DEPARTMENT OF AQUATIC BIOLOGY & FISHERIES, UNIVERSITY OF KERALA, INDIA
Supported by **Project ECOMARINE | Erasmus + Scheme of the European Union**

PLASTICS IN THE OCEAN

Source to Sea : Pollution to Solution

BIJU KUMAR A. | SUVARNA DEVI S.

"The sea, once it casts its spell,
holds one in its net of wonder forever." -

Jacques Cousteau

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Source to Sea: Pollution to Solution

by

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Preface

Plastics have become an integral part of human life and probably represent the most ubiquitous artificial materials on our planet. In their myriad forms, these polymers have revolutionized many industries, including packaging, construction, electronics, healthcare, and transportation. Plastics are lightweight, durable, and versatile, making them ideal for many applications. However, the widespread use of plastics has also led to numerous negative impacts on ecosystems and human life, and it has become the most 'visible' polluting material on land, though marine plastic pollution remains mostly 'invisible' to most of us.

A growing environmental crisis which threatens the world's oceans-- marine plastic pollution and microplastics-- has gained widespread attention from scientists, activists, and concerned citizens. Over 300 million tonnes of plastic are produced annually, 10 million tonnes of which enter the Ocean. Though we know several impacts of plastics on ecosystems and biodiversity, still many questions are unanswered on the journey of plastics into the oceans, its fate and toxicity on various marine ecosystems. This global challenge, affects not only marine organisms but also human health. Therefore, it requires a comprehensive understanding of the sources, distribution, and impacts of marine plastic pollution.

This coffee table book aims to provide a brief and up-to-date overview of the state of knowledge on marine plastic pollution and microplastics. We compile relevant information on the importance of oceans, the status of marine plastic pollution in global oceans and India; the origin, diversity and sources of marine plastics; the degradation process of plastics in the sea; impacts of plastics on the ecosystem, biodiversity, fisheries, aquaculture, ecosystem services and socio-economics; microplastics and their impacts on marine and human life; and plastic management in oceans, with few examples from India. The book ends with the latest developments in plastic waste management and policy, including prevention, reduction, and recycling solutions.

We hope this book will be a valuable resource for the public, policymakers, students, and those who are interested in understanding and addressing the growing threat of marine plastic pollution. Also, this book will help raise awareness of the magnitude of the problem and inspire action towards a sustainable and plastic-free future.This book is published as an open-access publication under Creative Commons Attribution (CC BY), and the text and its contents can be re-used for all awareness and education activities, provided the original publication is credited. Also, write to us for its translation into various other languages.

This book 'evolved' primarily due to our involvement with Project ECO MARINE (Building a Comprehensive Mechanism for Preserving Marine Ecosystems and Life from the Negative Consequences of Climate Change and the Disposal of Plastic Debris) co-funded by the Erasmus + program of the European Union, where the University of Kerala is a partner. The production of this book is also supported through the project. We also thank Dr Georgios Georgiou, Professor, Department of Mathematics and Statistics and Director, Oceanography Center, University of Cyprus, the coordinator of the ECOMARINE project, for his support to bringout the book.

We also thank the University of Kerala, the former Vice Chancellor Dr P. Mahadevan Pillai, former Pro- Vice Chancellor Dr P.P. Ajayakumar, the current Vice Chancellor Prof.(Dr.) Mohanan Kunnummal, Prof. (Dr.) K. S. Anil Kumar, Registrar (also the LEAR of Ecomarine project), the syndicate members Adv. K. H. Babujan, Dr S. Nazeeb and Prof Gopchandran K. G., Dr Mini Dejo Kappen (Director, Planning and Development), Prof. K Padmakumar, Director, Centre for Marine Biodiversity and A. Mohammed Hashir, Deputy Registrar, for their support. We also thank the project team of ECOMARINE and our friends and colleagues in the Department of Aquatic Biology and Fisheries, University of Kerala, for their support.

We are grateful to Mr Umeed Mistry for his excellent underwater photographs. We also thank Nishanth H.P. for the few photos provided. We thank Mr Shinelal for the superb layout of this book.

Biju Kumar
Suvarna Devi

Contents

The OCEANS

The largest planetary ecosystem: Oceans cover 71 percent of the earth's surface area. Several Ecosystems within Oceans: Ocean basins are composed of Earth's highest peaks, deepest valleys and flattest plains.

'Oxygenator' of the planet: Ocean produce the maximum amount of oxygen, through the minute 'plants' (phytoplanktons) that float on its surface.

Water Storage and Hydrological Cycle: Nearly 97% of earth's water is stored in oceans. It controls and maintains global hydrological cycle.

Life in the Oceans: Nearly 90 % of total biomass of earth is in oceans! The ocean contains nearly 200,000 identified species, but actual numbers may lie in the millions. One drop of seawater may contain as many as 35,000 species of bacteria!

Coastal Population: About 40 % of world's population lives 60 km from a coast.

Why ARE OCEANS IMPORTANT TO MANKIND?

Climate regulation: Oceans play a key role in regulating the earth's climate by absorbing and storing large amounts of heat and carbon dioxide from the atmosphere. This helps to stabilize the earth's temperature and weather patterns.
Biodiversity: Oceans are home to a diverse range of plant and animal species, many of which are still being discovered. This biodiversity supports a variety of ecosystem services, such as oxygen production, nutrient cycling, and water filtration.
Food and livelihoods: Oceans are a major source of food for millions of people around the world, especially in developing countries. They provide a wide range of seafood, including fish, shellfish, and seaweed, which are rich in protein and other nutrients. Oceans also support a range of industries, from shipping and tourism to oil and gas extraction and renewable energy.
Recreation: Oceans provide opportunities for recreational activities like swimming, surfing, and boating, which contribute to the well-being of communities around the world.
Scientific research: Oceans provide a unique environment for scientific research, from studying the behaviour of marine species to exploring the ocean floor and its geological features.

Overall, oceans are critical to the health and well-being of our planet and our species. It is important that we work to protect and preserve them for future generations.

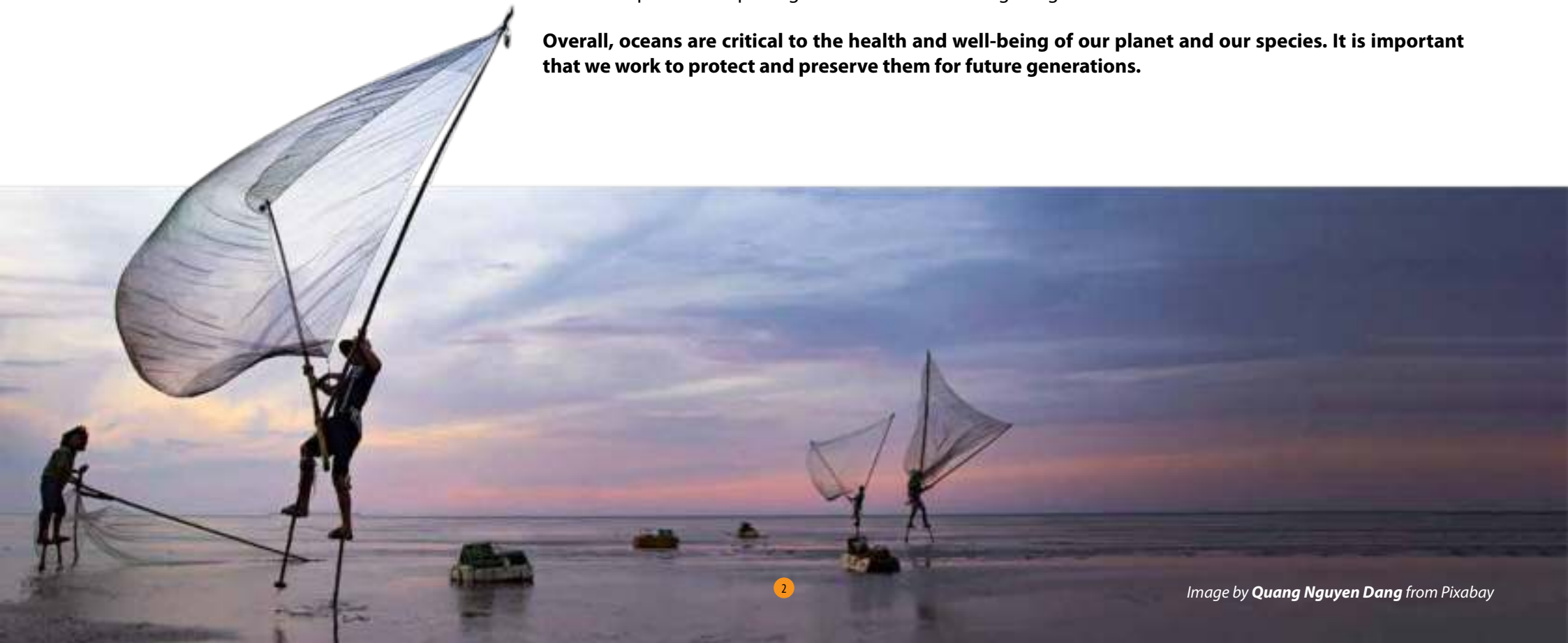
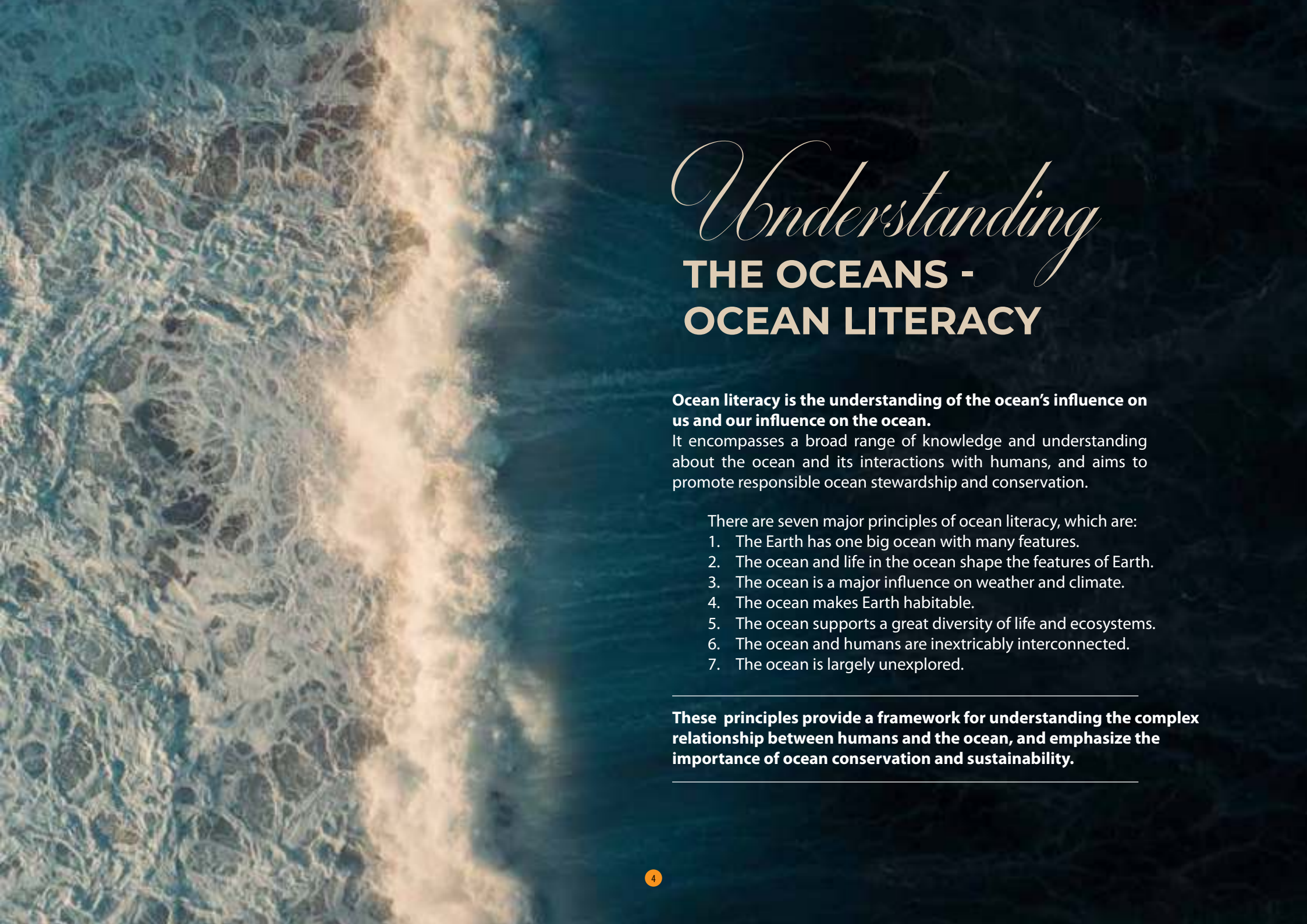


*Image by **Quang Nguyen Dang** from Pixabay*

Image by ***Tomáš-malík***

Ocean FACTS!

- More than 3 billion people utilize the oceans for their livelihood.
- About 80% of world trade is achieved using the seas.
- The oceans, seas and coastal areas contribute to food security and poverty eradication.
- About 80 per cent of all tourism takes place in coastal areas.
- Many medical treatments have been developed from resources that are found in the sea. These have been used to treat asthma, arthritis pain and cancer.
- Wave power is creating more renewable energy. In few countries it shall make up to 10 percent of the energy generated in future.
- The world's largest mountain, measured from base to summit, is Mauna Kea, located on the Big Island of Hawaii. It stands at an impressive height of 33,480 feet (10,205 meters) from its underwater base to its summit.
- The Mariana Trench in the Pacific Ocean is the deepest part of the world's oceans, with a depth of over 36,000 feet.
- The Great Barrier Reef, located off the coast of Australia, is the largest living structure on earth and can be seen from space.
- The ocean contains around 20 million tons of gold, although it is too diluted to be economically extracted.
- The ocean is constantly in motion, with currents and tides driven by a combination of factors like wind, temperature, and the rotation of the earth.



Understanding
THE OCEANS - OCEAN LITERACY

Ocean literacy is the understanding of the ocean's influence on us and our influence on the ocean.
It encompasses a broad range of knowledge and understanding about the ocean and its interactions with humans, and aims to promote responsible ocean stewardship and conservation.

There are seven major principles of ocean literacy, which are:

1. The Earth has one big ocean with many features.
2. The ocean and life in the ocean shape the features of Earth.
3. The ocean is a major influence on weather and climate.
4. The ocean makes Earth habitable.
5. The ocean supports a great diversity of life and ecosystems.
6. The ocean and humans are inextricably interconnected.
7. The ocean is largely unexplored.

These principles provide a framework for understanding the complex relationship between humans and the ocean, and emphasize the importance of ocean conservation and sustainability.

Oceans FOR THE **FUTURE**

Healthy Oceans are vital for the survival of the mankind, and health of the planet. The economists and politicians now look towards ocean with a greater hope, to use it as a main driver for boosting economy- the so-called **blue growth and blue economy.**

Blue growth: The sustainable development of ocean-related industries such as fisheries, tourism, shipping, renewable energy, marine biotechnology and deep-sea mining. It aims to promote economic growth and job creation while preserving the health of marine ecosystems and promoting social equity.

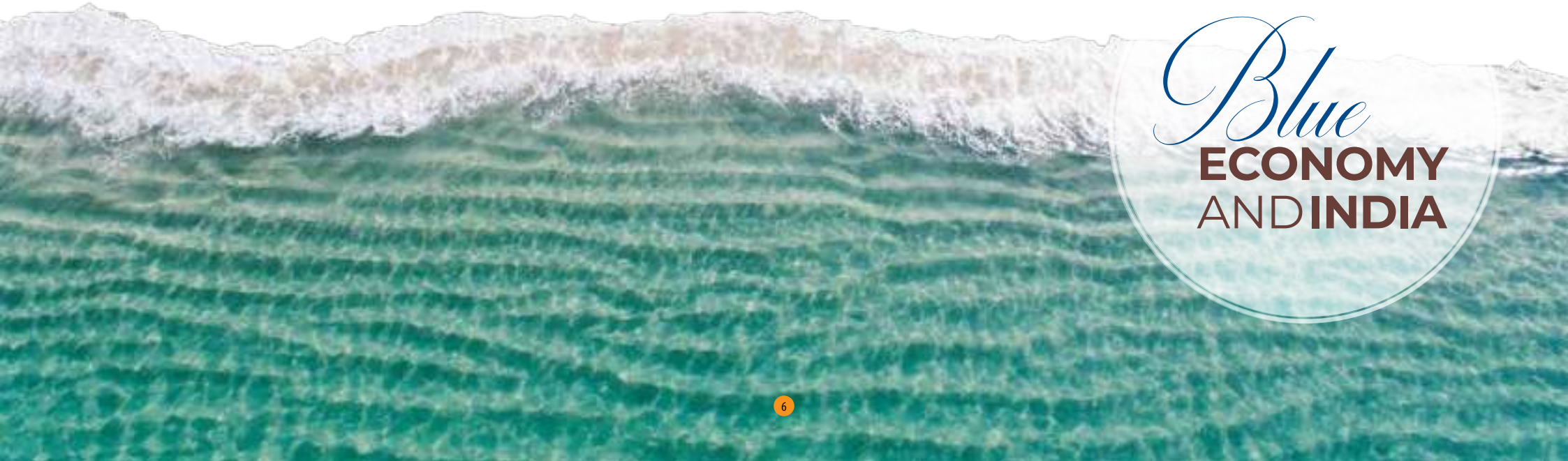
Blue economy: The concept that encompasses all economic activities related to the ocean, including the sustainable use of marine resources and the protection of marine ecosystems.

The blue economy seeks to maximize economic benefits while minimizing environmental impact and ensuring social equity. It includes activities such as aquaculture, coastal tourism, marine renewable energy, and ocean-based transportation.

Both blue growth and blue economy are aimed at promoting sustainable development and recognizing the importance of the ocean in economic and social development while ensuring the preservation of marine ecosystems.

https://www.bluebird-electric.net/oceanography/Blue_Growth.htm

- India has been leading the blue economy discourse at the highest level with its geographic and geostrategic position, putting greater focus on the Indian Ocean region. It is the world's third largest water body, covering 70 million square kilometers with rich mineral resources and connectivity with global cities.
- India has a vast coastline stretched over 7,517 kilometres and 1,382 offshore islands that bring generous resources and opportunities. Most coastal regions of India are densely populated and low-lying, with around 250 million people active within a 50-kilometre range of coast.
- There are 486 census towns along the Indian coast, according to the Census data of 2011. Of them, 36 are classified as Class I towns that have a population of more than 100,000 persons. Twelve major ports and 239 non-major ports are located along the Indian coast. More than 100,000 ships are estimated to transit close to Indian coastal shores per year.
- The Indian coastal economy sustains over four million fishermen and coastal towns. India is the second-largest fish producing nation in the world with a fleet of 250,000 fishing boats. In India, shipbuilding and shipping are also important aspects of the blue economy. The archetypal of coastal shipping has the potential to increase to 33 per cent by 2035 from 6 per cent at present.
- India envisions a blue economy will contribute to food security, poverty alleviation, the mitigation of and resilience to the impacts of climate change, enhance trade and investment, enhance maritime connectivity, boost diversification, job creation and socio-economic growth.
- This sector has grown despite the challenges caused by the COVID-19 pandemic and has recorded exports worth **$7.2 billion** from April 2021-February 2022.
- The Government of India launched the **Pradhan Mantri Matsya Sampada Yojana** (PMMSY) in May 2020 with a budgetary outlay of Rs 20,050 crore to bring a 'blue revolution' through sustainable and responsible development of the fisheries sector of the country.
- The Ministry of Earth Sciences is finalizing the **National Policy on Blue Economy** for the country.
- India has prepared a policy framework on India's Blue Economy. It envisages the optimal utilization of all sectors of the maritime domain, (living, non-living resources, tourism, ocean energy, etc.) for sustainable development of coastal areas. This policy document contains key recommendations on National Accounting Framework for Blue Economy and Ocean Governance, Coastal Marine Spatial Planning and Tourism Priority, Marine Fisheries, Aquaculture and Fish Processing. Manufacturing, Emerging Industries, Trade, Technology, Services and Skill Development, Logistics, Infrastructure and Shipping, Coastal and Deep-Sea Mining and Offshore Energy and Security, Strategic Dimensions and International Engagement.



Blue ECONOMY AND INDIA

The OCEAN DECADE (2021-2030)

The Science We Need for the Ocean We Want

- The Ocean Decade, also known as the United Nations Decade of Ocean Science for Sustainable Development, is a ten-year global initiative from 2021 to 2030 that aims to promote international collaboration in ocean science, research, and innovation to improve ocean health and ensure sustainable use of ocean resources.
- The Ocean Decade is led by the Intergovernmental Oceanographic Commission (IOC) of UNESCO and is a response to the urgent need to address the critical challenges facing the ocean and the urgent need to achieve the United Nations' Sustainable Development Goals (SDGs).
- The Ocean Decade will bring together governments, international organizations, academia, industry, and civil society to develop innovative solutions and technologies to achieve a healthy, resilient, and sustainable ocean for present and future generations.
- The Ocean Decade harnesses, stimulates and coordinates interdisciplinary research efforts at all levels, in order to generate and use knowledge for the transformational action needed to achieve a healthy, safe, and resilient ocean for sustainable development by 2030 and beyond.

