THE PLASTIC EPIDEMIC

AN INSIGHT INTO PLASTIC POLLUTION IN INDIA

CRADLE TO GRAVE | BIODIVERSITY | ECOSYSTEMS
CLIMATE CHANGE | COVID-19 | GANGES RIVER
OCEAN POLLUTION | GRASSROOTS WASTE MANAGEMENT

STORIES FOR THE UNITED NATIONS ENVIRONMENT PROGRAMME'S COUNTERMEASURE PROJECT

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Counter MEASURE
FOR PLASTIC FREE RIVERS

The CounterMEASURE project, launched in 2019, aimed to promote countermeasures against riverine plastic pollution in Southeast Asia and India, a major contributor to plastics in the marine environment. It was funded by the Ministry of Foreign Affairs (MOFA), Government of Japan and implemented by the United Nations Environment Programme in collaboration with multiple partners.

During the first phase of its implementation in India (May 2019 to May 2020), the project identified plastic leakage pathways through assessments in the cities of Prayagraj, Agra, Haridwarand Mumbai. The findings were used in inform policy at the local and national levels, as well as for outreach activities to raise awareness about plastic pollution. In its second phase (May 2020 to March 2022), the project expanded on efforts of the first phase, focusing on the cities of Haridwar, Agra, Prayaraj and Patna, for mapping of plastic leakage hotspots, and macro and microplastic assessments. Recommendations for city, state and national action plans have been developed for tackling marine plastics pollution. The project also supported research, and policy advocacy on the impact of plastic pollution on wildlife, particularly migratory species.

Outreach and awareness creation through print, social and electronic media was an important aspect of the project. This e-book is an anthology of twelve articles published under the project on different aspects of plastic pollution in India.

AUTHORS' NOTE

This compilation of articles based on research and interviews, explores the linkages of plastics with industry, social initiatives, ecosystems, and climate change, among other key issues, pertinent to India. We hope it serves as a compass in navigating the often-overwhelming issue of plastic pollution. We are grateful to the CounterMeasures team for giving us this opportunity and for all their support in our endeavours. We thank the Mongabay India team for their valuable suggestions and for publishing these pieces.

ANUSHA KRISHNAN

Anusha Krishnan is a bioscience writer interested in a wide range of biology-based topics, ranging from molecular biology and biochemistry to behaviour and ecology. She writes for online news sites such as Mongabay India, The Wire Science, and IndiaBioscience. Anusha has a PhD in Ecology from the Indian Institute of Science but abandoned a career in academia – despite a good publication list and strong research skills – in favour of communicating science.

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THE LIFE OF PLASTIC:

born a hero, dying an outcast, resurrected a monster

BY ANUSHA KRISHNAN

Plastic is a boon to many industries as a versatile material that can be moulded into myriad products from simple packaging bags to life-saving medical devices. When a plastic product is made, it is usually a hero – the ideal, low-cost, easily scalable answer to many industrial needs.

However, most used plastic products die as outcasts – openly burnt, buried, or discarded into overflowing landfills and leaking into terrestrial and aquatic environments.

According to a recent UN Environment Programme (UNEP) report, plastics currently make up at least 85% of all marine litter. An estimated 11 million metric tonnes of plastic are entering the world's oceans every year, and without urgent action, this number is set to increase to a quantity of 23-37 million by 2040 – equivalent to 50 kilograms of plastics per metre of coastline worldwide.

But the story of plastic does not end there. Plastic waste comes back with a vengeance as a toxic waste monster in soil, air, water, and on land, where it strangles and chokes life. In order to tackle the issue of plastic waste, we need to break the chain of events that lead to its leakage into the environment; and strengthen circularity in the material life cycle of plastic.

Cover image credit: Aparna K via Wikimedia Commons
Plastic litter at Cauvery Wildlife Sanctuary.

What is the material life cycle of plastic?

The material cycle of plastic consists of seven stages according to CounterMEASURE, a project by the UN Environment Programme (UNEP) and the Government of Japan, which aims to track, survey, and offer solutions for reducing plastic leakage into rivers in Asia. Stage 1 involves material engineering, where plastic manufacturers decide on what raw materials – petroleum-based or non-petroleum-based, recycled or virgin, or a mix of the two – will be used to create the primary product. In stage 2, the production and business models determine what end-products are made. These two stages collectively determine the reuse and recycling capacities of plastic products.

Stage 3 deals with the consumers' use, reuse, and behaviour; for example, some consumers tend to reuse PET bottles many times before discarding them, whereas others do not.

Stages 4, 5, and 6 deal with the collection, recycling/repurposing, and conversion or disposal of plastics, respectively. These stages affect the leakage of plastics into the environment. If collection is efficient, reuse is low, and disposal systems are inefficient, plastics flow through drainage and sewer systems or directly into water bodies. To minimise this loss, stage 7 uses clean-up drives in areas where the leaked plastic accumulates in a final attempt to recover plastic waste from the environment.

However, a lot of plastic escapes this cycle and is 'lost' into the environment.

What is 'lost' plastic?

In India, according to the Central Pollution Control Board, nearly 3.5 million tons of plastic waste was generated in the year 2019-2020. Of this, about 60% was reported as recycled, while the other 40% was 'lost' as mixed waste to poorly managed landfills and water bodies. Many of India's urban, rural, and even protected areas are heavily contaminated with this 'lost' plastic waste, as are its lakes, rivers, and seas.

Estimates from recent clean-up drives in Mumbai, Haridwar, Prayagraj, and Agra, indicate that 10-100 metric tonnes of plastic waste leaks into the surrounding ecosystems. Other reports from iFOREST (International Forum for Environment, Sustainability & Technology) indicate that about 35% of all the plastic waste generated in Haridwar and Rishikesh ends up mainly in the Ganges river. Data from these clean-up drives show that most of the lost plastic waste consists of lightweight and single-use plastics – such as thin polythene covers, toffee wrappers, straws, bottle caps, disposable cutlery, and multilayer packaging used as sachets and food packets.

Along the peninsular coast of India, in the major trawling grounds off Cochin, Ratnagiri, Mumbai, Veraval, and Visakhapatnam, plastic litter is a major problem, finds a 2020 report from ICAR-Central Marine Fisheries Research Institute. In these intensely fished areas, fishing boats routinely encounter 2-55 kg/km2 of plastic waste composed of polythene covers, packaging waste, and derelict fishing gear. On average, 0.3–3.8% of the total weight of a fish catch is marine plastic litter; since plastics weigh much lesser than fish, this fairly low weight percentage likely does not reflect the sheer volume of the plastics caught by trawl nets.

Another trawl-based study in 2021 from ICAR-Central Institute of Fisheries Education has found that marine debris, which is 90% plastic, makes up nearly 5.5% of every fishing haul along the Arabian coast.
A survey of six beaches in Kerala by researchers from the Cochin University of Science and Technology and the ICAR-Central Institute of Fisheries Technology in 2017-18, has found that about 70% of beach litter is plastic. Of this, nearly half was fishing-related plastic such as ropes, nets, buoys, and floats while the rest was foamed plastics, footwear, PET bottles, and food containers. In another study, published in 2020, from the Marine Research Institute at Tuticorin, Tamil Nadu, eight beaches in the area were assessed for plastic beach litter; a whopping 70–80% of the plastic litter found was single-use plastic.

How does lost plastic get 'lost'?

The most common reason for plastic waste escaping the reuse/recycling route is ignorance. Perception surveys in Mumbai indicate that only 30% of participants are aware of the amount of plastic waste generated and only 44% are aware of the ban on single-use plastic in the city. In Haridwar and Rishikesh only one in four people are aware of sustainable waste practices, and most households do not practice waste segregation.

Besides this, previous work and some preliminary data from the CounterMEASURE project indicates that many fishermen along the Ganges either lose or dispose of worn out fishing gear and nets along embankments or into the river itself. Yet, they are not blind to the problems these practices cause and express interest in conservation drives to save the Gangetic dolphin – an animal that faces grave danger from choking and drowning due to entanglement in the discarded nets.

Religious practices are another reason for plastic entering the Ganges, finds an investigation by the National Productivity Council. In Haridwar, pilgrims often purchase plastic cans near the embankments to carry Gangajal or holy Ganges water. These plastic cans are considered to be as auspicious as the Gangajal itself and are disposed of by 'immersion' in the river.

In other areas such as the mountains, plastics cause a very different type of problem – by changing waste profiles and escaping into the landscape due to ineffective waste collection.

The 'Himalayan Cleanup', a joint initiative started in 2018 between Zero Waste Himalaya and the Integrated Mountain Initiative (IMI), has thrown some light on how this happens. "Waste managers in the mountain states are facing a huge challenge as the waste profile has changed so much over the last few years," says Priyadarshinee Shrestha, Secretary IMI. "Now there is so much non-biodegradable waste that is also non-recyclable. Traditional methods of waste management simply cannot handle these wastes at the volumes they are being produced in," she adds.

Roshan Rai, a councillor at IMI and development practitioner with the Darjeeling-based NGO DLR Prerna explains that mountain geography and scattered human habitations pose immense problems for the logistics and costs of everyday waste collection and disposal. "Although tourism adds to the pressures of plastic waste in the mountains, it's not the only contributor," says Rai. "Our entire production system is geared to produce waste. Such a flawed production system has meant that the resident urban and even rural populations in the mountains are producing more plastic waste than we can handle."

The pristine landscape of the Himalayas is sadly no more. In many cases, the plastic waste 'lost' in the mountains makes its way back to civilisation through the many streams and rivers that arise in this majestic land. Studies on the Himalayan regions of the Ganges, Brahmaputra, and Indus rivers reveal that minuscule plastic particles are present in river water and sediment.

Plastic particles in garbage. **Photo by Parvathisri/Wikimedia Commons.**

How do we tackle the issue of plastic waste?

To decide how plastic waste must be handled, knowledge on what kinds of plastic wastes are being produced is essential. Thus, trash audits – inventories of waste – of what waste is generated where, by whom, and in what amounts are necessary. Since waste production can be highly variable across areas, economic/industrial sectors, and socio-cultural contexts, this information will be crucial for situation-specific waste management approaches.

In India, efforts are underway to curb the leakage of plastic waste into the environment. These include mass clean-up drives and plastic deposit schemes such as garbage cafés that offer meals in exchange for plastic, a school that accepts plastic waste as fees, and phone recharges offered by the Indian Railways in exchange for plastic bottles. Along with these initiatives, the Indian government is also encouraging the use of collected plastics in laying roads, as fuel for cement kilns, and diesel production through pyrolysis.

While these endeavours are laudable, they are yet to stand the tests of time, especially as questions on their economics, logistics, and sustainability arise.

Meanwhile, although several plastic bans have been put into place by various states in India, their usefulness is questionable. A peek into the history of plastic bans in India shows that although some good has come of them, most bans aren't very successful due to an absence of market-based and municipal support system.

Banner at Victoria Memorial, Kolkata. **Photo by Adam Jones, Ph.D./Global Photo Archive/Flickr.**

Is a plastic-free life possible?

"Although I don't think an entirely plastic-free life is currently possible for a lot of people, we can do a lot to reduce plastic consumption," says Soumya Prasad, the founder of Do no trash, a collective based in Dehradun committed to adopting sustainable living practices and promoting a plastic-free life. The collective's 30-day plastic-free challenge offers simple solutions to reduce or even eliminate plastic in our daily lives. The Do no trash ecostore has a range of eco-friendly products such as bamboo toothbrushes and baskets to help people transition to low-plastic-use lifestyles. "We are hearing about other stores in Dehradun that are beginning to stock similar eco-friendly products, and frankly, that's wonderful," says Prasad. "I'm happy to see that there's a market for non-plastic products, since their availability to consumers is the first step towards moving away from plastics," she adds.

While other initiatives like cutlery banks and crockery banks also gain popularity as plastic-free alternatives for serving food and drinks at large gatherings and public functions, an important question arises – how far can consumers carry the burden of reducing plastic waste?

“Unless there are systemic solutions and better designs from the producers, the issue of plastic waste cannot be resolved,” says Shrestha, adding that the Himalayan Cleanup project was one of the first exercises that drew public attention to extended producer responsibility under the Plastic Waste Management Rules of 2016.

Though slow on the uptake, industries are also beginning to realise this. Many companies are attempting to use less packaging and incorporating recycled plastics in their packaging. Others are mulling a shift to fully recyclable plastic pouches from the notoriously difficult-to-recycle multilayer plastics. Designs and fabrication methods for mixed-material products that can be readily recycled are being developed, as are products with modular designs; modularity ensures that different components of a product can be replaced independently to delay that product’s entry into the waste stream.

In addition, non-hazardous packaging substitutes and biodegradable plastics are also being explored as possible replacements for most common single-use plastics. Unfortunately, switching to these alternatives will also require well-run industrial-scale composting systems to handle the large quantities of greenhouse gases that will arise when such products enter the waste stream.

Despite these setbacks, both industries and consumers need to rethink traditional economic models of business with linear trajectories hard-wired to produce waste.

This will not only lay the foundations for a more circular economy, but can trap plastic within a material life cycle and prevent its resurrection as a toxic monster.

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By Anusha Krishnan
10 November 2021

ANTHROPOCENE:
What is the effect of plastics on ecosystems?

BY DEVAYANI KHARE

The Anthropocene - a proposed but still to be accepted term, represents the epoch when human activity began to leave an indelible, irrefutable mark on the planet. How would we determine if and since when has human activity been critically shaping the processes on Earth? The answer lies in rocks, seafloor sediments, and glaciers.

For over a decade, scientists from around the world have been collecting core samples from rocks, sediments, and ice in search of signatures from human activity. Such signatures include concentrations of mercury or lead pollution, heavy metals, fly ash, nuclear debris from the atomic age, isotopes in the rocks, trees, atmosphere, or humans, and plastics, especially microplastics. As none of these occur naturally, concentrations preserved in the geological record can be attributed to human industrial activity. This will help researchers, both in the present and the future, to identify the telltale, dramatic spike in the range of human activities, a period known as the 'Great Acceleration'.

Of all the evidence, plastic is poised to be the most perceivable, persistent, and pervasive indicator of the Anthropocene. After all, plastics are everywhere! There is a lot of recent research on the impact of plastics in different ecosystems; terrestrial, freshwater including wetlands, lakes, and rivers, and marine systems from continental shelves to deep ocean trenches. Yet we have not grasped how interlinked these ecosystems are, how plastic travels through them, its effect on biodiversity and how it will impact the entire biosphere.

Cover image credit: MarufRahman via Pixabay
Segregation by hand of plastics at a site in Bangladesh - one among many developing countries where trash from developing countries is shipped for recycling, though most of it ends up in landfills or waterways.

Most plastic originates on land, but is often dumped into wetlands, lakes, and rivers contaminating the shores, banks and beds. These waterways serve as conduits for plastic to travel further out past the estuaries, into seas where it settles on continental shelves or is carried across the open ocean. Within each waterbody, different organisms interact with plastics in different ways; some inhabit these new, long-lasting surfaces; a few others eat it and break it down for energy; but most ingest it, get entangled in it or are poisoned by the toxins with dangerous, often fatal results. The impact of plastics is overwhelmingly negative, and we are just beginning to realise the scale of the problem. Sometimes, the scales can be minuscule, as with microplastics, yet can have cascading effects on ecosystems.

The Butterfly Effect - how do microplastics affect terrestrial and aquatic ecosystems?

In chaos theory, the butterfly effect describes how small changes can have non-linear impacts on complex systems - often compared to a butterfly flapping its wings, and causing a typhoon. Microplastics have a similar result in ecosystems, as per a recent Environment Research paper by S. Sridharan et al. “Most research focuses on the effect of microplastics on biodiversity and human health, yet there was a marked absence of documentation on how different ecosystems are affected,” explained Srinidhi Sridharan, a senior research fellow at CSIR-National Environmental Engineering Research Institute (NEERI), and first author on the paper. “Hence, via an extensive literature review, we tried to understand the impact of different microplastics on terrestrial and aquatic ecosystems, as well as how they affect the ecosystem services rendered by different keystone species or bioindicators,“ she continued. Keystone species are those that play a crucial role in an ecosystem, and thereby ‘hold it together’. Bioindicators are organisms that are susceptible to small, adverse changes, and used to study environmental health.

Earthworms are key to soil ecosystems, and research has shown how microplastics affect their growth and metabolism, and their ability to render crucial ecosystem services.

