution
- III) Oil spill

In the modern world, marine pollution is becoming a bigger issue. Chemicals and rubbish are the two primary sources of pollution in our ocean. Chemical contamination, often known as nutrient pollution, is problematic for the environment, human health, and the economy. This kind of pollution happens when human activities, particularly the application of fertiliser on farms, cause chemical runoff into streams that eventually empty into the ocean. Algal blooms are encouraged by the elevated levels of chemicals in the coastal water, such as nitrogen and phosphorus, which may be hazardous to wildlife and dangerous to humans. Algal blooms have a severe impact on the ecosystem and human health, which hurts the local fishing and tourist sectors². All manmade items that wind up in the water, the majority of which are made of plastic, are considered marine garbage. This debris, which comes from sources on land in 80 percent of cases, accumulates as a result of littering, storm gusts, and poor waste management³. Numerous plastic goods, such as shopping bags and beverage bottles, together with cigarette butts, bottle caps, food wrappers, and fishing equipment are examples of common maritime garbage. Being such a persistent contaminant, plastic waste is particularly harmful. Decomposition of plastic products might take hundreds of years. Both people and animals are at risk from this garbage. In the debris, fish become entangled and hurt, and some animals mistakenly consume things like plastic bags thinking they are food. Micro plastic, or very small fragments of degraded plastic, is consumed by small creatures, which then take the chemicals in the plastic and absorb them into their tissues. Micro plastics have been found in a variety of marine organisms, including plankton⁴ and whales. The poisonous compounds become a part of bigger animals' tissues when they devour microscopic creatures that absorb micro plastics. In this way, the contamination from micro plastics moves up the food chain and finally ends up in the food that people eat. Preventing pollution before it happens and cleaning up after it does. Today's civilization uses a lot of disposable and single-use plastic, including plastic bottles, shipping boxes, and shopping bags. The process of altering society's perspective on plastic consumption will be drawn out and fiscally difficult. In contrast, some objects could make clean up difficult. Numerous trash kinds, including certain plastics, do not float and are thus lost in the depths of the ocean. When plastic does float, it tends to gather in vast "patches" in ocean gyres. One such collection is the Pacific Garbage Patch,

which is around 1.6 million square kilometers (617,763 square miles) in size and consists of plastics and micro plastics floating on and below the surface of whirling ocean currents between California and Hawaii. According to the National Oceanic and Atmospheric Administration, these patches are more like flecks of micro plastic pepper floating about an ocean soup than they are like islands of rubbish. The fight against marine pollution lacks even some viable options. Plastics marketed as "biodegradable" frequently only degrade at temperatures that will never be reached in the ocean. An oil spill is a type of pollution that occurs when a liquid petroleum hydrocarbon is released into the environment, particularly the marine ecology. Oil releases into the sea or coastal waterways are often referred to as marine oil spills, however land-based disasters are also possible. As a result of rendering the water unusable, oil spills are poisoning the world's water supplies. It contaminates areas of the ocean and has the potential to infiltrate into the clean water supply that is essential for the survival of people and other creatures. It may contaminate lakes, rivers, and other natural waterways that flow into the ocean. Beaches, parks, rivers, and commercial and recreational fishing may all be forced to close as a result of oil spills. There can be limitations on boating and hunting as well. Local economies might suffer a great deal as a result, both now and in the future. Oil pollution of water often takes the form of an oil slick, which is a thin layer of oil on the surface of the water, or oil droplets, oily bubbles, or both spread throughout the water column⁵.

3. CAUSES OF MARINE POLLUTION

There are several causes of marine pollution, the most of which are produced by humans. Sometimes it results from dumping waste, and other times it results from ocean mining. Regardless of the origin, marine pollution is having dangerous consequences on marine life and plants. Below are some of the sources of marine pollution that are discussed

• Marine pollution through sewage

Sewage is one way that pollution gets into the ocean directly. Rivers carry sewage into the ocean, which contaminates the marine life. Because of the decreased oxygen content of the water, marine animals and plants have a harder time surviving⁶.

