

## Plasticizing the Coastal Aquatic Environment: an Overview of Indian Coasts



### Aquaculture

**KEYWORDS :** Plastic debris, pollution, recycling, sources and suggestions.

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### ABSTRACT

*Indian beaches are no exception to the accumulation of considerable quantities of plastic debris. Plastics account for approximately 10% of discarded waste all over the world, and comprise 50–80% of the waste stranded on beaches, floating on the ocean surface and on the seabed. Plastics are dumped into the environment intentionally or unintentionally. Thus, the quantity of plastic debris entering the marine environment is almost parallel to their level of production over the last half century. The present widespread use of plastics as an alternative to wood or metal packing allows no room for a complete ban of plastics around the world. Therefore, the option available is to find innovative solution for the collection, segregation, recycling and reuse of plastics to reduce environmental pollution.*

### INTRODUCTION

Plastics find an important role in transforming everyday human life and the usage is increasing markedly. The increase in the use of plastics has created waste management issues with the discarded end-of-life plastics accumulating in landfills and in natural habitats. The very same versatile properties such as durability, bio-inertness, light weight and buoyancy are the major culprits for causing problems in the environment.

Plastics are versatile polymers and their application in variety of sectors has transformed day-to-day human life. Their use is increasing day-by-day. As a result, plastic debris is on the rise, and concerns the politicians, media, scientists, industry and the public. The plastic debris reaches coastal and marine environments as their ultimate sink and is accumulating around the world, even in the remote and uninhabited coastal environments. The marine organisms are facing the danger of possible entanglement, ingestion, habitat destruction and bio-invasion. The presence of debris affects the aesthetic and recreational value, causing considerable economic loss. The human health and safety is also threatened by the plastic debris.

The diversity of polymers and the versatility of their properties (low cost, excellent oxygen/moisture barrier properties, electrical and thermal insulation properties, bio-inertness, light weight, etc.) enabled

them to be used in variety of applications to improve resource use efficiency in sectors ranging from packaging, appliance, agriculture, construction, automobile to healthcare and hygiene. As the plastics are made durable by adding different additives to the petrochemical compounds extracted from oil, the microorganisms do not recognize plastics as their food and do not degrade them. Physical forces such as winds, waves and ultraviolet radiation can disintegrate larger plastics to smaller fragments and monomers in the marine environment. The longevity of plastics is a matter for some debate, and estimates range from hundreds to thousands of years. The global plastic consumption has been estimated at 260 million tonnes in 2008, and the consumption is to reach 297.5 million tons by 2015. It is considered that (with the exception of materials that have been incinerated) all of the conventional plastic that has ever been introduced into the environment still remains to date un-mineralized either as whole items or as fragments. The demand potential for plastics in India is likely to double from current levels of about 20 million metric tonnes (MMT) to about 40 MMT by 2020. In terms of waste generated, plastics account for approximately nine per cent of 1.2 lakh tonnes per day of municipal solid wastes in India.

### CHEMICAL NATURE OF PLASTICS

Plastics are synthetic organic polymers prepared by the polymerization of monomers derived from oil or gas. About 8% of global oil production goes towards the production of plastics. Different types of plastics are made by the addition of various chemical additives to the polymers. The most commonly used plastics are low-density polyethylene (LDPE), high density polyethylene (HDPE), polyethylene terephthalate (PET), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), nylon, Teflon and thermoplastic polyurethane (TPU).

### PLASTIC RECYCLING IN INDIA

The plastics are categorized into thermoplastics and thermoset plastics based on engineering behaviour. Thermoplastics form 80% of the plastic products in India and are easily recyclable. About 60% of plastic waste generated in India is recycled; the rest ends up in landfills or as stranded debris. The increasing demand for plastics is due to production of goods and its usage in packaging of various items. At present, plastic is the material of choice in nearly half of all the packaged goods and packaging represents largest Single sector accounting for about 35 per cent of total plastic consumption.

### CLASSIFICATION OF SOURCES OF PLASTIC POLLUTION

The sources of plastic debris can be broadly classified into land-based sources and sea-based sources. The land-based plastics include *tourism-related and sewage-related debris*. Plastic debris on beaches and in coastal waters originates from a wide and diverse range of sources.

#### • Land-Based Sources

Land-based debris can enter the beach and coastal environment through drains, or can be blown, washed or discharged directly from the land. The land-based plastics include tourism-related and sewage-related debris. The tourism-related debris mainly consists of direct discard by beach users such as food and beverage packaging material, beach toys and recreational articles.