Image credits: Anaterate via Pixabay

In terrestrial ecosystems, earthworms, springtails, mites, and some land snails are important denizens that facilitate soil nutrient cycling via decomposition, burrowing, tilling, and aeration. Soil can be contaminated with microplastics through sources like composting, sewage waste, agricultural run-off, and mulching. Studies on microplastic contamination in soil bioindicators documents poor reproductive success, retarded nutrient absorption and growth, increased antibiotic resistance, behavioural changes, and neurotoxicity. This will have consequences on agriculture productivity or what is known as the green economy.

Terrestrial mammals such as the polar bear, a keystone predator in the northern hemisphere and the Asiatic elephant, key to maintaining grasslands across the Indian subcontinent, also interact with microplastics and its chemical toxins, yet no physiological and ecological effects have yet been documented.

Terrestrial ecosystems are intrinsically linked to aquatic systems, as water, sediments and organisms move from one to the other, as do the contaminants. Bioaccumulation - the toxic build-up of chemicals as they travel up the food chain, begins here, and can have far-reaching implications across the biosphere. Yet research on the terrestrial impact of plastics falls far short of those in aquatic habitats. More documentation is crucial to understanding how contamination can spill over into other ecosystems.

Bioindicators in freshwater and brackish water such as aquatic plants, various plankton and crustacean species, zebrafish and other fish, also interact with microplastics, much to their detriment. Deformed larvae, reduced mobility due to neurotoxicity, impaired immunity, and increased death rates, are among some of the effects studied. Microplastic ingestion has also been recorded in some swamp eels, pond loaches and freshwater crayfish - key species for nutrient cycling in aquatic systems, though the long-term impacts remain to be studied.

While freshwater organisms do not migrate to the sea, microplastics can travel via water currents, ever-shifting sediments along lake and river bottoms, airways, and even precipitation, to reach other aquatic or marine ecosystems.

Studies on marine Prochlorococcus bacteria exposed to plastic leachates showed poorer photosynthesis efficiency, and productivity. If other autotrophs are similarly affected, this could have staggering consequences across marine food webs. Microplastic ingestion by filter feeders such as larvaceans, oysters and mussels hinders their ability to filter water of organic and inorganic pollutants, and causes plastics to be inadvertently transferred through marine ecosystems. Contaminated or dwindling fish stocks will cripple global fisheries or the blue economy, and lead to bioaccumulation further up the food chain. The list goes on.

Carbon Sinks - a legacy in sediment and coal

Phytoplankton, along with their grazers, the zooplankton, play crucial ecosystem services throughout their lives and even in death. As a substitute diet for plankton, microplastics are disrupting the fine balance of nutrient cycles in aquatic ecosystems.
Image: Public Domain

Plankton are the invisible heroes of many aquatic and marine ecosystems, as they provide food for a variety of species. Microalgae or phytoplankton, are unicellular, photosynthetic organisms that occur as individuals, in chains, or clusters through aquatic ecosystems. Phytoplankton are eaten by zooplankton, and are in turn consumed by molluscs, small crustaceans like shrimp and krill, sardines, herrings, manta rays, and even baleen and blue whales and form crucial links in aquatic food webs.

A study on aquatic microalgae determined that its growth, shape, and photosynthetic activity are adversely affected by the chemicals in microplastics. Another paper highlights how zooplankton stray from their usual diet of phytoplankton, and graze on microplastics instead. These changes can disrupt the entire food chain, hamper the nutrient cycling of phosphorus, nitrogen and carbon, and may cause plastics to accumulate further along trophic levels.

Plankton interact with plastics in other ways too. Along with other microorganisms, they inhabit plastic surfaces, creating a plastisphere - an ecosystem of discarded waste in open waters. The plastisphere, as per the Mare Plasticum - The Plastic Sea chapter, is a mini-ecosystem in itself, with primary producers, grazers, predators, parasites, symbionts, and nutrient recyclers. Plastispheres may increase productivity in the otherwise unproductive ocean ecosystem yet they serve as islands for harmful invasive microbes to travel across wide ranges, emitting greenhouse gases and ferrying antibiotic resistance genes along the way. Studying these man-made ecosystems will be crucial in the years ahead.

Interestingly, plankton play a vital role even in death. When plankton die or are consumed, they cause particles of carbon to sink from the surface to the deep ocean in a process known as marine snowfall. Some of this carbon is consumed by sea organisms along the way, some gets chemically broken down, but most of it reaches the deep ocean where it settles for hundreds or thousands of years. The ocean bed is an essential carbon sink for anthropogenic carbon emissions. When the plankton cycles are affected, they could have consequences for the oceanic carbon sinks, and also disrupt global biogeochemical cycles. If plastic travels along with sinking plankton, it will find its way into the ocean sediments and the geological record, and bear testimony to the Anthropocene.

In India, ospreys migrate from the Siberian stretches to the tip of the subcontinent, and have been observed using plastic material for their nests. Species across trophic levels interact with plastics in different ways, yet migratory species are more exposed to plastic, and thereby, its adverse effects.
Image credit: John581, CC BY-SA, via Wikimedia Commons.

What lies ahead?

Microplastics are ubiquitous, and their effects undeniable. “We have enough data to conclude that microplastics are hazardous to the functioning of keystone species and ecosystem services,” Sridharan adds. Yet most papers end on inconclusive notes. Researchers are unwilling to comment on the large-scale, or ecosystem-level impact of plastics, and call for more studies to be conducted. This might be in part due to the caution scientists naturally exhibit, as hard evidence is what good science is founded on, or partly due to some studies with no discernible, measurable impacts on biodiversity. Yet as Dr Ritesh Kumar, director of the Wetlands International South Asia (WISA) cautions, “with research analyses, the absence of evidence, should not be mistaken as evidence of absence”.

To add to the evidence, the CounterMEASURES II project, implemented by UNEP, hopes to generate new knowledge for policy changes at the local, national, and global levels. The recent report by the Convention on Migratory Species (CMS) and the United Nations Environment Programme (UNEP) highlighted the disproportionate impact that plastics have on migratory species. “Early next year, the Wetlands International will release a wetlands management plan with a species risk assessment tool,” reveals Dr Ritesh Kumar.

“Future research should focus on documenting the microplastic cycle, with standardized frameworks to quantify the generation, segregation, recycling, disposal, leaching of waste, to better understand the scale of the problem,” suggests Dr Manish Kumar, a project scientist at CSIR-NEERI, and a co-author on the Sridharan et al paper. “Research cannot keep generalizing plastics and microplastics, the latter needs to be categorized as a pollutant in its own right,” interjects Sridharan. “Integrated, interdisciplinary research correlating the abundance of plastics with the degradation of habitats, the biotic and abiotic disruptions, and the long-term implications for the biodiversity and ecosystems at large, with ground assessments wherever possible, will be key to finding effective solutions,” they both concur.

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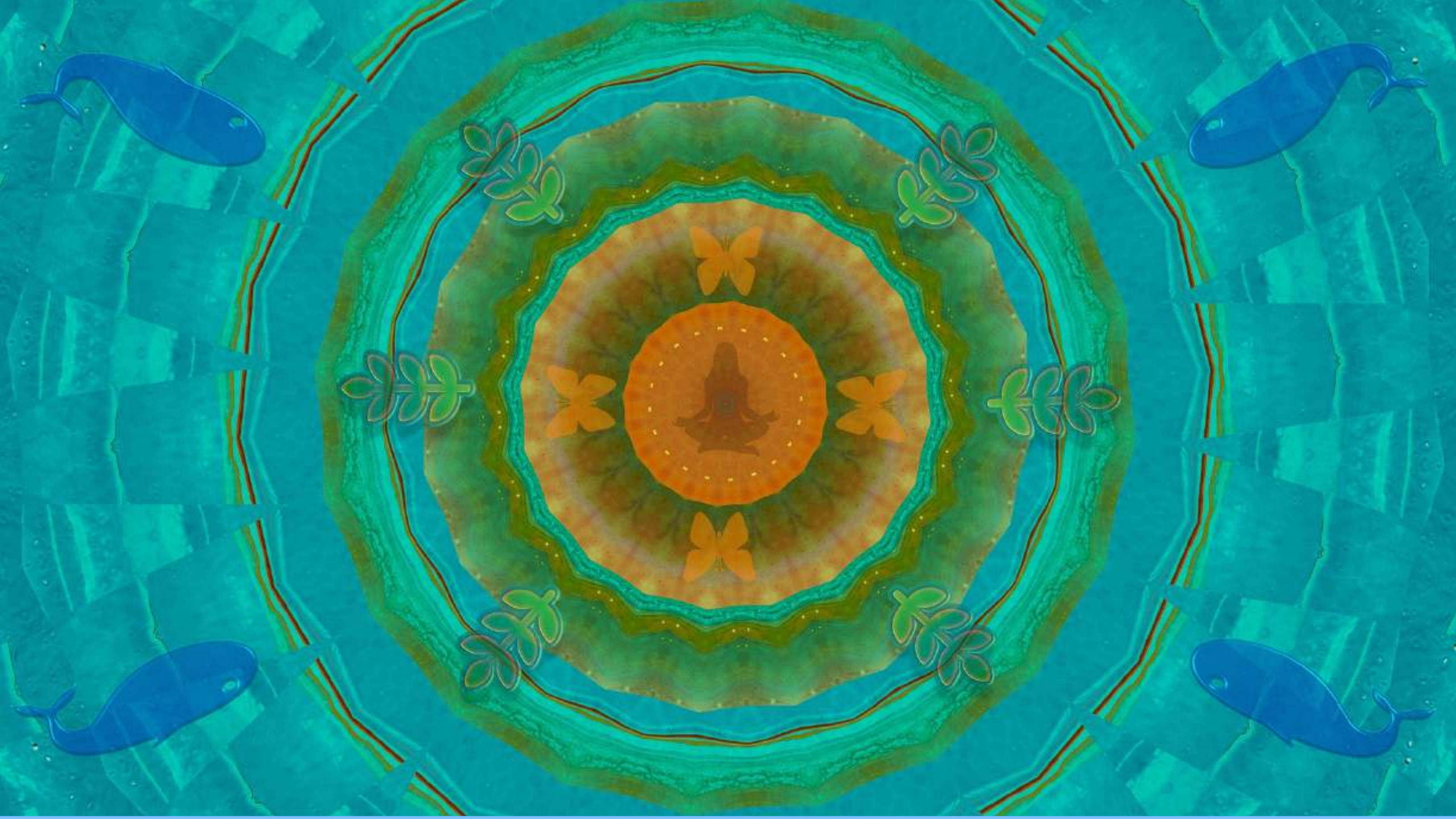


FANTASTIC BEASTS AND WHY PLASTIC IS BAD FOR THEM

BY ANUSHA KRISHNAN, KARTIK CHANDRAMOULI & LABONIE ROY

Plastics, which are infinitely useful materials, are ever present in our lives today. A quick look around one's house, whether in a city or in a village, will confirm this - every room will have at least one plastic product in it.

But plastic convenience comes with a heavy environmental cost.

The global carbon footprint for plastics, according to a 2021 report in Nature Sustainability, was calculated to have been two billion gigatons of carbon dioxide equivalent in 2015 alone, which accounted for 4.5% of global greenhouse gas emissions in that year. Apart from its effects on climate change, a many studies have documented the effects of discarded plastics on wildlife, especially in marine systems.

But did you know that plastics also affect land animals? While it is known that many wild animals visit dump sites to forage for food, and that microplastics (very small fragments of plastic invisible to the naked eye) can harm invertebrates like worms, very few scientific studies have looked at how plastics harm large animals. This is especially important when there is proof that large animals like elephants are eating and pooping plastics.

Cover image credit: Julius H via Pixabay

Indian foxes and plastic lunch boxes

Said the brown fox to her eager cubs,
"I've a new place to hunt!
The humans call it a rubbish heap,
But oh!
What precious things they dump!"

Into a stinking pile of trash
She and her cubs take a hasty dive,
Ripping into plastic packets
Is just another way to survive.

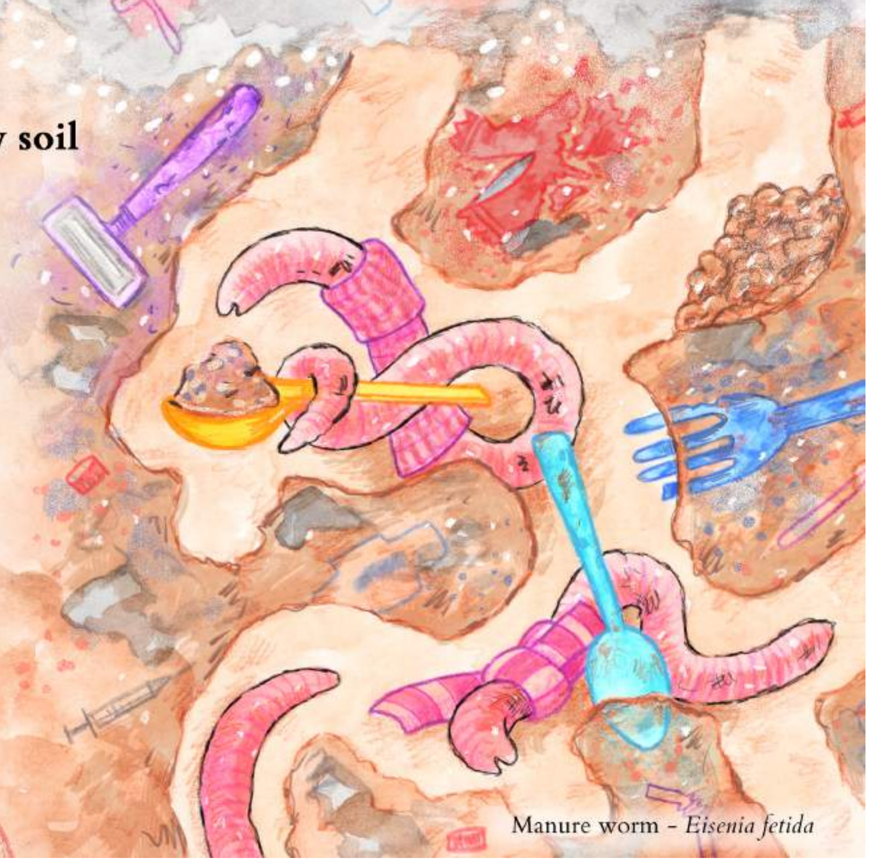
A fortune of calories they find
In a polythene bag of biscuits.
One more meal found in time,
So what if plastic's in their guts?

Indian fox - *Vulpes benghalensis*

When worms toil in plasticky soil

Microplastics in soil
Leave earthworms in a coil
For these invisible specks
Can be dangerous as heck.

They stunt the worms' growth
And affect the worms' skin
Cause hormonal confusions
That kill them from within.



Manure worm - *Eisenia fetida*

In Asia, plastic trash threatens the lives of many river and sea birds, according to a 2021 report from the CounterMEASURE project (which studies how the Ganges and Mekong rivers carry plastics from land into the seas/oceans, and is working to reduce this). Many birds find brightly coloured plastic twine/sheets/ribbons attractive and use them to line nests; but, these plastics can wrap around the birds' feet, wings, necks and heads to either strangle them or suffocate them.

In the Ganges, can you believe that ghosts can harm the river's wildlife? Sadly, this is true - plastic 'ghost fishing gear', which are lost or abandoned fishing tools such as nets, twine, ropes, etc. can entangle and choke many aquatic animals. Some scientists believe that since past studies focused heavily on ocean or marine systems, we have failed to understand how much plastic pollution threatens biodiversity in rivers and lakes. As of now, plastic pollution studies on river animals mostly investigate how microplastics affect fish and some invertebrates. The effects of how macroplastics (large pieces of plastic) affect mammals like otters and dolphins, and reptiles like turtles and crocodiles, are not very well known.

Of ospreys and plastic nests

A piece of pure misfortune
Is that colorful plastic sheet!
It will leave your fledglings orphaned
If it winds around your feet.

Here's a plastic ribbon,
A long piece of fishing line
And sadly, that little fledgling
Is tangled up in twine.

Oh Mr. and Mrs. Osprey,
Your carefully constructed nest
Is really (let's face it),
Not one of the best.

Osprey - *Pandion haliaetus*

Gharials and plastic fishing materials

The majestic Indian gharial,
Basking on a river bank's incline,
What is that in your teeth I spy,
A hank of plastic twine?

When you dive into the water
To hunt for a fish or four
You come back up trailing
A mass of broken fishing gear.

What's it do to your innards, one wonders?
As most scientists are too busy
Studying plastics and animals in the seas
To ponder how plastics affect the rivers.

Gharial - *Gavialis gangeticus*

Blind dolphins and plastic perils

The Ganges river dolphin
Which lives in waters murky,
Has a large melon head
And eyes that barely see.

