

PLASTICS POLLUTION IN COASTAL MARINE ENVIRONMENT —A REVIEW

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The coastal marine environment plays a vital role in India's Economy by virtual of its natural resources, potential habitats and wide Biodiversity. This review article summarizes sources, occurrences, fate and effects/ impacts of plastics debris in coastal marine environment due to its resistance to degradation. Most plastics debris will persist in the environment for centuries and may be transported far from its sources including great distances out to sea. Land and oceans based sources are the major sources of plastics entering the environment, with domestic, industrial and fishing activities being the most important contributors. Both macro plastics and micro plastics pose a risk to organisms in the natural environment, for example, through ingestion or entanglement in the plastics. Many studies have investigated the potential uptake of hydrophobic contaminants, which can then bioaccumulate in the food chain from plastic wastes by organisms. A large numbers of marine species is known to be harmed and /or killed by plastic debris, which could jeopardize their survival, especially since many are already endangered by other forms of anthropogenic activities. Marine animals are mostly affected through entanglement in and ingestion of plastic litter. Other less known threats include the use of plastic debris by "invader" species and the absorption of polychlorinated biphenyls from ingested plastics. Less conspicuous forms, such as plastic pellets and "scrubbers" are also hazardous. To address the issue of plastic pollution in the marine environment, governments should first play an active role in addressing the issue of plastic waste by introducing legislation to control the sources of plastic debris and the use of plastic additives. In addition, plastic industries should take responsibility for the end-of-life of their products by introducing plastic recycling or upgrading programmes.

INTRODUCTION

In recent years, pollution of the coastal marine environments has become a national and international problem because of its impact on living organisms, impairment of water quality for use, hindrance to aquaculture, fishery resources and human health.

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The coastal zone is a dynamic area with many cyclic and random processes owing to a variety of resources and habitats. Nearly three quarters of the worlds population live along the coast. India has long coast line of 8129 kms (including Islands) with many sprawling and still growing coastal cities. The coastal region is thus a place of hectic human activity, followed by intense urbanization, resulting in human interference because of rapid development. The coastal marine ecosystems are now highly

disturbed and very much threatened, encountering problems of pollution due to ever expanding human settlements. Major activities responsible for coastal pollution are:

(a) Discharge and disposal of untreated and partially treated domestic and industrial wastes (b) Discharge of industrial coolant waters (c) Harbour activities such as dredging, dumping of ship wastes, cargo handling (spilling of chemicals and metal ores, oil transport) (d) Fishing activities (mechanized fishing vessels movement [draining of waste oil], painting of fishing vessels, scrapping of metal linings of fishing boats, dumping of waste and trash fishes and aquaculture) (e) Oil exploration and oil refining activities (f) Recreation and tourism activities (g) Salt production etc.

A great variety of pollutants are produced by man and many of these reach the aquatic environment either directly or indirectly. Further, industrial, agricultural wastes and domestic sewage wastes from various sources have posed a threat for the survival of fish and other aquatic organisms in the ecosystem. Some organic materials are decomposed by normal biological process, but others such as chlorinated hydrocarbon pesticides are resistant to decay and persist for long time in the aquatic environment. For the persistent pollutants, the ocean is the ultimate sink in which they accumulate in the water, in organisms or in the bottom sediments.^{1,14}

The oceans and coastal ecosystems are facing a new threat—the Marine Debris. Most researchers believe that this is worse than any other problem faced by aquatic ecosystems. Debris ranging from cigarette butts to large plastic sheets have emerged as the latest threat to sustainability of coastal and marine ecosystem, endangering the flora, fauna, the physical and chemical processes and ultimately the livelihood of thousands of fishers and farmers. Not

only plastics, even other items like glass and metal which can be easily recycled also are thrown away as trash.^{2,3}

SOURCES OF POLLUTION

The sources of various types of pollutants are : (a) Sewage (Domestic & Municipal) (b) Industrial effluents (c) Agricultural wastes (pesticides) (d) Other organic wastes (Heavy metals) (e) Oil and oil dispersants (f) Radioactive material (g) Thermal effluents (h) Other solid wastes (i) Detergents (j) Plastics.

Recent studies have shown that there are 5.25 trillion pieces of plastic debris in the ocean. Of that mass, 2,69,000 tons float on the surface, while some four billion plastic microfibers per square kilometer litter the deep sea. The amount of plastic waste entering the ocean from land each year exceeds 4.8 million metric tons (MMT) and may be as high as 12.7 MMT.

Man-made items of debris are now found in marine habitats throughout the world, from the poles to the equator, from shorelines and estuaries to remote areas of the high seas beyond national jurisdictions, and from the surface to the ocean floor. This debris is harmful to organisms and to human health, can assist increased transport of organic and inorganic contaminants presents a hazard to shipping, and is aesthetically detrimental. Marine debris, and in particular the accumulation of plastic debris, has been identified as a global problem alongside other key issues of our time including climate change, ocean acidification and loss of biodiversity.^{4,5,6}

MARINE PLASTICS DEBRIS

- Over 300 million tons of plastics are produced every year for use in a wide variety of applications.
- At least 8 million tons of plastics end up in our oceans every year. Floating plastic debris

are currently the most abundant items of marine litter. Waste plastic makes up 80% of all marine debris from surface waters to deep-sea sediments.

- Marine species ingest or are entangled by plastics debris, which causes severe injuries and deaths.
- Plastics pollution threatens food safety and quality, human health, coastal tourism, and contributes to climate change.
- There is an urgent need to explore the use of existing legally binding international agreements to address marine plastics pollution.
- Recycling and reuse of plastic products, and support for research and innovation to develop new products to replace single-use plastics are also necessary to prevent and reduce plastics pollution.