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

The ocean decade will provide a 'once-in-a-lifetime' opportunity for nations to work together to generate the global ocean science needed to support the sustainable development of Our shared ocean.

https://oceandecade.org/

The OCEAN DECADE ACTION

The Ocean We Want for a sustainable future is represented by seven Decade Outcomes:

- A clean ocean where sources of pollution are identified and removed.
- A healthy and resilient ocean where marine ecosystems are mapped and protected.
- A predicted ocean where society has the capacity to understand current and future ocean conditions.
- A safe ocean where people are protected from ocean hazards.
- A sustainably harvested and productive ocean ensuring the provision of food supply
- A transparent ocean with open access to data, information and technologies.
- An inspiring and engaging ocean where society understands and values the ocean.

One of the key challenges identified for the Decade is to understand and beat marine pollution, including marine plastics.

Ocean: THE PLANET'S LARGEST ECOSYSTEM IS IN PERIL

- **The Second World Ocean Assessment (WOA II)** was released by the United Nations in 2021, a comprehensive report that assesses the current state of the world's oceans, including their health, productivity, and sustainability, provides the following key highlights:
- **Ocean warming, acidification, and deoxygenation:** The report found that the ocean has absorbed around 20-30% of anthropogenic CO_2 emissions since the Industrial Revolution, leading to ocean warming, acidification, and deoxygenation. These changes have significant impacts on marine ecosystems and biodiversity.
- **Biodiversity loss and habitat degradation:** The assessment also found that marine biodiversity continues to decline, with overfishing, pollution, and habitat degradation as the main drivers.
- **Economic and social impacts:** The ocean's health and productivity are critical for economic growth and social well-being, particularly in developing countries. However, unsustainable practices and climate change are threatening these benefits, especially for vulnerable coastal communities.
- **Marine Debris and Plastics:** Plastics represent the major share of marine litter and are now found in all marine habitats. In addition, amounts of marine litter are increasing in remote and unpopulated areas and there is a pressing need for more time series data to assess and monitor the impacts of marine litter, including microplastics and nanoplastics in the marine environment.
- Overall, the WOA II highlights the urgent need for action to address the many challenges facing the world's oceans, including climate change, overfishing, pollution, and habitat degradation. The report underscores the critical importance of the ocean for the health of the planet and the well-being of humanity, and calls for a collaborative and integrated approach to ocean management.

Marine DEBRIS, A GROWING CONCERN

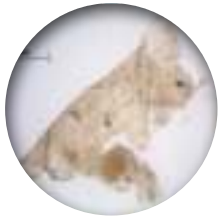
Marine debris: Any human-made solid material that has been discarded, disposed of, or abandoned and subsequently enters the marine environment. This can include items that were deliberately dumped, lost at sea, or washed into the ocean from land, and can range in size from small plastic particles to abandoned boats and fishing nets.

Plastics are the largest, most harmful and persistent fraction of marine litter, accounting for at least 85 per cent of total marine waste.

Some common items found in marine debris include:

- Plastic bags and bottles
- Fishing gear, such as nets, lines, and traps
- Packaging materials, such as foam and polystyrene
- Cigarette butts and other tobacco-related waste
- Food wrappers and containers
- Clothing and textiles
- Balloons and other party decorations
- Beverage cans and bottles
- Personal care products, such as toothbrushes, napkins, diapers and razors. Waste, such as phones and batteries.

Common COMPONENTS OF MARINE DEBRIS



Film

Foam fragments

Bags/cups

Beverage bottles

Food wrappers

Flip flops/slippers

Other containers

Straws

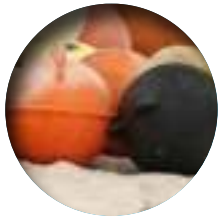
Utensils

Disposable lighters

Metal cans

Glass/glass bottles

Cigars/ Cigar butts

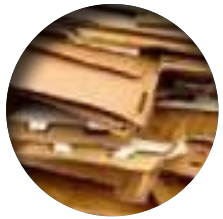


Buoys and floats

Discarded fishing gears, ropes

Personal care products

Other plastics



Paper bags/cartons

Clothing

Face Masks

Diapers

Shoes

Gloves

Tyre

Sources OF MARINE DEBRIS

01 Trashes left directly in beaches and from offshore facilities

02 Debris in land carried by storm drains, canals, or rivers.

03 Wind blown wastes from land

04 Accidents in ocean

05 Ghost nets - Fishing nets left or lost in the ocean by fishermen

From SOURCE TO THE SEA

- Millions of metric tons of plastic are produced worldwide every year. While half of this plastic waste is recycled, incinerated, or discarded into landfills, a significant portion of what remains eventually ends up in our oceans.
- Most of the plastic waste found in the deep blue waters comes from the litter in parks, beaches, or along the storm drains lining our streets. These bits of plastic waste are carried into our drains, streams, and rivers by wind and rainwater runoff.
- Rivers and lakes carry plastic waste from deep inland to the sea, making them major contributors to ocean pollution.
- It is estimated that 1,000 rivers are accountable for nearly 80% of global annual riverine plastic emissions into the ocean, which range between 0.8 and 2.7 million tonnes per year, with small urban rivers amongst the most polluting (UNEP)
- A large additional chunk of ocean plastic comes from damaged fishing nets or ghost nets that are directly discarded into the high seas.

The flood waters carrying plastic waste into the ocean during the massive flood in Kerala in 2018

Origin OF PLASTICS

- About 99 percent of the plastics we use today originate from fossil fuels like oil, gas or coal. Plastic production is therefore deeply linked with the fossil fuel supply chain, and many fossil fuel companies own, operate or invest in plastic production infrastructure.
- Of all the plastic waste we generate globally, scientists estimate that less than 10 percent is recycled. About 79 percent of plastic waste ends up in landfills or nature and some 12 percent is incinerated.
- Despite current efforts, it is estimated that 75 to 199 million tonnes of plastic is currently found in our oceans. Unless we change how we produce, use and dispose of plastic, the amount of plastic waste entering aquatic ecosystems could nearly triple from 9-14 million tonnes per year in 2016 to a projected 23-37 million tonnes per year by 2040.
- That is equivalent to 50 kilograms of plastics per metre of coastline worldwide.....

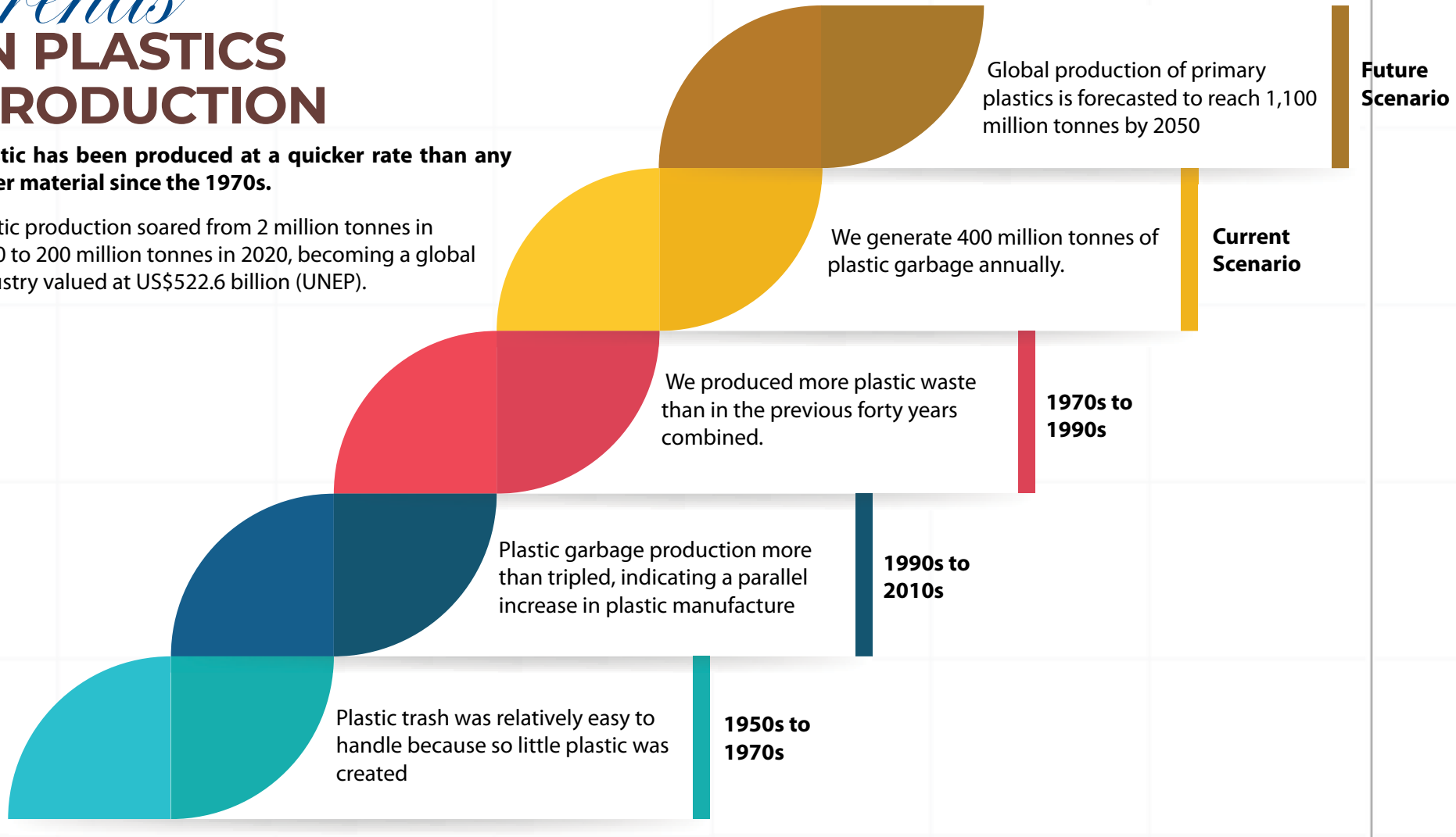
Plastics: A FRIEND OR FOE?

- Plastics have become an integral part of human life and have revolutionized many industries, including packaging, construction, electronics, healthcare, and transportation.
- Plastics are lightweight, durable, and versatile, making them ideal for many applications. However, the widespread use of plastics has also led to numerous negative impacts on ecosystems and human life.
- More importantly, we have become addicted to single-use plastic products (SUPs). These wastes now chock every part of the planet, causing severe environmental, social, economic and health consequences.
- In 2021, more than 17 million metric tons of plastic entered the world's ocean, making up 85 per cent of marine litter.
- The volume of plastics entering the ocean each year is expected to double or triple by 2040.
- It is, therefore, essential to use plastics responsibly and develop sustainable solutions to reduce their negative impacts.

Trends IN PLASTICS PRODUCTION

Plastic has been produced at a quicker rate than any other material since the 1970s.

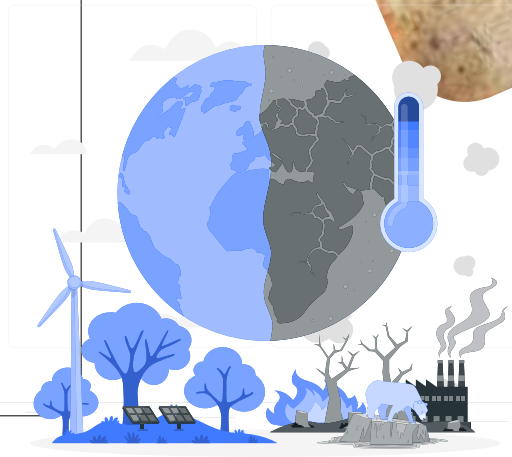
Plastic production soared from 2 million tonnes in 1950 to 200 million tonnes in 2020, becoming a global industry valued at US$522.6 billion (UNEP).



Source: UNEP

A symbol OF ANTHROPOCENE

- In today's world, plastics is omnipresent!
- One million plastic bottles are bought globally every minute, and up to five trillion plastic bags are used annually.
- In a year, around 500 billion plastic bags are used globally!
- Every minute, the equivalent of one garbage truck of plastic is dumped into our ocean.
- Globally, the fishing industry dumps around 150,000 tons of plastic into the ocean annually. This does not include plastic nets, buoys, lines, and packaging among others.
- In the swirling convergences within the oceans, there are billions of pounds of plastic and they make up around 40% of the worlds ocean surfaces.
- More than 11 million tons of plastic are dumped in our oceans every year; this may triple by 2040, we are going to have more plastic waste than fish!
- 15 plastic shopping bags for every meter of coastline on earth each year!
- There are about 46,000 pieces of plastic for each square mile of the ocean!
- Half of all plastic produced is intended for single-use applications, meaning it will only be used once before being discarded.
- They are accumulating in the fossil record of the planet and serving as a symbol of the Anthropocene, the period of time we are currently in.



Garbage Patch: 'THE PLASTIC SOUP'

- An ocean gyre is a large system of rotating ocean currents, particularly in the subtropical regions of the world's oceans.
- A garbage patch is an area in the ocean where debris, mainly plastic, accumulates due to ocean currents and wind patterns. These patches are also called **"plastic soup"** or **"plastic islands,"** but they are not visible from satellite images or from the shore, as the debris is dispersed throughout the water column.
- The plastic pollution in the patch poses a significant threat to marine life, as animals can become entangled in larger items or ingest small pieces of plastic, leading to injury or death.
- Reducing plastic consumption and increasing proper disposal and recycling of plastic waste are important steps towards addressing the problem of the Great Pacific Garbage Patch.
- Additionally, efforts to clean up existing debris and prevent new plastic from entering the ocean are also critical in mitigating the impact of plastic pollution on the marine environment.

Courtesy: UNESCO

01

Plastic of weight equivalent to that of 500 jumbo jets constitute the **Great Pacific Garbage Patch (GPGP)**. This is about 80,000 tonnes caused by an estimated 1.8 trillion pieces of plastic.

02

The **North Atlantic Garbage Patch** has a density of 200,000 pieces of trash per square kilometer in some places.

03

The **South Pacific Garbage Patch** has got up to 396,342 particles per square kilometer. There are also estimates as high as one million particles per square kilometer.

04

The **South Atlantic Garbage** Patch is between African and American continents. High density plastic accumulation is evident in this patch.

05

The **Indian Ocean Garbage Patch** detected in 2010, contains a plastic particle concentration of about 10,000 particles per square kilometre

There are five major ocean gyres: the North Pacific Gyre, the South Pacific Gyre, the North Atlantic Gyre, the South Atlantic Gyre, and the Indian Ocean Gyre.

Types OF PLASTICS IN MARINE DEBRIS

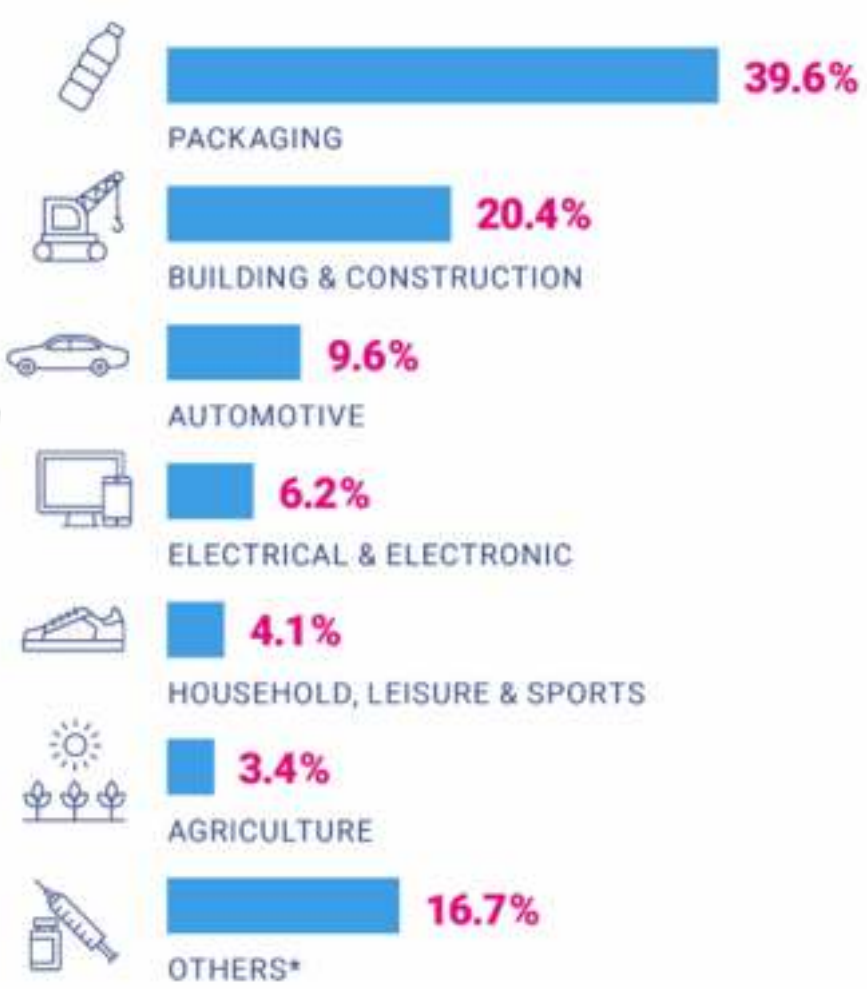
Plastics are one of the most common types of marine debris, and they can be divided into several categories based on their composition and characteristics.
Here are some of the most common types of plastics found in marine debris:

- **PET (polyethylene terephthalate):** used for water bottles, soda bottles, and food packaging.
- **HDPE (high-density polyethylene):** used for milk jugs, detergent bottles, and grocery bags.
- **PVC (polyvinyl chloride):** used for pipes, vinyl flooring, and shower curtains.
- **LDPE (low-density polyethylene):** used for grocery bags, bread bags, and produce bags.
- **PP (polypropylene):** used for yogurt cups, margarine tubs, and take-out containers.
- **PS (polystyrene):** used for foam cups, take-out containers, and packaging peanuts.

Source: "Banning single use plastic lessons and experiences from countries" UN Environment Programme

What DO WE USE ALL THAT PLASTIC FOR?

- Almost 40% of the plastics produced world over is used for packaging. So this is where the most environmental gains can be made if we want to reduce our plastic consumption.
- In the second and third places are the construction and the automotive industries respectively.



https://www.plasticsoupfoundation.org/en/plastic-facts-and-figures/

Countries

FEEDING PLASTIC PROBLEM

Which Countries Pollute the Most Ocean Plastic Waste?

- The Philippines—an archipelago of over 7,000 islands, with a 36,289 kilometer coastline and 4,820 plastic emitting rivers—is estimated to emit 35% of the ocean's plastic.
- Over 75% of the accumulated plastic in the ocean is reported to come from the mismanaged waste in Asian countries including India, Malaysia, China, Indonesia, Myanmar, Vietnam, Bangladesh, and Thailand.
- The only non-Asian country to make it to this top 10 list, with 1,240 rivers including the Amazon, is Brazil.

