

Removal of marine litter and its impact along the coast of India

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Abstract

In numerous Mann Ki Baat episodes, the Hon'ble Prime Minister highlighted the problems of plastics and marine litter. These episodes are inspiring for assessing the impacts of marine litter, their transport pathways, and the existing measures taken by the Government of India to combat these issues. Marine litter includes all synthetic materials that are discarded or abandoned in the marine environment, which is sourced to the sea through riverine systems. It is estimated that 0.6 million metric tons of plastic waste enter the Indian Ocean each year through various land-based (littering, dumping, tourism, recreation, surface run-off) and sea-based (fishing, aquaculture, shipping, coastal dumping, oil and gas exploration) activities. The marine litter accumulated in the Indian Ocean forms a "garbage patch" and also acts as a transboundary source. Marine litter negatively affects the environment, ecology, public health, climate, and economy. It is well known that the emergence of marine litter, especially plastic, has been a global problem for the past two decades and that its cost to society and the marine environment is enormous and irreversible. The Prime Minister of India led the country by example during the historic plogging at Mamallapuram and also urged the citizens to actively participate in coastal clean-up activities to remove litter from the coastal and beach areas of the country. At the national level, various campaigns (Swachha Sagar Abhiyan, Suchitwa Sagaram, Swachh Sagar, and Surakshit Sagar) are conducted to overcome the marine litter pollution along India's coast. Swachh Sagar Surakshit Sagar (1500 tonnes of litter removed from 75 beaches) and Puneet Sagar Abhiyan (100 tonnes of plastics removed, out of which about 60 tonnes of plastics were recycled) are some of the initiatives in India. Community action is successful in the removal of marine litter, as seen at Vengurla (a landfill converted to Swachh Bharat Waste Park) and Versova (5 million Kg of plastic removed), Maharashtra. The article highlights some of the best litter management practices in India, such as LiFE- Lifestyle for Environment, which encourages individuals to adopt sustainable practises, such as eco-labelling of beaches, trash booms in urban rivers, implementing the polluter pays principle, ensuring healthy oceans, and promoting a sustainable blue economy.

Key Words: Marine Litter, Coastal ecosystems, Lifestyle for the Environment, Marine Litter Management, Blue Economy.

Introduction

Mann Ki Baat is a radio programme hosted by the honourable Prime Minister of India, Narendra Modi. The programme is aimed at reaching out to the citizens of India and sharing the Prime Minister's thoughts and ideas with them. The programme typically includes the Prime Minister's reflections on various issues of national and international importance as well as his vision for

the country's future. The programme also often features stories of ordinary citizens who have made a positive impact in their communities. This programme allows the Prime Minister to communicate directly with the citizens of India on various topics of national interest. In some of his episodes, the Prime Minister has addressed the issue of plastic pollution and the importance of reducing the use of single-use plastics. He has also urged citizens to participate in cleaning up plastic waste from beaches and

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other coastal areas. Additionally, the Indian government has implemented various initiatives to promote the use of alternatives to plastic, such as promoting the use of cloth bags, jute bags, and other eco-friendly materials. The government has also launched the Swachh Bharat Abhiyan, which aims to promote cleanliness across the country. The present article is an output based on these episodes and aims to bring out the impacts of marine litter, their transport pathways, and the existing measures taken by the Government of India to combat these issues.

In recent decades, there have been many man-made changes to our planet, and one of the most obvious changes has been the prevalence of litter in the marine environment. Marine litter is defined as all synthetic materials that are discarded or abandoned in the marine environment, which is sourced to the sea via riverine

systems, waste discharge, and dumping activities. Litter pollution has led to global concerns over its socioeconomic and ecological impacts that pose health risks to marine biota, humans, and the food web. The fate and transport of marine litter are influenced by many factors, including coastal processes, geomorphological features, and coastal dynamics.

Marine litter is ubiquitous, even in the most remote areas such as the polar regions and the ocean floor. Over the past few decades, plastic pollution has been identified as a major component of marine litter on beaches around the world. Globally, plastic litter is classified into four major classes based on size: macroplastics (>25 mm), mesoplastics (5–25 mm), microplastics (<5 mm), and nanoplastics (<100 nm). Among the sizes of plastic litter, microplastics (MPs) are a toxic, persistent, and abundant pollutant that poses a

Honorable Prime Minister's Mann Ki Baat Quotes

Episode No. 59 telecasted on 24.11.2019: Scuba divers' efforts to remove plastic waste from sea

The honorable Prime Minister outlined the success story of scuba divers from Visakhapatnam and how they have led a successful battle against plastic waste. He highlighted the story of scuba divers who have helped remove plastic waste from the sea. These divers started scuba diving for a "swachh" cause. They dive deep to remove garbage and plastic lying on the sea floor. In around two weeks, these divers have helped remove more than 4000 kilograms of plastic waste from the sea. This small beginning by the divers is being transformed into a big mission now. PM also urged people to take inspiration from these divers and pledge to beat plastic pollution.

Episode No. 93 telecasted on 25.09.2022: Public participation in the coastal cleaning efforts

The honorable Prime Minister appreciated the public's participation in the coastal cleaning efforts in the Swachh Sagar – Surakshit Sagar initiative. About 5000 young friends from the NSS collected more than 30 tonnes of plastic.

The PM spoke about the importance of coastal cleaning and the many environmental challenges faced by the coastal areas. He further stressed that climate change remains a major threat to marine ecosystems, while the plastic litter spread on our beaches is a matter of great concern. He further urged the citizens to make sincere and continuous efforts to tackle these challenges.

The PM requested that the public resolve to say no to plastic pollution and use alternatives such as jute, cloth, and bamboo bags. He further opined that during the festive season, gifts are packed using polyethylene and other non-biodegradable bags. He suggested that the public promote the use of non-plastic bags like jute, bamboo, and banana. Finally, he emphasized the need to promote the use of non-plastic bags on the occasion of festivals and to take care of health and the environment, along with cleanliness.

Episode No. 98 telecasted on 26.02.2023: Jan bhagidaari in Swachh Bharat Abhiyan

The Prime Minister said that Swachh Bharat Abhiyan has changed the meaning of public participation (jan bhagidaari) in the country.

significant environmental and economic threat to coastal and marine ecosystems around the world (Karthik *et al.*, 2018; Robin *et al.*, 2020).

The total global production of plastics reached 390.7 million tonnes per year in 2021. Out of this, 332 million tonnes were fossil-based plastics, and 3.5 million tonnes were biological-based plastics (Plastics Europe, 2022). Global estimates show that 4.8–12.7 million tonnes of plastic enter the ocean every year (Jambeck *et al.*, 2015). More than two-thirds of the plastic waste comes from packaging (40%), consumer products (12%), and textiles (11%). As per 2019 reports, only 55 Mt of this waste were

collected for recycling, but 22 Mt ended up as recycling residue that needed further disposal. Ultimately, 9% of plastic waste was recycled, 19% was incinerated, and almost 50% went to sanitary landfills. The remaining 22% was disposed of in uncontrolled dumpsites, burned in open pits, or leaked into the environment (OECD, 2022).