IMPACTS ON COSTAL AND MARINE ENVIRONMENT

The most visible and disturbing impacts of marine plastics are the ingestion, suffocation and entanglement of hundreds of marine species. Marine wildlife such as seabirds, whales, fishes and turtles, mistake plastic waste for prey, and most die of starvation as their stomachs are filled with plastic debris. They also suffer from lacerations, infections, reduced ability to swim, and internal injuries. Floating plastics also contribute to the spread of invasive marine organisms and bacteria, which disrupt ecosystems.³

IMPACTS ON FOOD AND HEALTH

Invisible plastics has been identified in tap water, beer, salt and are present in all samples collected in the world's oceans, including the Arctic. Several chemicals used in the production of plastic materials are known to be carcinogenic and to interfere with

the body's endocrine system, causing developmental, reproductive, neurological, and immune disorders in both humans and wildlife.

Toxic contaminants also accumulate on the surface of plastic materials as a result of prolonged exposure to seawater. When marine organisms ingest plastic debris, these contaminants enter their digestive systems, and overtime accumulate in the food web. The transfer of contaminants between marine species and humans through consumption of seafood has been identified as a health hazard, but has not yet been adequately researched.

IMPACTS ON CLIMATE CHANGE

Plastic, which is a petroleum product, also contributes to global warming. If plastic waste is incinerated, it releases carbon dioxide into the atmosphere, thereby increasing carbon emissions.

IMPACTS ON LIVELIHOOD/TOURISM

Marine and shoreline debris can have a major impact on marine industries, which are often the major source of livelihood in coastal communities. As mentioned above, marine debris of all kinds can negatively impact marine tourism by reducing the aesthetic value of an area^{6,7}.

Plastic waste damages the aesthetic value of tourist destinations, leading to decreased tourism-related incomes and major economic costs related to the cleaning and maintenance of the sites¹³.

IMPACTS ON FISHERIES/AQUACULTURE

Size of fish catches and landings of commercially valuable aquatic organisms including plants may be influenced in numerous ways, directly or indirectly by pollution, the reducing of stocks by mass mortalities, the gradual decline or change in the composition of populations or whole ecosystem as a result of interference with fundamental life processes, increased competitiveness of individuals and increased occurrence of diseases.⁸

The rapid rise of industrial aquaculture has been accompanied by the expanded use of plastic infrastructure. Little to no attention has been given to the environmental consequences of accidentally lost plastic gear. No mention of lost aquaculture plastic is made in the 2014 FAO Annual Report or its "Code of Conduct for Responsible Fisheries". Lost aquaculture plastic is not monitored, and no regulatory remedies have been created, nor is it called out by certification organizations.⁹

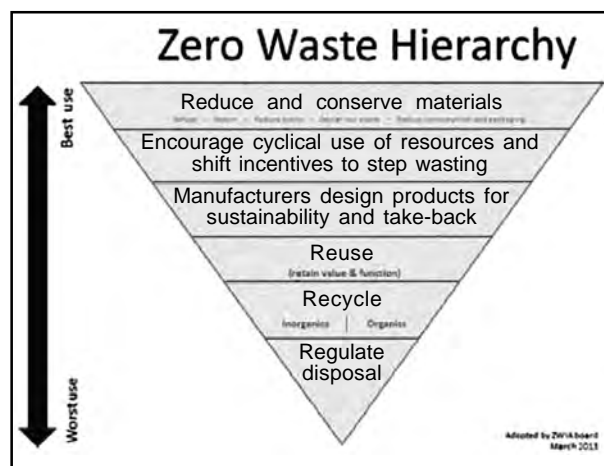
Derelict plastic gear used in aquaculture is being found in studies of bays, beaches and the open ocean, where it entangles a multitude of species¹⁵. Photo-degraded plastic bits enter the food web by mimicking natural prey. In addition to being non-nutritive and non-digestible, plastics transport toxic chemicals used in their manufacture and absorbed from seawater. This causes stomach blocking and laceration, starvation, liver deterioration, endocrine disruption, stressed protein profiles and cancer.^{10, 11, 12}



Fig 1. Plastics debris along the coastal beach

According to the reports by Fishery survey of India (FSI), Ministry of Govt. of India that during the trawling operations, for up to one kilometer distance in deep waters, 5 Kg plastics wastes are caught by trawl net. Hence, the fishermen are too sensitized that they should not carry any plastic items when they for fishing.

- According to National Center for Coastal Research (NCCR), Ministry of earth sciences Govt. of India that thirty percent of the marine litter on the oceans is abandoned fishing nets and gear made of synthetic material. They are a threat to marine life.
- Stressing on the need to develop a strategy, a recent report by Central Marine Fisheries Research Institute (CMFRI-ICAR, Govt. of India) mentioned, "Considering the growing threat to sustainability of resources and reduction in ecosystem functional services leading to loss of livelihood in fisheries sector, the report strongly recommend that there should be a National Marine Debris Management Strategy with specific goals for prevention and control of debris accumulating and spreading in coastal and marine ecosystem".



CONCLUSION

- To effectively address the issue of marine plastics, research and innovation should be supported. Knowledge of the full extent of plastic pollution and its impacts would provide policy-makers, manufacturers and consumers with scientific evidence needed to spearhead appropriate technological, behavioral and

policy solutions. It would also accelerate the conceptualization of new technology, materials or products to replace plastics.

- The Most Common Eco-Friendly Alternatives for Plastic Packaging.
- Glass-(Glass), is made from sand and not made from fossil fuels unlike plastics.
- Reusable Shopping Bags. Most supermarkets offer plastic bag alternatives today.
- Plastic Additives. Milk Protein. Chicken Feathers. Liquid Wood.
- PCL Polyesters and PHA Polyesters.

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