Marine

PLASTIC POLLUTION IN INDIA

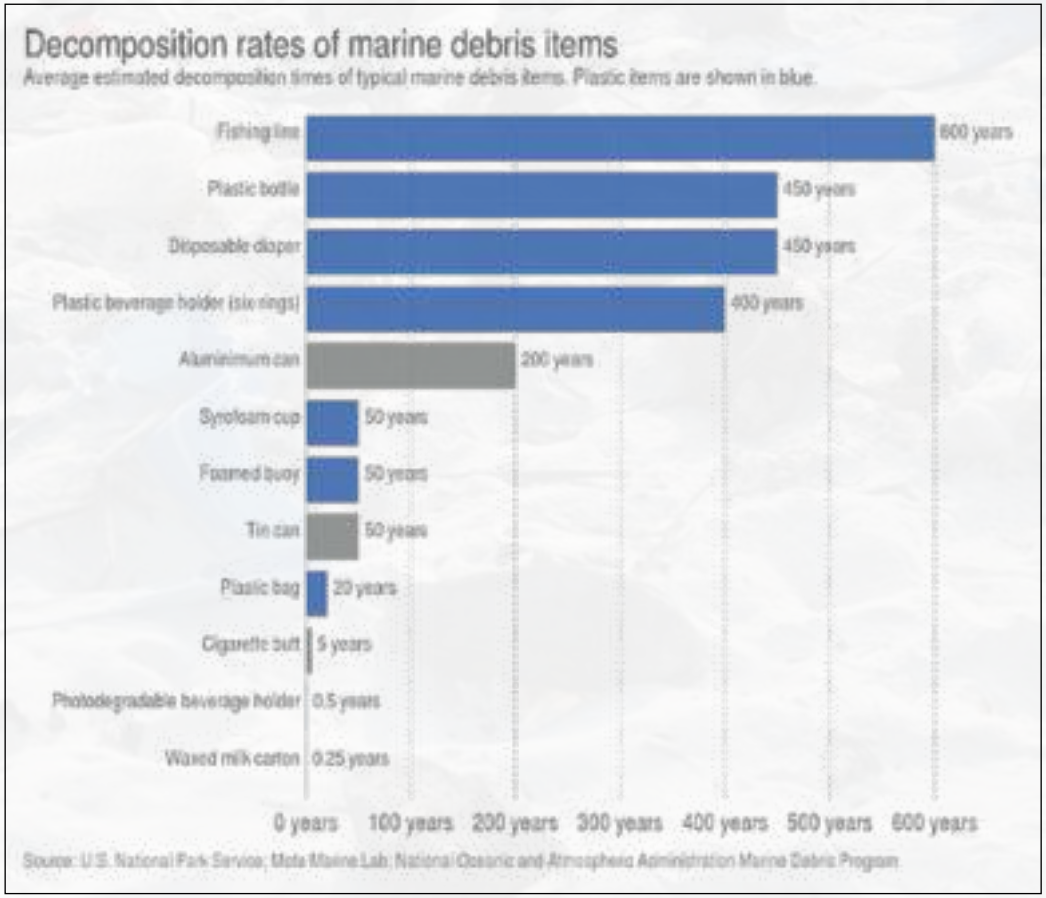
- India is one of the largest contributors to marine plastics pollution in the world. The country generates a significant amount of plastic waste, estimated at around 26,000 tonnes per day, of which around 10,000 tonnes is mismanaged, meaning that it is not collected, treated, or disposed of properly.
- As a result, a large amount of plastic waste finds its way into the country's rivers, which eventually flow into the ocean. According to a report by the Central Pollution Control Board (CPCB), there are 80 identified points along the Indian coastline where plastic waste enters the ocean, with the most significant sources being the cities of Mumbai, Chennai, and Kolkata.
- India and the rest of South Asia are the worst culprits for microplastic pollution, releasing 274 Kilo tonnes of primary microplastics into ocean, says the International Union for Conservation of Nature (IUCN).
- The seas near Kerala, Mumbai, Chennai and Andaman Nicobar Islands are worst polluted in the world.
- A study from IIT Bombay establishes that, Indian sea salts are contaminated with microplastics.

How LONG TO DEGRADE ?

The time it takes for marine debris to degrade depends on various factors such as the type of material, size, and environmental conditions. Here are some estimates for the degradation times of commonly found marine debris:

- **Plastic bags:** can take up to 20 years or more to degrade
- **Plastic bottles:** can take 450 years or more to degrade, and some types of plastics, even more or indefinite number of years.
- **Fishing line:** can take up to 600 years to degrade
- **Styrofoam:** can take up to thousands of years to degrade

It is important to note that even when plastic and other debris eventually degrade, they break down into smaller and smaller pieces, called microplastics, which can persist in the environment indefinitely. These microplastics can be ingested by marine organisms, potentially causing harm to the animals and the ecosystem as a whole.



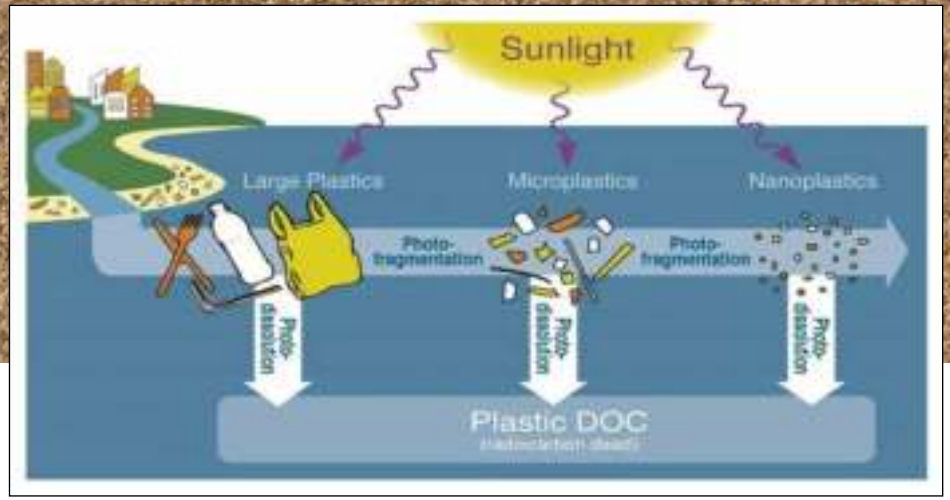
How DO PLASTICS BREAKDOWN?

Marine plastics can break down through a process called photodegradation, which occurs when the plastic is exposed to sunlight. UV radiation from the sun causes the plastic to break down into smaller pieces less than 5 mm called microplastics. The breakdown is also faciliated by wave action.

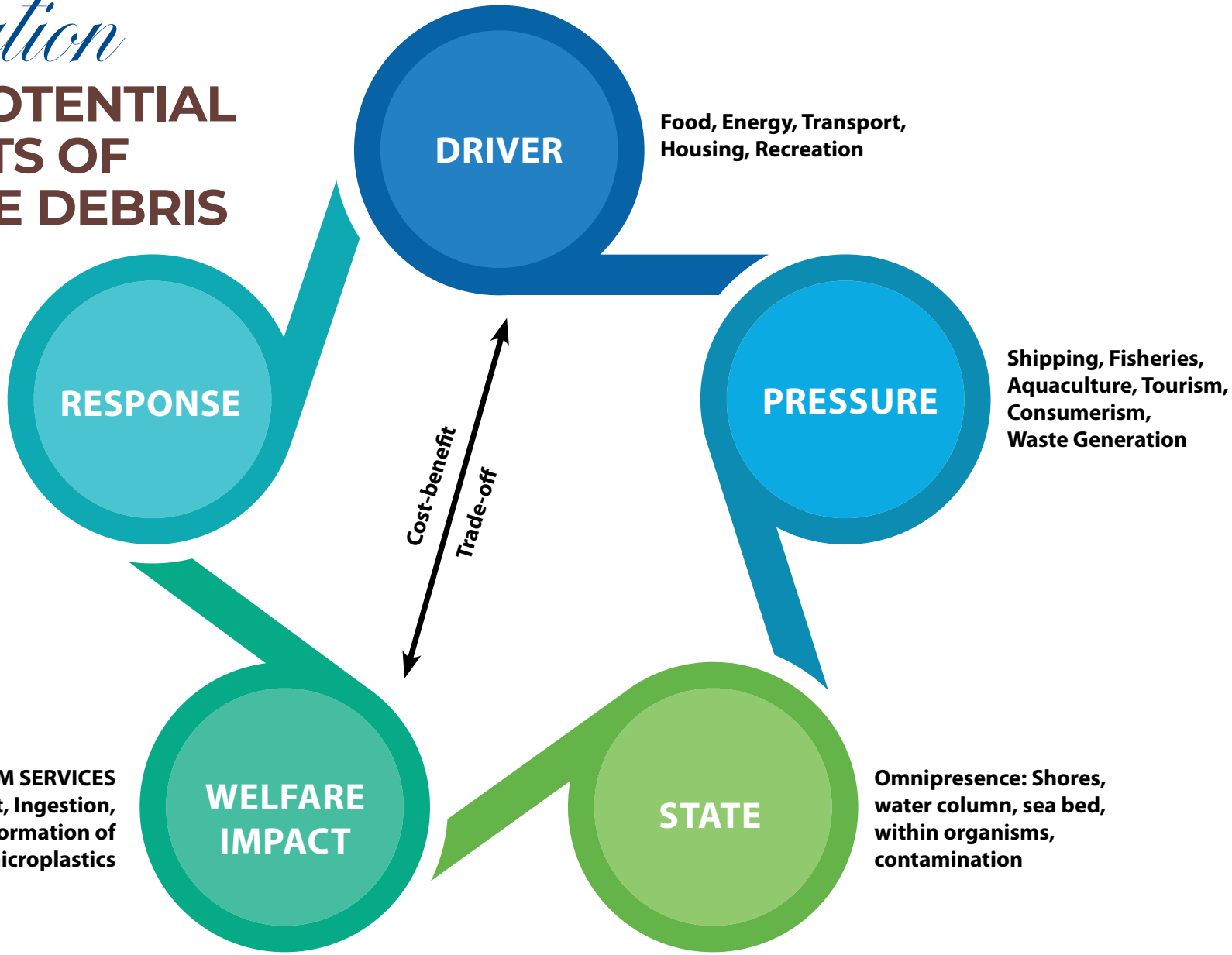
In addition, marine plastics can also break down through biodegradation, which occurs when microorganisms such as bacteria and fungi settle on their surface.

However, biodegradation of plastics in marine environments is generally slow, as the conditions in the ocean are not optimal for the growth of microorganisms that can break down plastics.

It is important to note that while marine plastics can break down, they never fully biodegrade or disappear. Instead, they persist in the environment as microplastics, which can have harmful effects on marine life and the ecosystem.



Generation AND POTENTIAL IMPACTS OF MARINE DEBRIS



Impacts ON MARINE LIFE AND SERVICES

A dead albatross chick found on Midway Atoll in the Pacific Ocean with plastic debris in its stomach. Source: U.S. Fish and Wildlife Service

- Plastic has increasingly become a ubiquitous substance in the ocean. Due to its size and colour, animals confuse the plastic for food, causing malnutrition; it poses entanglement risks and threatens their overall behaviour, health, and existence.
- Ingesting plastic may cause chemical poisoning through hazardous additives in plastic products.
- The marine plastics also carry invasive species to very distant places.
- It may also impede important biological processes such as carbon sequestration.
- According to the United Nations, at least 800 species worldwide are affected by marine debris, aespecially plastics.
- In general, the marine plastic pollution would impact the overall productivity and efficiency of marine fisheries and aquaculture industry. The impacts will be synergistic when is highly vulnerable to the impact of marine plastic, particularly when coupled with broader factors including climate change and over-fishing.
- The reduction in ecosystem services due to plastic pollution will impact the human health and wellbeing, linked particularly to fisheries, charismatic species, and recreation.

A seahorse wraps its tail around a plastic cotton swab near Sumbawa Island, Indonesia. Courtesy: Justin Hofman

Photo : Nishanth HP

Plastic INGESTION

Marine animals are often exposed to plastic pollution through ingestion, either by mistaking it for food or by consuming it inadvertently while feeding. The ingestion of plastic can have a range of negative effects on marine animals, including physical harm, reduced feeding efficiency, and even death.

Plastic ingestion can cause physical harm to marine animals in several ways. For example, plastic can cause blockages in the digestive system, leading to starvation or other health issues. Sharp edges on plastic items can also cause internal injuries or damage to the digestive tract. Additionally, chemicals and toxins associated with plastic can leach into the animal's tissues, leading to long-term health problems.

Reduced feeding efficiency is another negative consequence of plastic ingestion. When animals consume plastic, it can fill up their stomachs, making them feel full and reducing their appetite for nutritious food. This can lead to malnourishment and reduced growth rates, and can also affect an animal's ability to reproduce.

Finally, plastic ingestion can also result in death. For example, large items like plastic bags or fishing nets can entangle marine animals, causing them to suffocate or drown. Additionally, the chemicals and toxins associated with plastic can accumulate in an animal's tissues over time, leading to chronic health problems and reduced survival rates.

Plastic ENTANGLEMENT

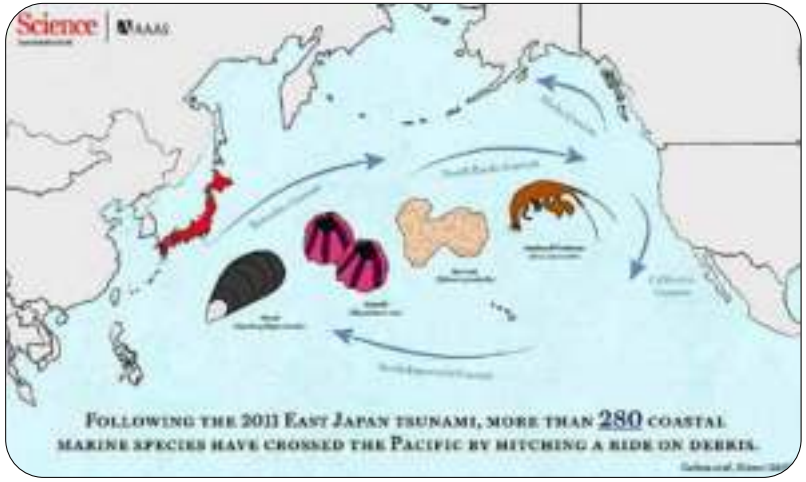
- Plastic entanglement in marine animals is a major issue that affects a wide range of species in our oceans. This occurs when marine animals become trapped or entangled in plastic debris, such as fishing gear, plastic bags, and other discarded plastic items.
- Entanglement can cause significant harm to marine animals, leading to injuries, infections, reduced mobility, and even death. The severity of the impact depends on the extent of the entanglement, the size and type of the plastic debris, and the species involved.
- Marine animals such as sea turtles, seals, dolphins, whales, and seabirds are particularly vulnerable to plastic entanglement. These animals can mistake plastic debris for food or become entangled in it while searching for food or trying to swim.

Images from social media

Photo : Umeed Mistry

Transportation OF ORGANISMS ACROSS OCEANS!

- Plastics carry organisms across oceans, including the invasive species!
- The 2011 East Japan earthquake generated a massive tsunami that resulted in the translocation of over 289 living species. This phenomenon is referred to as “mega-rafting” and scientists warn that a global increase in marine debris combined with climate-change-fueled storms will speed the pace of coastal species invasions.



Courtesy: Carlton et al., Science, 2017

Seabirds AND MARINE MAMMALS ARE MOST IMPACTED!

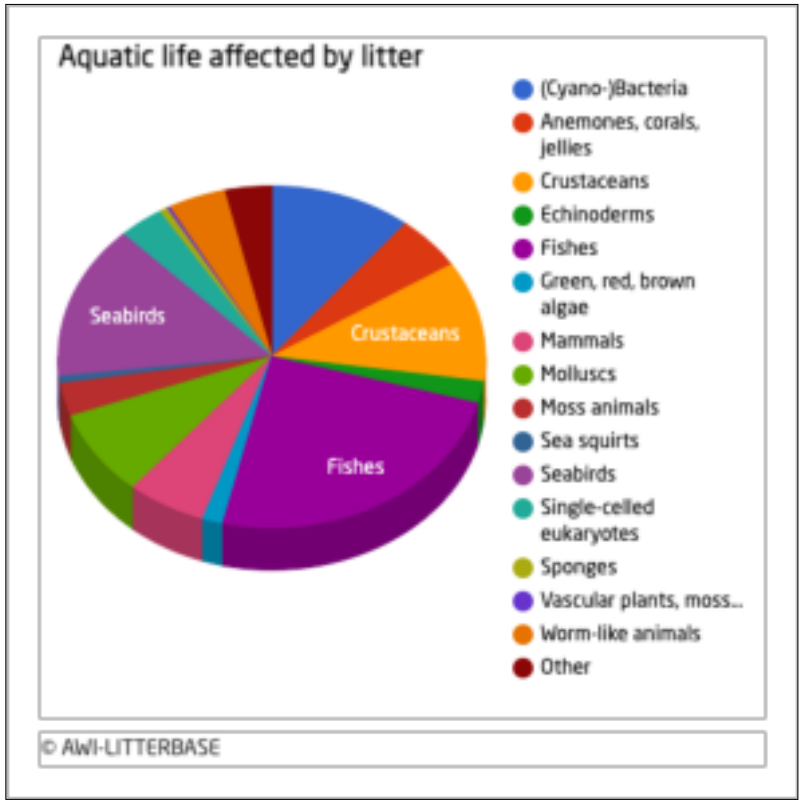
- Marine mammals also get entangled in plastic debris, leading to injuries, amputations, and drowning. Entanglement in discarded fishing nets, for example, is a common problem for marine mammals such as dolphins, whales, and seals.
- While dolphins are highly intelligent and thus unlikely to eat plastic, they are susceptible to contamination through prey that have ingested synthetic compounds.
- Sea birds are also vulnerable to the impacts of plastic pollution. They can mistake small plastic items for food and ingest them, leading to starvation, malnutrition, and even death. Plastic ingestion can also cause significant damage to the digestive system of sea birds, making them more susceptible to disease and parasites.
- Scientists estimate that 60 percent of all seabird species have eaten pieces of plastic, a figure they predict will rise to 99 percent by 2050.

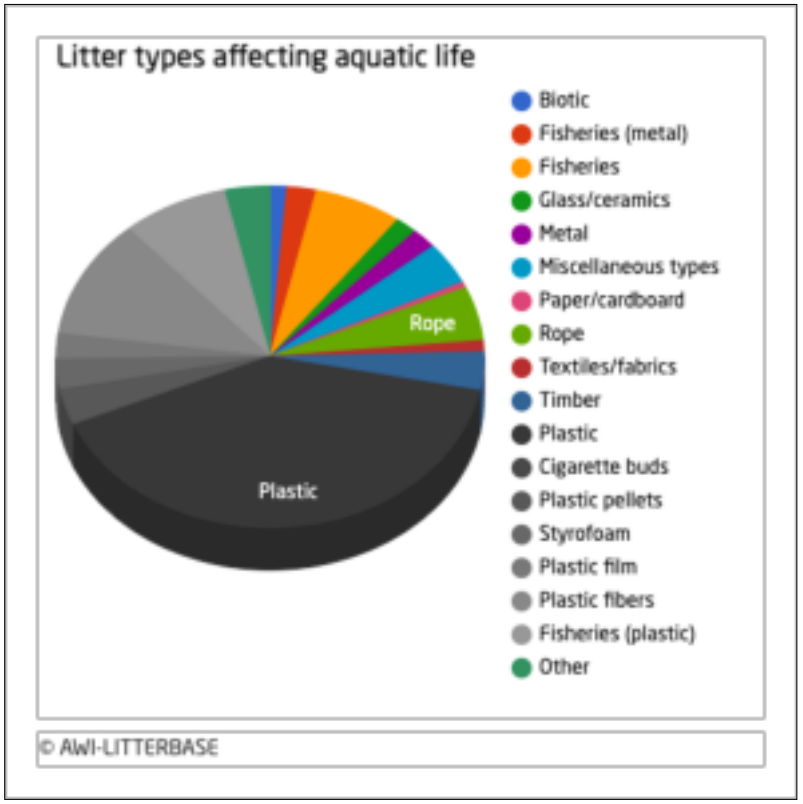
Around one million sea birds and 100,000 marine mammals are killed each year due to plastic ingestion

Types OF MARINE DEBRIS IMPACTING MARINE LIFE

Various kinds of marine debris impact marine life, including metals, glass/ceramics, cardboard, rope, textiles/fabrics, timber, cigarette butts, plastic pellets, Styrofoam, plastic film, plastic fibers, plastic bags and bottles, balloons, buoys, rope, medical waste, glass bottles, cigarette stubs, cigarette lighters, beverage cans, polystyrene, lost fishing line and nets, wastes from cruise ships and oil rigs, etc.

The marine debris impacts various types of marine taxa, with noticeable impacts on fish, sea birds and cetaceans.





Source: https://litterbase.awi.de/interaction_graph#

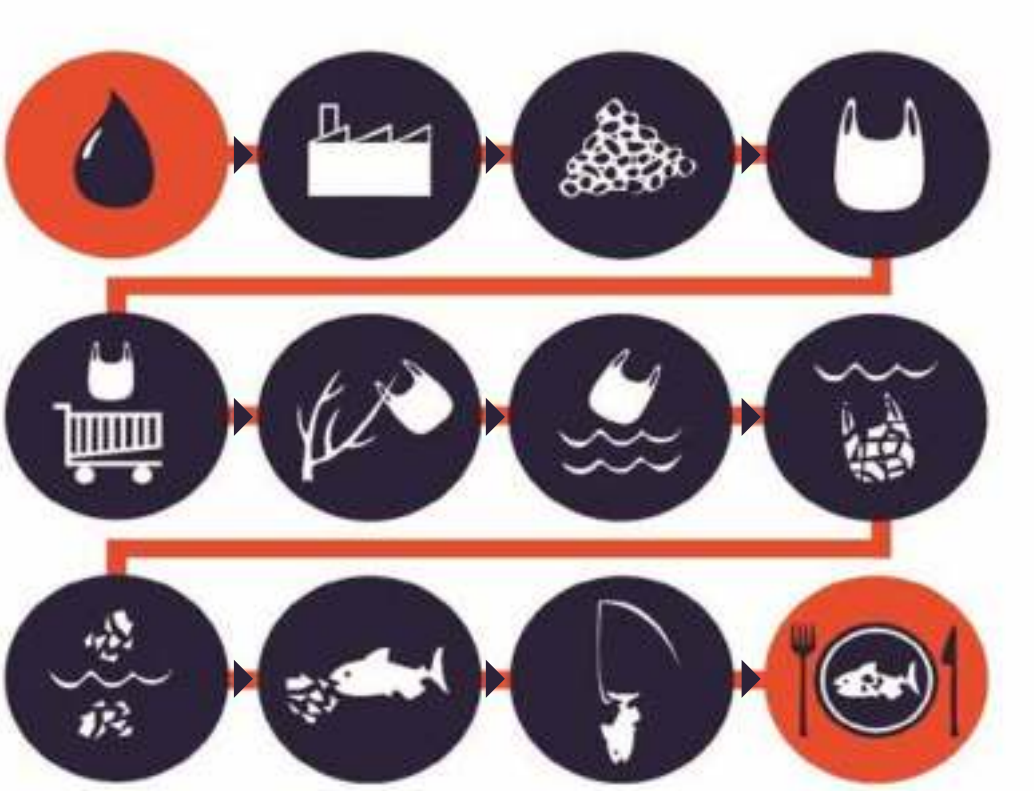
The GHOST NETS

- Ghost nets are Abandoned, Lost or Discarded Fishing Gear (ALDFG) in the ocean. These nets can continue to drift in the ocean currents for years, entangling and trapping marine life such as fish, sea turtles, dolphins, and even whales.
- The term "ghost" refers to the fact that these nets continue to fish and cause harm long after they have been abandoned.
- Ghost nets are a major problem for the health of the oceans and the marine life that inhabit them. They can cause injury and death to marine animals, as well as damage to coral reefs and other important marine ecosystems.
- In addition, they can also pose a threat to human safety, as they can become entangled in propellers and other equipment on boats and ships.
- About 20 per cent of all the plastic debris in the oceans is present in the form of ALDFG, according to the United Nation Environment Programme.
- Globally, about 640,000 tonnes of ghost gears are disposed of in the oceans annually. India has 174,000 units of fishing gear in operation, of which 154,008 units are gillnets / driftnets, 7,285 units are traps and the rest are fishing lines.
- Of these, India loses 15,276 tonnes of gillnets annually, according to the Food and Agriculture Organization (FAO).