#### • Sewage-Related Debris

The sewage-related debris includes the garbage from domestic and street discards that enter the sewer or drains. The sea-based debris include fishing-related, and ship or boat-related. Fishing lines, nets and ropes, floats and bait packaging material, those are lost accidentally or dumped intentionally into the ocean, constitute fishing-related debris. The ship- or boat-related plastic debris includes the garbage such as food and beverage packaging, toiletries, etc. used in the ship or boat.

### IMPACTS OF PLASTIC WASTES ON COASTAL ENVIRONMENT

The coastal environment and seafloor are important habitats for benthic organisms. The large-size plastic debris such as aban-

doned fishing nets and lines in the ocean entrap large animals and indulge in ghost fishing (i.e. discarded fishing gear continue to catch fish). Entanglement restricts the mobility of the animals which reduces the ability to obtain food and escape from predators; potentially resulting in serious injury or death by starvation, drowning or suffocation. The accumulation of plastic debris on the floor smothers the benthic habitats, damaging biota of both soft sediment and rocky substrates at all depths from intertidal to the abyss. The smothering affects gas exchange between pore water and sea water and thus makes the habitats unfit for benthic organisms. The plastic debris in the coastal and marine environment affects the ecosystem and human population in numerous ways such as destruction of habitat and introduction of alien species, entanglement and ingestion by marine biota, carrier of toxic organic and inorganic chemicals, dangerous to human safety and health, damaging the vessel, aesthetic value and economy. At least 267 species worldwide, including 44% of all seabirds, 43% of all marine mammals, 86% of all turtles as well as fish species were affected by marine debris.

### BIO-MAGNIFICATION

Plastics are known to adsorb hydrophobic pollutants and hence a potential danger of bio-magnification along the food chain apart from the additives added to the plastics during manufacturing process. The investigation of potential bioavailability of compounds added to plastics at the time of manufacture, as well as those adsorbed from the environment is needed.

### IMPACT ON HUMANS

The toxic chemicals and pathogenic organisms carried by plastic debris not only affect marine organisms but also human beings.

- The plastic debris, resulted from medical and hygiene products, cause infectious diseases through direct or indirect exposure.
- The safety of the swimmers, divers and snorkelers is under risk due to the possible entanglement of floating and submerged plastic debris such as discarded ropes, nets and lines.
- The beaches offer immense value in terms of recreation and tourism. The mere existence of plastic debris on beaches cause annoyance and reduce the aesthetic value, thereby lead to loss of tourism and recreational activities.
- Apart from this, the derelict nets and ropes damage sea-going vessels by entangling the propellers and clogging of water intake systems. The repair works of such damage are very expensive. The fishing gears also get entangled by plastic debris and cause considerable economic loss to the fishers.

### REGULATION FOR PREVENTING COASTAL POLLUTION

India has a long coastline of 5423 km along the mainland with 43% sandy beaches. Indian beaches are no exception to the accumulation of considerable quantities of plastic debris. A number of national and international regulations for preventing pollution in general and plastics in particular exists, such as Annex V of International Convention for the Prevention of Pollution from Ships (MARPOL) prohibits dumping of rubbish at sea from ships, UNEP Global Programme of Action for Protection of the Marine Environment from Land-based activities and the EU Marine Strategy Framework Directive (MSFD). The worrying fact is the extent of implementation of such regulations. Plastics being one of the most persistent pollutants, the strict implementation of the regulations to prevent such pollution, and management of plastic debris in a non-detrimental manner is essential at this juncture. Both prevention and cleanup aspects need to be considered in addressing the problem of plastic debris in the coastal and marine environment. The Governments should effectively implement the regulations and also formulate pro- environment policies with the active participation of the stakeholder to address the menace of plastic debris.

### RECOMMENDATIONS

- ❖ Educating the consumers on the environmental consequences of litter, would result in generation of less plastic waste as well as proper disposal of the debris.
- ❖ The efforts of all the plastic industries, retailers, consumers, researchers and governments should be carried out for the effective management of pollution by plastic debris.
- ❖ To developing eco- friendly alternatives, environment-friendly recycling and energy recovery technologies.
- ❖ Continuous *Monitoring and Impact Assessment* should be carried out by both state and central governments.
- ❖ To create sustained behavioural changes among consumers to reduce, reuse, recycle, refuse and rethink to manage the problem of plastic debris.
- ❖ To regulate the discharge of formaldehyde from domestic and industrial sources into aquatic systems. Also, the toxicant has to be taken into more consideration as an environmental contaminant.

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