Navigating by sound,
These strange but beautiful beasties,
Are alas in great peril
From floating plastic ghosties.

A mess of lost or unwanted
Fishing ropes and nets
Can tangle and choke these dolphins
To a sad plasticky death.

Gangetic dolphin - *Platanista gangetica*

Many studies have documented how plastic trash in the oceans harm or kill all kinds of marine life. Even plankton, the microscopic floating organisms that support the oceans' food webs, are affected by microplastics. According to the 2021 UNEP report titled 'From Pollution to Solution' on marine plastic pollution, the largest and most long-lasting types of pollution are caused by macroplastics (large pieces of plastic) in the form of lost or abandoned fishing gear and trash from inland sources. Externally, these macroplastics can entangle and suffocate marine species; internally, ingested plastics can choke animals or obstruct their guts and kill them by slow starvation.

Trash such as bottle caps, cigarette butts, and other small plastic products floating in the ocean become covered in algae that emit smells similar to many seabirds' main food sources – fish and krill. This tempts birds to eat plastic debris which accumulate in their stomachs and eventually starve them to death.

Birds' bellies full of plastic smellies

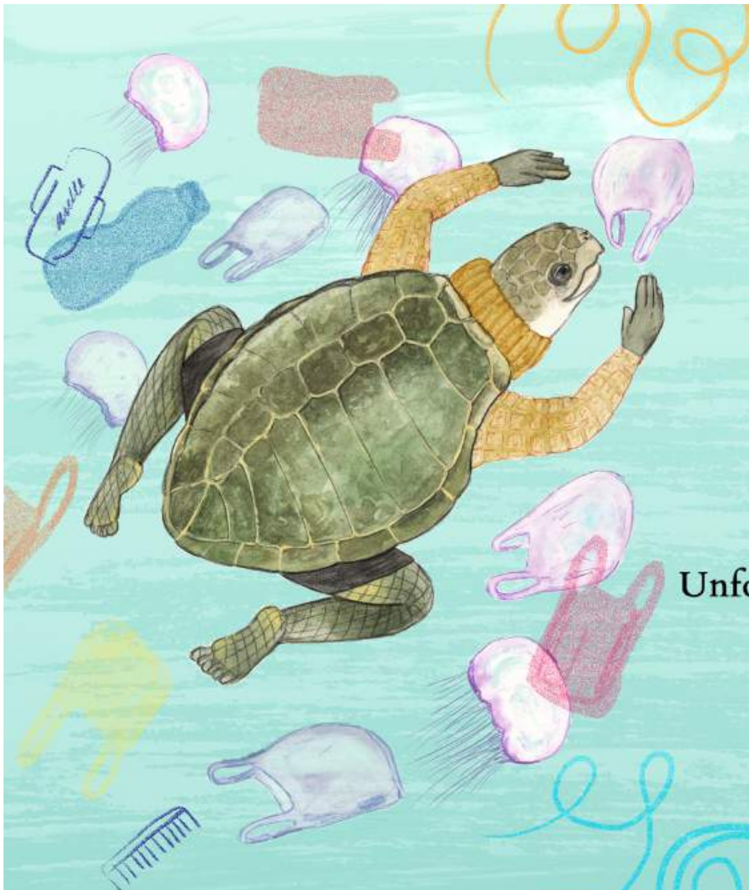
The stinky aquatic algae
That fish and krill eat,
Make clouds of dimethyl sulphide
A smell that most cannot abide.

But this odor that slaughters
A human's sense of smell,
Is much sought after
By the short-tailed shearwater.

Most unfortunately,
This smell now clings
To floating trash and debris
And discarded plastic rings.

So the poor shearwaters
Become very confused,
And end up with bellies
Full of plastic refuse.

Short-tailed shearwater – *Ardenna tenuirostris*



Turtles' bellies full of plastic jellies

A floating polythene packet
Billowing like a sail,
Catches the eye
Of a turtle passing by
One gulp, and it's in his gullet!

Unfortunate turtle! What have you eaten?
That wasn't a jellyfish meal divine!
T'was a piece of trash
That'll create a backlash
By stuffing up your poor intestine!

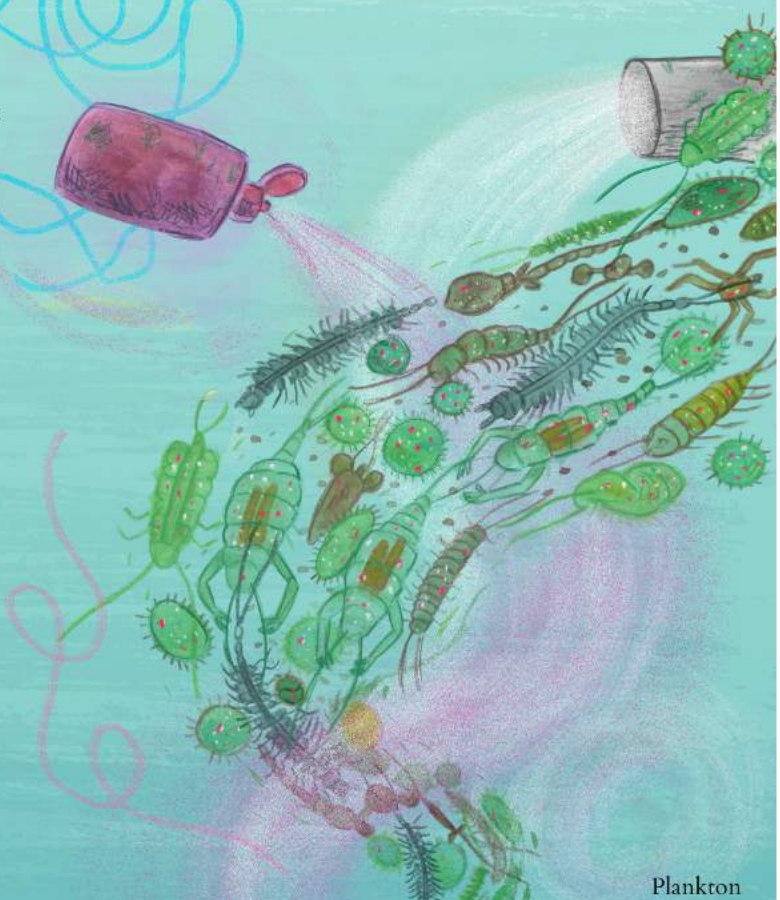
Olive Ridley turtle - *Lepidochelys olivacea*

Floating in plastic is not fantastic

The plastics in the oceans
Are affecting water columns
And making life difficult
For floating clouds of plankton.

This invisible army
That feeds many marine beasts,
And fixes tons of carbon
For oceanic feasts,

Is under a threat
From microplastic pollution,
Of fibres, beads, and pellets
That are synthetic poisons.



Plankton

Giant manta rays swim through plastic rain

The giant manta ray
Glides through the sea
Filtering out its food
Using teeth like a sieve.

But a rain of microplastics
That's sprinkling their food
Can poison these creatures
And cripple them for good.

Plastics coat their intestines
Plastics coat their skin
The rays are struggling with all our trash
In a battle they cannot win.

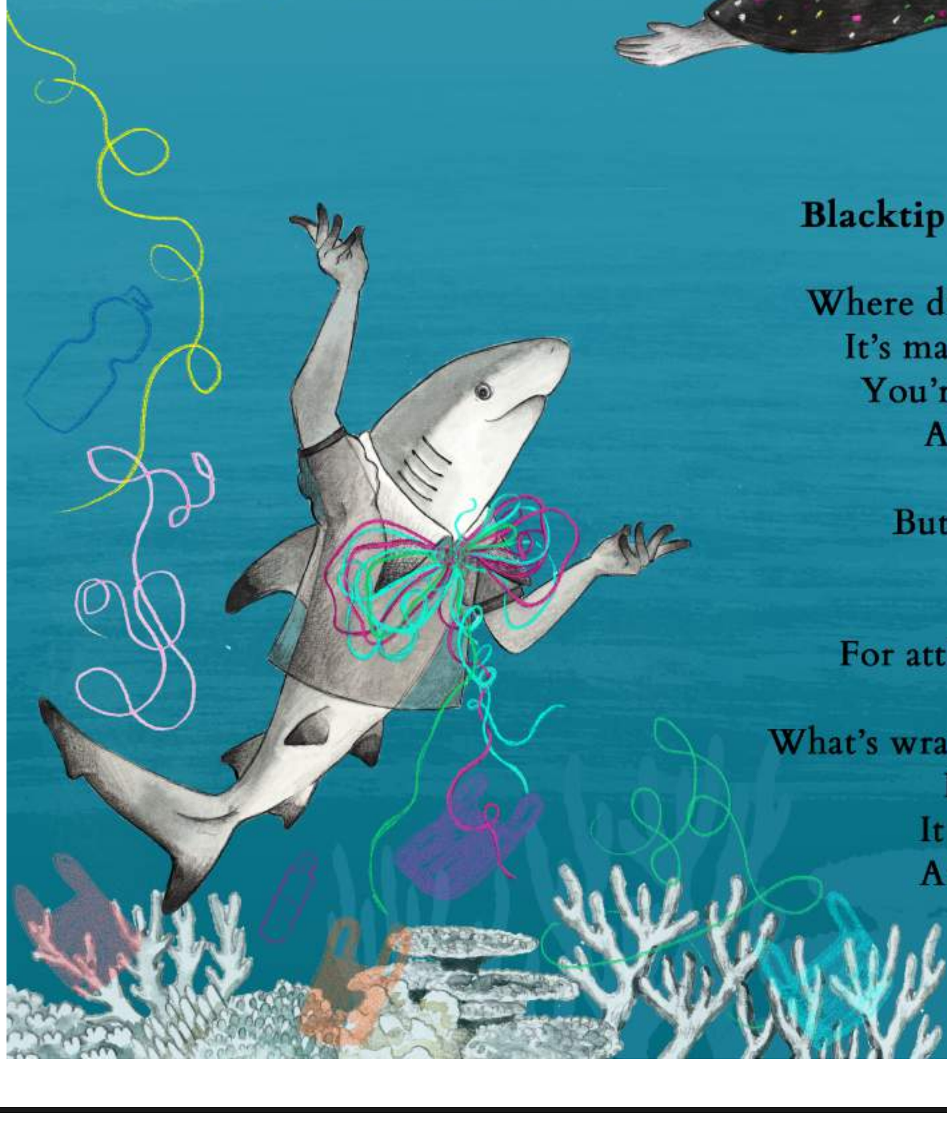
Manta ray - *Mobulus rostris*

Blacktip sharks caught by twine

Where did you get that lovely tie?
It's made of fishing twine, I see.
You're so in vogue, Mr. Shark,
Always so hip, oh so sharp!

But I wonder, is it advisable?
To sacrifice health
Which is such a wealth,
For attire that's just fashionable?

What's wrapped around your middle
It's not just plastic thread,
It will leave you in a pickle
And cut you to your death.



Blacktip shark - *Charcharhinus limbatus*

If we humans continue to produce and discard plastics at current rates, what does the future hold? If our water bodies turn into plastic soup, how will it affect life on Earth? It is perhaps worth pondering these questions the next time we reach for a plastic product.

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Fantastic beasts and why plastic is bad for them
By Anusha Krishnan
01 March 2022

THE MIGRATORY ROUTES OF PLASTIC

BY DEVAYANI KHARE

"There is symbolic as well as actual beauty in the migration of the birds, the ebb and flow of the tides, the folded bud ready for the spring. There is something infinitely healing in the repeated refrains of nature," wrote American conservationist Rachel Carson.

For many species, however, the repeated refrains of migration are more than just symbolic or healing. The journeys, often long and arduous, are undertaken for sheer survival. The assurance of better food or water supply, escape from inhospitable conditions, or the promise of mates and safe breeding grounds, stirs wildlife to undertake seasonal migrations across the globe. As species migrate, they run the gauntlet of increased predatory pressures, unfavourable or extreme weather conditions, some of which are linked to climate change, diminishing food supplies, habitat loss, and anthropogenic development that poses barriers to well-established routes. In recent years, plastic pollution has been added to this list of threats, as it is not just a burgeoning global problem, but one that disproportionately affects migratory species.

Cover image credit: G. J. Whitby via Pixabay
Unlike most migratory species, the Canada goose (Branta canadensis) is not instinctively tuned to migrating – it is a learned, adaptive behaviour due to the pressures of overhunting. When they migrate, their chances of interacting with plastic increase, like in this case.

When species migrate across the globe, their chances of encountering and interacting with plastic increase and they are, therefore, more vulnerable. As migrations are undertaken across continents, via land journeys, riverine routes, oceanic currents, or flyways, the effects of plastic pollution are far-reaching. Migratory species also play an unwitting role in transporting plastic across trophic levels and ecosystems – definitely a cause for global concern and action.

These concerns were highlighted in a recent report by the Convention on Migratory Species (CMS) and the United Nations Environment Programme (UNEP). Published in August 2021, as part of the CounterMEASURE II project, the report documents the threats faced by terrestrial, freshwater and avian migratory species in habitats across Asia and the Pacific.

So how does plastic affect biodiversity?

Based on size, plastic waste is divided into two types: macroplastics and microplastics. Macroplastics are large-sized materials that cannot be easily reused or recycled, and are discarded or accidentally lost from waste management cycles. Microplastics are 1 μm-5 mm sized particles designed for cosmetic, domestic or industrial use, or formed when larger plastics break down.

Macroplastics often entangle organisms making it difficult for animals to feed and in some cases, lead to smothering, or injuries such as the loss of a vital limb. Discarded fishing gear or ghost nets in rivers and oceans may also ensnare aquatic animals causing them to drown. Ingestion of plastics is another serious issue, resulting in gut blockages, and eventual starvation, in both terrestrial or aquatic species. When plastics are ingested, chemicals leaking from them accumulate inside the tissues resulting in a toxic build-up, a process known as bioaccumulation. If the contamination travels up the food chain, these toxins get concentrated at successively higher trophic levels in a process known as biomagnification. In aquatic systems, both riverine and marine, plastics form durable islands that organisms colonise. These islands facilitate the hitchhiking of non-native, invasive or pathogenic species to new regions, where they pose a serious threat to native biodiversity.

Microplastics, on the other hand, pose a different set of problems. This past decade, research into the impact of microplastics dispersed by human activities, weather phenomena, ocean currents, and planetary winds has yielded disturbing results. Microplastics have been found in the most remote of areas like the Mariana Trench, the deepest point in the world's ocean, within Arctic ice, in the freshwater channels at Antarctica, and even on desolate mountainous ridges. For organisms, the implications are more severe – microplastic ingestion can lead to particle toxicity, gut blockages, internal abrasions, tissue build-up or bioaccumulation, and inflammation affecting the fitness of an individual. At a population level, the effects may cause massive die-offs, however, no long-term studies of their impact on overall fertility rates have been undertaken yet.

Both macroplastics and microplastics are relatively new contaminants, yet as a worldwide issue, their impact on migratory species is undeniable.

India as a migration hub for terrestrial, avian and aquatic biodiversity

Every year, India receives 457 migratory species: 380 birds, 46 mammals, many of which are bats, 24 fish, and 7 reptiles. Their journeys that represent the country's tenuous, seasonal connection with almost all parts of the globe. Most migrants, both flighted and non-flighted, arrive in India via Central Asia over the Himalayas.

In the Himalayan stretches of Nepal, Bhutan and Sikkim, certain communities collect yarshagomba — a ghost moth caterpillar infected by the parasitic Cordyceps fungus, also known as Himalayan gold or Himalayan viagra. The yarshagomba is considered an aphrodisiac and hallucinogenic drug and commands a price equivalent to its weight in gold. The local communities who seasonally gather these caterpillars from their high-altitude habitats, often leave waste such as tarpaulin wrappers and plastic sheets behind. The plastic footprint of tourism is also writ large in these remote parts. These communities share their habitat with the elusive snow leopard, among other biodiversity.

Until recently, the migratory route of snow leopards (Uncia uncia) wasn't well established. Radio-collar studies determined that snow leopards are long-distance nomads, and stake a territory across 12 countries in Central and Southeast Asia. They prey upon species like marmot, pika, hare, Himalayan ibex, blue sheep, as well as migratory species like Argali sheep (Ovis ammon), urial (Ovis vignei), and the wild yak (Bos grunniens). Snow leopards have been photographed near garbage dumps, or in the wild, encountering plastics and some studies have found plastic in their scat. Their prey inhabits the same polluted territory. Grazing animals are indiscriminate feeders and could ingest plastic that makes its way into the Himalayan and trans-Himalayan food chains, and can have serious impacts on prey and predator alike. Yet, as per the CMS-UNEP report, the impact of plastic pollution on migratory terrestrial mammals is far lesser than that on avian and aquatic species.