Green turtle entangled in ghost fishing gear in Lakshadweep coast, India (Photo: Nishanth HP)

Life

CYCLE OF A PLASTIC BAG: FROM OIL TO YOUR PLATE



Courtesy: https://surfrider.eu

Impacts ON FISHERIES AND AQUACULTURE

- Marine plastics provide a direct risk to fish populations and aquaculture, which could result in physical entanglement and damage that lowers the productivity and efficiency of commercial fisheries and aquaculture operations.
- Many fishers, especially those operating trawlers in India, complaint that their fishing gears are often chocked with plastics, which not only chock the nets, but also reduce the amount of catch.
- The primary way that plastics affects fisheries is by ghost fishing, or the use of lost, abandoned, or otherwise discarded fishing gear (ALDFG).
- According to the GESAMP Working Group Report 43, the contribution of sea-based activities and industries to the global burden of marine litter is cause for concern, largely because synthetic materials make up a sizable portion and component of the litter that is introduced into the world's oceans through fishing, aquaculture, shipping, ocean dumping, and other maritime activities and sources.
- ALDFG is one sort of marine litter that is known to have an adverse effect on marine environments, species, and resources.
- Marine litter also has impacts on fisheries and aquaculture through the introduction of invasive alien species which can result in serious economic losses.
- The consumption of plastic and associated contaminants puts fish and shellfish stocks in lethal or sublethal harm in both in feral and captive environment.

Source: United Nations Environment Programme (2021). From Pollution to Solution: A global assessment of marine litter and plastic pollution. Nairobi.

Photo : Umeed Mistry

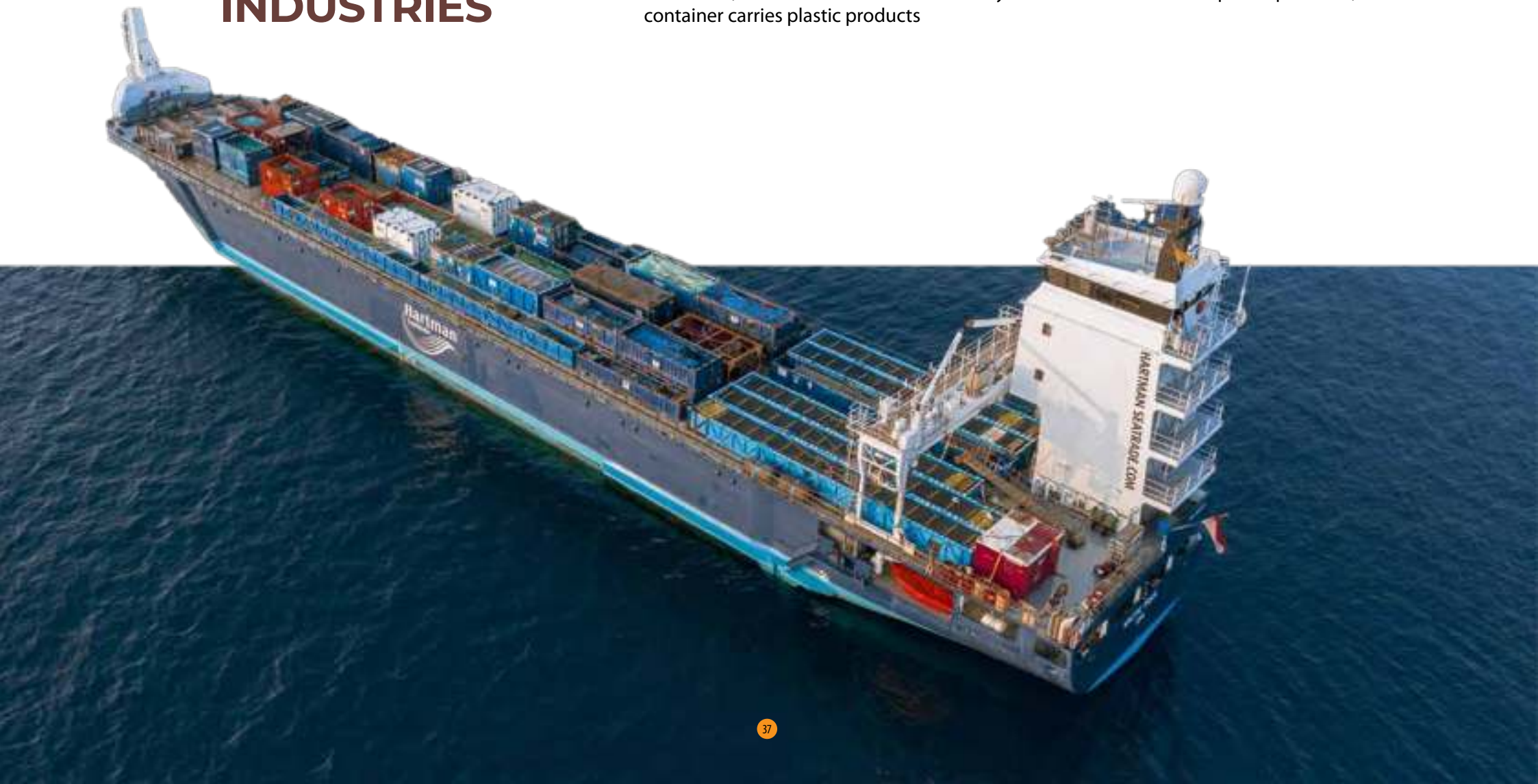
Photo : Umeed Mistry

Impacts ON TOURISM

- Marine debris, especially plastics, damages the aesthetic value of tourist destinations, leading to decreased income from tourism.
- Marine debris has a substantial negative impact on recreational experiences and overall beach enjoyment, causing declines in coastal tourism and a corresponding loss of revenue.
- It also generates major economic costs related to the cleaning and maintenance of the sites.
- The build-up of plastic litter on beaches can have a negative impact on a country's economy, wildlife, and the physical and psychological wellbeing of people.

Impacts ON MARITIME INDUSTRIES

- Marine debris can cause navigational hazards to ships at sea, for example due to entangled propellers and rudders, blocked water intakes, and collisions with floating objects.
- Derelict fishing gear (DFG) can be a navigational hazard to commercial or recreational vessels.
- The actual economic assessment of incidences have not been assessed properly.
- In contrast, the collision of vessels indirectly contribute to the marine plastic pollution, if the container carries plastic products



Economic IMPACTS OF MARINE PLASTICS POLLUTION

- According to estimates, the yearly global economic consequences of marine plastic pollution in relation to tourism, fisheries, and aquaculture, as well as other costs like cleanup efforts, range from at least US$ 6 to US$ 19 billion.
- This estimate only accounts for a small portion of the expected US$ 580 billion global market for plastic goods in 2020.
- However, all these estimates exclude economic impacts on marine ecosystems or human health. The amount of accessible research on these effects is insufficient.
- The economic costs can be categorized under four heads: (i) actual expenditures required to prevent or recover from damage caused by marine debris (e.g. for beach clean-ups, repair of vessels and fishing gears, etc.), (ii) losses of output or revenue owing to interactions with marine plastic pollution; (iii) losses of plastic material (as valuable material withdrawn from production); and (iv) welfare costs including human health impacts and loss of ecosystem services, including those related to aesthetic pleasure and recreation.

Source: United Nations Environment Programme (2021). From Pollution to Solution: A global assessment of marine litter and plastic pollution. Nairobi.

Social

IMPACTS OF MARINE PLASTICS POLLUTION

- For the society, the changes happening in ocean due to marine plastics pollution is not directly and immediately visible, and therefore, their perception(s) may be different.
- Many majestic animals in ocean, such as whales, dolphins, sea birds and turtles, are culturally and emotionally connected to people, and the story of them highly impacted by marine plastics, or the highly disturbing picture of these organisms killed by such incidences may have a a strong detrimental impact on people's emotions and sense of well-being.
- Further, people always show mental detachment from coastal areas, which are unhygienic or littered with plastics, which otherwise they used for spending their quality time, and increase family bondages and nurturing friendships.
- The people who are regularly involved in waste collection or those working in recycling plants may also have health implications, including those resulting from the exposure to hazardous chemicals associated with plastics.
- There are several human rights that might be violated by marine litter and plastic pollution. They disproportionately harm those who are already vulnerable, such as the poor, indigenous, and coastal communities, as well as children, potentially exacerbating current environmental inequalities.

Plastics AND CLIMATE CHANGE

- Plastics are also a climate problem.
- Plastics derived from fossil fuels account for 6% of global oil consumption resulting in greenhouse gas (GHG) emissions during every step of the plastic life cycle, from production to waste disposal, contributing to climate change.
- Plastic production, distribution, and widespread consumer demand have placed enormous pressure on Earth's limited ecological resources.
- In the absence of corrective measures greenhouse gas emissions from the production, recycling and incineration of plastics could account for 19 per cent of the Paris Agreement's total allowable emissions in 2040 if our track is to limit warming to 1.5 degrees Celsius.
- By 2050 greenhouse gas emissions associated with plastic production, use and disposal would account for 15 per cent of allowed emissions, under the goal of limiting global warming to 1.5°C (34.7°F).

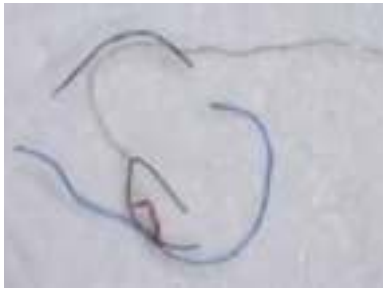
Classification OF MARINE PLASTICS BASED ON SIZE

1. **Macroplastics:** These are large pieces of plastic debris that are generally greater than 20 mm in size. Examples include plastic bags, bottles, fishing nets, and packaging materials.
2. **Mesoplastics:** These are medium-sized plastic debris that range in size from 5 mm to 20 mm. Examples include plastic fragments, disposable cutlery, and straws.
3. **Microplastics:** These are small plastic debris that range in size from 0.1 mm to 5 mm. They can be further divided into two categories:

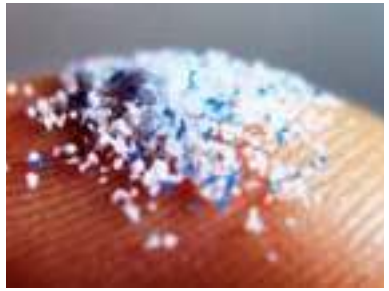
- **Primary microplastics:** These are small plastic particles that are intentionally manufactured for use in products such as cosmetics, toothpaste, and cleaning products.
- **Secondary microplastics:** These are small plastic particles that result from the breakdown of larger plastic items over time, such as plastic bottles, bags, and packaging materials.

4. **Nanoplastics:** These are the smallest plastic debris, ranging in size from 0.001 mm to 0.1 mm. They are not yet well understood, but are thought to be produced by the breakdown of larger microplastics or by the release of nanoparticles from consumer products.

- It's important to note that all of these types of marine plastics can have significant negative impacts on marine ecosystems and wildlife, regardless of their size.

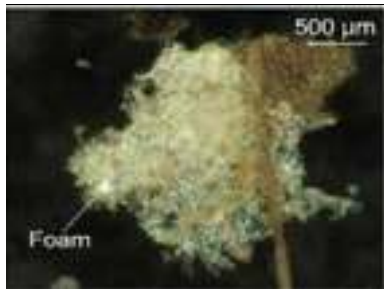


Microfibre



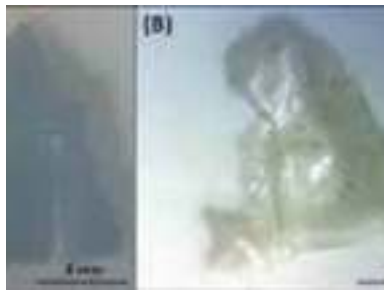
Microbead

Microfragment



Microfoam

Micropellet

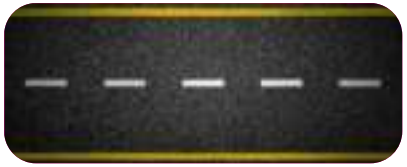


Microfilm

Average annual global release of primary microplastics into the ocean is estimated to be around 1.5 million tons
There are an estimated 51 trillion microplastic particles in our seas.

Sources

OFMICROPLASTICS IN MARINE ENVIRONMENT



Source: IUCN

Journey OF MICROBEADS: FACE WASH TO DINING TABLE

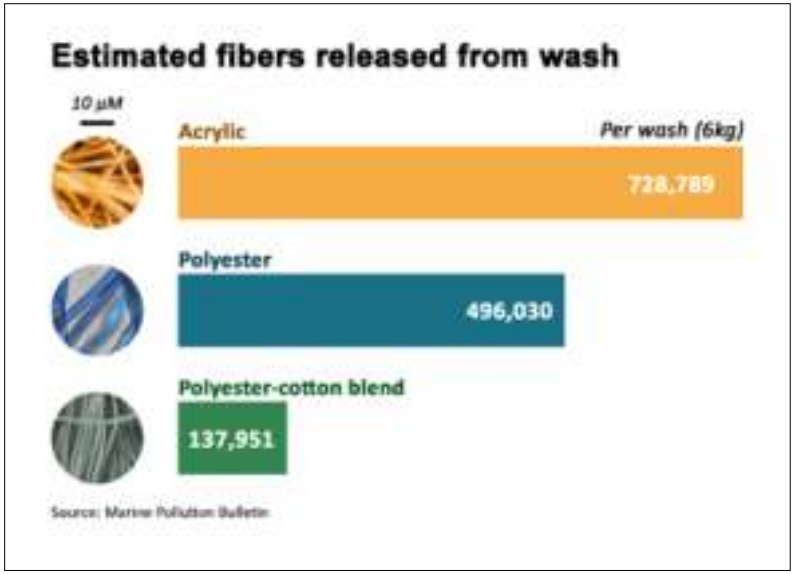
- Microbeads are tiny bits of plastic found in exfoliating body washes and facial scrubs.
- These are pieces of plastic, usually spherical in shape, that range in width from a fraction of a millimeter to about a millimeter and a quarter.
- They're used in soaps because exfoliating products need small, hard particles to rub debris from the skin.
- Since their introduction in 1972, they have made their way into more than 100 personal care products sold by many coroporate companies.
- There is mounting evidence that these beads are equally adept at killing marine life and bringing harmful chemicals into the food chain.
- Plastics used in microbeads readily absorb pollutants . And to a hungry aquatic organism, little pieces of plastic look pretty tasty. The smallest microbeads can even become snacks for plankton, and travel all the way up the food chain, and may reach humans.
- Some of the pollutants that microbeads pick up have been linked to birth defects, cancer, and developmental problems in humans.
- Microbeads don't just contain pollutants; they can also release BPA and other chemical additives.
- Many countries have now banned the use of microbeads, including India.

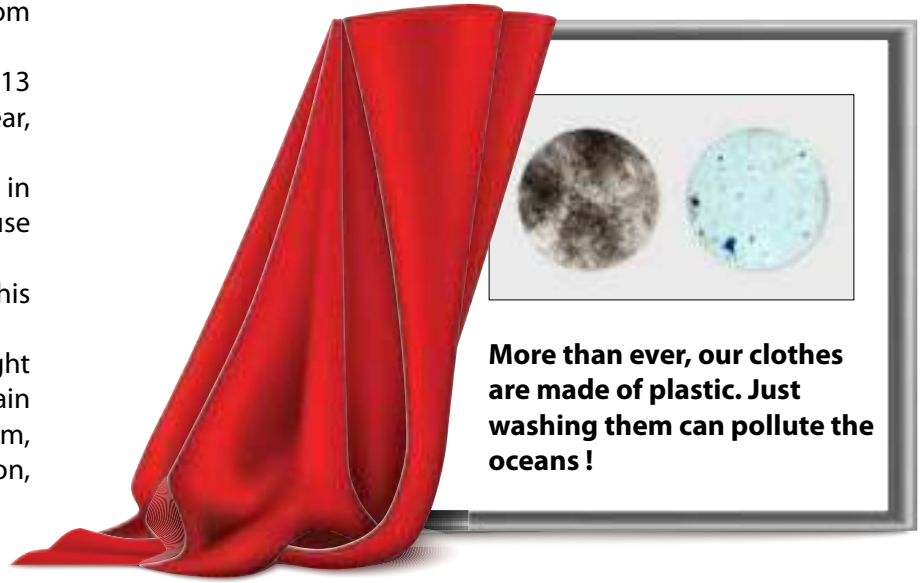
Microfibers
AN EMERGING THREAT

- A microfiber is a type ofplastic used to make synthetic fabrics.
- These fibers are shed from synthetic clothing during a washing machine cycle.
- Because they are so small, microfibers aren't all caught by wastewater treatment plants; instead, many are released into the environment.

How bad is the problem?

- Microfibers are emerging pollutants with widespread distribution in the environment and have adverse ecological impacts.
- Approximately 2 million tonnes of microfibers are released into the ocean every year from various sources, of which 700,000 micro fleeces are released from each garment through domestic laundry.
- Microfibers are the major marine pollutant throughout the world estimating 13 million tonnes of coastal synthetic fabric waste entering the ocean each year, out of which 2.5 million tonnes enter through adjoining rivers.
- It is anticipated that, till date, 1.5 million trillion of microfibers are present in the ocean. Microfibers are mistakenly ingested by marine animals and cause hazardous effects to aquatic species.
- Microfiber treatment techniques are under progress for efficient control of this pollutant.
- Though we don't yet know the extent to which microplastic pollution might affect humans. But we know that many animals within the aquatic food chain ingest these plastics and the toxics they absorb from the water around them, and transferred to their tissue and causing gut impaction, hormone disruption, and liver damage.