In India, plastic production has seen a significant increase in recent years, with the country becoming one of the world's leading producers of plastic after China and the United States. However, per capita plastic consumption in India is still relatively low compared to developed countries, and a large portion of the plastic produced is

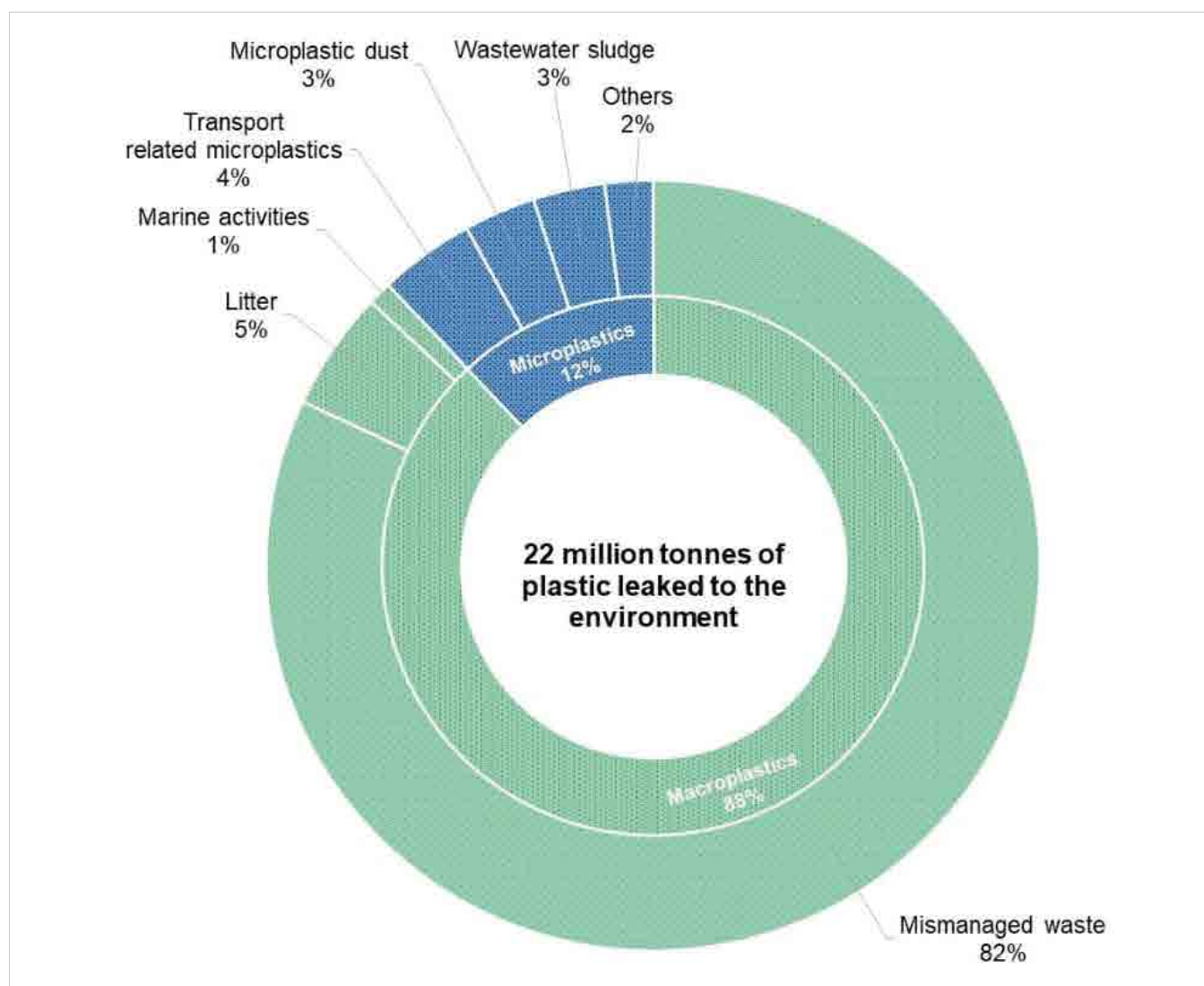


Figure 1: Plastic leakage into the environment. (Source: OECD Global Plastics Outlook Database, <https://doi.org/10.1787/c0821f81-en>)

used for industrial applications rather than consumer goods. The Indian Government has initiated steps to monitor the temporal and spatial distribution of marine litter along the Indian coasts and adjacent seas as part of an exercise towards the formulation of a national policy on marine litter. Currently, there is a shortage of data on marine litter sources, pathways, transport processes, and the quantification of the amount of litter entering the marine environment. The research conducted so far indicates that the national beach litter average was 0.475 ± 0.51 and 0.3 ± 0.4 items/m² in 2019 and 2021, respectively. Plastic was the dominant litter type (65% in 2019 and 74% in 2021), and single-use plastics (SUPs) were predominant. Marine litter is spread along the entire water column and sediment, and high quantities are noticed during the monsoon due to its spread into coastal water through creeks, rivers, and estuaries by huge fresh water discharge (Mishra *et al.*, 2023).

Plastic leakage contributes to climate change, the destruction of marine ecosystems, and the release of hazardous chemicals. The widespread use of plastics coupled with inadequate end-of-life management resulted in 22 million tonnes of plastic materials being released into the environment in 2019, contributing to persistent plastic pollution. The vast majority (19.4 million tonnes) are macroplastics, and most (82%) entered the natural environment due to inadequate collection and disposal. Other leakage routes include littering or fly-tipping (5%), and marine activities (1%) as shown in **Fig. 1**. Microplastics also account for a significant proportion of total leakage (12%) and enter the environment largely through wear to tyres and road markings, as well as the accidental loss of plastic pellets and washing of synthetic textile fibres (OECD, 2022).

The common sources of microplastics include land-based and sea-based sources. The land-based activities comprise littering, dumping of waste in rivers and waterways, improper waste management practises on the coast, recreational activities such as boating, improper disposal of plastic bottles, cups, and food packaging on beaches, sewage discharge into the waterways, surface run-off, and industrial activities. The sea-based sources include fishing, shipping, and transportation; aquaculture; marine-based tourism and recreation (diving, snorkeling, and boating); and coastal and offshore dumping. Further microplastics accumulate in the Indian Ocean and act as transboundary sources (Karthik *et al.*, 2018; Mugilarasan *et al.*, 2021).

The present article aims to bring out the sources and impacts of marine litter along the coastal regions of India. India has joined hands with several international organisations to tackle the problem of litter through several flagship programmes. The Government of India has put out several policies in its fight against marine litter, and some of the best litter management initiatives that can be practised to reduce marine litter are highlighted.

Scientific approach adopted to address the issue

The coastal states and Union Territories of India

India's 7500km long coastline has diverse ecosystems with unique biodiversity, including mangroves and coral reefs **Fig. 2**. The coast is surrounded by the Arabian Sea to the west, the Bay of Bengal to the east, and the Indian Ocean to the south.

The coastline has the following features:

- » Coastal length: 7500 km (including island territories)
- » 9 coastal states and 4 union territories
- » 79 coastal districts
- » 3600 fishing villages
- » 250 million live within 50km of the coast
- » about 30% of the total population
- » 12 major ports and 185 minor ports
- » 4120 km² of mangroves
- » 5790 km² of coral reefs
- » 1382 Islands: Mainland & Offshore

The coastline is engaged in several activities such as fishing, shipping, tourism, and recreation. However, the coast faces a myriad of issues, including the degradation of the rich ecosystems, pollution from agriculture run-off and domestic industries, and, most importantly, the vast coastal population exerting pressure on the natural resources for livelihoods and sustenance.

Moreover, the coastal and marine waters are also potential areas for development, which is promoted by the government to support economic growth. India has a coastal population of 420 million people, of whom around 330 million live on or near the coast. The population density of these coastal states ranges from 600 people per sq. km. to over 860 people per sq. km. with the highest density in Kerala. The population of Puducherry UT,