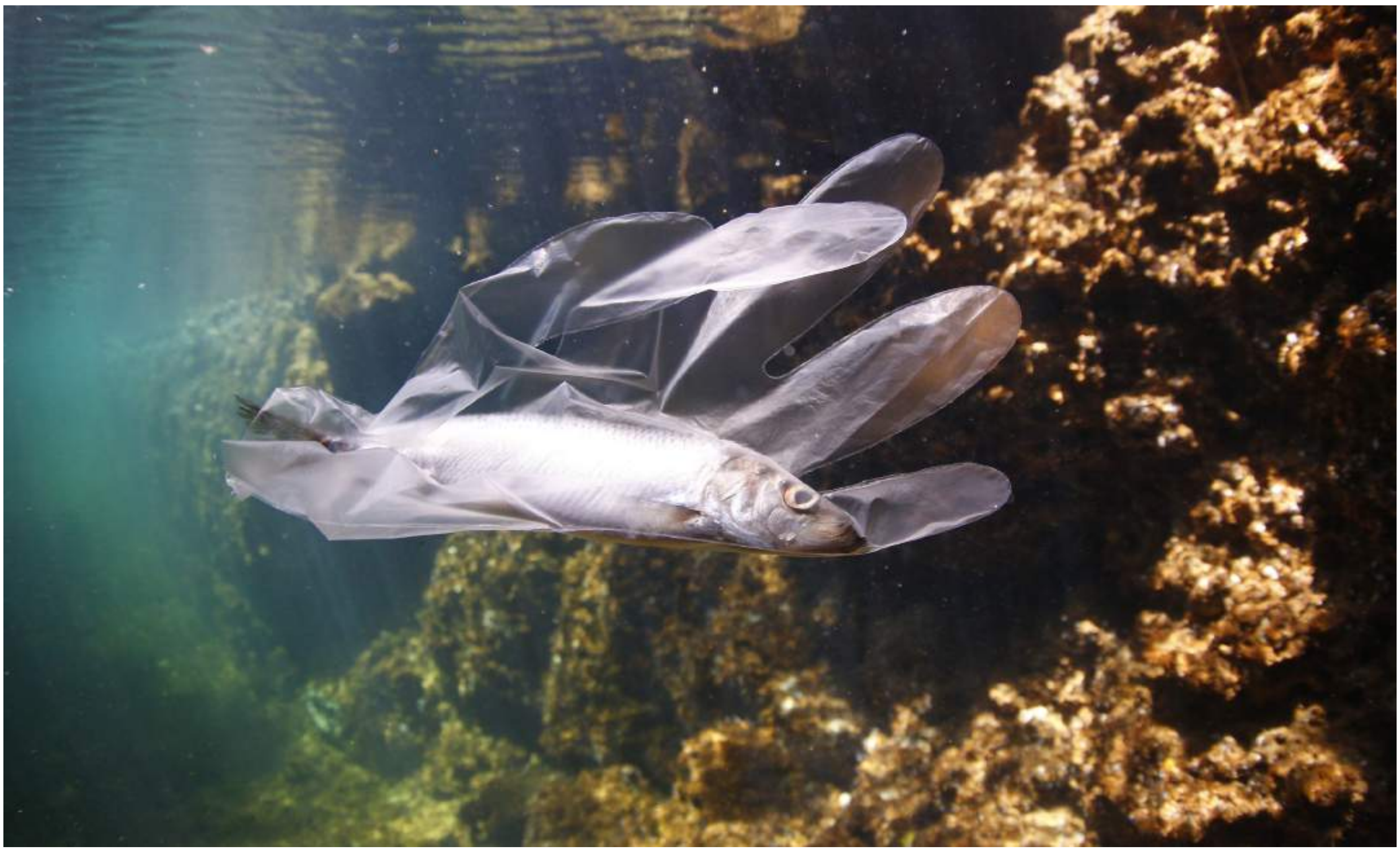
The bar-tailed godwit (Limosa lapponica) charts one of the longest, most arduous journeys; it breeds in Alaska and flies across the Pacific to winter along the coasts of Africa, the Persian Gulf, Southeast Asia, Australia and New Zealand.

Through winter, wetlands along the west and east coasts of India host bar-tailed godwits in huge numbers. Along the water's edge or in the shallows, these birds feed on a wide range of prey, like earthworms, polychaete worms, insects and insect larvae, spiders, molluscs, crustaceans, tadpoles, and small fish.

Bar-tailed godwit (Limosa lapponica) migrate over the Pacific to winter, among other destinations, along India's western and eastern coasts.
Image credit: P. Subraty via Pixabay.

For the bar-tailed godwit and other wading birds, the threat of plastic pollution in wetlands includes entanglement, ingestion, and bioaccumulation. "Earthworms are vital prey for wetland wintering birds. There is some research on microplastic pollution in soil, and its impact on earthworms," says Reuben Gergan, the Biodiversity and Plastic Pollution Consultant with the UN Environment Programme. "Yet more research on the toxic build-up from soils into earthworms and other prey is needed if we are to understand the role of wetlands as sanctuaries for migratory species," he adds.

Beyond earthworms, fish are another link through which toxins accumulate in the food web. In September 2021, a synthesis of published literature on microplastics found that 49% of all fish sampled globally, had ingested plastic, with an average of 3.5 pieces per fish. Such contamination can have widespread consequences across marine, riverine and estuarine habitats.



Fish form an important linkage between different food chains, terrestrial, aquatic and avian, and plastic pollution along waterways, can have an impact on entire ecosystems.
Image credit: Joel Saucedo via Pixabay.

Fish are the preferred prey for many migratory species of birds, reptiles like turtles and crocodiles, and cetaceans—including whales, dolphins, and porpoises. India has over 18 species of cetaceans, 8 species of turtles, and 2 species of crocodiles, that migrate in both marine and riverine habitats. "While many global studies have been undertaken to study the impact of plastics in freshwater and marine fish, few studies have been published from India", says V. S Basheer, Principal Scientist at ICAR-National Bureau of Fish Genetic Resources (NBFGR).

The CMS report showed that aquatic creatures are most prone to ingestion — and India's visitors are no exception. Across India, reports of whales, dolphins, porpoises, among others, washing up dead on shores abound. Autopsies reveal that their stomachs were full of plastic, and point to starvation as a cause of death.

Recent studies have largely focused on plastic pollution in marine systems, yet there is a need for more research on its impact on riverine species. This was highlighted at the 13th Conference of the Parties to the Convention on the Conservation of Migratory Species of Wild Animals (CMS COP13). River ecosystems are affected when lesser sediment travels from upstream channels and disrupts the formation of sandbanks for breeding, disturbances caused by large-scale dams, indiscriminate fishing activities, illegal sand mining, and the dumping of industrial effluents. Plastic waste is a recent addition to this list and migratory riverine species pay the price.

The critically endangered gharial is a keystone species of riverine ecosystems, both in India and Nepal.
Image credit: Joachim Schnürle via Pixabay.

For instance, the critically endangered gharial (Gavialis gangeticus), was once common along the Ganges, Indus and Mahanadi basins. Today, it only inhabits a few rivers in India and Nepal and is nearly extinct in Bangladesh. As a freshwater species, the gharial is intrinsically linked to the health and vitality of our rivers, and it is telling that the relatively unpolluted Chambal river, is among the last of its breeding grounds. Gharials are also very likely to get entangled in ghost nets – an often fatal encounter, as their snouts are rather sensitive. Exposure to toxic chemicals leached from plastics that enter the food chain via contaminated fish is another problem shared by creatures who undertake riverine migrations each year.

The nail in our coffins

These stories do not just represent the seasonal journeys of wildlife, but also the routes along which toxic plastic migrates across geographies. Migratory species carry plastic within their systems back to their native habitats, which adversely affects the local flora and fauna. In 2014, turtles were recorded ingesting plastic as they migrate across open oceans, only to succumb to death closer to their breeding grounds. In 2015, a study of 50 years' worth of literature, compared litter distribution and the range covered by 186 species of seabirds to assess the risk of plastic migration. The study found that seabirds carried plastic back from global hotspots to areas with low anthropogenic pressures and debris concentrations like the Southern Ocean boundary in the Tasman Sea between Australia and New Zealand. Imagine the risk posed by thousands of migratory species, the geographies covered, and the distances plastics travel.

These repeated refrains of nature bear one last grim truth, all this migration of plastic has one final destination. Humans.

Humans are the top consumers in any food chain and inhabit almost every ecosystem in the world. The effects of bioaccumulation and biomagnification of plastic and its toxins will be felt most acutely by our species. What goes around, comes around. The Food and Agriculture Organization (FAO) estimates that over 3.3 billion of the world's population relies on fish for their protein intake, and India is among the 3rd largest capture producers, which means it contributes significantly to global fisheries harvests (as of 2018). Thereby contamination in India's water channels, and fish stocks will have implications across the globe.

How far can such plastic migrate? It is difficult to say, but in December 2020, a study found microplastics in the placenta of live pregnancies, and a more recent study in September 2021, demonstrated that the first poop of newborn infants may contain up to ten times more polyester than in an adult's sample. Research is constantly unravelling the consequences of plastic pollution, more so microplastics, on human health. Apathy is not an option, nor is inaction. "Perhaps understanding these crucial linkages of plastic pollution in the food web, and their cascading effects on all organisms, including humans, would be the only way to influence behavioural change," laments UNEP's Reuben Gergan.

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The Migratory Routes of Plastic
By Devayani Khare
08 October 2021

TRACKING RIVERS, HIGHWAYS OF PLASTIC WASTE

BY ANUSHA KRISHNAN

The world's water bodies are turning into plastic soup. Literally.

Plastics are now found in almost every ocean, sea, river, wetland and lake on the earth. Even remote areas like the alpine lake Sassolo in Switzerland, which is hundreds of kilometres away from any human habitation, have been contaminated by plastics.

The first ever report of plastic in the oceans has been traced to 1965 when an old-fashioned metal box used to monitor plankton snagged a plastic bag off the coast of Ireland. However, the issue of marine plastic litter truly came into the spotlight with the discovery of the Great Pacific Garbage Patch in 1997. This patch stretches across 1.6 million square kilometres, and contains plastic not only on its surface, but all through the water column and on the ocean floor.

Research has shown that rivers are like highways that transport 0.4–4 million metric tonnes of plastic from human inhabited land into the oceans. The most recent study, published in April this year, states that roughly 1000 rivers account for 80% of all the riverine plastic waste that flows into marine environments. Although previous work in 2018 identified ten of the largest rivers in the world as the top plastic waste carriers—including the Indus, Brahmaputra, and Ganges from India—the new study reports a more complicated picture. Smaller rivers that pass through heavily populated areas can often carry more plastic than larger rivers.

Cover image credit: P Jeganathan via Wikimedia Commons
Plastic litter on a river bank in India.

As of now, much of the data on plastic waste in water bodies is from marine environments as research has mostly been focused on plastic pollution in the oceans. Research on fresh water bodies has lagged behind; consequently, little is known about how plastic leaks into and is transported by riverine systems.

In 2018–2019, one of the first expeditions to assess the full extent of plastic waste carried by the Ganges was undertaken by an all-women crew of scientists and engineers in India and Bangladesh. The effort was supported by the 'Sea to source: Ganges River expedition' program backed by the National Geographic Society.

Soon after, the United Nations Environment Programme (UNEP) with funding from Japan, launched the CounterMEASURE project to track and survey the leakage and movement of plastic waste in the Ganges and Mekong rivers.

Hotspots of plastic accumulation and leakage into the Ganges

In India, the CounterMEASURE project has been deployed in Haridwar, Agra, and Prayagraj (also known as Allahabad) along the Ganges to identify plastic accumulation and leakage hotspots – places within and around the cities where a higher than normal amount of plastic piles up and eventually enters the river.

A report published by the National Productivity Council (NPC) in partnership with the United Nations Environment Programme (UNEP) provides a detailed overview of how and what kinds of hotspots were identified in these cities. In each city, physical surveys of geographical areas were combined with data from GIS mapping to chart out land and drainage topologies and human land-use patterns. Surveys and clean-up drives then provided information on plastic litter, which was combined with the physical survey data to gain an understanding of the plastic accumulation and leakage hotspots within each city.

"The clean-up drives to assess plastic litter in select hotspots were a big task in themselves," says Amit Jain, Technical and Plastic Pollution Consultant at UNEP India for the project CounterMEASURE at the NPC. "Each clean-up session at a hotspot required at least 40–50 volunteers and safai karamcharis from the local municipality to work for an entire day to collect, segregate, and pack the plastic waste for further analysis at our laboratories".

"The clean-up drives were very engaging, and we went about them in a scientific manner with clearly marked grids. Overall, these clean-up drives were very good learning opportunities for us", says an NPC team member. "At one of our clean-up drives in Agra near the Yamuna river, we needed 40–50 gunny bags to hold all the waste collected," she adds.

The results of these efforts indicate that in all three cities, roughly 10–25% of all the plastic waste generated was littered and was not routed into recycling or appropriate waste disposal channels. This litter, which is either generated in or accumulates in the different cities' hotspots is a major source of plastic leaking into the riverine system in the area, especially during the rainy season. Much of the litter was multilayer plastic packaging, disposable bottles and cutlery, nylon sacks, and polythene bags.

Haridwar, which generates close to 11 tonnes of plastic waste as untreated waste and litter on a normal day may generate more than twice this amount during festivals. Much of this plastic waste is either directly dumped at the Ganges ghats (embankments on the banks of the Ganges where pilgrims bathe and offer prayers) or is illegally dumped at vacant sites. The CounterMEASURE project identified 17 leakage hotspots in Haridwar including areas such as vacant lots, slums/areas with open drains, and sluice valves at barrages.

Haridwar generates close to 11 tonnes of plastic waste as untreated waste and litter on a regular day.
Photo by: Vis M/Wikimedia Commons

In Agra, an estimated 10–30 tonnes of plastic waste from 9 hotspots makes its way into the Yamuna river, which is a major tributary of the Ganges. Much of this leakage seems to occur from riverside slums where garbage collection is poor, and plastic waste enters the river through open drains. A significant amount of the plastic in the river also consists of thin plastic sheets (used in sweet shops) or comes from the industrial sector as trimmings of synthetic leather and synthetic rubber from the footwear industry.

In Prayagraj, roughly 8 tonnes of plastic litter per day is estimated to leak into land and riverine ecosystems. A majority of this is household plastic waste often dumped in open areas, many of which are in flood zones. The leakage scenario in Pragyaraj appears to be the most diffuse of all three cities with almost 100 hotspots identified across the city limits.

Macroplastics and microplastics in the Ganges

Another source of plastic pollution in the Ganges is ghost fishing gear—abandoned, lost, or discarded nets and other plastic equipment used by the fishing industry. The study, which included sampling sites along the length of the Ganges from the Bangladesh coast to the Himalayas in India, found higher levels of waste fishing gear near the sea. This is probably due to higher levels of fishing activity and downstream accumulation of the fishing gear in these areas. The nets, ropes, string, floats and line, which comprise the ghost fishing gear can entangle and kill freshwater animals such as Gangetic dolphins, turtles, and smooth-coated otters.

The leakage hotspot analyses and work on ghost fishing gear, however, only expose the tip of the plastic waste iceberg in the Ganges as they deal solely with macroplastics – plastic pieces that are larger than 5 mm in size and usually clearly visible to the naked eye. Macroplastics entangle, choke, and kill millions of aquatic animals every year; macroplastics floating on ocean surfaces may also affect surface temperatures and optical properties of water columns and through them, cause unanticipated climate change effects. Besides these effects, macroplastics cause further issues by fragmenting into smaller pieces known as microplastics.

Microplastic particles are smaller than 5 mm in size and are either generated from macroplastic disintegration or manufactured as microbeads (less than 1 mm in size) that are used in biomedical devices and personal care products like face washes, scrubs, and tooth pastes.

These tiny pieces of plastic, however, have big impacts. Microplastics are often hotbeds of antibiotic resistance as they support the formation of layers of adherent microorganisms. They may also be vectors of heavy metal contamination in ground and surface water systems. In addition, microplastics are ingested by a wide variety of aquatic life forms including plankton, fish, and molluscs. These particles have infiltrated the entire marine food web, and eventually also end up in humans. While microplastics are known to harm aquatic life, their effects on humans are still being studied.