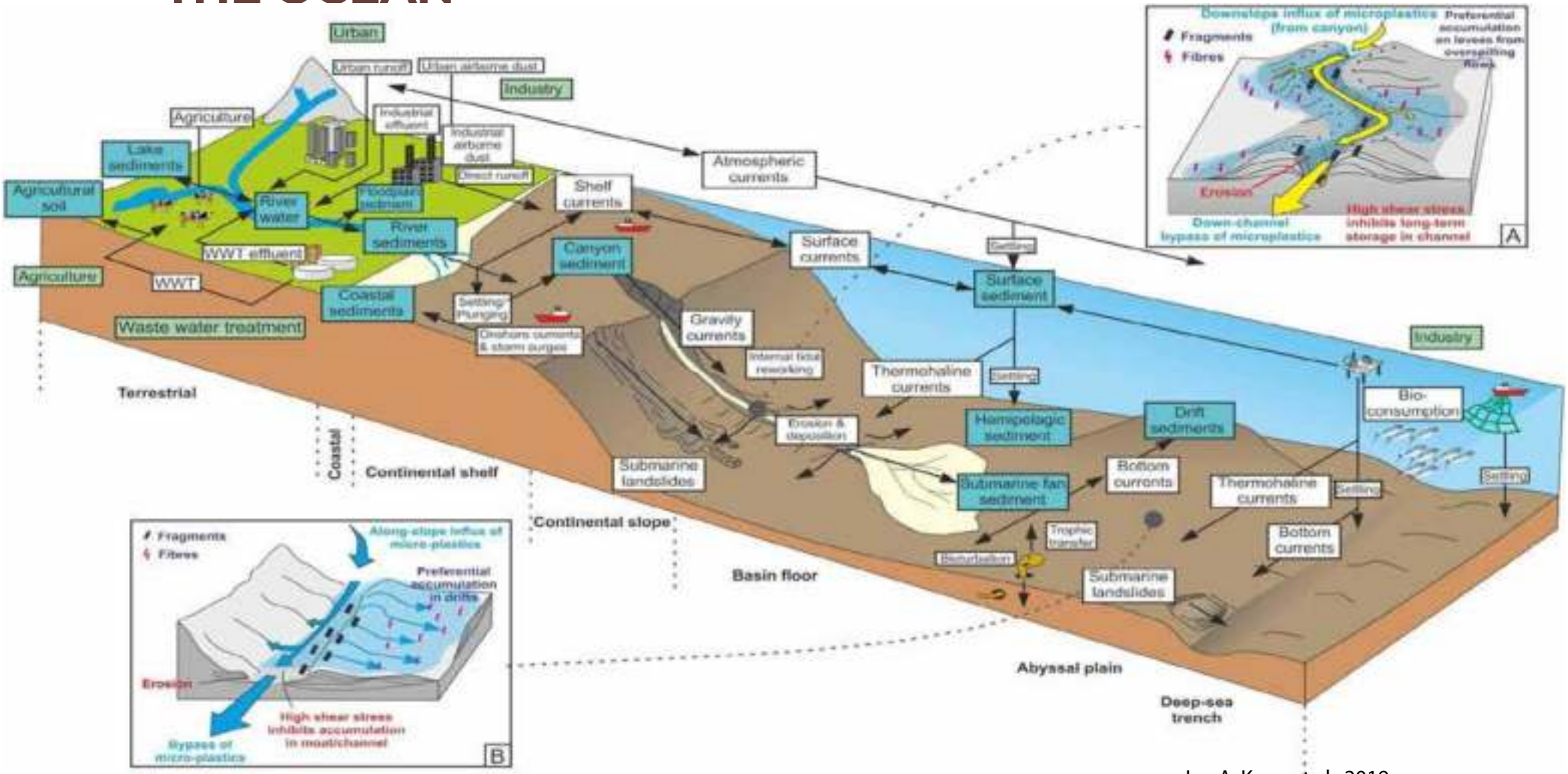




Sources,

PATHWAYS AND ACCUMULATION POINTS FOR MICROPLASTICS IN THE OCEAN

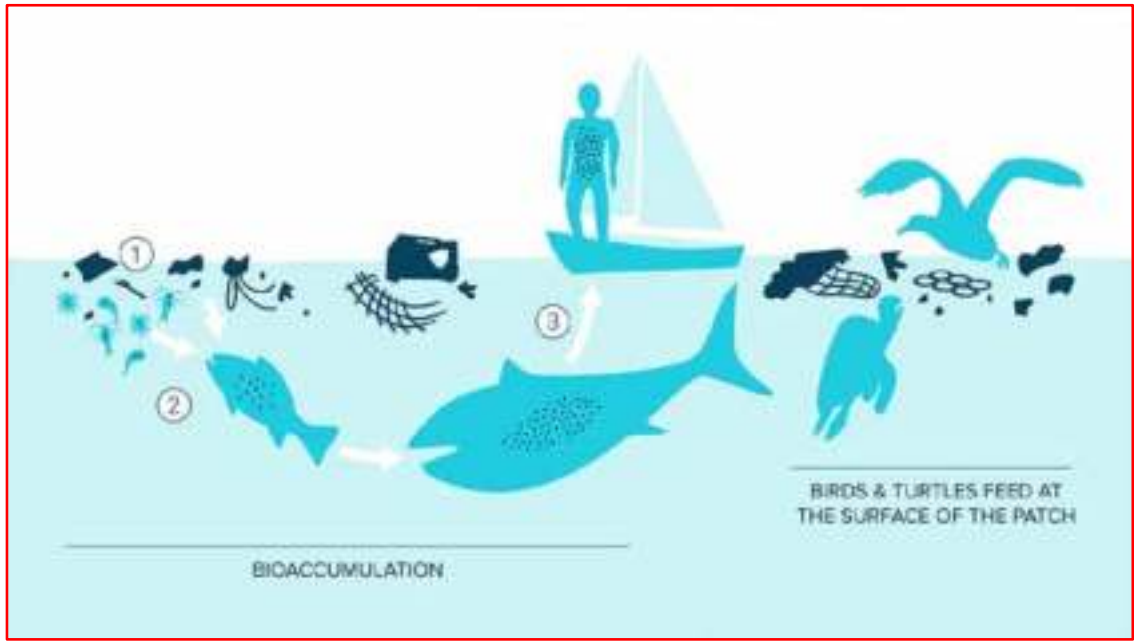
(Source: Frontiers in Earth Science)

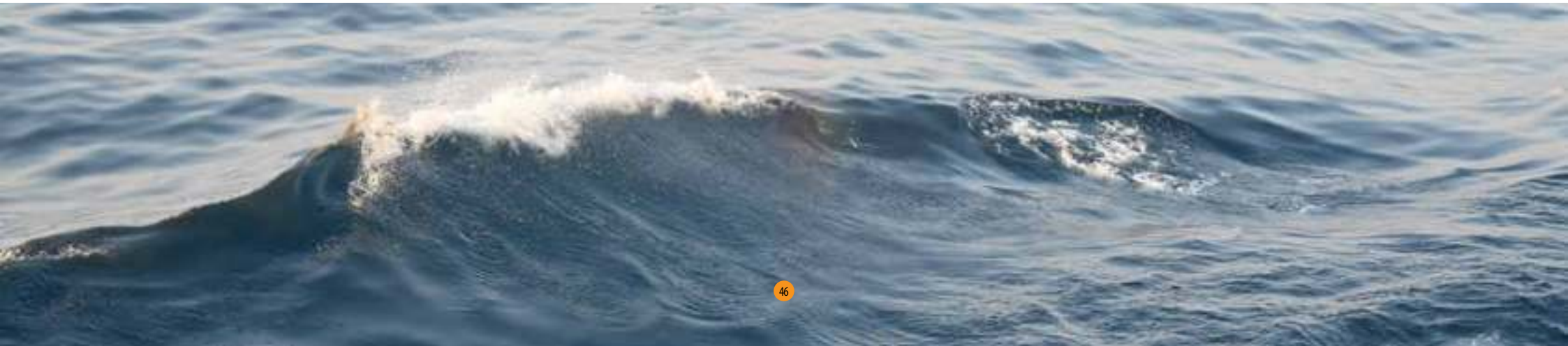


Ian A. Kane et al., 2019

Why, MICROPLASTICS IS AN ISSUE?

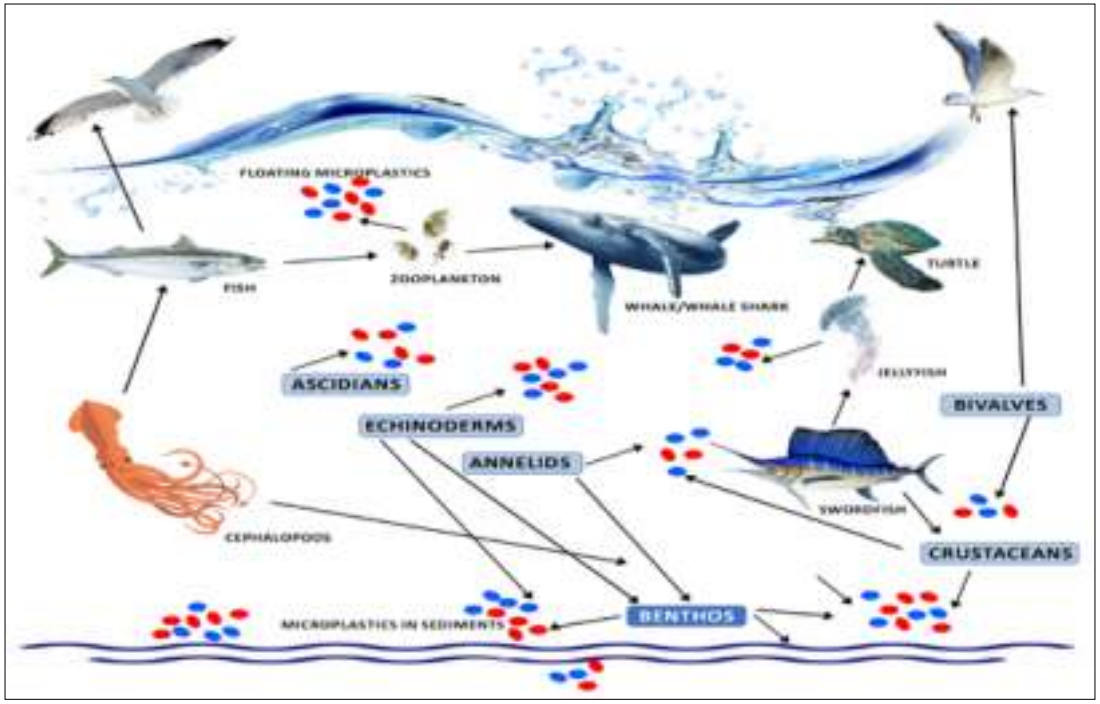
- Microplastics undergo various processes of physical, enzymatic and microbial degradation in nature, but do not get completely broken down.
- Omnipresent! Though it goes unnoticed and often remain microscopic, their presence is detected in tap water, bottled water and salt that we consume every day!
- Microplastics can adsorb extremely harmful hydrophobic organic pollutants.
- Removal of microplastics from aquatic environment is extremely difficult as it could lead to the elimination of smaller microscopic organisms from the sea which are key in the food web and ecology of the oceans.
- Microplastics exist in air as airborne pollutants originating from the plastic textile fiber production.
- They may get into the body of even smaller organisms and may reach humans through food chain and at each trophic (feeding) level, their quantity in the body of organism increase (bioaccumulation).

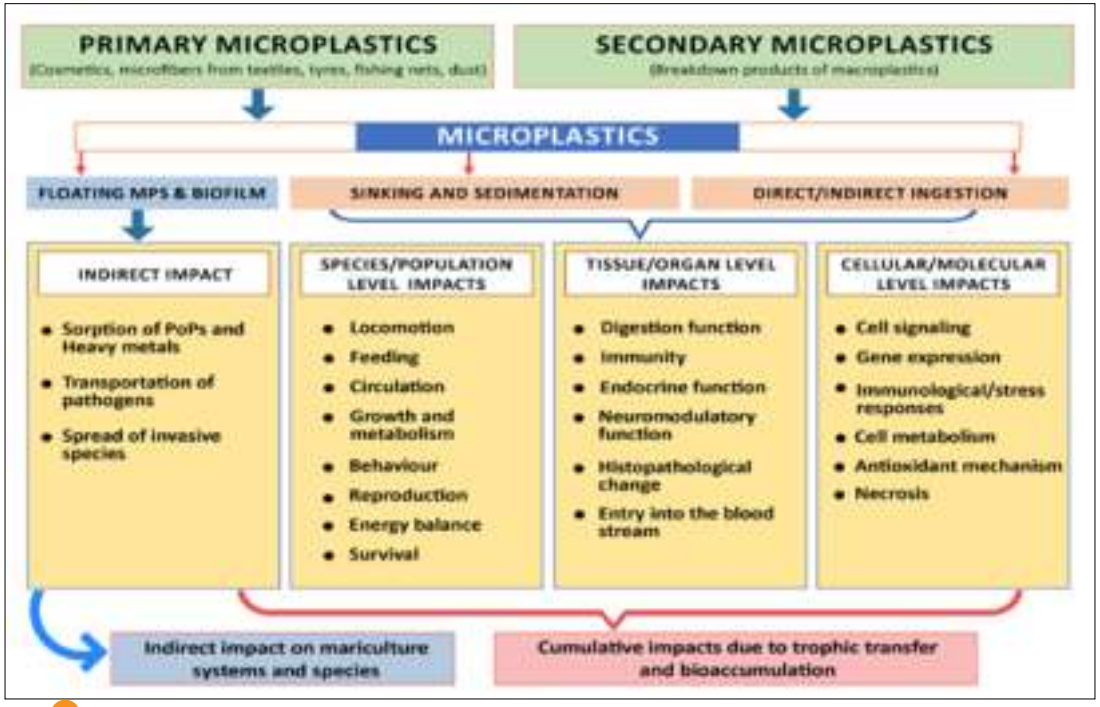




Uptake OF MICROPLASTICS

Microplastics are present throughout the oceans, in all realms, from surface to deep trenches, and are consumed by organisms in all habitats. Further, they are transferred through food chains and food webs. Above all, the chances of bioaccumulation of chemicals in organisms of higher trophic levels is also realized in marine ecosystem.





Impacts OF MICROPLASTICS ON MARINE LIFE

- Ingestion of plastics in the wild was noticed in wide variety of fauna and flora.
- Laboratory data suggest a growing list of zooplankton, arthropods, molluscs, and sediment worms impacted by MPs.
- Along with phytoplankton interactions microplastics affect sedimentation rates.
- Mussels in the laboratory demonstrated that 10 µm microplastics were translocated to the circulatory system.
- Micro- and nanoplastics can bridge trophic levels into crustaceans and other secondary consumers

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- **Primary consumers** --bacterivorous, herbivorous, detritivorous, and deposit-feeding species -- specialized in foraging on particulate matter and have the capacity to ingest MP particles.
- The direct ingestion of MPs might be the major route for primary (e.g., herbivores) and secondary consumers (e.g., zooplanktivores), while apex predators are additionally prone to an indirect ingestion of MPs via prey (food web).
- Intake of food and MPs depend on complex interactions between biotic (e.g., feeding type, physiological state, competition, food size, and availability) and abiotic factors (e.g., temperature).

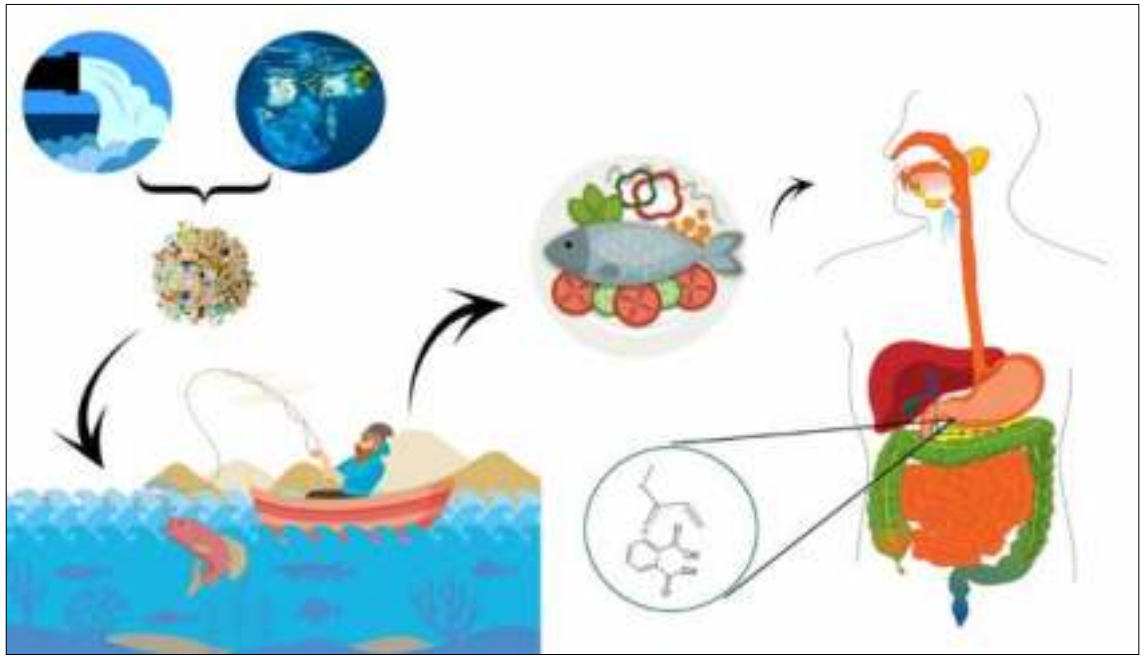
Impacts OF MICROPLASTICS

- Pollution of the environment and accumulation of pollutants. Microplastics may carry microbial pathogens or adsorb chemical contaminants. The microplastics themselves may be manufactured with toxic additives.
- The toxins, including **endocrine disrupting chemicals (EDCs), persistent organic pollutants (POPs), organochlorine pesticides,** carried by these microscopic plastic particles are transported long distances by water systems and released inside the organisms, impacting further.
- Easy ingestion by microscopic organisms in water and further entry into food chain and food web.
- Humans can be exposed to microplastics either directly through contaminated water and air, cosmetics or indirectly from seafood consumption. It can lead to bacterial infections in the gum, skin or injure the cornea by sticking in the eye.
- The consumption of plastics and microplastics by marine animals can lead to false satiation, starvation and death.

Health

IMPACTS OF MICROPLASTICS

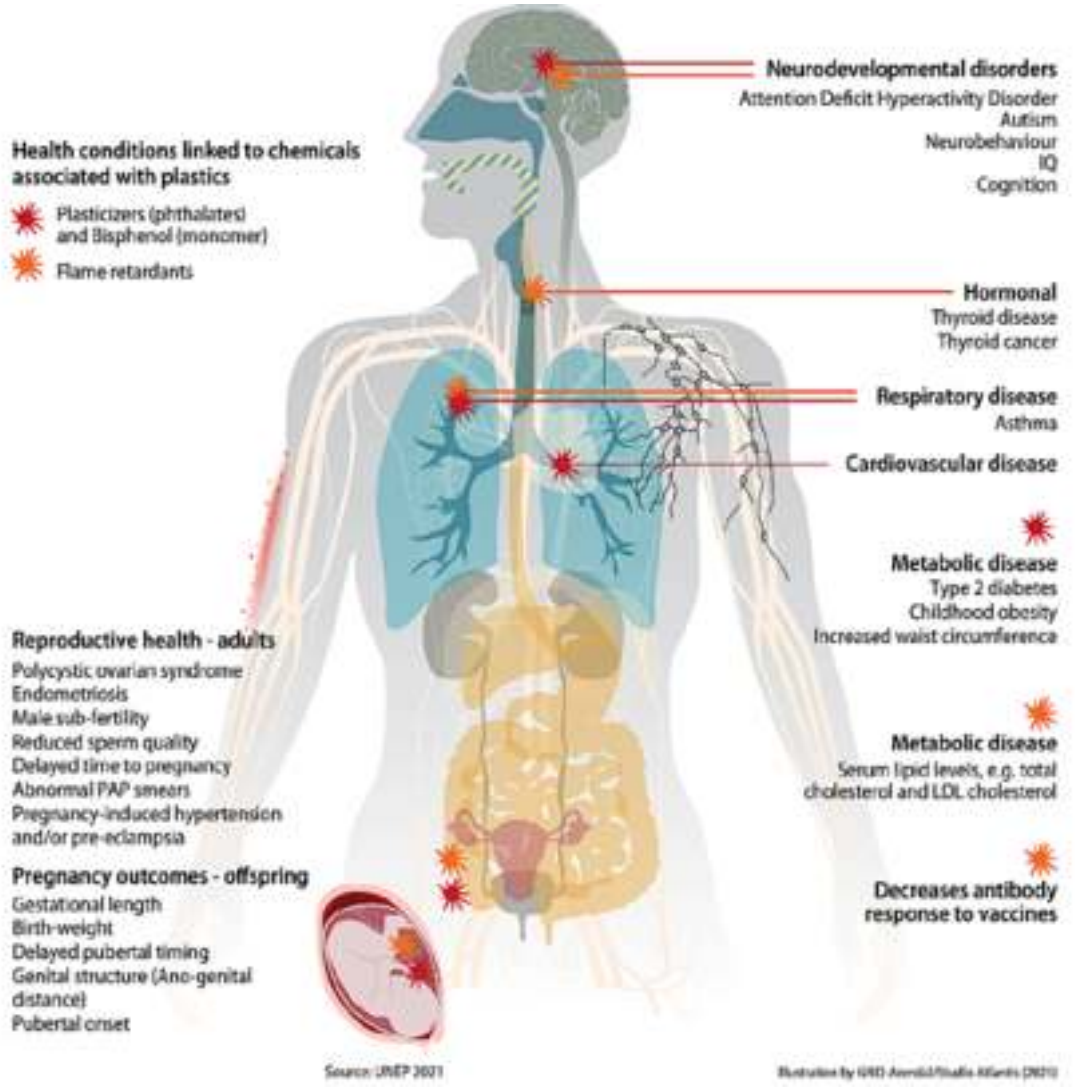
- Microplastics damage aquatic creatures, as well as turtles and birds: They block digestive tracts, diminish the urge to eat, and alter feeding behaviour, all of which reduce growth and reproductive output. Their stomachs are stuffed with plastic, some species starve and die.
- Microplastics have chemical impacts: free-floating pollutants such as **polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals**—tend to adhere to their surfaces.
- Other than the food chain, constant contact with day-to-day life plastic products allows oral, dermal and inhalation exposure to microplastics and additive chemicals to human body. Scientists say plastic particles can reach our stomach, and depending on their size, these plastics are either excreted, get entrapped in stomach and intestinal lining or move freely in body fluids such as blood, thereby reaching various organs and tissues of the body.
- Aggregated microplastic-protein complexes inside the body can block flow of body fluids.
- The toxic effects of MPs in both fish and human are still unknown.