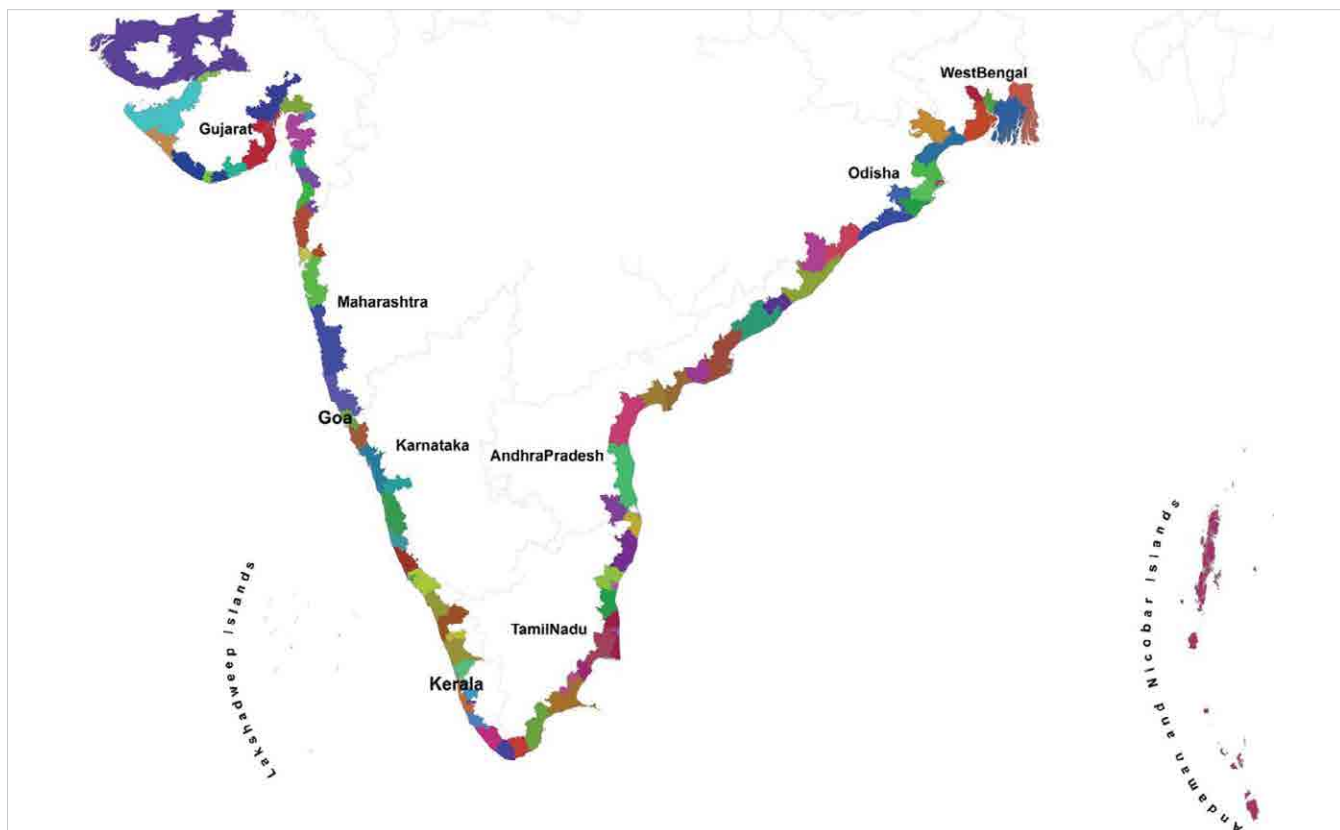


Figure 2: Coastal States of India.

including all four districts, is about 12,48,071 people, while that of Daman and Diu UT is 2,43,247. Lakshadweep has a population of 64,429 people, while the population of Andaman and Nicobar is 3,79,944 people. The coastal and island populations of India are dependent on various activities such as fishing, agriculture, tourism, and other related industries.

The methodological approach followed by Ajith *et al.* (2020) was adopted to conduct this bibliographic review. Articles were collected using various search terms, such as “marine litter”, “oceanic processes”, “the socioeconomics of marine litter”, “policies and recommendations on marine litter”, etc. To collect the articles, various bibliographic databases such as Google, Google Scholar, Research Gate, Science Direct, and Wiley Online Library were analysed. All types of material, such as peer-reviewed scientific articles, books and book chapters, technical reports, and information on projects from academic and government online portals, were used. Data on policies, initiatives, schemes, and campaigns was collected from government portals and government-authorized websites.

Results and discussion

The study attempts to review the impacts of marine litter on coastal systems and assess the various management measures and policies to reduce marine litter. Some of the best litter management practices are detailed, which provides an impetus in the management of marine litter. The current status of marine litter and microplastics in coastal areas of India is illustrated in Fig. 3 and Table 1, respectively.

Impacts of marine litter on the environment and ecology

Marine litter can have a range of negative impacts on the environment and poses a serious threat to marine wildlife, as animals can become entangled in nets or ingest plastic and other debris (Mugilarasan *et al.*, 2023). This can lead to injury, illness, and even death. Large items of marine litter, such as abandoned fishing gear, can damage or destroy sensitive marine habitats such as coral reefs and seagrass beds. Marine litter can have significant economic impacts, particularly on industries such as tourism and

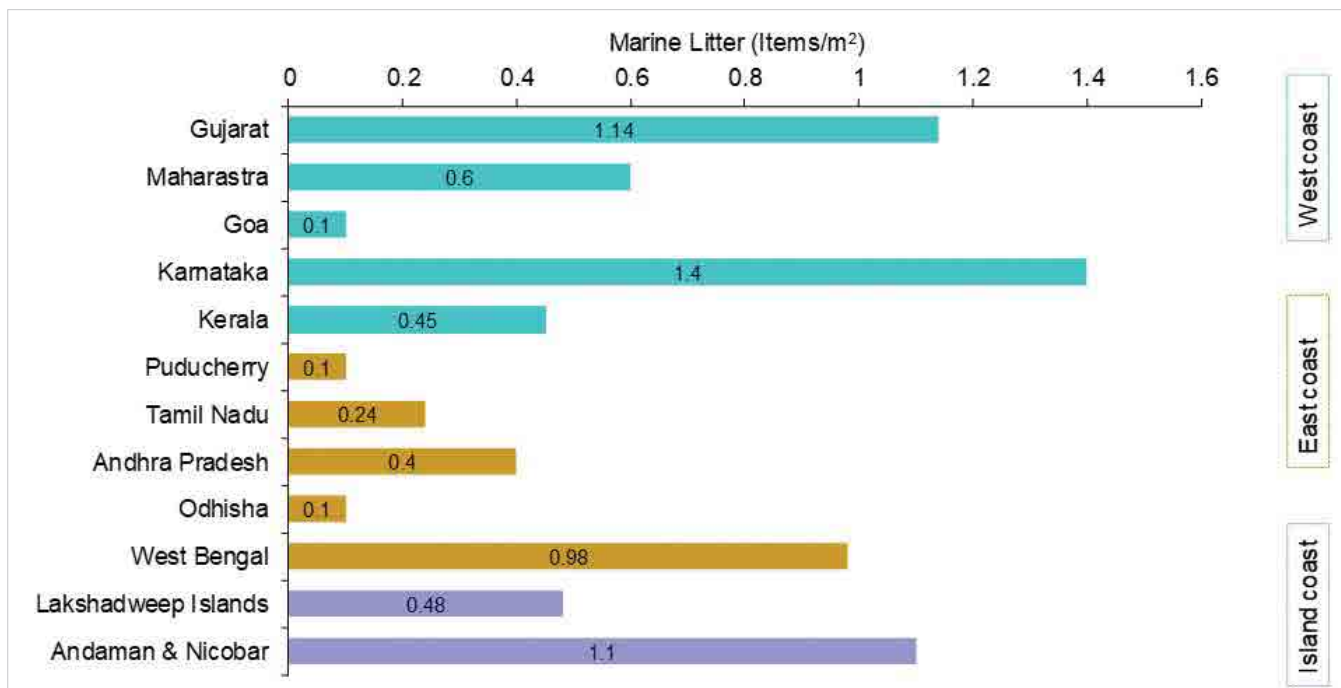


Figure 3: Marine litter data in the various states, union territories and islands of India.

Table 1. Abundance of microplastics in the beach sediment samples reported from different coastal states in India.