One study used water samples from 10 sites along a 2575 km stretch of the Ganges to estimate microplastic contamination in the river. The results indicate that Ganges surface waters contain 0.026–0.051 microplastic particles per litre (or 26–51 particles per m3); roughly 90% of these were plastic fibres, while the rest were plastic fragments. Based on the water flow rates at different sites, the study estimates that combined with the flow from the Brahmaputra and Meghna rivers, the Ganges probably releases 1–3 billion microplastic particles into the Bay of Bengal.

Another study reports that 100–400 microplastic particles per kg of river sediment were present in samples collected across 7 locations in the lower and estuarine reaches of the Ganges; a majority of the microplastics were composed of polythene terephthalate (used to make PET bottles) and polyethylene. Similar studies on the Indus and Brahmaputra rivers as well as the Alaknanda (a tributary of the Ganges) indicate that hundreds to thousands of microplastic particles are present in river sediments and water.

Different systems, similar results; but are they comparable?

Besides the Ganges and its tributaries, several other freshwater systems in India have been investigated for the presence of plastic pollution. Clean-up drives on the Karamana river in Kerala have shown that macroplastics make up 80% of the trash found in the river and along its banks; most of this comes from household waste and litter.

Another study on the Netravathi river—which originates in Kudremukh in Karnataka and flows through the major pilgrimage centres of Dharmasthala and Subrahmanya to empty into the Arabian sea—concludes that the river is contaminated with microplastics from its source to its sink. On an average, hundreds of microplastic particles are found in every cubic meter of water and kilo of sediment from the river. Much like what was found in the Ganges and its tributaries, most of these microplastics are fibres released from garment washing or bits of polyethylene and PET. Another study on the Sabarmati river found hundreds of microplastic particles per kilo of river sediment. Investigations on the Adayar and Kosasthalaiyar rivers in Chennai indicate that they may be responsible for discharging 11.6 trillion microplastic particles into the Bay of Bengal. The same study also indicates that remote mountain rivers with low anthropogenic influences (the Muthirappuzhayar River, that flows along the Southern Western Ghats) may contain microplastic particle levels as high as 0.2 particles per litre (or 200 particles per m3).

Plastic waste in a mangrove swamp near a river mouth in Kannur district of Kerala.

Photo by S. Gopikrishna Warrier/Mongabay.

Similar investigations in the Vembanad lake in Kerala as well as the Red Hills lake and Veeranam lake in Tamil Nadu have found microplastic particles in both water and sediment samples.

While the presence of microplastics in India's fresh water systems is alarming, the levels of microplastics in most of these systems are fairly low, especially when compared to those of the Pearl river in China (which contains 10,000–20,000 microplastic particles per m3 of water).

However, the values of microplastic particles from these different systems may not be comparable, warns an NPC team member. "As of now, there is need for commonly adopted standardised methods for all the groups working on microplastics across the world", she says.

Sampling methods and analysis systems vary widely in most of the published studies on microplastic abundance in water bodies. Many studies only look at microplastics in surface water or in sediments, but rarely in the entire column from surface water to sediment. Some studies use microscopes to detect microplastic particles, whereas others use FTIR (Fourier Transform Infrared Spectroscopy), a technique which can detect smaller microplastic particles than microscopes.

"We are finding microplastics in our seas, our rivers and lakes, ground water, and even drinking water sources. But there's no harmony between researchers' efforts when it comes to work on microplastics", says the NPC team member. "There is scope for connects to be made between scientists, and a need for mutual sharing of knowledge if we are to tackle this huge problem of microplastics contaminating the natural world."

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Tracking rivers, highways of plastic waste
By Anusha Krishnan
18 October 2021

G A N G E S

Born at the confluence of the Alaknanda and Bhagirathi rivers, the Ganges river traverses a distance of over 2500 kilometres from the snow-capped Himalayas, through the vast alluvial plains of north India, before it meets the Brahmaputra river and joins the sea.

As the Ganges, fed by its many tributaries, flows through some of the most densely inhabited stretches of India and Bangladesh, it is a vital water source for over 655 million people. Throughout history, religions have been born on the riverbanks - with temples that still welcome pilgrims from far and wide to worship its sacred waters. Imperial capitals and civilizations have risen, ebbed and flowed along its fringes.

For decades, the river has carried more than just prayers downstream: municipal garbage, untreated sewage, industrial chemical effluents, agricultural run-offs, religious offerings, and ghost fishing gear have polluted the waters, with plastic as the most pervasive, persistent pollutant.

Throughout its journey, the river accumulates plastic - macro, meso, and micro, from various sources, and transports it towards the sea. The Ganges network forms the second-largest plastic polluting catchment in the world, with over 0.12 million tonnes of plastic discharged into marine ecosystems per year, and is among 14 continental rivers into which over a quarter of global waste is discarded. (Source: [Riverine plastic pollution from fisheries: Insights from the Ganges River system, Nelms et al., Science of the Total Environment]())

Several kinds of plastics are used in day-to-day life that end up as pollutants in river channels:

EVOH or ethylene vinyl alcohol offers the best barrier resistance to gases such as oxygen, nitrogen, and carbon dioxide. Hence, it is used to package food, drugs, cosmetics, and other perishable products.

Polyacetylene a conductive polymer, has no commercial application but is used as a doping agent in manufacturing electronics and thin films.

PP or Polypropylene is very commonly used in packaging, plastic sheets, fibre and fabrics, tape, rope etc.

Phenol, isopropylated phosphate or PIP is mainly used in footwear and baby bottle nipples.

Polyamide (PA) commonly known as nylon, is used as a natural fibre and metal wires in clothing and industry.

PVC or polyvinyl chloride is used in pipes, wires and cables, medical devices and automotive industry, with major application in the cosmetics and pharmaceutical industries.

The Ganges is among the top contributors of land-based plastic pollution into global oceans - the river serves as a conduit for terrestrial waste ending up in marine ecosystems.

Here's an illustrated look at the plastic pollution along the Ganges river course, and its impact on

Water Quality

Biodiversity

Economy

Human Health

Upper Ganges

The Upper Ganges zone stretches from the mountainous catchment areas of its two major tributaries, Alaknanda and Bhagirathi, to the alluvial plains of Uttar Pradesh, terminating at the state's administrative boundary with Bihar. The main stem of the Ganges river begins where the Alaknanda and Bhagirathi rivers meet at Devprayag, in the Garhwal district of Uttarakhand. Along its upper reaches, the Ganges is fed by many headstreams or source streams like Dhauliganga, Nandakini, Pindar, Mandakini, as well as the catchments of rivers like Ramganga, Ghaghara, Gomti, and Tons. During its journey, it erodes and transports a lot of sediment from higher elevations, to deposit it downstream as rich, alluvial soil along the plains and has long been an essential lifeline for biodiversity, people, agriculture, and civilizations in north India.

The major threats to biodiversity and human wellbeing from plastic pollution in the **Upper Ganges** are:

Industry

Untreated industrial effluents from textile mills, metal processing plants, distilleries, tanneries and agro-chemical factories are major contributors of plastic pollution along the Ganges. Industrial effluents with chemical pollutants may increase the nutrient load in river water, resulting in poor oxygen levels, eutrophication and algal blooms.

Religion

Due to its religious significance, there are numerous pilgrimage sites along the Ganges. Tourists and pilgrims often leave behind a trail of garbage, mainly single-use plastics. Discarding offerings wrapped in plastics, cremations, and idol immersion during religious festivals are some of the irresponsible ways we contribute to river pollution, both plastic and chemical.

Human Activities

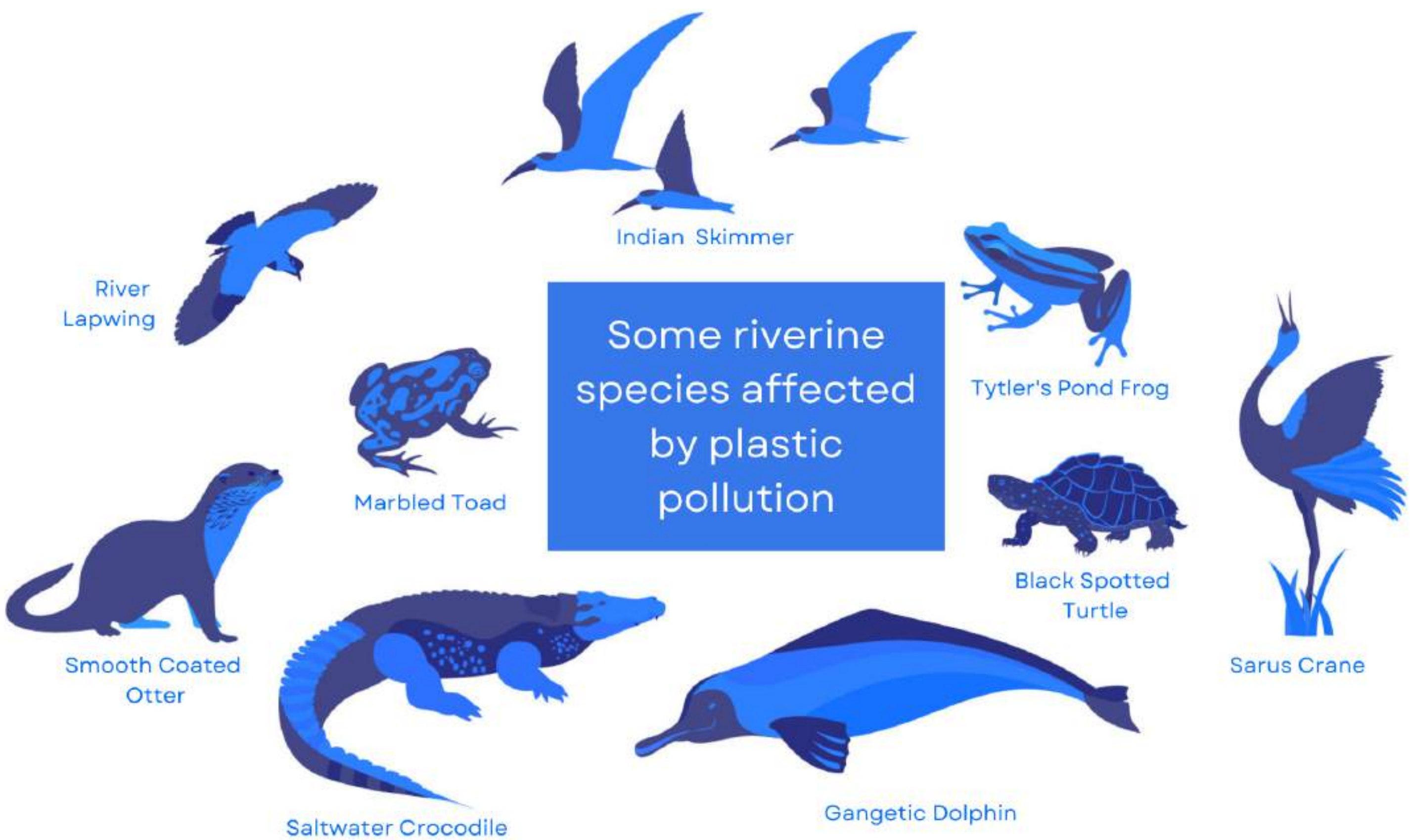
Plastic can find its way into rivers via municipal sewage, illegal landfilling and dumping, waste from slaughterhouses and hospitals, among many other anthropogenic activities. Along the Ganges, human activities like domestic washing, abrasion of tyres, use of personal care products, and the fragmentation of large plastics contribute significantly to microplastic contamination. Microplastics flow from rivers to oceans and are transferred across trophic levels where they can have grim consequences for biodiversity and human life.

Fishing

The Upper Ganges is globally important for biodiversity and hosts a number of endemic aquatic species, many of which are of conservation concern due to pressure from dam construction, habitat degradation, pollution and fisheries by catch.

To add to this, plastic pollution from ghost gear - any derelict, discarded, lost or abandoned fishing gear in aquatic systems, and from urban centres poses a further threat to biodiversity and human wellbeing.

In Feb 2021, ghost gear sampling was carried out in cities like Bhola, Chandpur, Varanasi, Kannauj, Anupshahr, Rishikesh (Uttar Pradesh), Patna (Bihar), Sahibganj (Jharkhand), Rajbari (West Bengal). (Source: [Riverine plastic pollution from fisheries: Insights from the Ganges River system, Nelms et al. 2021])



In August 2021, the Convention on Migratory Species (CMS) and the United Nations Environment Programme (UNEP) published a report as part of the CounterMEASURE II project, which documented the threats faced by terrestrial, freshwater and avian migratory species in habitats across Asia and the Pacific. It concluded that plastic pollution has a disproportionate impact on migratory species, as they cover larger geographical areas and face greater exposure.

Lower Ganges

The Lower Ganges zone starts at the administrative boundary of Uttar Pradesh and Bihar. From here, the river flows eastwards past the Farakka barrage to meet the Brahmaputra, forming a massive delta of ever-shifting, mangrove-covered islands, before it empties into the Bay of Bengal.

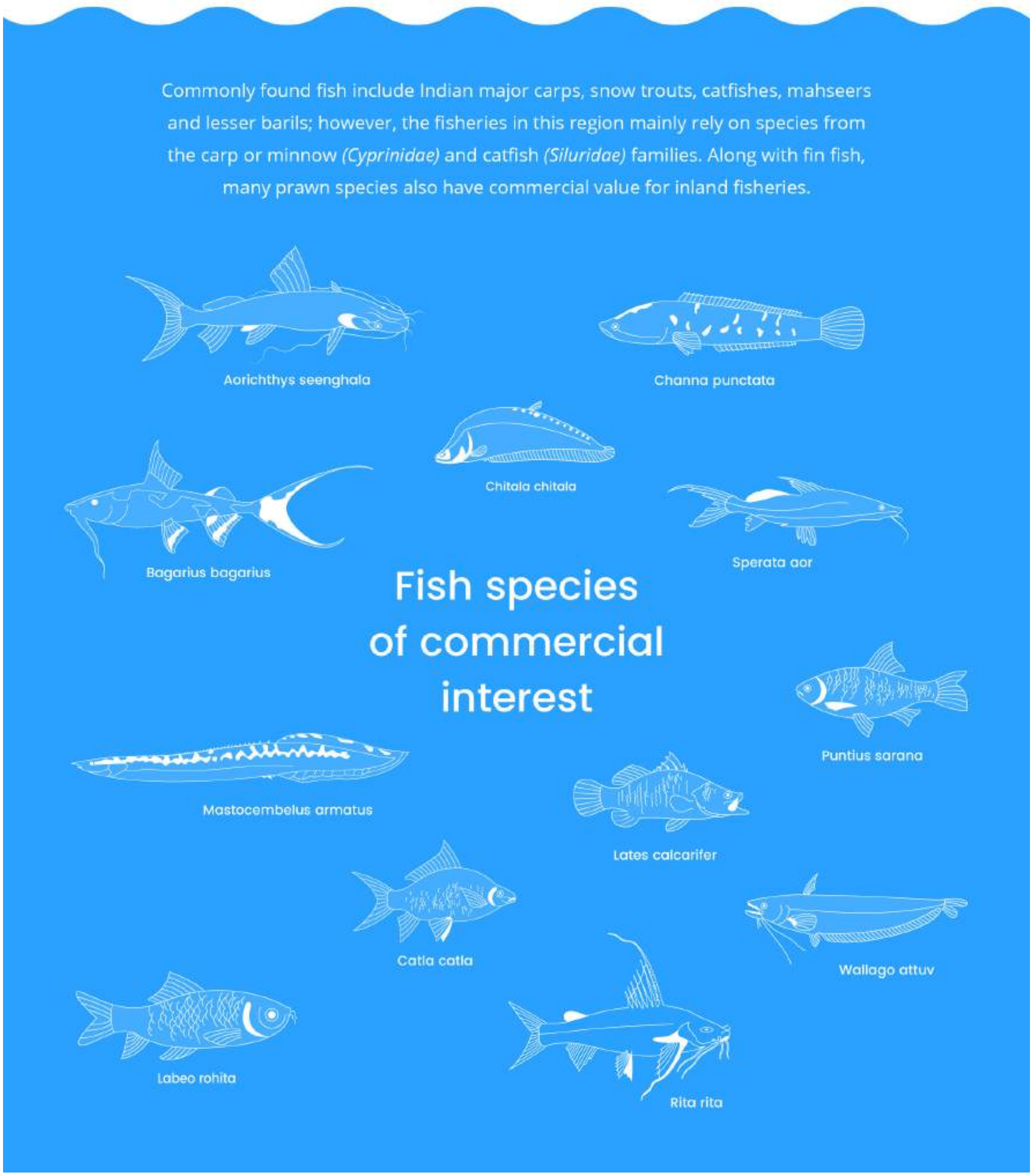
The major contributors to riverine plastic pollution in the **Lower Ganges** are:

In 2018, the Central Pollution Control Board (CPCB) of India reported that **6.07 billion litres** of wastewater from city drains are discharged into the Ganges. This wastewater carries *untreated sewage, religious offerings, agricultural run-off, industrial effluents from chemical plants, thermal power stations, sugar mills, paper mills, distilleries, and tanneries.* Bold, unrealistic promises to clean up the river have been the stock-in-trade by local and national government bodies for a while, yet few clean-up programmes have had desired sustained and long-term effects. The pollutants from human habitation and industry have consequences on the Lower Ganges and estuarine fishing economy.