• Marine pollution through the oil spill

Marine contamination is also brought on by ship oil spills. It is one of the main poisons that pollute ocean water, which is difficult to clean up. Numerous thousands of innocent marine

² Brubaker, Douglas; Marine Pollution and International Law, Principles and Practice, Belhaven Press, 1993; P.12 60 Marine Pollution: New Research, Tobias N. Hofer ,Nova Publishers, 2008, p 340

³ Industrial Discharge and their Effect to the Environment, Journal of hazardous materials, Vol. 150, No. 3, pp 783-789, ISSN 0304-3894

⁴ Plankton that consists of tiny animals, such as rotifers, copepods, larger animals eggs and larvae's and of

microorganisms once classified as animals, such as dinoflagellates and other protozoa's.

⁵ Dias, Ayesha., "The Oil and Gas Industry in the tangled Web of Environmental Regulation: Spider or Fly?" in Gao, Zhiguo., Ed. Environmental Regulation of Oil and Gas, (Kluwer Law, London-The Hague-Boston 1998) P. 61

⁶ R.Sen Gupta, Sugandhini Naik And V.V.R. Varadachari, Environmental Pollution in Coastal Areas of India, Published by John Wiley & Sons Ltd., p 6

creatures perish as a result of oil spills' poisonous and suffocating impacts⁷.

- **Marine pollution through industrial chemicals**

Toxins and chemicals introduced into saltwater by industrial and agricultural wastes also contribute to ocean pollution. These substances function as significant thermal pollutants. Thermal pollution causes the ocean's temperature to rise. Some marine species can't survive in high temperatures, therefore they die.

- **Marine pollution through mining**

Not only does ocean mining contribute to marine pollution, but it also creates noise pollution. The base level of the ocean is affected by deep-sea mining. The marine ecology is impacted by the contaminants that are released into the saltwater as a result of the mining of metals like silver, gold, copper, etc.

- **Marine Pollution through Land Runoff**

Land runoff also contaminates marine water. It happens when too much water from rain, flooding, etc. seeps into the sea water. This water pollutes the seas when it enters them with toxins including pesticides, oil, fertilisers, and animal faeces. These contaminants have detrimental impacts on marine life and cause the demise of aquatic animals and vegetation.

Other causes of Marine pollution

- Fossil fuel emissions that contribute to climate change are a key factor in marine pollution and water acidification.
- Marine pollution is also influenced by atmospheric pollution. For instance, the acidity of ocean water is increased by atmospheric carbon dioxide.
- The marine environment is polluted by nuclear waste from numerous sectors, which has an impact on the marine ecosystem's food chain.
- Oceans are exposed to thermal pollution from industrial, power plants, and other sources, which raises the water's temperature.
- Marine pollution is also a result of acid rain.
- Sulfuric and nitric acids combine with sea water during acid showers to make the water more acidic.

4. EFFECTS OF MARINE POLLUTION

- The majority of the garbage deposited in seas across the world takes a very long time to disintegrate, which causes the oxygen level in the water to drop very quickly, affecting the health of the plants and animals.
- Industrial and agricultural waste are carried downstream by rivers into the ocean, where they settle to the ocean's bottom and continue to exist for a long time. Small marine creatures that consume these substances are later consumed by larger marine creatures. The entire food chain is impacted in this way.

- Oceanic plants cannot grow when sunlight cannot penetrate an oil spill that covers the seawater's surface. Consequently, it has an impact on photosynthesis. The coral reef cycle is disrupted as a result.
- These animals are directly or indirectly exposed to hazardous chemicals, pesticides, and oil spills, which result in a variety of health problems and occasionally even death.
- When the affected animals are consumed by the humans, the pollutants transferred to the human body and affects indirectly

5. WASTE MANAGEMENT STRATEGIES

5.1 International Regulations

- **MARPOL (International Convention for the Prevention of Pollution from Ships)**

The major international treaty that deals with preventing ship pollution of the ocean from intentional or unintentional causes is called MARPOL. One of the most significant international treaties relating to maritime environmental issues. The treaty comprises rules aimed at avoiding and minimizing pollution from ships, including pollution from ordinary operations and accidental contamination. There are six annexes to MARPOL, each of which addresses a distinct form of maritime pollution:

Annex I: Regulations for the prevention of pollution by oil.

Annex II: Regulations for the control of pollution by noxious liquid substances in bulk.

Annex III: Prevention of pollution by harmful substances carried by sea in packaged form.