S. No	Locations	Mean ± SD	Unit	Reference
1	Beaches of Mumbai, Maharashtra	204 ± 110	Particles/kg	Dutta et al., 2022
2	Mumbai coast, Maharashtra	9630 ± 2947	Particles/kg	Gurjar et al., 2022
3	West coast of India, Goa	3950 ± 930	Particles/kg	Saha et al., 2021
4	Arabian Sea coast, Karnataka	664 ± 114	Particles/kg	Yaranal et al., 2021
5	Southwest coast of India, Kerala	65.1 ± 34.9	Particles/m²	Robin et al., 2020
6	Beaches of Puducherry	72.03 ± 19.16	Particles/100g	Dowarah et al., 2019
7	Gulf of Mannar and Palk Bay, Tamil Nadu	65.4 ± 39.8	Particles/m²	Karthik et al., 2022
8	Gulf of Mannar, Tamil Nadu	31.4 to 137.6	Particles/kg	Patterson et al., 2022
9	Southeast coast of India	505 ± 121	Particles/kg	Kaviarasan et al., 2022
10	Central east coast of India, Bay of Bengal	209 ± 99	Particles/kg	Sambandam et al., 2022
11	Southeast coast of India, Tamil Nadu	46.6 ± 37.2	Particles/m²	Karthik et al., 2018
12	Southeastern coast of India, Odisha	258.7 ± 90.0	Particles/kg	Patchaiyappan et al., 2021
13	Golden beach, Odisha	731 ± 719	Particles/kg	Singh et al., 2021
14	Wandoor beach, Andaman and Nicobar Islands	249.8 ± 105.7	Particles/kg	Mohan et al., 2022
15	Port Blair Bay, Andaman and Nicobar	45.1 ± 25.2	Particles/kg	Goswami et al., 2020

fishing (Fig. 4). For example, beaches covered in litter may deter tourists, while discarded fishing gear can damage or destroy fishing equipment (Mugilarasan *et al.*, 2023). Marine litter present in the environment can be consumed by organisms, and this ingested litter can biomagnify to affect larger organisms and also affect the wider food chain (Hariharan *et al.*, 2021). Marine litter can damage or destroy sensitive marine habitats such as coral reefs, seagrass beds, and mangrove forests. These habitats provide important shelter and food for a variety of marine species, and their destruction can have cascading effects on entire ecosystems (Sivadas *et al.*, 2021). Marine litter can transport invasive species from one location to another. This can alter the balance of ecosystems and potentially lead to the displacement of native species (Audrézet *et al.*, 2021). Marine litter, comprising plastics and chemical pollutants, can disrupt the reproductive cycles of marine animals, which can lead to reduced populations or alter their distribution.

Negative impacts on public health

Marine litter can have several negative impacts on public health. Plastics can break down into smaller fragments,

known as microplastics that can be easily ingested by marine organisms. When humans consume microplastics contaminated seafood, these microplastics enter the human food chain, potentially leading to various health problems (Ajith *et al.*, 2020). Marine litter can increase the risk of waterborne diseases such as cholera and typhoid as they provide a breeding ground for disease-carrying insects and also contaminate water sources (Moss *et al.*, 2017). Discarded electronic equipment contains hazardous chemicals such as lead and mercury. These chemicals can leach into the water and contaminate seafood, potentially leading to health problems such as neurological damage. Discarded items such as fishing hooks, glass, and metal can pose a physical risk to swimmers and beachgoers.

Impacts of marine litter on climate change

Plastic litter can have several impacts on climate change, both in terms of its production and its disposal. The production of plastic requires significant amounts of fossil fuels, such as oil and natural gas, which are major sources of greenhouse gas emissions. In addition, the transportation and processing of plastic also require energy, further contributing to carbon emissions. When plastic is disposed



Figure 4: Marine litter impacts on environment, ecology, human health and economy.

of in landfills, it can emit methane, a greenhouse gas that is even more potent than carbon dioxide. When plastic is burned, it can release harmful pollutants into the air, including carbon dioxide, sulphur dioxide, and nitrogen oxides. These pollutants can contribute to climate change and other environmental problems, such as acid rain and air pollution. Plastic litter can disrupt the growth of plants and the productivity of soil, which can affect the ability of ecosystems to store carbon (Hamilton *et al.*, 2019).

Impacts of marine litter on the blue economy

Marine litter can have several impacts on the blue economy, which refers to the economic benefits that can be derived from marine resources and activities. Marine litter can negatively impact the tourism industry, which is a significant component of the blue economy. Litter on beaches and in the water can discourage tourists from visiting, leading to reduced revenue for businesses that depend on tourism. Marine litter can harm the fishing industry by damaging or destroying the fishing gear, reducing the productivity of fisheries, and potentially leading to economic losses. Litter in the water can damage shipping vessels and interfere with navigation, potentially leading to increased costs and reduced efficiency. The presence of marine litter in aquaculture can affect the growth of farmed organisms, potentially reducing yields and revenue. Managing marine litter requires the development and implementation of waste management strategies and technologies, which can create job opportunities and stimulate economic growth in the waste management sector (McIlgorm *et al.*, 2022).

Global Flagship Programmes to Combat the Impacts of Marine Litter

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

MARPOL is an international treaty that was adopted in 1973 and is the main international convention covering the prevention of pollution from ships. The Convention includes provisions to prevent pollution of the marine environment by ships, including oil pollution, garbage pollution.

Global Partnership on Plastic Pollution and Marine Litter (GPML)

GPML was launched by UNEP and is a multi-stakeholder partnership that brings together all actors working to

prevent marine litter and plastic pollution. It provides a platform for cooperation and coordination, sharing ideas, knowledge, and experiences; identifying gaps and emerging issues; and harnessing the expertise, resources, and enthusiasm of all stakeholders.

Clean Seas campaign

Through the Clean Seas campaign, UNEP is connecting and rallying individuals, civil society groups, industry, and governments to catalyse change and transform habits, practises, standards, and policies around the globe to dramatically reduce marine litter and its negative impacts. Since its launch in 2017, the campaign has become a catalyst for change, transforming habits, practises, standards, and policies around the globe. About 69 countries have joined, making the Clean Seas Campaign the biggest and most powerful global coalition devoted to ending marine plastic pollution.

The G20 countries initiatives on marine litter compacting

The G20 countries have recognized the critical importance of addressing marine litter and have taken various initiatives to manage marine litter. Germany has launched a project called “Clean Seas - One Ocean, Many Worlds” to support the implementation of the G20 Implementation Framework for Actions on Marine Plastic Litter. The project focuses on promoting sustainable waste management practices and raising awareness about the impacts of marine litter. Japan has launched the “Plastics Smart” campaign to raise awareness about the impacts of plastic waste and promote the reduction of single-use plastics. The campaign encourages individuals and businesses to take action to reduce their plastic use and promote sustainable waste management practices. The Japanese government has also provided financial support for the development of waste management infrastructure in Southeast Asian countries to help reduce the amount of plastic waste entering the oceans. Australia has launched the “National Plastics Plan” to address plastic pollution and promote a circular economy for plastics.

The plan includes initiatives such as banning the export of unprocessed plastic waste, supporting innovation in plastic recycling technologies, and reducing the use of single-use plastics. Canada has launched a “Zero Plastic Waste Strategy” to address plastic pollution and promote sustainable waste management practices. The strategy includes initiatives such as banning single-use

plastics, promoting innovative recycling technologies, and investing in waste management infrastructure. The European Union has adopted the “Single-Use Plastics Directive,” which includes a range of measures to reduce the use of single-use plastics and promote sustainable waste management practices. The directive includes bans on certain single-use plastic products, such as plastic straws and cutlery, and requires member states to reduce the consumption of other single-use plastics.

India, as a member of the G20, has taken various initiatives to address marine litter management. Swachh Bharat Abhiyan: India’s national cleanliness campaign, includes a focus on reducing plastic waste and promoting sustainable waste management practices. The campaign has led to increased public awareness about the impacts of plastic waste and has encouraged the adoption of sustainable waste management practices. India has implemented an Extended Producer Responsibility (EPR) policy that requires producers to take responsibility for the end-of-life management of their products, including plastic packaging waste. The policy aims to incentivize producers to adopt sustainable packaging practices and reduce the amount of plastic waste entering the environment.

India has introduced the Plastic Waste Management Rules, which provide a framework for the environmentally sound management of plastic waste. The rules include provisions for the collection, segregation, and disposal of plastic waste, and require manufacturers to use environmentally friendly materials in their products. National Clean Energy Fund: India has established the National Clean Energy Fund, which provides financial support for innovative projects that promote clean energy and sustainable development. The fund has supported initiatives such as waste-to-energy projects, which convert waste into energy and reduce the amount of waste entering the environment. India has launched the National River Conservation Plan, which aims to reduce pollution in the country’s rivers and promote sustainable river management practices. The plan includes initiatives such as the installation of sewage treatment plants and the promotion of sustainable agricultural practices to reduce the use of harmful chemicals.