Inland fisheries

Inland fisheries provide key income and nutrition for people in the lower parts of the Ganges, and India and Bangladesh are two of the world's major inland fisheries producers. Over 140 species of fish have been reported along the Ganges, with freshwater fish in the zones above the Farakka barrage, and estuarine species in the lower part. (Source: [Freshwater Fish Biodiversity in the river Ganges, Sarkar et al.])

Inland fisheries face threats from urban and industrial waste, agricultural pesticides, heavy metal contamination, the construction of the Farakka barrage, resulting in dwindling stocks. In turn, over-exploitation by fisherfolk threatens the biodiversity along this stretch, and their ghost gear has far-reaching consequences in aquatic ecosystems.



Message in a (plastic) bottle

In days of yore, notes from doomed castaways, lovelorn letters or distress messages were put in bottles to be cast adrift on ocean currents, with the hopes that it will one day find a sympathetic soul. Messages in bottles have also served as historical records of shipwrecked sailors.

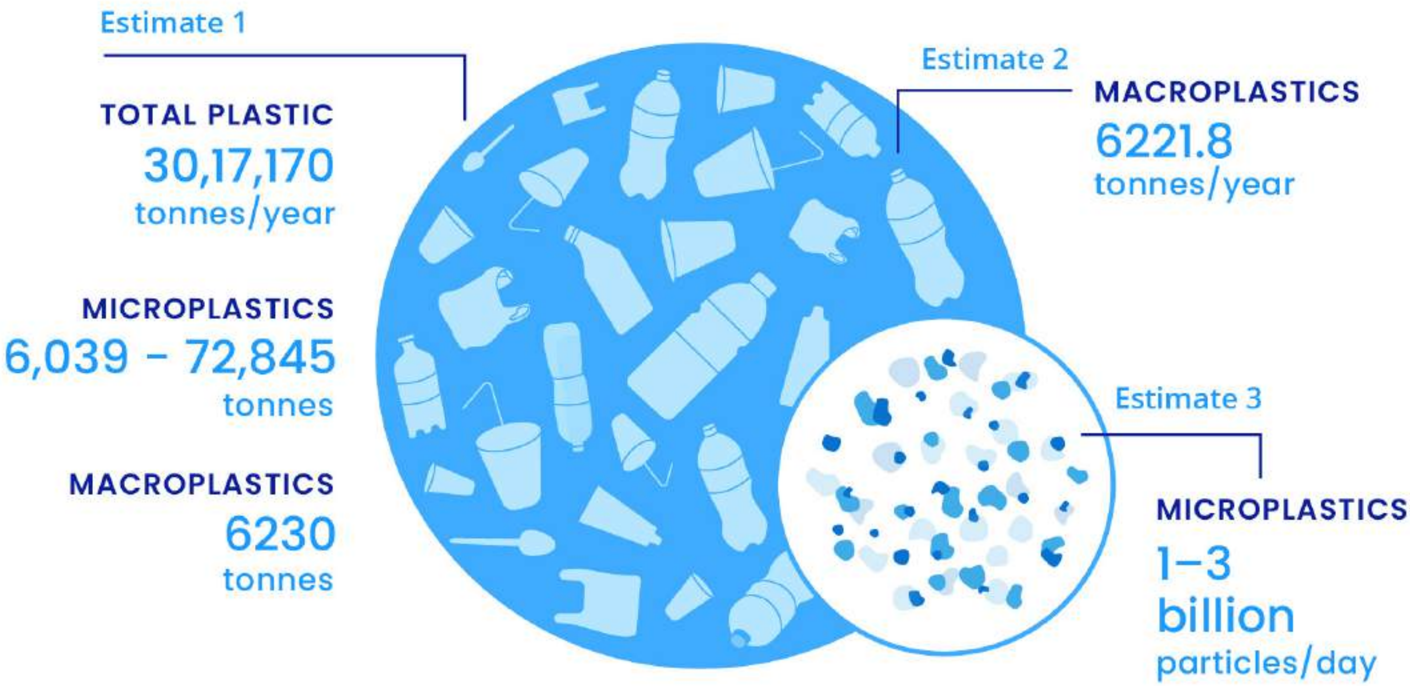
Though often used in a romantic sense, a message in a bottle is often a bleak, lonely attempt to be heard - much like what clogged rivers are trying to do, send us a dire message about how plastic pollution affects us here and now!

In Dec 2020, as part of the Sea to Source: Ganges Expedition run and funded by the National Geographic Society, a study used geo-tagged bottles to show how plastic travels along the Ganges.

Plastic can travel
2,845
kilometres in
94 days

That's how far-reaching the consequences of every single bottle or piece of plastic you discard can be.

Estimates for how much plastic travels from the Ganges river to the Bay of Bengal



Estimate 1

Source: Export of Plastic Debris by Rivers into the Sea by Christian Schmidt, Tobias Krauth, and Stephan Wagner, Environmental Science & Technology (Oct 2017).

Estimate 2

Source: More than 1000 rivers account for 80% of global riverine plastic emissions into the ocean by Lourens J. J. Meijer, Tim van Emmerik, Ruud van der Ent, Christian Schmidt and Laurent Lebreton, Science Advances (Apr 2021).

Estimate 3

Source: The abundance and characteristics of microplastics in surface water in the transboundary Ganges River by Napper et al., Environmental Pollution (Jan 2021).

It isn't too late - we need to take action now. Our solutions need to start with finding and adopting alternatives to plastic, and then addressing terrestrial sources and dumping grounds, before tackling marine litter. Further research, like that undertaken by the CounterMEASURE project, implemented by the United Nations Environment Programme's Asia and Pacific chapter, funded by Japan, can help identify the key sources and pathways of microplastic to better design intervention measures.

Targeted, informed interventions will be crucial in ensuring the health of humans, biodiversity, and ecosystems - and perhaps, the bottles of hope, heartbreak, historical records in the future, will have a better chance of avoiding plastic gyres, and reaching human hands.

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Illustrations by: Sumita Nanda (https://superpixel.in/)

Sources & Citations:

Sea to Source: Ganges Expedition
Message in a bottle: Open source technology to track the movement of plastic pollution
Qualitative analysis of microplastics along the river Ganges, Toxic Links report, 2020.
Riverine plastic pollution from fisheries: Insights from the Ganges River system
Impacts of Plastic Pollution on Freshwater Aquatic, Terrestrial and Avian Migratory Species in the Asia and Pacific Region
Freshwater fish biodiversity in the River Ganga (India): Changing pattern, threats and conservation perspectives
The abundance and characteristics of microplastics in surface water in the transboundary Ganges River
Spatial distribution of meso and microplastics in the sediments of river Ganga at eastern India

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Words: Devayani Khare. Illustrations: Sumita Nanda
10th March 2022

THE COST OF PLASTIC WASTE

BY ANUSHA KRISHNAN

Over the last decade, the waste industry has been quietly growing.

Given the growing rates of trash generation, this is hardly a surprise. In 2012, the world generated 1.3 billion tons of municipal solid waste per year. According to a 2018 World Bank report, this number is set to hit 3.4 billion tons by 2050. To meet this demand, the global waste management market — which was estimated at $400–1600 billion in 2020-2021 — is expected to reach $700-2483 billion by 2030.

India, with its growing population and rapid development, has a waste management industry estimated at $1.3 billion (Rs. 9656 crore). As of January 2020, estimates indicated that the country handled approximately 0.15 million (150,000) tons of solid waste. Of the 54 million tons of solid waste produced in this year (2019), 3.3 million tons was plastic.

As per the Central Pollution Control Board (CPCB) plastic waste management guidelines, all plastic waste must be segregated with non-recyclable plastics to be used in road laying, waste-to-energy projects, or conversion into refuse-derived fuels; and only a small fraction of non-recyclables should be disposed of in sanitary landfills.

Cover image credit: Ted Mathys for The Advocacy Project via Flickr
Waste pickers and animals at the Ghazipur landfill, New Delhi

However, this rarely occurs. In 2019-2020, only 60% of India's plastic waste was handled according to the CPCB's guidelines. The remaining was likely burnt, lost in nearby water bodies, or dumped as mixed waste into landfills, which are usually nothing more than vast, poorly maintained, overflowing dump sites.

What is the cost of dumping plastic waste into landfills and open dump sites?

In India, landfills — synonymous with open dumping in many countries around the world, including India — are undoubtedly the cheapest, short-term option for managing solid waste, which usually contains about 6% plastic. Today, only 20% of collected waste is sorted and processed, while 80% is dumped as mixed waste into the 1,684 landfills that India currently has. On average, most urban local bodies spend Rs. 500-1,500 per ton of waste in 'tipping fees' for collecting, transporting, treating, and disposing of waste in dump sites.

A 2021 study from IIT-Bombay, which assessed different waste management scenarios for the 9000 tons of solid waste produced daily by Mumbai, confirms that landfills are the most monetarily economical option. It compared the capital, operations, and maintenance costs of running a material recovery facility (to sort waste into recyclables and non-recyclables) with incineration, composting, or landfills. Costs were offset by income from compost and electricity through waste incineration and biogas. The results showed that recovering recyclables and using landfills are the least expensive way to handle waste over 20 years. This system is likely to cost $19 (Rs. 1400) per ton, whereas incineration would cost nearly double, $36-38 (Rs. 2800 per ton).

Yet, landfills are not sustainable as mixed waste has severe ecological effects due to substantial emission of greenhouse gas such as methane and production of leachates. Leachate is a form of 'liquid pollution' containing many toxins and pathogens that is formed when water seeps through waste piles. Currently, most landfills in India are overfilled and new landfills are difficult to establish in the face of stiff local resistance and skyrocketing prices of urban/semi-urban land. The poor condition of Kanjurmarg, Mumbai's newest waste management site with a material recovery facility and bioreactor landfill, exemplifies the failure of the system.

The costs of dumping mixed waste have been building up over several decades, ranging from large-scale fires due to methane generated by biodegradable waste to leachates poisoning local water sources. Toxic chemicals and microplastics leaching out of untreated waste piles are lowering life expectancies of locals. Calculations show that Delhi's three landfills at Okhla, Bhalswa, and Ghazipur are collectively responsible for environmental damage worth Rs. 450 crores (Rs. 4.5 billion) as per a 2018 study by the National Environmental Engineering Research Institute (NEERI), CPCB, and the Indian Institute of Technology-Delhi.

Waste segregation does not stop the majority of plastic waste from entering landfills or being dumped, as only high-value plastics like PET (polyethylene terephthalate) and HDPE (high density polythethylene) are recovered for recycling. The vast majority of single-use plastics, multilayer packaging, and polystyrene end up in open dumps, eventually leaking into the environment. A 2020 report from the National Productivity Council in partnership with the CounterMEASURE project outlines how open dumping of mixed waste in cities leads to plastics entering rivers and seas. The latest UN Environment Programme (UNEP) report on marine plastics estimates that land-based sources contribute 80% to the 11 million tons of plastic entering the oceans annually. The report also highlights the huge impacts of marine plastic pollution on wildlife, human health, and climate change; these negative impacts likely cost the world $3,300–33,000 per ton per year in terms of reduced natural capital in affected ecosystems.

Since the cost of open dumping/landfilling plastic waste is extremely steep in the long run, especially for environmental health, is it perhaps better to burn plastic waste for energy?

What is the cost of burning plastic waste?

Incineration has been a strategy for handling plastic waste in many countries. Japan and Singapore have been incinerating 37% and 78% of their municipal solid waste since 2017 and 2015, respectively. The waste-to-energy incineration market in China has vastly expanded since 2017 and the country plans to build a further 600 plants by 2025. Sweden began importing trash from other European countries in 2016 to power its waste-to-energy plants. However, waste-to-energy in India has had a stormy past and will likely have a rocky future.

In 1987, the first waste-to-energy plant in India was constructed at Timarpur, Delhi, in 1987 to generate 3.75 MW of electricity by incinerating 300 tons of waste per day. As the plant received low calorie waste (600-700 kcal/Kg) instead of high-calorie waste (>1462 kcal/Kg) it was shut down 21 days after it began operations. Since then, India has installed 14 more waste-to-energy plants of 130 MW capacity, of which half have been shut down while the operational ones are under scrutiny for environmental safety violations. In February 2017, the National Green Tribunal fined the Okhla waste-to-energy plant Rs. 25 lakhs (Rs. 250,000) for violating environmental safety norms.

Waste-to-energy plants have been unsuccessful in India due to several reasons. Firstly, most waste-to-energy projects rely on fuel from municipal solid waste, which in India, is of low calorific value. Secondly, waste-to-energy plants are expensive; despite several financial subsidies and incentives, electricity produced by these plants costs more (Rs. 7/kWh) than electricity from coal/solar plants (Rs. 3-4 /kWh). Lastly, these plants often burn mixed waste unsuited for incineration and manage emissions and fly ash so poorly that they are extremely polluting.

Yet in 2017, the National Thermal Power Corporation invited developers and investors to set up 100 WTE plants in the country. The Ministry of New and Renewable Energy aims to generate 0.5 GW of energy from waste-to-energy projects across India, and has reached 40% of its goal.

“Although past waste-to-energy projects were unsuccessful, the technology can still be useful. Waste composition in cities is changing. Plastic waste fractions are rising, but most cities do not inventory waste. Without this data, the usefulness of waste-to-energy is moot,” says Swati Sambyal, an independent waste and circular economy expert. Sambyal points out that data-backed decisions must drive the technologies used for handling waste, and not the other way around. “But right now, many waste-to-energy plants are being set up without a thorough understanding of the waste that will power the plant,” she adds.

Apart from waste-to-energy plants, coprocessing — using plastic waste as an alternative fuel — in cement kilns is another way to burn plastic gainfully. Typically, cement plants obtain segregated municipal dry waste and extract combustible material to make refuse-derived fuel (RDF).

“However, coprocessing has been marred by many cost issues. Typically, the quality and quantity of municipal waste is not optimal for RDF. So, cement plants need to spend money on pre-processing waste to make it useful,” says Kaushik Chandrasekhar, a solid waste management expert from TERI. “Then there’s the transportation cost – who pays for transporting waste from cities to the cement plants? This cost is huge as the waste has to be transported hundreds of kilometres to cement plants,” he adds.

Therefore, if burying plastic waste and burning are both expensive, recycling plastic may prove to be a better solution than either. A 2005 US case study seems to support this by showing that recycling consumes lesser energy and creates fewer environmental burdens than either landfills or incineration.

A wastepicker scans the waste for plastic bottles. **Photo by Kartik Chandramouli/Mongabay.**

But what is the cost of recycling plastic?

“Frankly, we don’t really know, especially for India,” says Sambyal. “Also, most plastic is never recycled in the true sense of the word. It’s all downcycled, meaning that the plastic is downgraded to a lower quality,” she says. In addition, data on plastic recycling in India is woefully incomplete. In the CPCB’s 2019-2020 annual report on plastic waste management, only 14 states have detailed data on plastic waste usage and recycling and most reported numbers of recycling units are clubbed together with manufacturing units.

The greater part of recycling in India occurs as ‘backyard recycling’ where waste pickers sort plastic waste by hand, wash it in drums, and pass it through single-unit extruders that mechanically shred and melt it to form granules and pellets. According to the PlastIndia Foundation, the plastic recycling industry in India employs over 100,000 people with a majority (10000+ units) in the unorganised sector as compared to the organised sector (100+ units).

“Most of our recycling is through the informal sector which has invested its own money and runs small plants,” says Bharati Chaturvedi of Chintan, a Delhi-based environmental research and action group. “These plants can be polluting, but there have been no efforts to help them find better solutions. Despite its issues, this sector is still helping to curb plastic pollution, and a lot can be achieved by formalising and upgrading this sector in scale, capacity, and technology,” she adds.

A structure made with discarded plastic bottles at Fort Kochi in 2015. **Photo by Augustus Binu/Wikimedia Commons.**

“Crude recycling by the informal sector not only releases hazardous emissions, but also causes a lot of plastic leakage. Since the sector is informal, most plants cannot afford to clean dirty plastic; so, material contaminated with wet waste is dumped into drains or at roadsides,” says Sambyal. “There isn’t enough evidence to establish how polluting recycling is, which is why the true cost, and ‘environmental friendliness’ of recycling is unknown,” she adds.