Annex IV: Prevention of pollution by sewage from ships.

Annex V: Prevention of pollution by garbage from ships.

Annex VI: Prevention of air pollution from ships.

- **Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal**

The Basel Convention is an international agreement created to limit the exchange of hazardous waste between states and, more especially, to stop the transfer of such garbage from industrialised to developing nations. It seeks to reduce the production of hazardous trash and encourage ecologically sound waste management. According to the convention, wastes can be divided into three groups: radioactive wastes, other wastes, and hazardous wastes. It creates a set of regulations to regulate the transboundary movement of hazardous wastes, including the need for the destination country's prior informed permission before the trash is sent. In order to address environmental issues connected to maritime pollution and the management of hazardous waste, the international community has made substantial efforts through both MARPOL and the Basel Convention. These agreements serve as a reminder of the value of international collaboration in preserving the environment and advancing sustainable practices.

5.2 Technological Innovations

Bioremediation, which uses microorganisms to break down pollutants, physical barriers like booms to contain oil spills,

⁷ Anianova, E, Oil Pollution and International Marine Environmental Law, The International Maritime Organization-Tanker or Speedboat?, In: International Maritime Organizations

and chemical treatment utilising agents to neutralise pollutants are examples of advanced waste treatment technologies used to address marine pollution. In addition, there are developing technologies with potential for tackling marine pollution, such as Nano remediation and electrocoagulation. To properly develop and enhance these technologies and protect marine habitats, ongoing study is necessary⁸.

Combating marine pollution necessitates the use of recycling and upcycling. Recycling entails turning garbage into new goods, which saves on raw resources and reduces pollution. Contrarily, upcycling extends the life of waste materials and lessens their environmental effect by turning them into higher-value goods. Recycling and upcycling initiatives in the context of marine pollution concentrate on plastic trash, one of the main causes of ocean pollution. Recycling plastic garbage lessens the likelihood of ending up in waterways, while upcycling projects can transform it into usable things, so lowering the demand for new plastic manufacture. Expanding these practises can considerably reduce marine pollution and help preserve marine ecosystems. Innovative technology, recycling legislation, and community awareness are crucial.

5.3 Community Engagement

- **Reduce Single-Use Plastic Use:** Cut back on single-use plastics to keep them out of the ocean.
- **Proper Disposal:** To stop trash from entering the water, improve waste collection and disposal procedures in coastal regions.
- **Public Education:** Inform people about the dangers of marine contamination and the significance of proper trash disposal.

6. CASE STUDIES

There are certainly a lot of case studies that show the difficulties in controlling marine pollution. A case study in pollution control in a densely populated area is the pollution of the Ganges River in India. Due to the high population density and lack of resources for the implementation of efficient waste management practises, efforts to restrict industrial and household garbage discharge into the river confront difficulties.

- **(2010) Deepwater Horizon Oil Spill**

Gulf of Mexico Situation/Problem: Millions of barrels of crude oil were dumped into the Gulf of Mexico during this disastrous oil spill, severely harming fisheries, coastal communities, and marine ecosystems. Containing the large oil leak, cleaning up the oil, and determining the long-term environmental effects were all difficult aspects of addressing this pollution.

- **In the Great Pacific Garbage Patch, there is plastic pollution**

Challenge: The Great Pacific Garbage Patch is a significant buildup of plastic waste in the North Pacific Ocean. It emphasises how challenging it is to control plastic pollution given the size of the issue and how tenacious plastics are in the marine environment.

- **Nuclear disaster at Fukushima Daiichi (2011)**

Challenge: The Fukushima Daiichi nuclear tragedy, which resulted from the tsunami that followed a significant earthquake in Japan, sent radioactive materials into the water. Significant difficulties were encountered in controlling the radioactive pollution and its effects on marine life and coastal regions.

- **The 1989 Exxon Valdez Oil Spill**

Location: Prince William Sound, Alaska **Problem:** This oil leak severely damaged Alaska's marine ecology and shoreline. It exposed the difficulties in efficiently cleaning up oil spills in isolated and environmentally delicate places⁹.

- **Great Barrier Reef coral bleaching**

Location: Australia **Problem:** Pollution, warming sea temperatures, and ocean acidification continue to pose problems for the Great Barrier Reef. Keeping this famous reef healthy brings attention to the global problem of coral bleaching and the challenges involved in preserving such a large and interconnected marine environment.