UNEA Resolutions on End Plastic Pollution

At the United Nations Environment Assembly (UNEA) 4, held in March 2019, India co-sponsored a resolution on “Addressing single-use plastic products pollution” which

aimed to address the environmental impacts of plastic waste and promote sustainable management practices. The resolution recognized the need for urgent action to reduce plastic pollution, particularly from single-use plastic products, and called for increased global cooperation to address the issue. India’s co-sponsorship of this resolution is significant given the country’s large and growing plastic waste footprint. According to a report by the Central Pollution Control Board (CPCB) of India, the country generates an estimated 26,000 tons of plastic waste every day, of which only 60% is collected and about 15% is recycled. Overall, India’s co-sponsorship of the UNEA 4 resolution on “Addressing single-use plastic products pollution” reflects the country’s commitment to promoting sustainable management practices and addressing the environmental impacts of plastic waste.

The UNEA 4 resolution co-sponsored by India called for a range of actions to address single-use plastic products pollution, including:

- » Developing and implementing policies and strategies to reduce the production and consumption of single-use plastic products.
- » Promoting sustainable alternatives to single-use plastic products, such as reusable bags and containers.
- » Encouraging research and innovation to develop new materials and technologies to reduce the environmental impact of plastics.
- » Enhancing waste management infrastructure and systems to improve collection, sorting, and recycling of plastic waste.
- » Strengthening international cooperation and coordination to address plastic pollution, including through the implementation of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

In UNEA 5.2, the Government of India worked collectively with all member states to reach agreement on a resolution to drive global action on plastic pollution by establishing an intergovernmental negotiating committee for a new international legally binding treaty, with its adoption by 175 countries.

UNEP Countermeasures for Plastic Free Rivers

The United Nations Environment Programme (UNEP) implemented a project funded by the Ministry of Foreign Affairs (MOFA) and the Government of Japan in

collaboration with local partners such as line ministries, academia, and civil society. The project, entitled “Promotion of Countermeasures against Marine Plastic Litter in Southeast Asia and India,” aimed to develop countermeasures to reduce plastic waste in the regions of the Mekong Basin, the Ganga Basin, and Mumbai by conducting surveys and outreach activities. The project developed a methodology for identifying plastic leakage pathways in the Mekong region and India. Data collection and surveys in study areas in the Mekong basin, Ganga basin, and Mumbai were conducted based on the developed data inventory. Moreover, the project conducted several outreach activities that linked science with policies and raised awareness among the general public.

India-Norway cooperation project

The India-Norway cooperation project on capacity building for reducing plastic and chemical pollution in India (INOPOL) is a part of the India-Norway Joint Marine Pollution Initiative and involved partnerships of key Indian and Norwegian organisations working in the sustainability space to explore various dimensions of plastic and chemical pollution in India, with particular focus on Gujarat, and to jointly develop a holistic action plan for its mitigation. The project aims to implement the Stockholm Convention on Persistent Organic Pollutants by providing science-based knowledge and strengthening the local and regional capacity to prevent and mitigate the environmental threat posed by plastic and chemical pollution.

Circular Economy Solutions for Preventing Marine Litter

The German Federal Ministry for the Environment (GIZ), Nature Conservation, and Nuclear Safety (BMU) implemented a circular economy project in collaboration with the Ministry of Environment, Forest, and Climate Change, Government of India, which is operational at NCSCM, Chennai, India. The project supports relevant regulatory authorities, like the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs) in Kerala, Tamil Nadu, and Uttar Pradesh, in developing and using digital technologies to quantify and track marine litter, monitor leakages in the selected ecosystems, and work on implementing extended producer responsibility (EPR).

Flagship programmes Legislation and Policies in India

The Government of India has taken various initiatives to fight the cause of marine litter. The existing legislation, policies, and flagship initiatives are elaborated below.

Plastics and recycled plastics manufacture, sale, and usage rules (1999)

Rules have laid down provisions for the manufacturing, usage, end-of-life (EoL) product management, and criteria for manufacturing plastic carry bags and containers. Amendments (2002, 2003) provide specifications for virgin and recycled plastic manufacturing, extend the definition of “vendor,” and mandate registration and authorization for manufacturers who produce, sell, or trade plastic packaging.

Plastic Waste Management (Amendment) Rules (2011, 2016, 2018, 2022)

The Government of India enacted the Plastic Waste (Management and Handling) Rules, 2011, which set out certain conditions for the manufacture, storage, sale, and use of plastic carrier bags and sachets, which are regulated by the State Pollution Control Board and local authorities. In addition, the Plastic Waste Management Rules, 2016, provide a comprehensive framework for the management of plastic waste. The rules also emphasize the promotion of extended producer responsibility and the use of environmentally friendly packaging materials. Manufacturers and brand owners who introduce plastic carry bags, multi-layered plastic sachets, pouches, and packaging into the marketplace are required to submit an EPR plan. The amended (2018) rules state that only those multi-layered plastics (MLPs) that are non-recyclable, non-energy recoverable, or have no alternate use will be phased out.

It has laid down responsibility for the handling and storage of hazardous waste. It also deals with the import and export of hazardous waste for recycling, recovery, and reuse. It defines processes generating hazardous waste, including plastic production, and where such processes are prohibited. The new (2016) rules ban the import of solid plastic waste, including PET bottles. It also distinguishes hazardous waste from others and recognizes waste as a resource for recycling and reuse, supplementing industrial processes.

Missions and initiatives to tackle marine litter in India

National Marine Litter Policy of India

Steps towards the formulation of a national marine litter policy have been initiated by the Ministries of Environment, Forestry, and Climate Change (MoEFCC), Earth Sciences (MoES), Science and Technology (MoST), and Fisheries, Animal Husbandry, and Dairying. Studies have been undertaken to identify the source to sink of litter, especially the plastic waste that flows into India's coast and ocean waters. The exercise was the first step towards framing a national marine litter policy with the objective of ocean cleanup, which is in line with UNEP's "Clean Seas Campaign.

The National Marine Litter Policy aims to (i) track and monitor litter in riverine, coastal, ocean, and marine ecosystems, (ii) Monitoring of Marine Litter through remote sensing and AI Technique, (iii) develop circular economy solutions for preventing marine litter in ecosystems, (iv) implement extended producer responsibility (EPR) to reduce, reuse, and recycle plastics with the participation of the private sector, such as the recycling industry and other stakeholders, as well as informal waste recyclers, (v) implement management and mitigation measures to overcome the impact of marine litter for clean and healthy oceans, (vi) engage in the development of sustainable coastal tourism through the ecolabel certification of beaches to minimize beach litter.

Several studies have been undertaken to map the marine litter, which is important to the policy framework. Further, the policy promotes economic, ecological, and public health by driving innovation and technology, building capacity, and supporting international cooperation, all of which are critical components of a sustainable blue economy. Further, several national workshops have been conducted and envisaged involving scientists from different research institutions, stakeholders, policymakers, industry experts, and academic experts to prepare a roadmap for formulating the National Marine Litter Policy and evolve best practises for the management of marine litter.

Swachh Sagar, Surakshit Sagar

As part of the Azadi ka Amrit Mahotsav celebrations, a 75-day coastal clean-up drive was conducted at 75 beaches in India. This is a step towards India's commitment to protect

30% of its oceans, waters, and lands by 2030 in a phased manner. The volunteers have removed over 1500 tonnes of litter from the beaches, which has proven to be a relief for people staying in the coastal areas.

Swachh-Nirmal Tat Abhiyan

Swachha Sagar Abhiyan is a campaign under the Ministry of Environment, Forest and Climate Change. It is a nationwide cleanliness-cum-awareness drive conducted at 50 identified beaches located in 10 coastal states and UTs of India. Around 2000 youths have collected over 48 tonnes of waste from the selected beach in Mumbai. Likewise, around 8000 kg of waste was removed from the chosen beach in Thiruvananthapuram.

Namami Gange Programme

It is an Integrated Conservation Mission, approved as a flagship programme by the Union Government in June 2014, to accomplish the twin objectives of effective abatement of pollution and conservation and rejuvenation of the National River Ganga. Under this programme, about 99 sewage projects have been completed, and another 48 projects are under construction in the states of Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, West Bengal, Delhi, Himachal Pradesh, Haryana, and Rajasthan. Further, work is in progress to construct a sewage capacity of 5,658.37 (MLD). River surface cleaning activity to remove floating solid wastes in the river is in progress at 11 locations. Also, the Ministry of Drinking Water and Sanitation (MoDWS) has aimed to construct 15,27,105 units of toilets, of which 8,53,397 have already been constructed.