Issues with downcycling and estimating the true costs of plastic recycling are global problems. This is because currently, scaling-up chemical recycling methods which minimise downcycling, are financially unviable and the true cost of recycling plastics is often unknown due to the sheer variety of plastics produced. Usually, no information on either the plastic’s characteristics or the additives used to create it are available to recyclers, which makes it hard to predict if plastic waste is safe or even suitable for recycling.

Despite these setbacks, recycling still has enormous potential to reduce the industrial and environmental costs associated with the production of virgin plastic from fossil fuels. Recycling one ton of plastic is estimated to save 13.8 barrels of oil, 5744 kWh of energy, and 810 cubic feet of landfill space.

But until the day that a plastic bottle or polythene bag is converted back into a plastic bottle or polythene bag, respectively, recycling will remain short of what it promised.

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[Explainer] The cost of plastic waste
By Anusha Krishnan
30 December 2021

PLASTICITIES:
a tale of 3 grassroots waste management initiatives

BY DEVAYANI KHARE

“There is no such thing as ‘away’. When we throw anything away, it must go somewhere,” quoted Annie Leonard, executive director of Greenpeace USA.

Most of us forget all about our waste once it is discarded into dustbins or municipal garbage trucks. Municipalities and waste management companies are just at the tip of an iceberg - the formal waste sector - funded, regulated and managed by local governments. This sector is involved with all kinds of waste: organic, inorganic, domestic, hazardous, horticultural refuse, and construction debris, among others. They are responsible for the collection, transport, recycling, and appropriate disposal of waste which they often execute directly or via an external vendor.

Ideally, segregation of waste into recyclables and non-recyclables should be done at source - by the households, residential areas, or business centres that generate waste. Paper, metal, and glass have long been salvaged as they have good potential for recycling. Plastic is the new kid on the block. While polyethylene terephthalate or PET has a fair recycling value with the plastic-to-textile industry creating high demand, other commonly used plastics have little to no value and are often discarded. Hence, this plastic often reaches landfills, where it is incinerated or buried. Many chemical additives from these plastics leach into the soil and surrounding ecosystems, often finding their way into rivers and marine ecosystems.

Cover image credits: Bijay Chaurasia, CC BY-SA via Flickr.
Kabadiwallas are among many players in the informal sector - a near-invisible, shadowy waste economy that we rarely acknowledge or appreciate.

In much of the developing world, as in India, recovering recyclable waste between source and landfill is expensive, tedious and labour-intensive - this gap in the waste ecosystem is filled by the informal sector. This is a near-invisible, shadowy waste economy that we rarely acknowledge or appreciate, that falls outside the purview of the formal system.

The informal sector, often concerned with inorganic waste, has many players. Waste pickers collect and segregate recyclable waste from residential areas, and are incentivized by the chance to earn a livelihood from it. They then sell the waste to small scrap dealers or kabadiwallas. The scrap dealers further segregate the waste and sell it to a Level 2 small or medium aggregator. From here, it is carted off to a wholesaler or stockist, and finally, to specific recycling units.

In India, many national policies have recognized the role of the informal sector, mainly waste pickers, and have expressed value in their inclusion in the waste ecosystem. Yet waste pickers face other challenges while operating within the formal waste economy: outsourcing of waste management to private companies, waste-to-energy plants touted as alternatives to recycling, and urban zoning plans that do not factor in the infrastructure requirements of waste management. What's more, waste pickers at the frontline of the informal sector work in challenging, often unsanitary conditions that affect their health and face uncertainty due to fluctuating market prices of recyclables.

Waste Management Solutions in India

This past decade, grassroots organisations like Kabadiwalla Connect (Chennai), Hasiru Dala (Bengaluru), and Chintan (Delhi) have been working with waste pickers, in a bid to integrate them into the waste economy. Here is what can be learned from them:

Chennai: Kabadiwalla Connect

"Every year, Chennai generates over 1,30,000 tonnes of waste, of which plastic accounts for 10-15,000 tonnes. It is a huge challenge for the municipality to implement waste segregation at source. Hence, most of the waste, including 10-15% of which can be recycled, ends up in landfills. City authorities spend $200,000 every day to collect the waste and transport it to the Pallikaranai and Kodungaiyur landfills," states Siddharth Hande, CEO of Kabadiwalla Connect, a Chennai-based initiative for decentralised waste management.

"If cities across India are keen on optimising their resource recovery and recycling in the future, and finding solutions to plug the 'leak' of plastics into our oceans, integrating the formal and informal waste sectors will be crucial," adds Hande.

"The informal waste system helps Chennai collect roughly 20% of its recyclable waste, over 100,000 tonnes annually," he continues. By linking networks of waste pickers and scrap shop owners, he believes that almost 70% of the waste being sent to landfills could be diverted.

Kabadiwalla Connect helps leverage the city's existing informal waste infrastructure in the collection, segregation and processing of post-consumer waste, with the help of innovative, technology-based solutions. Their inclusive, cost-efficient, and industry-compliant solutions harness the untapped resource of the informal sector in the supply chain, reduce the health risks faced by waste pickers, and pay rich dividends while tackling plastic waste at urban, and semi-urban levels.

Kabadiwallas are level zero aggregators, who further sell it to other aggregators, along the informal waste chain.
Image credits: Damien Naidoo, CC BY-SA via Flickr.

"In the informal sector, we rarely talk of the stakeholders beyond waste pickers. Yet there is a nexus of scrap dealers or kabadiwallas, aggregators, wholesalers and recyclers, that are an essential part of the waste ecosystem. This lack of classification is key to the problem of integrating the formal and informal sectors," laments Hande.

The involvement of upstream stakeholders of the value chain such as plastic manufacturers and retailers is needed to bring about an integration of the waste ecosystem.

Hasiru Dala: Bengaluru

In Bengaluru, the informal waste ecosystem is much the same - door-to-door collecting of waste is done by the municipality, or waste pickers, and is deposited at dry waste collection centres, where it is sorted for recycling. Paper, metal, glass, cloth, and plastics are usually recovered, with plastics like tetra packs - which are technically recyclable but have a poor market value, sent off to waste-to-energy plants or as fuel for cement kilns.

Since 2011, Hasiru Dala has been working to bridge the gap between waste workers and other stakeholders, like the local governments, policymakers, and citizens, while improving the lives and livelihoods of waste pickers. Bengaluru with over 35,000 waste pickers and itinerant buyers, has approximately 3,500 tonnes of plastic traded in the informal economy every single day - rescuing it from landfills, incineration sites and water networks. In 2021, Hasiru Dala actively worked with over 40 wards in the city, and their dry waste collection centres handled a total of 13,656 metric tonnes (T) of waste, of which 4,097 T was recyclable, and 9,559 T was non-recyclable waste.

Kabadiwallas or ragpickers scour urban and rural areas in search for waste that they can trade. This curbside, manual scavenging rescues a lot of waste before it can be transported to landfills.
Image credits: Raj Gopal Singh Verma, CC BY via Flickr.

"Often plastics that can be recycled, such as food containers, aren't washed properly, and hence, have to be discarded. Working with residents and encouraging them to put in the effort to clean food-related waste, often discarded improperly due to convenience, is essential," says Rohini Malur, Communications Manager at Hasiru Dala. "Putting the onus of cleaning and segregation on households reaps benefits further up the waste ecosystem, as lesser waste, especially plastic, ends up at the highly polluting waste-to-energy plants, "she continues.

The pandemic adversely affected the entire informal waste ecosystem, and as single-use plastic consumption soared, recovery and recycling couldn't keep pace. Waste pickers are essentially daily wage workers, and restricted mobility affects their ability to collect recyclables and earn a livelihood. With waste pickers clocking fewer hours, there was lesser income for scrap shops too. There were months during the first wave when the entire recycling industry shut down. Dry waste collection centres were deemed essential services, yet scrap shops and godowns were not, and had to close down. Collection centres stayed open during the lockdowns yet they had nowhere to send the aggregated waste, causing the waste economy to stagnate. Workers struggled to get by as they could collect but not sell the recovered recyclable waste, payments from the authorities were often in arrears and they had little to no savings to fall back on.

To kickstart economic gains that had died down during the lockdown, Hasiru Dala began a pilot project with material recovery centres to help with the movement of goods from dry waste collection centres directly to recyclers. Yet just as it seemed like the economy was getting back on its feet, India faced its second wave.

"For grassroots organisations across India, the pandemic destabilised whatever headway was achieved in supporting the informal sector, and we would need to rebuild this network in the months ahead," reflects Malur. "While some people are committed to sustainable, segregated waste management, the message may not necessarily have reached everyone. It is crucial for grassroots organisations to amplify the messages of other efforts across India if we are to see a bigger shift in our waste management practises and to realise how vulnerable and essential these waste warriors are," she adds.

Chintan Environmental Research and Action Group: Delhi

Beyond providing essential services, waste workers play a crucial environmental role.

Every day, Delhi produces 12,350 tonnes of solid waste, most of which ends up at 3 major dumpsites: Ghazipur, Bhalaswa, and Okhla. The city has an estimated 40,000 waste pickers, with other recyclers, itinerant buyers, small and large kabadis, re-processors and other waste workers adding to a total of a 1,50,000 strong informal sector. They collect 15-20 per cent of Delhi's total waste (in terms of weight) and 55% (in terms of volume) and recycle about 2,000 tonnes of the city's waste each day. As in other cities, much of this recycling happens due to the toil of waste pickers.

In addition, as unsegregated waste accumulates at landfills, rotting, wet waste releases methane - a highly combustible gas. This results in spontaneous combustion of waste, with plastics, among other hazardous, polluting materials being set on fire. Sometimes, waste is incinerated at landfills before being buried. This adds significantly to Delhi's air pollution issues. Waste pickers by diverting waste from reaching dumping sites can help Delhi tackle some of its air pollution problems.

Methane from rotting food waste sets off fires in landfills that are difficult to quench, often claiming all kinds of waste before they are doused.

Image credits: Mike Prince, CC BY via Flickr.

As a partner of the CounterMEASURE initiative under the United Nations Environment Programme, funded by Japan, Chintan Environmental Research and Action Group (Chintan) strives for better waste recovery between source and landfills. Their work with waste pickers ensures lesser plastics end up in the Yamuna, and further downstream into the Ganges, and the Bay of Bengal. In 2018, Chintan's report titled 'Wastepickers: Delhi's Forgotten Environmentalists', highlighted the role of the informal sector in tackling the burgeoning problem of waste management and plastic pollution.

"Ironically, Delhi's Master Plan 2041 talks in detail about solid waste management and environmental pollution, yet doesn't make provisions for the labour involved, nor for the space and infrastructure they require," says Shruti Sinha, Manager of Policy & Outreach at Chintan. "Recently, many dhalaos - large three-walled concrete structures used by waste pickers to collect garbage from a locality or market, have been put to alternate use. A study by Chintan in 2021 found that 73.8% of waste pickers do not have access to sheltered spaces, which makes it difficult to work through monsoon and winter," Sinha continues.

The Chintan report advocates establishing partnerships between the informal and private sectors, as well as the public, legitimising the informal workers, developing waste management protocols, and training and monitoring waste workers. This would ensure they can operate effectively in their niche while performing key environmental roles.

Waste Management Blueprint

The CounterMEASURE initiatives are committed to identifying sources and pathways of plastic pollution and finding solutions to prevent city-sourced plastic from reaching rivers and oceans. Working at the grassroots level with stakeholders in the waste economy, is an effective way to raise awareness about source segregation to reduce mismanaged waste, as well as build on existing knowledge to inform policy decisions.

The 2021 report on 'Waste-wise Cities' by the Centre for Science and Environment (CSE) and Niti Aayog looked at solid waste management initiatives in 28 cities to better understand the mechanisms that worked best. Across cities, grassroots initiatives concur that the integration of the informal and the formal sector is an effective solution for waste management. The report found that decentralised systems and public-private partnerships would be ideal if we want to achieve our 'smart cities' objectives.

It is time city planners and municipal organisations took cognisance and found ways to integrate the waste ecosystem. This would not just ensure better living and working standards for the informal sector, but incentivize their role in last-mile resource recovery and recycling, while providing cities with a decentralised, cost-efficient blueprint for waste management.

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PlastiCities: the role of grassroots initiatives to manage waste in cities
By Devayani Khare
08 February 2022

COVID-19 AND THE CHANGING NATURE OF WASTE

BY ANUSHA KRISHNAN

As the COVID-19 pandemic brought sweeping changes to lifestyles, it also altered an important but seldom thought-of aspect of human existence – trash. The pandemic has drastically changed the types and amounts of waste that are being generated in the last two years and will likely continue to do so for the next few years.

For instance, a report in The Science of the Total Environment in November 2021 points out that the waste produced during the mass vaccination drives to curb COVID-19 transmission could have huge environmental effects. India, which initiated one of the world's largest vaccination drives in January 2021 with 3,000 vaccination centers across the country has generated massive amounts of biowaste from discarded vials. In addition, every step of the vaccination process – starting with the bulk production and usage of surgical masks, gloves, syringes, and disinfectants, to the production and storage of vaccines – are contributing to global greenhouse gas emissions. Improper disposal of the waste such as masks is also creating toxic plastic wastes.

In India, as elsewhere globally, COVID-19 created surges in the demand and use of single-use plastic products – most notably, in the biomedical, pharmaceutical, and food and delivery businesses. As a result, the waste produced from these industries has skyrocketed. While the amounts of plastic waste generated by altered consumer patterns during the pandemic are as yet unknown, India's reported biomedical waste generation increased by 17% over a year (2020–2021).

Cover image credit: GST_HBK via Wikimedia Commons
Discarded glass vials that contained antibiotics

Globally, it is estimated that 4.4 to 15.1 million tons of pandemic-related plastic waste was generated as of August 2021, of which roughly 25,000 tons have entered the world's oceans. A vast majority of this – roughly 87% – was found to come from hospitals in the form of plastic sheets, gloves, bottles, and syringes. While discarded face masks are the most noticeable, they, along with personal protective equipment (PPE) kits and packaging material account for only 12-13% of the pandemic-related plastic wastes currently polluting the world's oceans.

Surge in biomedical waste during the pandemic

As per the Central Pollution Control Board (CPCB), India produced 47,200 tons of COVID-19-related biomedical waste between August 2020 and June 2021; these include PPE kits, face masks, gloves, needles, and other medical items contaminated with blood/body fluids. This is over and above the average 600 tons/day of biomedical waste that was being produced in pre-COVID times.

However, India's waste management sector was and still is not fully prepared for this surge in biomedical waste. In September 2020, Mumbai's already beleaguered waste management system was left reeling under a three-fold increase in COVID-related waste generation.

Masks sold at a railway station in Mumbai. Photo by Kartik Chandramouli/Mongabay.

While the situation in Indian cities is not as dire as Wuhan's – which produced 250 tons of biomedical waste/day during its pandemic peak between February and March 2020 – there are rising concerns about missing biomedical waste and underreporting of generated waste.

Despite CPCB's assurance that India's 198 biomedical waste treatment facilities (incinerators) could handle about 800 tons per day of biomedical waste, a lot of the improperly disposed waste is being spotted in landfills and as litter along roads, beaches, and open dumps near hospitals and crematoriums. In addition to this, PPE kits, masks, face shields, and gloves are often seen in household waste, not only in India, but in several other countries.

According to a report published in October 2021 by the United Nations Environment Programme (UNEP), the pandemic drove global PPE kit production up by 300%, while the production of medical masks went up by 1,200%. Pre-pandemic India produced no PPE kits; but between March and May 2020, it grew a PPE-production industry capable of producing nearly 450,000 thousand PPE kits/day. A lot of these masks and PPEs are ending up in India's water bodies. Huge numbers of discarded plastic masks and gloves have been washing up on beaches and are being dredged up from ocean beds. In Assam, alarms over COVID-19 spread were raised when used PPE kits, blood pouches, and other hospital waste that had been openly dumped were seen floating on floodwaters. The CounterMEASURE project – an initiative by UNEP and the Government of Japan to tackle riverine and marine plastic litter – found that face masks were the most common biomedical waste littered along the Ganges and Mekong rivers in 2021.

For the first time in its 35 years of running the International Coastal Cleanup campaign, the Ocean Conservancy has had to add PPE (including face masks, gloves, and wipes) as a category in its list of beach litter. By late 2020, 94% of all volunteers had found PPE at cleanups in 70 out of 115 participating countries, and more than 62000 PPE items were found in the 1.5 million pounds (0.6 million kgs) of trash collected in beaches worldwide.