Impact TO HUMANS

- Humans are also at risk from marine plastic pollution. Environmental health is inextricably linked to human health. The pervasiveness of microplastics across our planet raises serious concerns for people's safety.
- Recent studies show that people are inhaling microplastics through the air, consuming them through food and water and even absorbing them through the skin. Microplastics have even been found within **our lungs, livers, spleen, and kidneys. Recent studies** found microplastics in **the placentas of newborn and even in human sperm!**
- The full extent of the impact on human health is still unknown since the research is nascent.
- There is, however, substantial evidence that plastics-associated chemicals, such as methyl mercury, plasticizers and flame retardants, can enter the body and are linked to health concerns, especially in women.
- Scientists also believe that some of the common chemicals found in plastics, such as bisphenol A, phthalates, and polychlorinated biphenyls (PCBs), could leach into the body.
- These chemicals have been linked to endocrine disruption, developmental disorders, reproductive abnormalities and cancer.
- This essentially means that there should be enough precaution.

https://www.unep.org/interactives/pollution-to-solution/

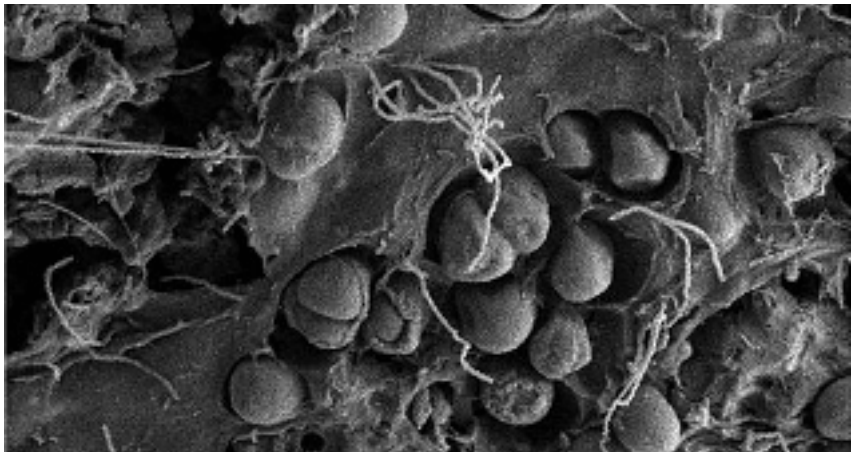


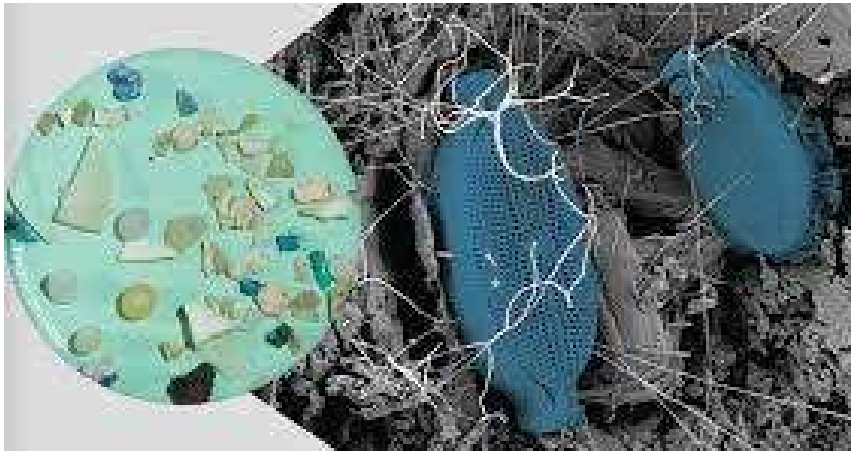
https://www.unep.org/interactives/pollution-to-solution/graphics/Fig_3_Harm%20to%20Humans.pdf

Plastisphere

THE 'BIOSPHERE' ONBOARD PLASTICS!

- Plastisphere is a term used to describe the ecological community of microorganisms that colonize plastic debris in marine environments. It is a relatively new field of research that has emerged due to the increasing amount of plastic waste found in oceans and other bodies of water.
- Microorganisms such as bacteria, algae, fungi, and protists can attach themselves to plastic surfaces, forming a biofilm that can affect the physical and chemical properties of the plastic. This can result in changes in the way the plastic interacts with its environment and the potential for harmful effects on marine life.
- These biofilms can influence the MP's fate: either to sink or float or 'smell' or breaking them down into even tinier bits.
- Very little is known about what kinds of microbes are in the Plastisphere, and how they interact with one another and the plastic.
- Research on the plastisphere is still in its early stages, but scientists are working to better understand its composition and potential impact on marine ecosystems. It is hoped that this research will help to inform efforts to reduce plastic waste and mitigate its impact on the environment.





Zettler et al., 2013

Impact

OF PLASTIC IN THE REGULATORY ROLE OF CARBON AND NUTRIENT CYCLES PLAYED BY BACTERIA VIA THE MICROBIAL LOOP

Dissolve Organic Matter (DOM) and particulate Organic Matter(POM) originated from the linear trophic chain is returned to higher trophic levels via its incorporation in bacterial biomass.

(Jacquin et al., 2019)

Plastic

BIODEGRADATION AT SEA

Under experimental aerobic conditions percentage of conversion from plastic to CO_2 range from 60 to 70% (3 months to 24 months, with various kinds of plastics) None of the standards for anaerobic degradation set in lab are applicable to the natural condition in oceans.

The very diverse and active bacteria living on plastics as compared to the surrounding waters suggest a potential impact on the global biogeochemical cycles associated with the relatively recent introduction of plastic in the oceans, impact that remains to be determined.

(modified from Dussud and Ghiglione, 2014; after Jacquin et al., 2019).

Microplastics IN DEEP SEA

- About 1 percent of the plastic in the ocean floats on the surface and the rest sinks. Ocean currents and other near-seafloor flows appear to control where the sinking plastic ends up.
- It is essential that we develop a basic understanding of the processes that control the distribution of microplastics, so that we can better understand where and how these tiny fragments and fibres enter the food chain through seafloor marine life.
- Microplastics often accumulate on the deep sea floor in the same place as diverse and dense marine life communities.
- This is because the same submarine sediment flows that transfer the oxygen and nutrients needed to sustain life, also transport microplastics from urban rivers to the deep-sea floor via pathways such as submarine canyons.

Not much is known about the degradation of microplastics in the deep sea.

Photo : Umeed Mistry

SUPs: *The* THE VILLAIN IN PLASTICS

These single-use plastic products (SUPs) are everywhere. For many of us, they have become an integral part of our daily lives.

- The use of single-use plastic products (SUPs), items that are meant to be thrown away after a single short use has intensified in the last few decades.
- Approximately 36 per cent of all plastics produced are used in packaging, including single-use plastic products for food and beverage containers, approximately 85 per cent of which ends up in landfills or as unregulated waste.
- Additionally, some 98 per cent of single-use plastic products are produced from fossil fuel, or "virgin" feedstock.
- Of the seven billion tonnes of plastic waste generated globally so far, less than 10 per cent has been recycled.
- Millions of tonnes of plastic waste are lost to the environment, or sometimes shipped thousands of kilometres to destinations where it is mostly burned or dumped.
- The estimated annual loss in the value of plastic packaging waste during sorting and processing alone is US$ 80- 120 billion.
- Cigarette butts — whose filters contain tiny plastic fibers — are the most common type of plastic waste found in the environment. Food wrappers, plastic bottles, plastic bottle caps, plastic grocery bags, plastic straws, and stirrers are the next most common items.
- Many of us use these products every day, without even thinking about where they might end up.

Impacts ON MARINE ECOSYSTEM SERVICES

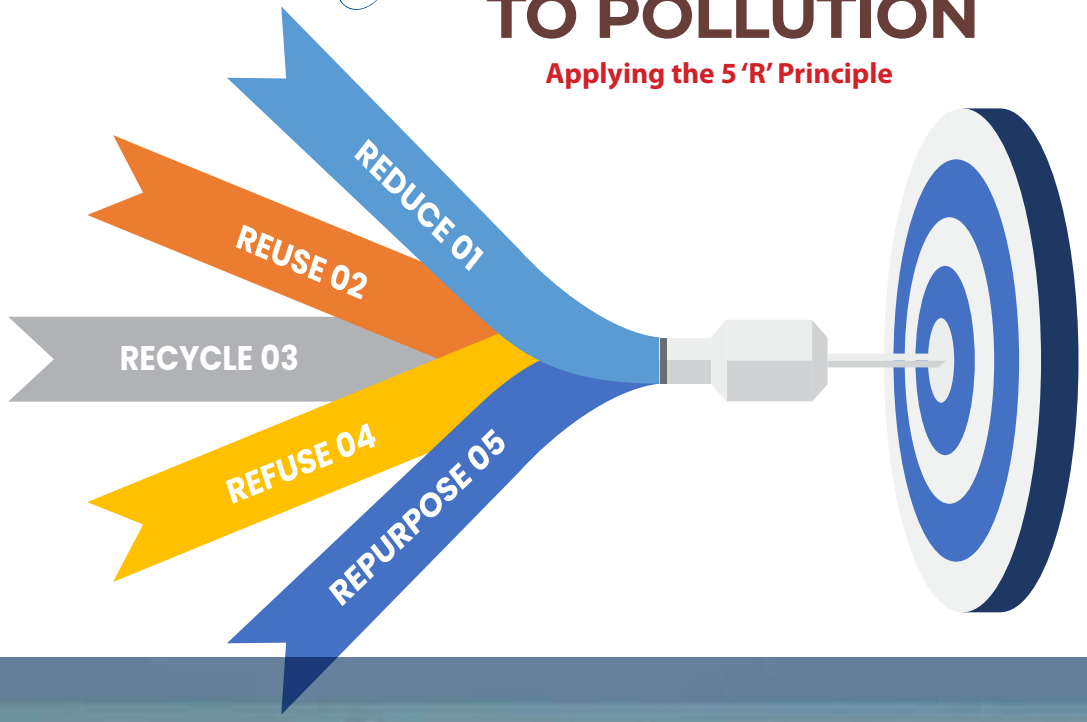
- Marine plastics negatively impact the ability of myriad ecosystems to provide the basic benefits that humans both enjoy and take for granted, which range from clean water to productive aquaculture and fisheries, pest and disease control, climate regulation, heritage and recreation.
- According to the Pollution to Solution Assessment, marine plastics pollution reduces valuable marine ecosystem service by at least US$500 billion to US$2,500 billion each year, and that's not including other social and economic losses like tourism and shipping.
- The Assessment finds that the direct economic losses to coastal and maritime industries, such as fisheries and shipping, are significant. In the Asia Pacific Economic Cooperation region, the losses total US$10.8 billion, a nearly ten-fold increase compared to 2009.
- However, these losses aren't well reported, and the true costs of marine litter and plastic pollution on human, environmental, and social health are still being discovered.

(https://www.unep.org/interactives/pollution-to-solution/)

The remote uninhabited Pakshi Pitti island, Lakshadweep, with plastic bottles carried by the wave action.

Solutions TO POLLUTION

Applying the 5 'R' Principle



The "5 Rs" in plastics management refer to the following principles:

- **Reduce**: This means reducing the amount of plastic we use in the first place, by finding alternatives or using less plastic overall.
- **Reuse**: This means finding ways to use plastic items again, such as using reusable containers or bags.
- **Recycle**: This means separating plastic waste and sending it to recycling facilities where it can be turned into new products.
- **Refuse**: This means saying no to single-use plastic items, such as straws or plastic bags.
- **Repurpose**: This means finding new uses for plastic items that cannot be recycled, such as using plastic bottles as planters or building materials.

By following these principles, we can reduce the amount of plastic wastes, especially the SUPs that ends up in landfills or polluting our environment.

Solutions TO POLLUTION

- To mitigate plastic impact on marine ecosystem, it is important to reduce the amount of plastic waste that ends up in the ocean.
- This can be achieved through individual actions such as reducing plastic consumption, proper disposal of plastic waste, and recycling. Governments and businesses can also take action by implementing policies and practices that reduce plastic pollution and promote sustainability. Additionally, initiatives such as beach cleanups and community outreach programs can raise awareness about the issue and encourage behavior change.
- Efforts are being made to address the problem of ghost nets, including initiatives to remove them from the ocean and prevent their use in the first place. One approach is to encourage the use of biodegradable nets that break down over time, reducing the risk of entanglement. There are also organizations and programs dedicated to removing ghost nets from the ocean, either through manual removal efforts or through the use of specialized equipment.

Upstream MANAGEMENT OF MARINE PLASTICS

Upstream management of marine plastic pollution refers to the strategies and actions that are taken to prevent plastic waste from entering water bodies in the first place. These strategies aim to address the root causes of plastic pollution by reducing the amount of plastic waste generated and improving waste management practices.

Some examples of upstream management strategies for marine plastic pollution include:

1. **Promoting 5 'R's of waste management:** - reduce, reuse, recycle, refuse and repurpose- can help reduce the amount of plastic waste generated and prevent it from entering water bodies.
2. **Extended Producer Responsibility (EPR):** EPR is a policy approach that holds manufacturers responsible for the end-of-life management of their products, including plastic packaging. By incentivizing manufacturers to design products that are more easily recyclable, EPR can help reduce plastic waste and prevent it from entering water bodies.
3. **Plastic bag bans and taxes:** Governments can implement policies that ban or tax single-use plastic bags, which are a major contributor to marine plastic pollution. By reducing the use of these bags, governments can help prevent them from entering water bodies.
4. **Improved waste management infrastructure:** Investing in better waste management infrastructure, such as recycling facilities and landfill sites, can help prevent plastic waste from entering water bodies by ensuring that it is properly disposed of.
5. **Education and awareness-raising:** Educating the public about the impacts of plastic pollution and promoting responsible waste management practices can help reduce the amount of plastic waste generated and prevent it from entering water bodies.

Overall, upstream management strategies for marine plastic pollution are essential for addressing the root causes of this global environmental issue and preventing it from causing further harm to marine ecosystems and human health.

Upstream INTERVENTIONS AT THE SOURCES

- Zero waste strategies, improving waste recovery, and management and mitigating point and nonpoint sources of microplastic creation and loss to the environment.
- Microplastic at sea is a case of the tragedy of the commons, whereby its abundance in international waters and untraceability makes it nearly impossible to source to the company or country of origin
- Capturing and quantifying microplastics in any environment is difficult and can easily be contaminated or misidentified
- While there are processes in the environment that degrade plastic into smaller particles (UV degradation, oxidation, embrittlement and breakage, biodegradation), there are other terrestrial activities and product/packaging designs that create microplastics. These may include the mishandling of preproduction pellets at production and distribution sites, industrial abrasives, synthetic grass in sports arenas, torn corners of sauce packets, vehicle tire dust, tooled shavings from plastic product manufacture, road abrasion of plastic waste on roadsides, unfiltered dryer exhaust at laundry facilities losing microfibers to the air, or combined sewage overflow that discharges plastics from residential sewer lines, like personal care products, fibers from textiles, and cosmetics, into the aquatic environment. These many sources lack specific methods of measurement
- New standardised technologies to measure their significant, especially the secondary microplastics.

Scorpionfish amongst the plastic debris at 40 m depth in Thiruvananthapuram coast, Kerala

Photo : Umeed Mistry

Downstream
MANAGEMENT OF MARINE PLASTICS

Downstream management of marine plastics involves strategies and actions aimed at reducing the amount of plastic waste that enters the ocean and managing the existing plastic debris in marine environments.

Here are some examples:

1. **Source reduction:** This involves reducing the amount of plastic waste generated in the first place. For example, using reusable bags instead of single-use plastic bags, or avoiding unnecessary plastic packaging.
2. **Recycling:** This involves the collection, sorting, and processing of plastic waste to create new products. Proper recycling of plastics can help prevent them from ending up in the ocean.
3. **Waste management:** This involves proper disposal of plastic waste in landfills or waste-to-energy facilities. Effective waste management systems can prevent plastics from entering waterways and eventually ending up in the ocean.
4. **Beach and ocean clean-ups:** This involves the removal of plastic debris from beaches and waterways. While this does not solve the root problem of plastic pollution, it can prevent immediate harm to marine life and ecosystems.
5. **Public awareness and education:** Educating the public about the impacts of plastic pollution on the environment and encouraging responsible behaviour can help reduce the amount of plastic waste that enters the ocean. This can include campaigns to reduce plastic use, promote recycling, and encourage responsible disposal of plastic waste.
6. **Innovation and research:** Developing new technologies and materials that are more sustainable and less harmful to the environment can help reduce the impact of plastics on marine ecosystems. This can include research into biodegradable plastics or alternative materials that can replace traditional plastics.

Technical SOLUTIONS- WILL IT WORK?

Downstream (Ocean Recovery) or Upstream Intervention

- Floating nets to capture debris and plastic-to-fuel pyrolysis machines on ocean-going barges, to seeding the seas with bacteria that consume PET, polyethylene, and polypropylene
- All of these schemes fail on several fronts: economics of cost-benefit, minimizing ecological impacts, and design and testing in real ocean conditions. Recent analysis of debris hot spots and current modelling support the case for nearshore and riverine collection rather than mid-ocean clean-up!
- **Fishing for Litter** was presented as the only viable ocean clean-up program, and described as "a useful last option in the hierarchy, but can only address certain types of marine litter"- Effective only for few kinds of marine debris.
- Most scientists and policymakers, ocean clean-up is not economically or logistically feasible…..

Biodegradable PLASTICS

- Biodegradable plastics are types of plastic materials that can be broken down by microorganisms into natural substances such as water, carbon dioxide, and biomass. However, the biodegradation process depends on various factors, such as temperature, humidity, and the presence of microorganisms.
- In the context of marine environments, biodegradable plastics can be beneficial if they break down quickly enough to avoid causing harm to marine life. However, some biodegradable plastics may only break down under certain conditions, such as high temperatures or prolonged exposure to sunlight, which may not be present in marine environments. Additionally, some biodegradable plastics may only break down partially, leaving behind microplastics that can still be harmful to marine life.
- It is important to note that biodegradable plastics should not be seen as a solution to the problem of plastic pollution in the ocean. The most effective way to reduce the impact of plastic on marine environments is to reduce the amount of plastic that is produced and consumed in the first place, and to properly dispose of plastic waste through recycling and other responsible methods.
- **Disadvantages**: The cost of biodegradable polymers is typically much higher. For well-founded purposes (such as the essential components of a fishing trap), their adoption in lieu of less expensive alternatives may call for financial inducement.
- Limited research suggests that public views of an item's biodegradability can affect how people litter; for example, if a bag is designated as biodegradable, it is more likely to be abandoned carelessly.

Few

EXAMPLES OF BIODEGRADABLE PLASTICS

Common Biodegradable Plastics: Their sources, properties, and usage

Composition	Abbreviation	Usage
Poly(lactic acid)	PLA	Packaging, paper coatings, mulch films, compost bags, *etc.*
Polyhydroxyalkanoate	PHA	Disposable drinking cups, cutlery, trays, food plates and food containers, soil retention sheathing, shopping bags, *etc.*
Polyhydroxybutyrate	PHB	Bottles, bags, packaging film and disposable nappies, *etc.*
Starch blends	-	Food packaging, bottles, cutlery, straws, disposable bags, *etc.*
Polyglycolic acid	PGA	Packaging films, synthetic fast absorbable sutures for surgery, etc.
Cellulose acetate	CA	Textiles, optical film for LCD technology, antifog goggles, filters, *etc.*
Poly(ε-caprolactone)	PCL	Mulch and other agricultural films, *etc.*
Poly(butylene Succinate)	PBS	Food packaging, mulch film, plant pots, hygiene products, fishing nets, fishing lines, *etc.*
Poly(butylene adipate)	PBA	Injection molding for automotive, mechanical and electronic industries, *etc.*
Poly(butylene adipate-co-terephthalate)	PBAT	Food packaging, agricultural film, *etc.*

Source: Chen H. Biodegradable plastics in the marine environment: a potential source of risk?. Water Emerging Contaminants & Nanoplastics. 2022; 1(4):16. http://dx.doi.org/10.20517/wecn.2022.11

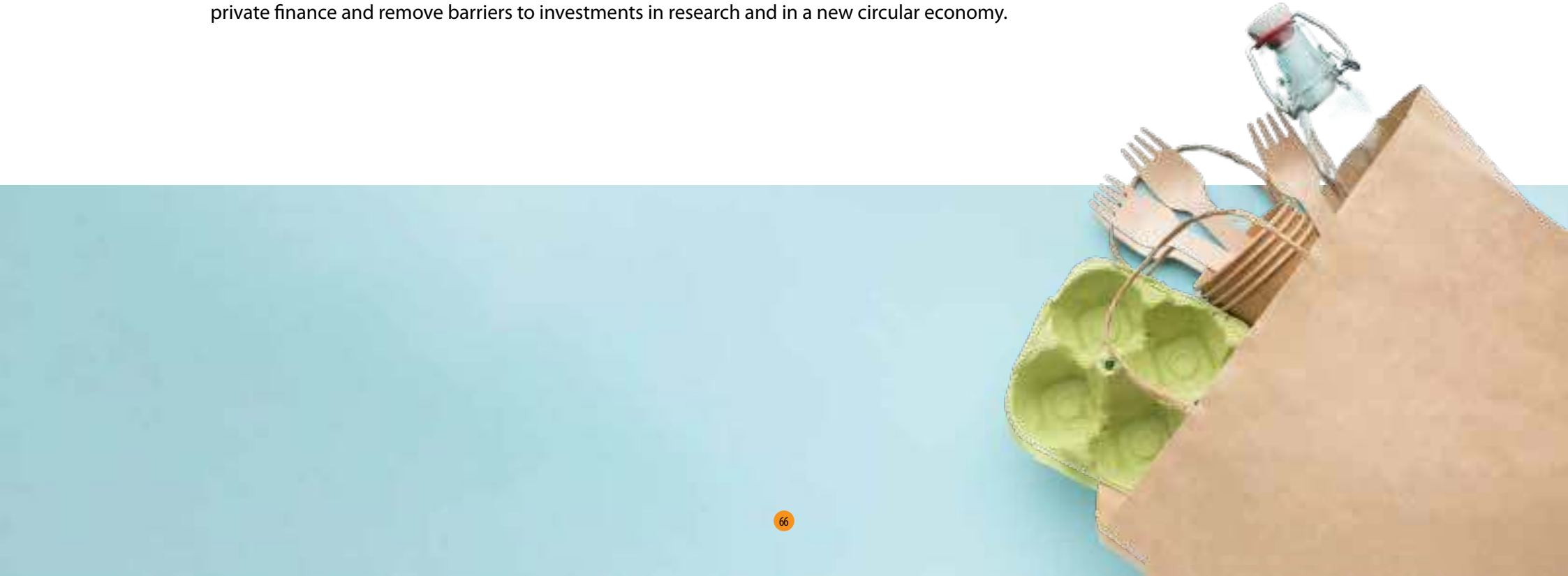
Starting FROM OURSELF!