Puneet Sagar Abhiyan

The initiative was aimed at tackling the problem of plastic pollution and achieving cleanliness in the water bodies. It is a nationwide flagship campaign to clean seashores of plastic and other waste materials while raising awareness about the importance of cleanliness. In this campaign, about 12 lakh NCC cadets have collected over 100 tonnes of plastic waste from over 1,900 locations in India. More than 60 tonnes of plastic waste collected have been recycled.

Suchitwa Sagaram

An initiative of Government of Kerala asking the fishermen to bring plastics back to the shore. Kerala

fishermen are now fishing for plastic to clean up the seas. Litter brought back from the sea is converted into useful products, increasing the value chain of plastics. The fishers carry the plastic waste back to shore, where it is cleansed, made into granules, and reused either as raw material in new plastic products or as an additive to road asphalt.

Ban on Single-Use Plastics (SUP)

The Government of India has implemented a ban on the use of single-use plastics (SUP) effective July 1, 2022. The SUPs include balloon sticks, cigarette packs, cutlery items including plates, cups, glasses, forks, spoons, knives, and trays; earbuds; sweet boxes; candy and ice cream sticks; invitation cards; polystyrene for decoration; and PVC banners measuring under 100 microns. The following online platforms are in operation for effective monitoring of the ban on identified single-use plastic items and plastic waste management in the country: (a) the National Dashboard for monitoring the implementation of a comprehensive action plan; (b) the CPCB Monitoring Module for Compliance on the Elimination of Single-Use Plastic; and (c) the CPCB Grievance Redressal App.

Initiatives for effective plastic waste management

The government of India has launched various green initiatives for effective plastic waste management which includes i) National Dashboard on Elimination of Single Use Plastic and Plastic Waste Management; ii) Extended Producer Responsibility (EPR) Portal for Plastic Packaging (CPCB) for improving accountability, traceability, transparency and facilitating ease of reporting compliance to EPR Obligations by Producers, Importers and Brand-owners; iii) Mobile App for Single Use Plastics Grievance Redressal (CPCB) to empower citizens to check sale/usage/manufacturing of SUP in their area and tackle the plastic menace; iv) Monitoring module for SUP (CPCB), for local bodies, SPCBs/PCCs and CPCB, to inventorize details of SUP production/ sale & usage in commercial establishments at district level, and on-ground enforcement of ban on SUP; v) Industrial production of Graphene from Waste Plastic to promote more industries to come forward to up cycle plastic waste.

Beat Plastic Pollution

The Indian government took significant steps to support the “Beat Plastic Pollution” campaign for World Environment Day 2018. Prime Minister Narendra Modi

announced a national pledge to eliminate all single-use plastics in India by 2022, calling for a “plastic-free India.” The government also encouraged the use of eco-friendly alternatives to plastic, such as cloth bags, paper bags, and biodegradable plastics. To promote the use of these alternatives, the government launched a “Green Good Deeds” campaign, encouraging people to adopt environmentally friendly practices in their daily lives. Overall, the Indian government’s efforts to support the “Beat Plastic Pollution” campaign for World Environment Day 2018 were significant and demonstrated a commitment to addressing plastic pollution in the country.

Community-led or citizen-led initiatives

The Hon’ble Prime Minister of India led by example during the historic Mamallapuram Beach plogging. The citizen science approach plays an important role in addressing the issue of marine litter, which has proven to be an effective means of monitoring plastic litter, bring potential benefits to researchers and authorities, and create awareness on plastic pollution at the society level (Fig. 5).

During the visit, he urged the citizens to take part in national coastal clean-up drives to remove litter from marine environments. This approach engages citizens with the environment and has the potential to generate data that enables policymaking (Mishra *et al.*, 2023). Apart from national campaigns, there are several citizen-led initiatives that may be considered pioneer models that can be practised nationally and globally.

Swachh Bharat Waste Park at Vengurla, Maharashtra

Vengurla is a coastal town in India where a landfill was converted into a waste management park called “Swachh Bharat Waste Park”. The local communities have practised waste segregation at the source and have currently achieved 95% waste segregation. A local body in the town earns Rs. 1.5 lakh per month from processing the generated waste. The park now hosts a biogas plant, a briquette-making plant, a segregation yard, and a plastic crusher unit. To earn additional revenue, the municipality recently started collecting user fees from households (Rs. 15), multi-story apartments (Rs. 30), hotels (Rs. 500), and restaurants (Rs. 200). To encourage reuse, unused items are dropped into a box placed under a tree called the Tree of Humanity. The municipal council has installed GPS on solid waste collection vehicles to keep track of the vehicles location. This helps to achieve 100% door-to-door collection.



Figure 5: Citizen-led beach cleaning initiatives.

Coastal clean-up by community action at Versova Beach, Maharashtra

In 2015, Versova was one of the dirtiest beaches in the world, but it is now pristine. This is due to the largest beach clean-up programme initiated by Afroz Shah and later joined by 1,000 volunteers, including local residents of Versova, slum-dwellers, politicians, celebrities, and schoolchildren. Clean-up has been carried out every Sunday for the past several years, and about 5 million Kg of plastic waste have been removed.

Role of non-governmental organisations in the removal of marine litter

International Solid Waste Association (ISWA)

ISWA is working towards waste management together with professionals, companies, organisations, and individual experts, to provide relevant and critical knowledge to identify both short-term mitigating interventions and long-term solutions. ISWA works towards the prevention of littering and dumping, develops practises for sound waste collection and disposal of municipal waste, and promotes the sufficient value of secondary plastics as part of a resource-efficient circular economy. Their waste management strategies involve biological treatment of waste, energy recovery, management of hazardous

and healthcare waste, recycling to minimise waste and highlighting the role of waste management in climate change.

ReefWatch Marine Conservation

Over the last year, with the help of a dedicated team of veterinarians and biologists, ReefWatch has attended to over 75 marine stranding incidents, rescued, rehabilitated, and released several sea turtles and birds, and conducted several coastal clean-ups in coordination with local volunteer groups. Studies were conducted on the waste to establish the source, types of waste, brand assessments, etc. The ReefWatch team in Karnataka is working on projects to improve our coastal marine habitats and the lives of people dependent on them. Another issue that plagues our coastlines is unsustainable practices such as overfishing, mussel farming, and irresponsible waste disposal. Alternative methods of waste disposal and mussel farming are being introduced to the locals to help create livelihoods and improve the health of local ecosystems. For effective progress to be made, it is imperative to work with stakeholders, local governing bodies, communities, and young minds. ReefWatch continuously involves the forest department, local volunteer organisations, and the children of regional areas in engaging activities.

Terra Conscious

The organisation has initiated programmes on responsible marine wildlife watching and sustainable tourism to develop livelihood opportunities for the local residents of Goa. They have also raised awareness about marine wildlife and ecosystems through learning experiences, built capacity through green skills training for conservation action and practise, and advocated for responsible marine and coastal governance.

International cooperation on measures to remove marine litter

India and the United Kingdom have been collaborating under the Commonwealth Litter Programme (CLiP) on scientific endeavours to share knowledge and techniques and improve understanding of marine plastic pollution. India, Australia, and Singapore come together to address marine pollution with a focus on plastic debris. India and Norway to work jointly towards mitigating marine plastic litter and microplastics. India and Germany sign an agreement on 'Cities combating plastic entering the marine environment'. India and Japan have joined hands to fight plastic pollution through data collection, advanced scientific research, and development, which will aid both governments in rolling out helpful policies to address plastic pollution in our waterways.

River Recycle

River Recycle is working towards installing waste management systems on the shores of the most polluted rivers, collecting and recycling plastic waste and floating debris. These operations enable local municipalities to effectively manage plastic waste, create safe and fair work for the hosting communities, and help stimulate the economy by involving companies that will buy the end products of the river cleaning and recycling system, making the whole process self-sufficient. River Recycle takes action by closing the loop on plastic waste in the most affected areas close to rivers and reintroducing the recovered material into the economy.