These case studies highlight the urgency and complexity of addressing marine pollution, which calls for multilateral collaboration, cutting-edge technology, and sustainable practises to lessen its effects on human communities and the environment.

7. FUTURE OUTLOOK

There are a number of innovative approaches being investigated to clean up marine pollution. Some of them consist of:

Ocean clean up arrays: Vast floating barriers that concentrate and gather plastic waste using natural currents. For instance, the Ocean Clean-up project places such arrays in ocean gyres to gather plastic debris.

Biodegradable Plastic: To lessen the permanence of plastic garbage in the oceans, biodegradable polymers are being developed and promoted for usage. Since these polymers degrade naturally, they don't impact marine life as much.

Drone technology: To track and find marine pollution, drones with cameras and sensors are utilised. They can assist organisations and governments target their cleaning operations more successfully by identifying regions with high pollution levels.

Robotic cleaners: Autonomous underwater robots called robotic cleaners are used to gather and remove marine trash. These robots can gather rubbish without human assistance while navigating difficult underwater areas.

Biosensors: Using living things like bacteria or enzymes to find and remove water contaminants. These biosensors may identify certain contaminants, assisting in effective and focused cleanup operations.

Recycling Technologies: Development of innovative recycling techniques that may turn marine plastic garbage into useable

⁸ The Hindu, July 25, 2011

⁹ <http://www.all-recycling-facts.com/3-types-of-pollution.html#ixzz38pw1A2wm> Sewage dumping.

products. This lessens the need for new plastics and halts the spread of pollution¹⁰.

Community Clean-up Initiatives: Organising regular cleanup activities and utilising awareness campaigns to include the neighborhood communities in cleanup operations. This grassroots strategy aids in preventing pollution of beaches and coasts.

Innovative Sorbents: Developing fresh substances that can take up toxins from water. These materials, which are frequently made from natural resources, can be used to remove contaminants from the marine environment, including oil spills. The removal of marine pollution and the preservation of our seas for future generations may be greatly aided by combining these cutting-edge solutions with international cooperation and concentrated efforts by governments, companies, and communities.

8. CONCLUSION

Finally, it should be noted that the problem of marine pollution is a complicated and urgent worldwide issue that requires immediate attention and coordinated actions by people, communities, governments, and international organisations. The condition of our seas directly affects the health of all living things and the stability of our climate because more than 70% of the surface of the Earth is covered by water. Marine ecosystems, human health, and the global economy are all seriously threatened by marine pollution, which includes chemical contamination, plastic trash, oil spills, and other contaminants. This situation is further exacerbated by human activities such as inappropriate waste disposal, industrial runoff, maritime

operations, and overfishing. Many tactics and solutions are being used to effectively tackle marine pollution. Global regulations and reductions in marine pollution are greatly aided by international accords and conventions like MARPOL and the Basel Convention. Physical barriers, sophisticated waste treatment technology, and bioremediation are a few examples of technological advancements that have the potential to reduce pollution and clean up impacted regions. Addressing marine contamination requires both community involvement and public education. A cleaner maritime environment may be achieved through reducing single-use plastic, enhancing garbage collection and disposal procedures, and increasing public knowledge of the effects of pollution. Case studies from significant oil spills like the Deepwater Horizon event to ongoing problems like plastic pollution in the Great Pacific Garbage Patch and coral bleaching in the Great Barrier Reef serve as examples of the difficulties in regulating marine pollution. A more sustainable future is possible thanks to forward-thinking strategies including ocean cleaning arrays, biodegradable plastics, drone technology, robotic cleaners, biosensors, recycling technologies, and community cleanup programmes. We can fight to protect our seas for future generations and lessen the negative consequences of marine pollution by combining these solutions with international collaboration and the collaborative efforts of people and organisations worldwide. To save our marine ecosystems and the many lives they sustain, we must move quickly and aggressively.

9. CONFLICT OF INTEREST

Conflict of interest declared none.

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¹⁰ International Tanker Owners Pollution Federation Ltd., Response to Marine Oil Spills, Second Edition, Witherby & Co., London, 1987, p. 125.
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