- **Shop Sustainably:** Next time you are out shopping, choose food with no plastic packaging, carry a reusable bag, buy local products, and refill containers to reduce your plastic waste and effect on the environment.
- **Try a Zero-Waste Lifestyle:** Become a zero-waste champion. Invest in sustainable, ocean-friendly products- reusable coffee mugs, water bottles and food wraps. Consider options like menstrual cups, bamboo toothbrushes and shampoo bars. These will help you save money and the ocean too.
- **Travel Sustainably:** When you are on holiday, try to watch your single-use plastic intake. Refuse miniature bottles in hotel rooms, take your own reusable drinking bottle and use reef-safe sunscreen, without microplastics.

(Source: UNEP)

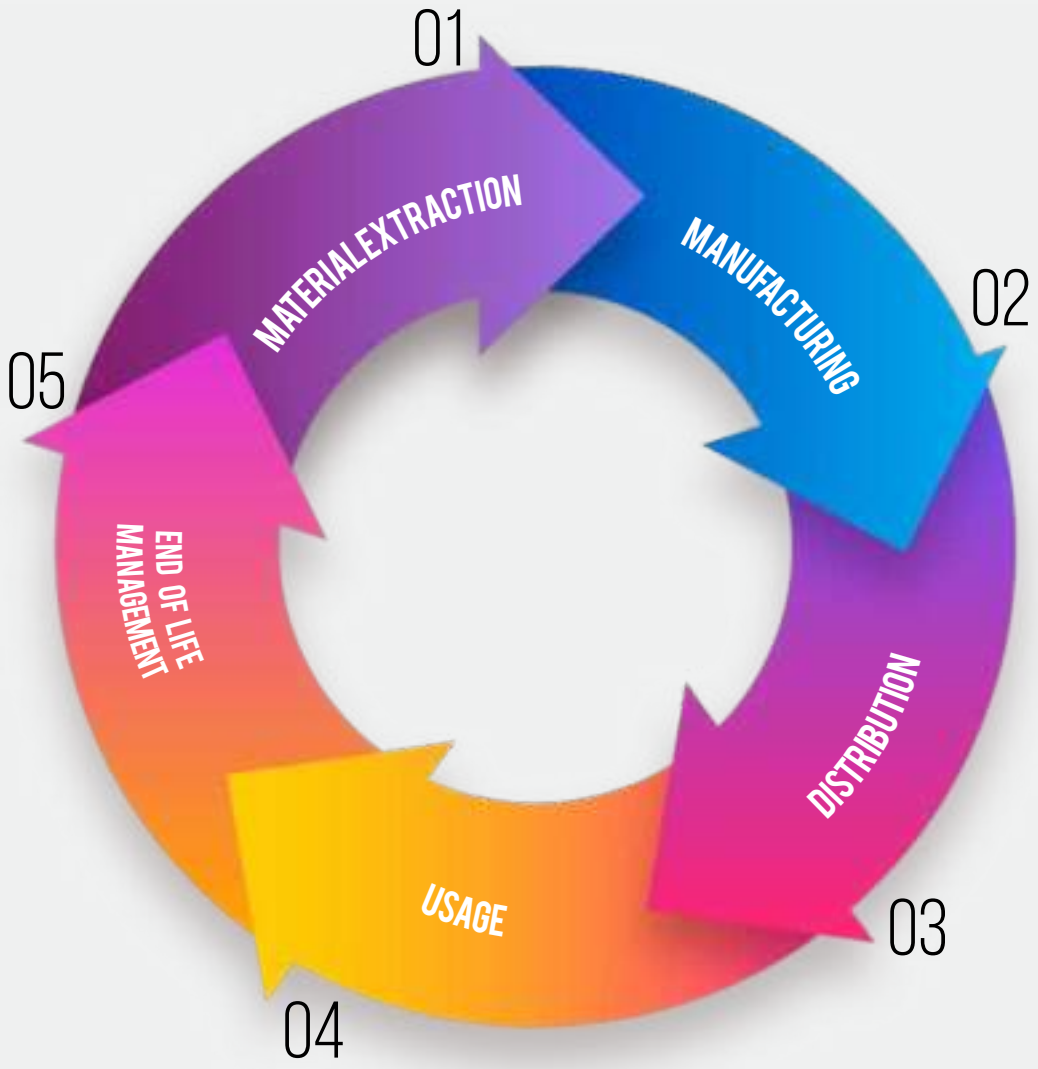
INTER-GOVERNMENTAL INITIATIVES

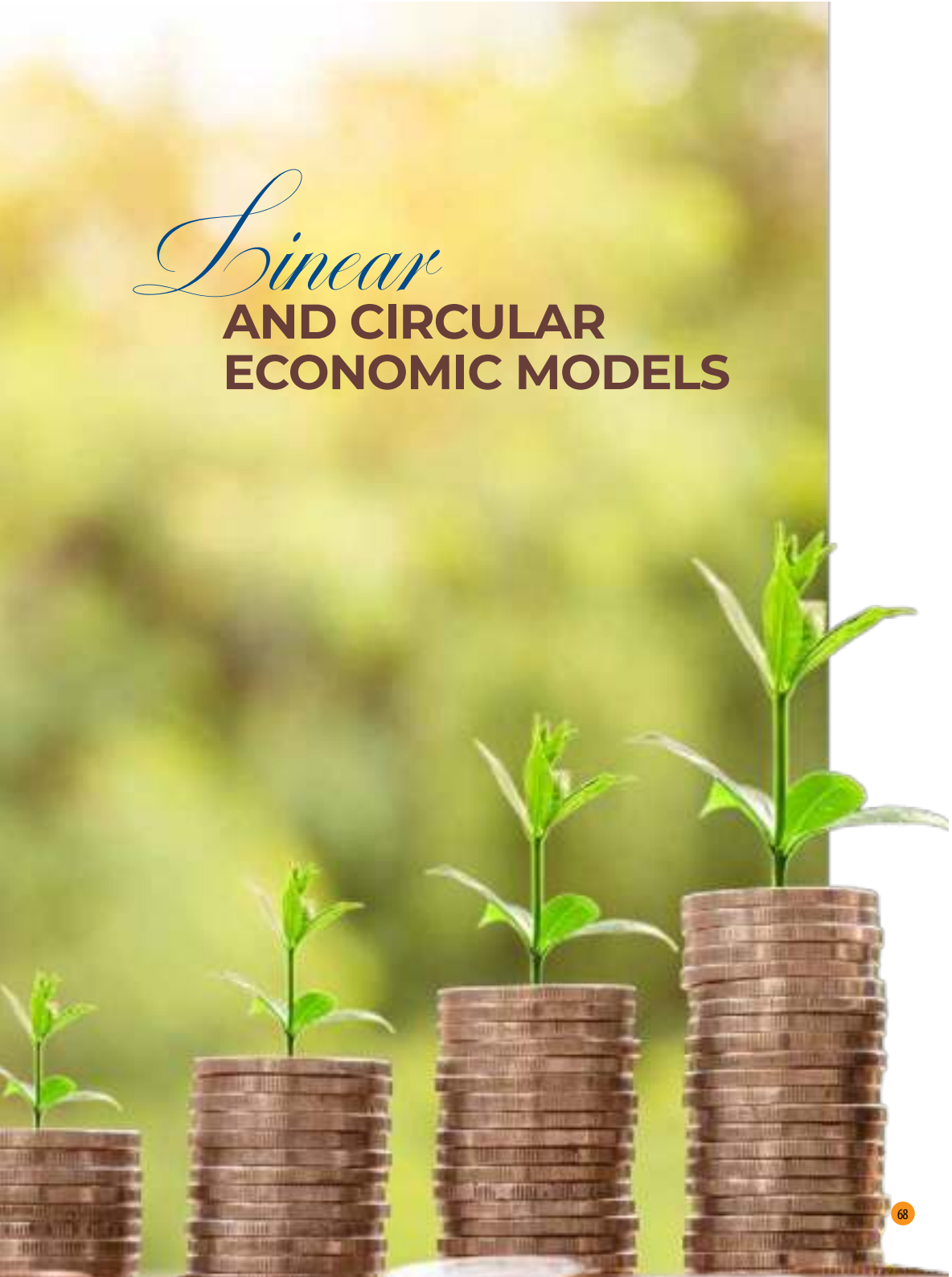
- Heads of State, Ministers of environment and other representatives from UN Member States endorsed a historic resolution titled **"End plastic pollution: towards an international legally binding instrument"** at the UN Environment Assembly (UNEA-5) on 2nd March 2022 in Nairobi to End Plastic Pollution and forge an international legally binding agreement by 2024. The resolution addresses the full lifecycle of plastic, including its production, design and disposal.
- It is expected to present a legally binding instrument, which would reflect diverse alternatives to address the full lifecycle of plastics, the design of reusable and recyclable products and materials, and the need for enhanced international collaboration to facilitate access to technology, capacity building and scientific and technical cooperation.
- UNEP will work with any willing government and business across the value chain to shift away from single-use plastics, as well as to mobilise private finance and remove barriers to investments in research and in a new circular economy.



Extended PRODUCER RESPONSIBILITY (EPR)

- Extended Producer Responsibility (EPR) is a concept where producers of goods are held responsible for the entire lifecycle of their products, including post-consumer disposal. In the context of managing plastic waste, EPR is an approach where manufacturers and brand owners are responsible for the collection, recycling, or disposal of the plastic waste generated by their products.
- EPR is increasingly being used to manage plastic waste, as it creates a financial incentive for manufacturers and brand owners to design products that are easier to recycle, reuse, or dispose of.
- EPR schemes can take various forms, such as deposit-return systems, where consumers pay a small deposit when they purchase a product, which is refunded when they return the empty packaging to a collection point.
- However, the success of EPR schemes depends on effective implementation and enforcement, as well as collaboration between governments, producers, and consumers.





Linear AND CIRCULAR ECONOMIC MODELS

- A circular economy is an economic system that aims to eliminate waste and promote the continuous use and reuse of resources. In a circular economy, resources are kept in use for as long as possible, and waste is minimized through strategies such as recycling, reuse, and product redesign.
- The circular economy is based on the idea that resources are finite, and that the traditional linear economic model of "take-make-use-dispose" is no longer sustainable. Instead, the circular economy aims to create a closed-loop system in which resources are continually reused and recycled, reducing the need for new resource extraction and minimizing waste.
- Some of the sources could be stopped by effective legislation (e.g., banning microbeads in cosmetic products), education and regulation enforcement (litter laws), and technological advancements (effluent filters, biodegradable polymers).
- Microplastics to the terrestrial and ultimately aquatic environment (primary or secondary by input in form of large objects which later degrade into microplastics) occur throughout the supply chain, e.g., in form of loss of preproduction pellets, littering, or irresponsible waste management.
- Little material remains in the system, and most would not be fit for effective recycling (i.e., reusing) because of contamination or expensive recuperation schemes.
- Deposition in landfills or energy recovery through incineration therefore appears as the ultimate strategy to remove almost all material from the system, effectively creating a linear economic model.
- Energy recovery is not a form of recycling and does not break this linearity, because it essentially removes used plastics from the economic system through destruction and conversion.

Campaigns, AMBASSADORS AND IMAGES!

- Campaign using print and electronic media--ICT, social media
- Campaign using used religious institutions/activities
- Campaign with striking images
- We need ambassadors for taking up ocean campaigns
- Installations/arts/cultural events
- Education and awareness and inclusion in curriculum

Circular ECONOMY (CE)

Circular economy (CE): Practice to manage resource circularity, efficiency and optimisation that proposes to use wastes as resources to create value (Blomsma et al., 2017; Homrich et al., 2018)

CE principles

Plastic can be reused, recycled, or composted in practice (Eg: Bioplastics)

Decouple plastic from the consumption of non-renewable resources.

Free plastics from hazardous chemicals

Education as the driving factor: For better realising the relevance of CE, and changing the consumer behaviour, education is key driver; the education may be extended from society to educational institutions to business and policy makers (Including politicians).

- **Plastics: Essential components of a circular and climate neutral economy:**
- Durability, resource and energy efficiency, and recyclability: promotes circularity of products and a climate neutral society.
- **Plastics for a sustainable and climate neutral future:** Electric cars, wind power stations and energy efficient homes.
- **CE and CN demands special investment and innovation**

Management OF MARINE DEBRIS AND CE: LINKAGES WITH SDGs- 2030

Creation of new jobs; managing discarded fishing gears

Reduced leakage of plastics into ocean
Reduced exposure to chemicals and toxins
Clean production technology
Management of wastes (upstream and downstream)

Development of better plastic alternatives
Alternatives and recycling technology
Promotion of circular economy and research
Improved plastic management through promotion of circular economy and carbon neutrality

Mainstreaming marine pollution management in ESDs, ocean literacy programmes, and development of tools and kits
Networking; private-public partnerships

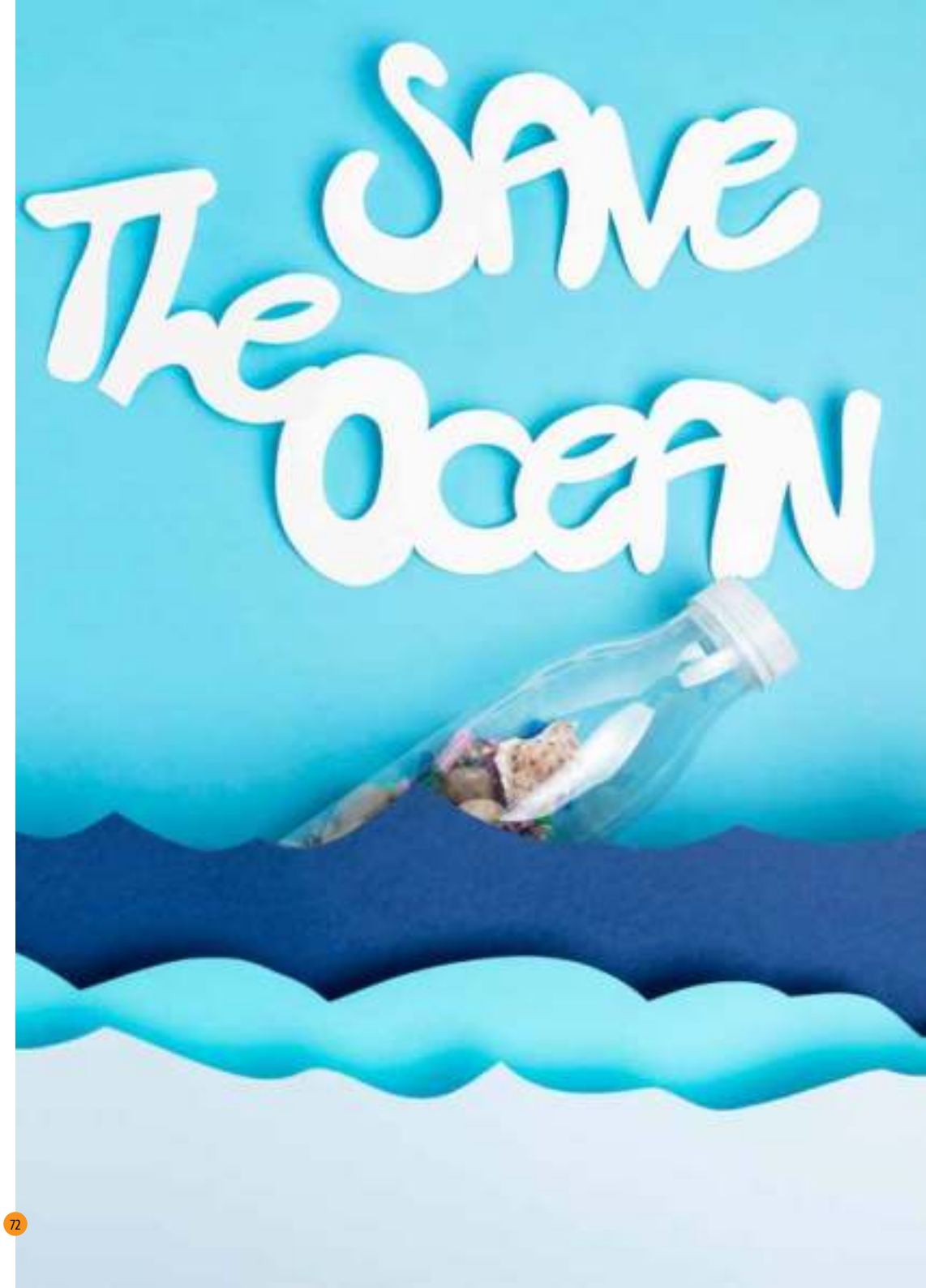
Awareness

USING ALL MEDIA, ALL TECHNOLOGIES AND ALL CULTURAL EVENTS

Things You Can Do to Save the Ocean

- Mind Your Carbon Footprint and Reduce Energy Consumption
- Make Safe, Sustainable Seafood Choices
- Use Fewer Plastic Products and totally avoid single use plastics
- Help Take Care of the Beach and help others cleaning the beach
- Don't Purchase Items that Exploit Marine Life
- Support Organizations Working to Protect the Ocean
- Influence Change in Your Community
- Educate Yourself About Oceans and Marine Life
- Speak for the Oceans

JOIN MOVEMENTS TO PROTECT THE OCEANS



Think ABOUT ALTERNATIVES

Educate
TO STOP SINGLE-USE PLASTICS USE

Use all get-together in institutions, public meetings, religious gatherings to spread the message

Start **Social Media Campaigns** to stop using single use plastics

Reduce your **Plastic Foot Print**

31 DAY PLASTIC FREE CHALLENGE

Get started on living plastic free by completing these challenges.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Day 1  Use a reusable water bottle	Day 2  Keep a green bag handy	Day 3  Use aluminium foil instead of cling film	Day 4  Decline plastic straws	Day 5  Bring your reusable cup	Day 6  Compost food waste	Day 7  Refuse plastic cutlery
Day 8  Use a handkerchief instead of disposable tissues	Day 9  Switch to e-bills	Day 10  Reuse jars and containers for leftovers	Day 11  Only choose snacks without plastic packaging	Day 12  Bring your own bags for fresh produce at the supermarket	Day 13  Try a solid bar soap instead of plastic bottles	Day 14  Buy natural fabrics, not synthetic
Day 15  Drink your coffee in the cafe if you forget your cup	Day 16  Invest in beeswax wraps for food	Day 17  Opt for drinks in glass bottles or cans instead of plastic	Day 18  Buy from an op-shop instead of new	Day 19  Buy items wrapped in paper or cardboard instead of plastic	Day 20  Upcycle for gifts and art projects	Day 21  Use a water fountain if you don't have a reusable bottle
Day 22  Choose a takeaway item that doesn't come in plastic containers	Day 23  Make your own cleaning products	Day 24  Bring your own containers to buy loose nuts and grains	Day 25  Say no to a coffee if you don't have your reusable cup	Day 26  Use cloths instead of disposable paper towel	Day 27  Use newspaper and a pooper-scooper for pets	Day 28  Only buy from ethical businesses
Day 29  Bring your own containers to the takeaway shop	Day 30  Buy a recycled or non-plastic phone cover	Day 31 Join a 'Buy nothing' group and commit for August				

Co-funded by the Erasmus+ Programme of the European Union

www.cleanaway.com.au/

Solutions IN A NUTSHELL

- Improve waste management systems so that the right infrastructure is available to receive plastic waste and ensure its reuse.
- Enhance circularity by promoting more sustainable consumption and production practices across the entire plastic value chain.
- Engage consumers in addressing plastic pollution to influence the market and to inspire behavioral change.
- Close the tap by phasing out unnecessary, avoidable, and most problematic plastic items and replacing these with alternative materials, products and services.
- Deal with the legacy through effective monitoring to identify sources, quantities and the fate of plastic.
- Improve and strengthen governance at all levels.
- Enhance knowledge and monitor effectiveness using sound science.
- Improve finance with technical assistance and capacity building.