Dakshin Foundation

It is a non-profit, charitable, and non-governmental organization committed to environmental sustainability and social justice. They organized clean-up drives at the major tourist beaches of the Andaman and Nicobar

Islands. The participants of the clean-up drive included multiple groups, such as government, non-government, and local groups, to engage in a concerted beach clean-up activity. The larger goal was to initiate a dialogue between stakeholders to manage and mitigate the growing problem of coastal litter on the islands.

TREE Foundation

It is an Indian-based NGO focusing on marine conservation. For over a decade, the TREE Foundation and the Indian Coast Guard have been jointly conducting beach clean-up activities on International Coastal Clean-up Day (September 16). Prior to the clean-up event, awareness programmes are conducted to sensitize coastal dwellers about the importance of protecting the ocean as much as possible from human-induced pollution. Volunteers for the clean-up include members of the TREE Foundation, the Indian Coast Guard, Roots and Shoots, students from various schools and colleges, NSS, and NCC.

HCL Foundation

The Tamil Nadu Forest Department (TNFD) has joined hands with the HCL Foundation in a timely step towards marine and coastal conservation to resolve the 'ghost net' and marine debris problem in the Gulf of Mannar Marine National Park, Tamil Nadu. In alignment with SDG 14, the HCL Foundation supports TNFD in taking up a 3-year action plan for the removal of ghost nets and marine debris in this region.

SWITCH Asia

The PROMISE project, part of the SWITCH Asia programme, seeks to promote source-to-sea solutions to reduce marine littering in tourism clusters along the Lakshadweep shorelines of India, Sri Lanka, and the Maldives. It focuses explicitly on small and medium-sized enterprises contributing to the tourism sector to support them in waste minimization, thus enhancing the attractiveness of tourism industries, avoiding further deterioration of marine ecosystems, and improving people's living conditions.

Greenwaves Environmental Solutions

It is a Visakhapatnam-based organisation working along with WWF India on a project called 'Ghost Gear Upcycling'. The project, initiated in Visakhapatnam, Andhra Pradesh, in June 2021, upcycles ghost nets to make products like bracelets, pouches, doormats, and pots. The concept of upcycling fish nets is aimed at reducing the impact of marine pollution and providing alternative livelihoods for fisherwomen.

Increasing the value chain of ghost nets

DSM Engineering Materials, a Pune-based company working on sustainable living, is converting 'ghost nets' collected from the sea into surfboards. Already, 6000 tonnes of 'ghost nets' have been converted, while presently, 2000 tonnes of ghost nets are processed annually. Green Waves Environmental Solutions, a Visakhapatnam-based organisation working along with WWF, India, on a project called 'Ghost Gear Upcycling', the project, initiated in Visakhapatnam, Andhra Pradesh, in June 2021, upcycles ghost nets to make products like bracelets, pouches, doormats, and pots. The concept of upcycling fish nets is aimed at reducing the impact of marine pollution and providing alternative livelihoods for fisherwomen.

Best litter management practises in India

LiFE (Lifestyle for Environment)

The Hon'ble Prime Minister of India launched a global initiative - "Lifestyle for the Environment" (the "LiFE Movement"). A successful amalgamation of this global initiative with beach cleaning, environmental awareness, and a plastic-free life needs collective effort and robust action by the Pro-Planet People. Lifestyle for Environment (LiFE) India is an initiative launched by the Ministry of Environment, Forest, and Climate Change (MoEFCC) in collaboration with the United Nations Environment Programme (UNEP) to promote sustainable lifestyles in India. The initiative aims to encourage individuals to adopt more sustainable practises in their daily lives in order to reduce their impact on the environment and promote sustainable development. The Lifestyle for Environment LiFE India initiative includes a range of activities and campaigns to raise awareness of sustainable lifestyle practises, including education and awareness campaigns, sustainable product choices, greening workplaces, and sustainable tourism. Overall, the Lifestyle

for Environment LiFE India initiative is an important step towards promoting sustainable lifestyles in India and reducing the country's environmental carbon footprint. By encouraging individuals and businesses to adopt more sustainable practises, the initiative can help protect India's natural resources and promote sustainable development.

Eco-labelling of beaches

Blue Flag certification is a globally recognised eco-label accorded by the Foundation for Environment Education in Denmark (FEE). The certification is given to water bodies if they maintain stringent criteria. In India, presently, twelve beaches have been awarded the Blue Flag certification. The criteria for Blue Flag Beach include a zero waste management system and also include infrastructure such as a solid waste disposal system, a grey water treatment plant, bio-toilets, changing rooms and showers, security and surveillance systems, and daily beach cleaning activities. The solid waste management (SWM) system under Blue Flag Beach enables waste collection, segregation, recycling, and disposal. The efforts include managing the generated solid waste in a scientific and holistic manner by installing composting and other methodologies for transforming solid waste into useful commodities. In addition, regular cleaning is carried out to remove small litter materials such as cigarette butts, plastic wrappers, bags, glass, metal particles, etc. with the help of manual cleaning and mechanical vehicles called surf rakes.

India now has 12 Blue Flag beaches, an eco-label given to the cleanest beaches in the world. Beach Environment & Aesthetics Management Services (BEAMS), which is one of the initiatives under the ICZM approach, has been undertaken for the sustainable development of coastal regions of India, with a prime objective to protect and conserve the pristine coastal and marine ecosystems through holistic management of the resources.

The positive impacts of this eco-label include sand dune restoration and nourishment (95,000 km²), reduction of marine litter (85%) and plastics (78%) in the last 3 years, disposal of 750 tonnes of marine litter, improvement of cleanliness from poor (C) to outstanding (A++), saving 1100 ML/year of municipal water through recycling, educating about 1,25,000 beachgoers for responsible beach behaviour, and providing alternate livelihoods for 500 fishermen families.

Trash booms in urban rivers

The Government of Tamil Nadu has taken measures to reduce plastic pollution in the Greater Chennai Corporation. In urban rivers such as the Cooum and Adyar

Rivers, trash booms were installed to prevent plastics from entering the sea (Fig. 6). Garbage gets trapped in these booms, and it was estimated that about 23,000 tonnes of garbage were prevented from reaching the Bay of Bengal.

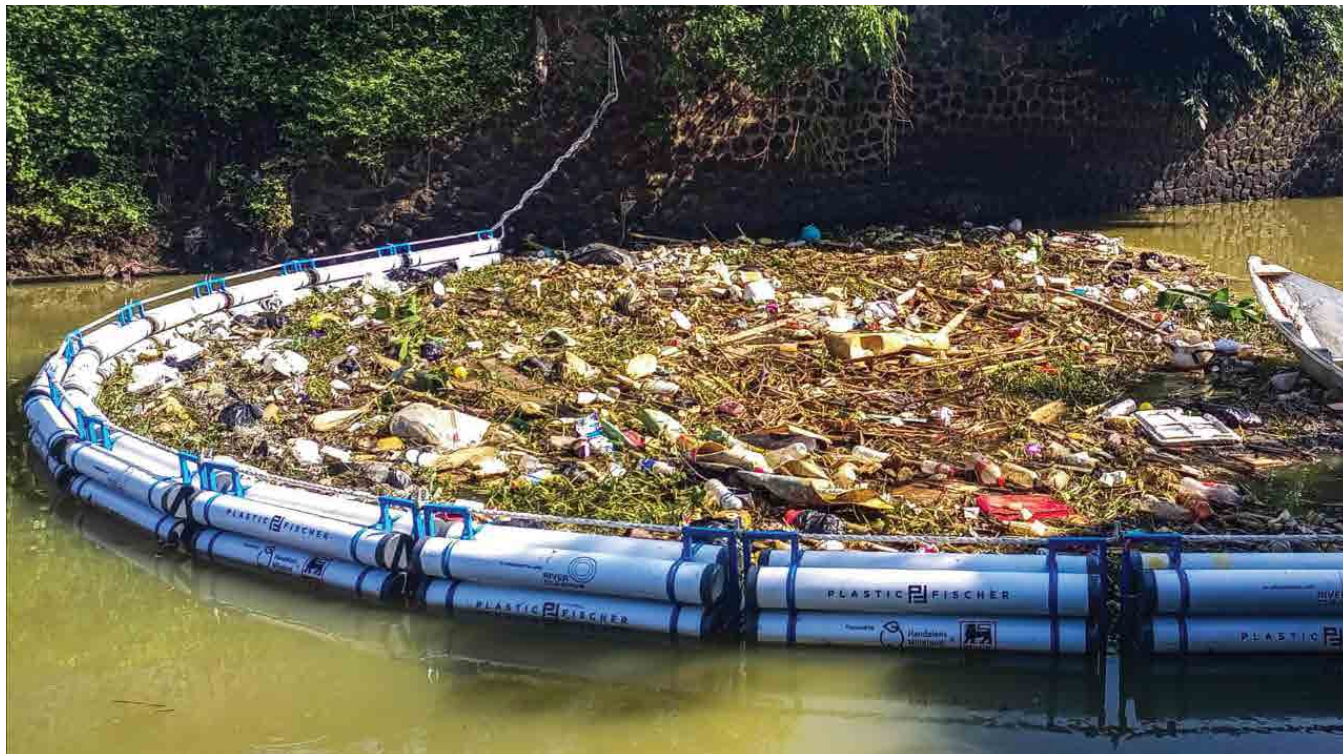


Figure 6: Installation of trash booms in urban rivers.