Management OF MARINE DEBRIS: LINKAGES WITH SDGS- 2030

Direct linkage: SDG 14 (Life below water)- Target 14.1 “by 2025, prevent and significantly reduce marine pollution of all kinds (...)” --SDG indicator 14.1.1b, “marine litter.”

- Goals 3: Zero hunger
- Goals 3: Good health and wellbeing
- Goals 4: Quality education
- Goal 6: Clean water and sanitation
- Goal 11: Sustainable cities and communities
- Goal 12: Responsible consumption and production
- Goal 13: Climate action
- Goal 17: Partnership for the goals

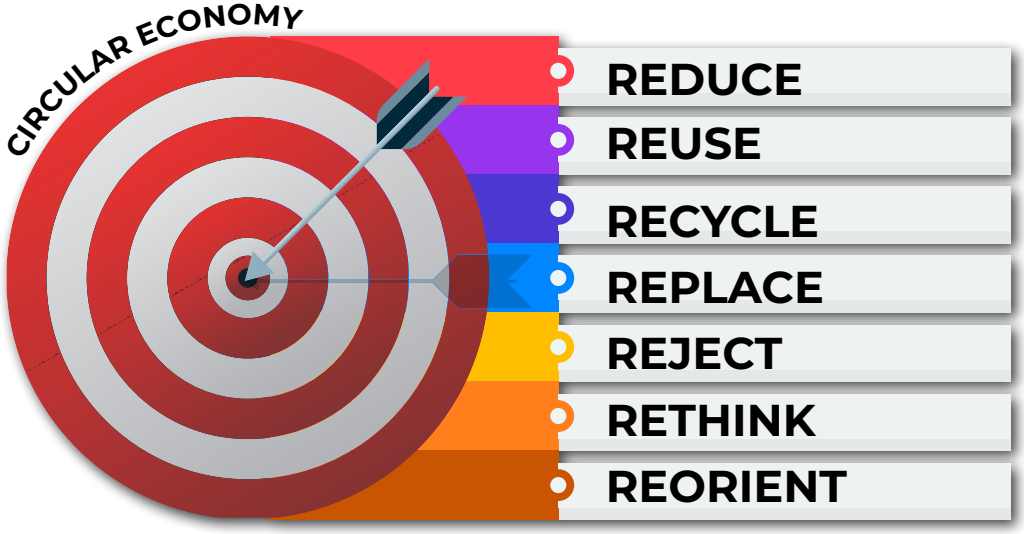
Photo :Umeed Mistry

Advancing
MOVE FROM 5 'R' TO 7 'R'

The need for change and promote education to popularize circular economy

In the absence of effective management strategies, including the failure in adopting circular economy, the scenario will be:

- By 2040 the volume of plastic in the market will be doubled.
- Annual plastic production is >380 million tonnes (annual rate of 4%).
- The amount of plastics entering the ocean has increased from 11m tons in 2016 to from 29 MT in 2040
- The stock of marine plastic debris would quadruple and reach over 600 MT.



Breaking the Plastic Wave (www.pewtrusts.org/en)

Photo : Umeed Mistry

Indian INITIATIVES

स्वच्छ सागर, सुरक्षित सागर
Clean Coast, Safe Sea

- To safeguard life below water and above sea from adverse impact of marine litter, the Union Ministry of Earth and Sciences launched a coastal clean-up drive under the **"Swachh Sagar Surakshit Sagar"** (Clean Coast Safe Sea) campaign in 2022.
- A mobile app "Eco Mitram" has been launched to spread awareness about the campaign and also for the common people for voluntary registration for the beach cleaning activity.
- National Marine Litter Policy of India is in the making.
- In 2021, the Government of India prohibited the manufacture, import, stocking, distribution, sale, and use of several single-use plastic items like plastic flags, plates, cups, spoons and straws from July 2022. A roadmap to this effect remains to be prepared.
- The Government of India has already banned the import of plastic waste in the country.
- It is also engaged in blue beach development for tourism preferring clean blue beaches with 'zero waste' approaches.
- Extensive research and expeditions are being conducted by the National Centre for Coastal Research (NCCR) of the Union Ministry of Earth Sciences (MoES) and National Centre for Sustainable Coastal Management (NCSCM) of the Union Ministry of Environment, Forest and Climate Change (MoEF&CC), the National Institute of Oceanography, the Central Marine Fisheries Research Institute (CMFRI) as well as other academic and research institutions to document the extent of marine plastic pollution and offer management solutions.

The PARTNERSHIPS

Partnerships, both at global and regional levels, are essential towards managing marine debris and plastics. The actions include networking for awareness creation, exchange of ideas and experiences, and transfer of emerging technologies to combat pollution.

Further, the countries which lack funds and technologies need support from the wealthier nations, as we share the same planet and oceans.

UNEP-led programmes

- Global Partnership on Plastic Pollution and Marine Litter (GPML) (https://www.gpmarinelitter.org/)
- Clean Seas platform https://www.cleanseas.org/
- Global Tourism Plastics Initiative
- https://www.oneplanetnetwork.org/programmes/sustainable-tourism/global-tourism-plastics-initiative
- New Plastics Economy Global Commitment https://www.newplasticseconomy.org/

FEW OTHER PROGRAMMES

- The Global Ghost Gear Initiative (GGGI) (https://www.ghostgear.org/)
- The Global Plastic Action Partnership (GPAP) (https://www.globalplasticaction.org/home)
- The Ocean Conservancy's Trash Free Seas Alliance
- (https://oceanconservancy.org/trash-free-seas/plastics-in-the-ocean/trash-free-seas-alliance/)
- Asia-Pacific Economic Cooperation (APEC): Virtual Working Group (VWG) on Marine Debris
- Plastic Waste Partnership under Basel Convention
- United Nations Environment Assembly (UNEA) and Marine Litter

Blue Flag CERTIFICATION TO BEACHES

- The Blue Flag certification is an international eco-label awarded to beaches and marinas that meet certain environmental and safety standards. It is managed by the Foundation for Environmental Education (FEE), a non-profit organization based in Denmark.
- To receive the Blue Flag certification, beaches must meet strict criteria related to water quality, environmental management, environmental education and information, safety, and services.
- Yet another recognition of India's commitment to protect and conserve the pristine coastal and marine ecosystems through holistic management of the resources, the country has 12 beaches certified under the Blue Flag certification.

1. GOLDEN BEACH – ODISHA
2. SHIVRAJPUR BEACH – GUJARAT
3. KAPPAD BEACH – KERALA
4. GHOGHLA BEACH – DIU
5. RADHANAGAR BEACH – ANDAMAN & NICOBAR
6. KASARKOD BEACH – KARNATAKA
7. PADUBIDRI BEACH – KARNATAKA
8. RUSHIKONDA BEACH – ANDHRA PRADESH
9. KOVALAM BEACH – TAMIL NADU
10. EDEN BEACH – PUDUCHERRY
11. MINICOY THUNDI BEACH - LAKSHADWEEP
12. KADMAT BEACH - LAKSHADWEEP

Clean-Coast INDEX (CCI)

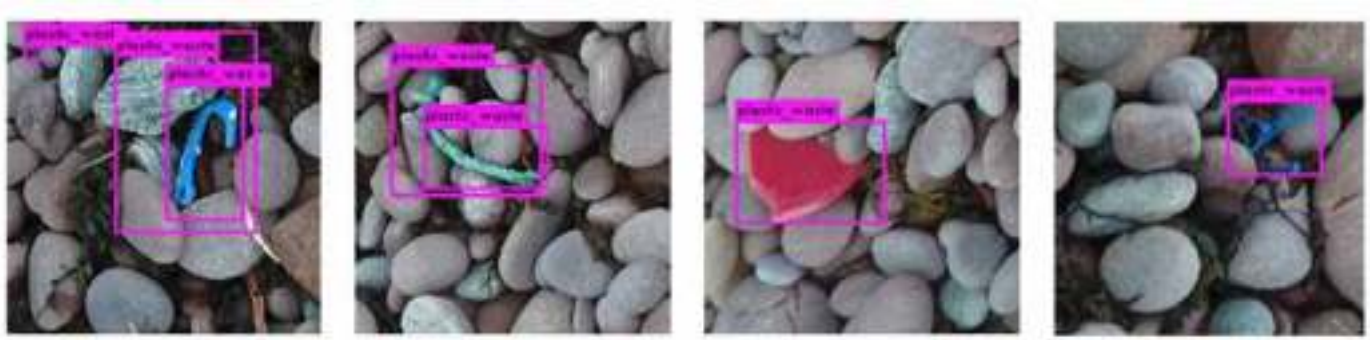
As a tool for assessing the real cleanliness of the coast, the **clean-coast index (CCI)**, was created. It easily eliminates assessor bias by measuring plastic waste as a sign of how clean the beach is.
The CCI is now used as a tool by the Union Ministry of Environment, Forest and Climate Change in India to assess and rank the cleanliness of beaches in the country. It was launched in 2019 as part of the **"Swachh Bharat Abhiyan" (Clean India Mission)** initiative.
The Clean Coast Index assesses beaches on the basis of 33 criteria, which are grouped into four categories:

- **Beach Environment:** This includes criteria related to the cleanliness of the beach, such as litter and waste management, and the presence of public toilets and showers.
- **Beach Amenities:** This includes criteria related to the availability of facilities and services for visitors, such as parking, food and beverage options, and recreational activities.
- **Beach Safety:** This includes criteria related to the safety of visitors, such as the presence of lifeguards, first aid facilities, and warning signs.
- **Environmental Education and Awareness:** This includes criteria related to the promotion of environmental education and awareness among visitors, such as the availability of information on the local environment, biodiversity, and environmental issues.

Based on the scores obtained by each beach on these criteria, the Clean Coast Index ranks beaches from cleanest to dirtiest, and assigns them a star rating (out of five). The index is updated annually, and the rankings and ratings are made public to encourage public participation in efforts to maintain and improve the cleanliness of India's beaches.

Artificial INTELLIGENCE/MACHINE LEARNING FOR MARINE DEBRIS MONITORING

- Artificial intelligence (AI) can help to document marine debris by automating the process of identifying and categorizing debris in images and videos of the ocean.
- AI algorithms can be trained to recognize and detect different types of marine debris, such as plastic bags, fishing nets, and bottles, in images and videos. Further, such data generated can be used to classify debris and data analysis.
- AI algorithms can be deployed in underwater drones and other remote sensing devices to continuously monitor the marine environment and detect debris in real-time. This allows for rapid response to debris events and more effective management of ocean pollution.
- Machine learning can be used to document marine debris by analyzing images and videos of the marine environment.
- The data generated by the automated classification can be analyzed to identify patterns and trends in the type, size, and distribution of marine debris. This can help to inform policy and management decisions related to marine conservation and pollution prevention.
- Studies on high-precision density mapping of marine debris and floating plastics via Satellite Imagery have already begun in many parts of the world.
- Marine Debris Archive (MARIDA) is a marine debris-oriented dataset on Sentinel-2 satellite images (https://mlhub.earth/data/marida_v1)



https://www.theplastictide.com/blog-1/2017/7/29/algorithm-update-detection-and-mapping-of-plastics-on-beaches-using-mavs

Model

INITIATIVES SUCHITHWA SAGARAM

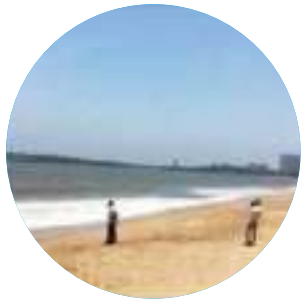
- **Suchitwa Sagaram'** (Clean Ocean), project implemented by the Department of Fisheries, Government of Kerala India envisages bringing back plastics from the ocean with the help of fishers (through the Boat Operators Association, specifically those using bottom trawlers), and convert the marine plastics into raw materials (shredded particles) for the construction of the road, with the help of women self help groups (Kudumbashree).
- Hundreds of tons of plastics have been thus recovered from the ocean and reused for infrastructure development through this initiative.
- This projected initiated at Sakthikulangara fishing harbour in Kollam district of Kerala has set a model, and the government has now implemented a new Programme 'Suchitwa Sagaram, Sundara Theram' (Clean Ocean, Beautiful Shore).
- This programme will be implemented in three phases: creating awareness, waste collection, and recycling.
- About 15,000 volunteers will take part in the clean-up drive and the project will be extended to 20 harbours in Kerala.

Inspiring PEOPLE! AFROZ SHAH:

The man behind the world's biggest beach clean-up.

- Advocate Afroz Shah initiated the world's largest beach clean-up, attracting dozens of volunteers every weekend for the past few years and turning the devastated stretch of plastic-strewn sand in Versova, Mumbai India in to a clean beach.
- Now vulnerable turtles have started laying eggs in the beach!
- He started this individually and later he has been joined by slum-dwellers, Bollywood stars, foreign diplomats and politicians.
- So far, the volunteers have removed around 15 million kilograms from the 2.5-km beach.
- He is best known for his work cleaning Versova beach in Mumbai but his battle against marine plastic pollution goes much deeper.
- Every week, he and his volunteers clean beaches and mangrove swamps, and visit schools to educate children about what they do.
- Another key element of Shah's five-point action plan is his work among the 50,000-strong population of two beach-side settlements -- what he calls human-ocean conflict zones -- to educate them about the devastating effects of plastic litter and turn them into zero-waste communities.
- Key to his strategy is his belief in the importance of changing mindsets.
- "The problem is not with plastic," he says. "The problem is our empathy towards plastic or how we handle plastic."




Specially-abled

RAJAPPAN IS AN INSPIRATION

- The 73-year old Mr NS Rajappan, a native of Kottayam in Kerala, who is paralysed below his knees, has been engaged in collecting plastic bottles floating on the Vembanadu backwaters to find his livelihood.
- He has been removing the bottles for the last several years from the prestigious, yet polluted Vembanad brackishwater lake, a Ramsar site. His untiring efforts and determination is an inspiration.
- A self-determined and selfless service to clean the lake. He has been awarded The Supreme Master Ching Hai International's World Protection Award.
- He received a special appreciation by **Shri Narendra Modi, Prime Minister of India** through his monthly radio programme- 'Mann Ki Baat'.

Image: Pro Media, Nandu KS

Be PART OF THE BEACH CLEAN-UP CAMPAIGN

The goal of a beach clean-up program is to remove any litter that may have accumulated on the beach or washed up from the ocean. This litter can be harmful to marine life and the environment, as well as to human health and safety. Beach clean-up programs can be organized by local communities, environmental organizations, academic institutions or government agencies. They may involve a one-time event or ongoing efforts to keep the beach clean throughout the year. The program typically involves providing volunteers with gloves, bags, and other tools to collect and dispose of litter properly. The collected waste is often sorted and recycled where possible. Participating in a beach clean-up program can be a great way to make a positive impact on the environment and meet like-minded people who share a passion for protecting our planet.

Skip A STRAW MOVEMENT!

- The **"Skip a Straw"** movement is an environmental campaign aimed at reducing the use of plastic straws, which are a major source of plastic pollution in the world's oceans. Besides, in many cases a straw is 'unnecessary' luxury!
- The campaign encourages individuals, businesses, and governments to reduce their use of single-use plastic straws or switch to more eco-friendly alternatives, such as reusable metal or bamboo straws.
- The movement gained popularity on social media and has been adopted by many organizations and businesses worldwide as a way to reduce their environmental impact.
- Hundreds of individuals and organizations including restaurants have joined this movement.

Green ACADEMIC INSTITUTIONS

- The academic institutions such as Universities can adopt green protocols, a set of practices and policies aimed at promoting environmental sustainability and reducing their carbon footprints.
- The critical components in this include actions towards energy conservation, waste reduction, sustainable transportation, sustainable food, and environmental education.
- The green protocol adopted by the University of Kerala exclude all plastic and single use materials from the academic programmes, including seminars, use of steel/porcelain plates and cups for catering, use of nature-based materials for decorations, etc.
- The UNEP has published "Greening Universities Toolkit: Transforming Universities Into Green and Sustainable Campuses"
- **Under the ECOMARINE project supported by the European Union, the University of Kerala has also launched a Programme called 'Ink Pen Drive', to promote the use of ink pens rather than plastic pens, to avoid the use of Single Use Plastics by the faculty and students.**

An ink pen may be a weapon of choice to fight the plastic menace.
Leave your plastic pen and use ink pen…an option to reuse resources and refuse plastics!
Have Your Ink from us and join the 'Ink Pen Drive' of the ECOMARINE project.

Calculate YOUR CARBON FOOTPRINT!

- Think about everything you have touched today. Your toothbrush, the shower curtain, your laptop, your telephone… We can't avoid it – we are surrounded by plastic. The material has become so ubiquitous that we believe that we can't live without it anymore.
- **My Little Plastic Footprint App**

https://www.plasticsoupfoundation.org/en/what-we-do/health/my-little-plastic-footprint/

The

FUTURE IS IN THE HANDS OF YOUNG PEOPLE!

- There is greater optimism when the young leaders like **Greta Thurnburg** lead the strike for change.
- **We need to change and the initiate should start with the young children, then to their homes, society and nation.**
- Start asking genuine questions to ALL polluters!
- **Start discussing sustainable solution for a better PLANET**

The problem of plastic pollution in the ocean is even worse than anyone feared. There's actually more microplastic 1,000 feet down than there is in the Great Pacific Garbage Patch."
We can't continue like this.
Greta Thurnburg#ecologicalbreakdown #WorldOceanDay

Ocean Literacy

AWARENESS USING ALL MEDIA, USING ALL TECHNOLOGIES AND ALL CULTURAL/RELIGIOUS EVENTS TO SPREAD AWARENESS ON OCEANS

Things You Can Do to Save the Ocean

- Mind your carbon footprint and reduce energy consumption
- Make safe, sustainable seafood choices
- Use fewer plastic products and totally avoid single use plastics
- Help take care of the beach and help others cleaning the beach
- Don't purchase items that exploit marine life
- Support organizations working to protect the ocean
- Influence change in your community
- Educate yourself about oceans and marine life
- Educate others on the importance of oceans and marine life
- Speak for the oceans

Spread The Word

Every action we have has an impact upon our planet. Let people know why the environment is important, how plastic can impact on nature, and what they can do to take care of it. We can only help the planet if we do it together!

1 ***Trapped in a Deadly Web:*** *The Devastating Consequences of Ghost Nets on Coral Reefs and Marine Life; Andaman and Nicobar islands, India. (Photo: Umeed Mistry)*
2 ***The Ugly Truth:*** *Our careless discarding of plastic waste in nearshore regions, would ultimately suffocate the oceans: A scene from Sakthikulangara, Kerala. (Photo: Biju Kumar)*

An Ocean of Abundance: *A clean and healthy ocean would nurture the livelihood of thousands of fishers in India, besides ensuring a wide array of ecosystem services for the mankind: A scene from Lakshadweep*

Photo: Biju Kumar

Photo: Biju Kumar

Nature's Haven: *The Serenity and Splendour of Lakshadweep's Pristine Beaches*

Photo: Biju Kumar

Pure Bliss: *Ocean's Joyous Embrace as Children Revel in the Delight of Swimming. Scene from Lakshadweep*

THERE ARE MANY THINGS PEOPLE CAN DO TO HELP PROTECTING THE OCEANS. EVEN PEOPLE LIVING FAR FROM THE OCEAN CAN HAVE A POSITIVE EFFECT ON MARINE ECOSYSTEMS BY REDUCING PLASTIC POLLUTION IN THEIR LOCAL WATERWAYS, AND SPEAKING OUT FOR THE FUTURE OF OUR OCEANS.

“Not only are plastics polluting our oceans and waterways and killing marine life – it’s in all of us and we can’t escape consuming plastics.” – *Marco Lambertini, Director General of WWF International.*

Be the change that you wish to see in the world

Mahatma Gandhi

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PLASTICS IN THE OCEAN

Source to Sea : Pollution to Solution

BIJU KUMAR A. | SUVARNA DEVI S.

This book takes readers on a profound journey into the alarming world of marine plastics pollution. As the ocean's silent crisis unfolds, this eye-opening book unveils the staggering magnitude of the problem, its devastating impacts on marine life, and the urgent need for action. Dive beneath the surface as the narrative uncovers the startling truth about the origin and journey of plastics into the ocean, their 'avatar' as microplastics and entry into various organisms and through the food web, and finally back to human beings. Yet, amidst the despair, it also illuminates the inspiring stories of people involved in beach and ocean clean-ups and offers solutions to pollution through upstream and downstream interventions. A clarion call for action, this book, with vivid imagery, is an essential read that will forever change the way you view the world's most precious ecosystem. Join the journey, be inspired, and become part of the movement to restore the health and vitality of our oceans for generations to come.