Beach cleaning machines

Asia's largest beach, namely The Marina, is polluted due to the improper disposal of litter by its visitors. Manual and mechanical methods of litter removal involving the use of beach cleaning machines (the Surf Rake) were employed. The machine can collect materials such as broken glass, polythene sheets or bags, plastics, foams, ropes, syringes, cigarette butts, pop-tops, straws, cans, tar balls, stones, sea grass, seaweed, fish, wood, coconut, fishnets, etc. and transfer them to dumping trucks, which are later transferred to waste segregation facilities.

Eco-alternatives to plastics

The Defence Research and Development Organisation (DRDO) Lab has developed a technology for biodegradable cutlery. Biodegradable tableware (spoon, fork, spork, bowl, khullad, plate, and teacup) can be used as an alternative to plastic tableware. DRDO and Ecolastic Products Pvt. Ltd. (Hyderabad) have jointly developed technology to make

compostable plastics. This technology of starch-based compostable bags and films is being commercialised, and it is competitive and meets the performance requirements of most short-life applications. The National Institute of Ocean Technology (NIOT), Ministry of Earth Sciences, Government of India, has developed plastic films using marine seaweed. The Central Pollution Control Board (CPCB) has certified over 150 compostable plastic manufacturers who are producing films, bags, cutlery items, straws, gloves, aprons, thermoformed products, etc. CPCB states that about 3,00,000 TPA of compostable plastics are produced. The Waste Management Agency of Goa has set up treatment plants for the processing of non-biodegradable waste.

Polluter pays principle

The 'polluter pays' principle is the commonly accepted practise that those who produce pollution should bear the costs of managing it to prevent damage to human health or

the environment. In India, the ‘polluter pays principle’ was first applied and defined in 1996. The principle requires stricter implementation in India.

Circular economy

The Plastic Waste Management (Amendment) Rules, 2022, will provide a framework to strengthen the circular economy of plastic packaging waste and promote alternatives to plastics. A circular economy relies on resource reuse, sharing, repair, refurbishment, remanufacturing, and recycling to create a closed-loop system that reduces resource use, waste generation, pollution, and carbon emissions. Plastics that cannot be recycled will be sent for end-of-life disposal in such applications as road construction, waste to energy, waste to oil, cement kilns (for co-processing), etc., as per relevant guidelines issued from time to time. NITI Aayog has undertaken several initiatives towards a circular economy. To expedite the transition of the country from a linear to a circular economy, 11 committees have been formed to be led by the concerned line ministries and comprise officials from MoEFCC and NITI Aayog, domain experts, academics, and industry representatives.

Aatmanirbhar Bharat Abhiyan

The Government of India has been actively formulating policies and promoting projects to drive the country towards a circular economy. It has already notified various rules, such as the Plastic Waste Management Rules, the e-Waste Management Rules, the Construction and Demolition Waste Management Rules, the Metals Recycling Policy, etc., in this regard.

Education, Awareness, and Outreach Programmes on Marine Litter in India

Beach Environment and Aesthetic Management Service (BEAMS)

Under this programme, various activities related to pollution abatement, beach awareness, aesthetics, safety, surveillance service, environmental education, etc., have been done at identified beaches with the aim of achieving international standards for Blue Flag Beach Certification.

Swachh Sagar, Surakshit Sagar, Clean Coast, Safe Sea

Under the Swachh Sagar, Surakshit Sagar campaign, a mobile app called “Eco Mitram” was launched to spread awareness about the campaign and encourage voluntary

registration for the beach cleaning activity. Through this campaign, a mass behavioural change among the masses is intended by raising awareness about how plastic usage is destroying our marine life.

National Education Policy, 2020

In India, environmental education is mandated by the Supreme Court of India and overseen by the National Council of Education Research and Training (NCERT). The National Curriculum Framework, developed by NCERT, includes a “Protection of the Environment” component that focuses on environmental education through human behaviour, which is directly related to human interaction with the biophysical environment. Environmental education in the student’s curriculum will teach students the importance of following good littering practices.

Climate Literacy and Marine Litter Management (CLMLM)

It is an education and communication campaign. The campaign was able to increase local awareness of climate change adaptation and marine litter management by 62% and improve the resilience of the communities’ responses to climate change.

Removal of marine litter contributes to a sustainable blue economy

Marine litter is a significant environmental problem that can have negative impacts on both marine life and the economy. Impacts on marine life can directly affect the economy. The presence of marine litter causes entanglement of organisms as well as ingestion, which can negatively affect the fisheries and aquaculture sectors. Reduced fisheries and aquaculture production can raise food security concerns. Marine litter in the recreational centres fail to attract tourists, which can affect revenue. Litter has a synergistic link with climate change as it can release greenhouse gases such as methane and carbon dioxide. This can contribute to global warming and affect carbon sequestration in the oceans. All these problems can negatively affect the blue economy, which is essential to the country’s growth.

Effective management of marine litter is crucial for ensuring healthy oceans and promoting a sustainable blue economy. Preventing marine litter from entering the ocean is the most effective way to manage the problem. This can be

achieved by reducing the production of single-use plastics and promoting recycling and responsible waste disposal practices. Businesses can also take responsibility by using sustainable materials, reducing packaging, and developing more environmentally friendly products. Educating people about the impacts of marine litter and promoting awareness of the issue are crucial for preventing litter from entering the ocean. Awareness-raising campaigns can include social media campaigns, public service announcements, and community-led initiatives such as beach clean-ups. Developing new technologies and innovations to prevent and manage marine litter can be an effective strategy for reducing the amount of litter that enters the ocean. This includes innovative technologies in the development of biodegradable materials, new recycling technologies, and waste-to-energy technologies. Biodegradable materials can replace single-use plastics, and new recycling technologies can increase recycling rates and reduce waste. Waste-to-energy technologies can also be used to convert waste into energy, reducing the amount of waste that enters landfills or the ocean. Hence, it can be understood that litter management is itself a source of economic activity, while the removal of litter can improve various sectors and contribute to a sustainable blue economy.

Conclusion

Mann Ki Baat of the Hon'ble Prime Minister has served as a platform for the Hon'ble Prime Minister to reach out to the citizens of India and share his reflections on various issues of national and international importance. In several such

episodes, the Hon'ble Prime Minister has brought out the menace caused by marine litter particularly plastics. There are several campaigns put forward to tackle the problem of marine litter. The campaigns such as Swachh Sagar, Surakshit Sagar, Swachh-Nirmal Tat Abhiyan, and Puneet Sagar Abhiyan among others have been successful in bringing citizens together and indulging in coastal clean-ups involving community action. During the plogging event at Mammallapuram, the Hon'ble Prime Minister has shown the way forward to combat the problems of litter.

Several private and non-government organisations have come forward to increase the value chain of plastics. The discarded plastics are being converted into valuable products such as pouches, bracelets, and carpets. Certain organisations have attempted to manufacture products that are eco-alternatives to plastic. The Hon'ble PM has appreciated such organisations and urged the commercial sector to follow such practices.

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