Changes in consumerism during the pandemic

But the dramatic appearance of discarded PPE in beach litter is only a part of the huge change in plastic trash flowing into the oceans since the pandemic began. The 2020 coastal cleanups also found unprecedented amounts of single-use food packaging items in the form of plastic cups, plates, grocery bags, and takeaway containers. Plastic food containers and cutlery were also the most-reported trash found in rivers and along shorelines. Takeaway containers were among the three most common types of plastic litter seen in the macro-plastic surveys conducted in 2021 along the Mekong and Ganges.

The rise in plastic food containers in oceans and rivers mirrors the rise in these plastics in municipal wastes. Thailand, Singapore, Malaysia, and the UK are only a few countries that have reported rising levels of plastic waste (between 20-200%) coming from increased use of food and grocery delivery services during and after the pandemic lockdowns.

Convenience powered single-use plastic consumption even before the pandemic; but concerns over safety and hygiene, especially due to COVID-19 have driven up their use. Shifts in the perception of food safety have also pushed consumers to prefer more packaged products. This was and even now, continues to be the norm in food servicing and delivery sectors.

In India, e-tailers and e-grocery services such as Amazon, Flipkart, BigBasket, and Grofers (now renamed Blinkit) have reported a two-to-threefold increase in order volumes, and overall e-commerce in 2020–2021 grew by 25%. Local governments in India busy fighting the pandemic had no resources left to enforce bans on single-use plastics such as disposable cups, cutlery, and plastic bags whose usage boomed in the wake of the first lockdown.

Policy rollbacks on the use of plastics have also contributed to this problem. In several countries, including UK, USA, South Korea, and Australia, bans on the use of disposable paper/plastic bags have been lifted or postponed. In India, the Indian government's pledge to eliminate single-use plastic packaging by 2022 has hit a roadblock. This comes from the All-India Plastic Manufacturers' Association (AIPMA) requesting that the deadline be pushed to 2023 to allow the industry to recover from the economic distress of the pandemic.

Problems in handling waste

"It's not just waste generation that changed during and after the pandemic. Waste management has also been affected by lockdowns, mainly because there was a disconnect between collecting the waste and processing it," says Mushtaq Memon, Regional Coordinator for Resource Efficiency (UNEP, Asia Pacific Regional Office) and Project Manager for SWITCH-Asia Regional Policy Advocacy Component.

India's recycling sector, which is largely informal, was severely impacted by the pandemic and the lockdowns in a series of cascading events.

"During lockdowns, waste collection was considered an essential service, but downstream processes like recycling, were not," says Rohini Malur, Communications Manager at Hasiru Dala, a Karnataka-based NGO that works to ensure livelihoods with dignity for waste pickers.

Malur explains that the lockdowns were disastrous for the waste picker community and small recycling businesses because they were barred from doing the work that sustained them. Dry waste collection centers in Bengaluru were receiving waste and segregating it, but couldn't sell to recyclers and cement kilns (that co-process non-recyclable dry waste), which resulted in two issues. One was a space crunch as waste was coming in but not going out, and the other was a loss of steady revenue.

"As part of our pandemic-relief work, Hasiru Dala had to arrange for aggregation centers where waste could be sent, because most dry waste collection centers don't have much space but were mandated to remain functional. We also had to arrange for daily wage support for garbage collectors as their pay was intermittent and often delayed," adds Malur.

Adding to these woes were the day-to-day dangers of handling contaminated household waste and facing social stigmas for providing an essential service.

A Municipal Solid Waste collector at work during the Covid-19 lockdown. **Photo by P. Jeganathan/Wikimedia Commons.**

During the second wave, as COVID-19 cases rose, and hospitals became full, at-home quarantine and treatment for people with milder cases of COVID-19 became prevalent. This caused medical waste to wind up in household waste, a situation which most waste workers are untrained to handle. Unsurprisingly, many waste pickers and garbage collectors and their families contracted COVID-19. "These people were already struggling to make daily wage, and now they had medical bills piling up to add to their burdens," says Malur.

As segregation of dry waste ground to a halt, junk shops shut down, and recycling units lay idle, the amount of trash sent to landfills shot up.

Post-COVID recovery in waste management

The waste management sector, especially recycling, is still struggling to recover from the effects of the pandemic. A report by PEMSEA (Partnerships in Environmental Management for the Seas of East Asia) states that in India, less than 10% of plastic recyclers were operating during lockdowns; post-lockdown, although 20–70% of these recyclers are functional, they are operating at only 25–50% of their full capacity.

"India can move forward at an accelerated pace by taking a holistic approach, as a piecemeal approach may not be fruitful. The informal sector must be strengthened, supported, and formalized through policy, funding, and

The Mavallipura landfill in Bengaluru. As the pandemic shut down junk shops and recycling units, the amount of trash sent to landfills soared. **Photo by L. Shyamal/Wikimedia Commons.**

incorporating a circular economy approach. For example, the 'Swachh Bharat Mission' focuses on cleanliness with 'cleanliness drives' useful in keeping streets clean; but, a holistic circular economy model to reduce trash proper recycling could work even better," says Memon. "Like Japan and South Korea, India's waste can become a resource. Indian policies could be the flagship in South Asia if they strengthen waste reduction, recycling systems, and adopt a circular economy approach to waste management," he adds.

Recently, the Government of India's policy think-tank, NITI Aayog (National Institute for Transforming India), published a report titled Waste-wise Cities, in which successful attempts at managing different types of waste have been highlighted. Leh has been lauded for its technology-led use of solar power to process municipal solid waste. Several cities including Thiruvananthapuram have been upheld as models demonstrating the sustainability of decentralized waste management systems. Many cities including Panaji have been highlighted for their achievement of 100% waste segregation at source which lay at the heart of their ability to manage waste and generate income through composting, recycling, and production of refuse-derived fuels.

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[COVID-19 and the changing nature of waste]

By Anusha Krishnan

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TACKLING THE INTEGRATED CHALLENGE OF PLASTIC POLLUTION & CLIMATE CHANGE

BY DEVAYANI KHARE

In the run-up to the UN Climate Change Conference (COP26), the United Nations Environment Programme (UNEP) released a global assessment of the marine plastic crisis, titled 'From Pollution to Solution'. An update to a 2016 report on Marine Plastic Debris and Microplastics, this assessment hopes to raise awareness of the magnitude and severity of marine litter, especially plastics and microplastics. This evidence-based report is aimed at identifying gaps in knowledge, promoting effective solutions and global interventions for marine pollution, and safeguarding ecological and human health.

This was just one among many recent reports and solutions aimed at turning the tide on plastic pollution across the world. In October 2021, two publications by the Organization for Economic Co-operation and Development (OECD) provided recent information and recommendations on addressing plastic pollution, including a working paper on the most effective policy interventions to control single-use plastic waste. Other global organizations also took a firm stance on plastic pollution. The Common Seas' evaluation tool for national governments, Plastic Drawdown, focuses on a country's available resources to assess effective mitigation strategies. The Zero Waste framework for reducing plastic waste targets legal and financial solutions in European cities to reduce greenhouse emissions. Youth ambassadors from the Plastic Pollution Coalition also petitioned the leaders at COP26 to act on the issue of plastic pollution and the climate crisis. So have The Global Alliance for Incinerator Alternatives (GAIA), Break Free From Plastics (BFFP), Beyond Plastics, Recycling Association and the list goes on.

Credits: Chris Jordan via Ars Electronica on Flickr (CC BY-NC-SA)
The "Gyre" artwork by Chris Jordan represents 2.4 million pieces of plastic - the estimated amount of plastic pollution that enters the world's oceans every hour. All the plastic in this image was collected from the Pacific Ocean.

Demonstrations outside the COP26 venue.
Photo by Priyanka Shankar/Mongabay.

Why are so many organizations raising a ruckus about plastic pollution at a climate change conference? Beneath growing concerns about the impacts of plastic on oceans, ecosystems, and human health, there's another critical, lesser-known angle to the plastic crisis: it plays a significant role in global greenhouse gas emissions and climate change.

"Plastic production is the last gasp of the fossil fuel industry."
Judith Enck, head, Beyond Plastics

In 2019, a report titled 'Plastic & Climate: The Hidden Costs of a Plastic Planet' examined the plastics lifecycle and identified major sources of greenhouse gas emissions, unaccounted sources of emissions, and uncertainties that lead to an underestimation of plastic's climate impacts. In October 2021, Beyond Plastics released another report built on previous findings, titled 'The New Coal: Plastics & Climate Change', to assess the devastating impact of plastics on climate, much of it happening with little public scrutiny and lesser government and industrial accountability. While both reports focus on the plastic industry in the United States - the worst global plastic polluter, the findings will hold true for other nations with expanding petrochemical industries.

Plastics add to the global carbon burden from the moment of fossil fuel extraction, when methane, a greenhouse gas, escapes into the atmosphere, and continues to do so throughout their lifecycle. Plastic is manufactured from naphtha, a crude oil-based substance, and ethane, liquid natural gas, with the addition of other chemicals, most of which are fossil fuel-based. Hence, plastic manufacturing is a significant source of greenhouse emissions. Plastics are further processed into polymers with the help of chemical additives. Additives help plastics assume the properties that make it so convenient: hard, soft, squeezable, colourful, water-repellent, fire-proof, or microbe-resistant, among others. A recent study identified over 8,000 chemical additives used for plastic processing, some of which are a thousand times more potent as greenhouse gases than carbon dioxide. Products like single-use packaging, plastic resins, foamed plastic insulation, bottles and containers, among many others, add to global greenhouse emissions.

Most plastic cannot be recycled, only downgraded, and is often incinerated, or used as fuel in waste-to-energy plants, sometimes known as chemical recycling. While plastics are worth three to four times as much for fuel than as scrap, these recycling processes release more carbon dioxide into the atmosphere, adding to the greenhouse effect.

India's Plastic Cycle

The roof of an informal recycling unit in Dharavi slum. As per some estimates, 60% of Mumbai's plastic is recycled in Dharavi without which the city would be choking in waste.
Credits: Cory Doctorow via Flickr (CC BY SA).

India is among the many countries scaling up its petrochemical industries. With an investment of $100 billion to boost domestic production by 2030, the next decade will catalyze India's crude oil demand, and accelerate petrochemical production. Industrial practices like decarbonization, and plastic-based fuels touted to be sustainable, are less optimal and cost-effective than claimed, with the result being more emissions and a larger carbon footprint.

On the recycling front, the news is bleak. Every year, India generates 9.46 megatons of plastic waste, of which 40% is not collected and is either burnt, lost, or dumped into landfills or waterways. Of the total plastics produced, half are used in packaging, most of which are single-use in nature. Despite 5000 registered recycling units, plastic recycling is largely informal. A complicated aggregator system segregates, recycles, and makes some profit off the plastic economy.

The cost of plastic waste is staggering, and the mechanisms to deal with recycling are riddled with problems, some of which add to India's carbon footprint. Waste-to-energy plants and refuse-derived fuels are examples of suboptimal processes with high emissions. Despite many setbacks, from shutdowns due to poor waste-to-energy efficiency, fines for flouting environmental safety norms, and high operational costs, we continue to invest in these recycling technologies, for lack of alternatives.

"While these are scientifically proven methods to dispose or process waste, more mechanisms are needed to address the challenges of efficiency and cost," implores Kaushik Chandrasekhar, a solid waste management expert at The Energy and Resources Institute (TERI).

Yet incineration and recycling-as-fuel can only be a part of the solution, especially if they add to India's greenhouse emissions. We need bolder solutions if we are to meet our net-zero targets by 2070.

As per the CEEW estimates, if India is to achieve net-zero carbon goals in the next 50 years, our solar-based electricity generation capacity must increase to 1689 GW by 2050 and to 5,630 GW by 2070.

Credits: Sarangib via Pixabay.

India aims for Net-Zero Carbon Emissions by 2070

In November 2021, numerous publications celebrated India's ambitious net-zero target for carbon emissions - the country committed to becoming carbon-neutral by not adding any greenhouse emissions to the atmosphere by 2070. As the world's fourth-biggest carbon emitter, these targets marked India's cognizance of the issue of climate change, and its commitment to address it. Yet our industrial practices are headed in a very different direction - can we realistically achieve net-zero in the next 50 years?

A recent analysis by the Council for Energy, Environment and Water Research (CEEW), a think tank in New Delhi, estimated a cost of over $10 trillion (₹700 lakh crore), for the upgraded infrastructure of renewable energy sources for electricity, transport, building, and industry sectors to meet the net-zero targets. For the crude oil sector, an ideal scenario would mean consumption must peak by 2050 and decrease by 90 per cent between 2050 and 2070. "If we are to account for the petrochemical industry emissions in future scenarios, data on energy use for plastic production, both as fuel and as feedstock - the raw material used but not burned during an industrial process - is essential," surmised Dr Vaibhav Chaturvedi, co-author of the CEEW report. "However, it is in the petrochemical sector's commercial interests to introduce circular economies that allow plastics to remain in the industrial ecosystem, rather than find non-plastic-based alternatives."

A grim reminder that recycling plastics as industrial fuel is not a viable long-term solution to pollution. As our petrochemical industries expand, could infrastructure interventions that consider the plastic lifecycle help turn the tide on climate change?

Circular economy approach for the lifecycle of plastics

In April 2021, TERI's roadmap proposed a circular plastic value chain to address the problem of both plastic pollution and greenhouse emissions. The roadmap hopes to dissociate plastic production from virgin fossil fuels, and incentivize the reduce-reuse-recycle principles to address the issue of waste.

Bio-based plastics, manufactured partially or wholly from biomass, and oxo-biodegradable plastics that degrade under favourable conditions offer more viable, less GHG-emitting alternatives to fossil-fuel plastics. Yet neither are completely biodegradable, hence industries need to look for other packaging solutions.

In September 2021, the India Plastics Pact (IPP) was signed under a collaboration between the World Wildlife Fund, the Confederation of Indian Industries, with support from UK Research and Innovation. The IPP, the first in Asia of its kind, aims at a circular economy for plastics with innovative ways to eliminate, reuse, or recycle the plastic packaging across the plastics value chain, and forge collaborations between businesses and NGOs to collectively achieve long-term targets. International brands like Amazon, Coca-Cola, and local businesses like Hindustan Unilever, ITC Limited, Tata Consumer Products Limited, and 3 of Godrej's trademarks, have signed the pact. If such businesses change their packaging practices, it would be a revolutionary step for end-use plastic pollution in India.

In the recycling sector (as in any other), infrastructure interventions incur great public and private investments, with much of the capital frittered away due to corruption. "When government land is allocated for public recycling infrastructures, such as a landfill, a waste-to-energy plant, or a biogas plant, the informal sector is largely ignored. Yet they are the largest investors in the recycling business. Instead of spending on public infrastructure, the government could strengthen the informal sector, allow them to expand in scale, capacity and technology, so that they have a vested interest not just in making a profit but in addressing the issue of pollution," advises Bharati Chaturvedi of Chintan, an environmental research and action group in Delhi.

Both TERI and Chintan, along with other grassroots organizations like the Integrated Mountain Initiative and Development Alternatives, are partners of the Japan-funded UNEP project, CounterMEASURE. The project is committed to identifying sources and pathways of plastic pollution in river systems in Asia, with a focus on the Mekong (China) and Ganges (India) rivers - among the top contributors of marine pollution. Their policy-driven approach hopes to tackle plastic at different stages of its lifecycle and ensure rivers transport lesser plastic into the marine ecosystem.

Last but not least, to deal with discarded plastics in the ecosystem, we can restore coastal blue carbon habitats such as mangroves, tidal marshes and seagrass meadows. These habitats trap and bury plastics, preventing them from entering marine ecosystems, with the added advantage of sequestering more carbon than terrestrial forests.

In the wake of COP26, finding and financing integrated solutions to address two of the most critical global problems of this century, namely plastic pollution and climate change, would help us achieve net-zero goals, while protecting communities and habitats.

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Tackling the integrated challenge of plastic pollution and climate change

By Devayani Khare

11 January 2022

WHERE THE PLASTIC THINGS ARE: UNEXPECTED PLASTIC PRODUCTS IN OUR LIVES

BY ANUSHA KRISHNAN

Plastics are the Anthropocene era's ultimate convenience.

The more mundane uses of plastics in our lives range from kitchenware, storage containers, and packaging materials to toys and small tools that make everyday chores a little easier. But plastic is so pervasive that there are many unexpected places where it finds use.

For example, many people are unaware that synthetic textiles are essentially plastics.

"During a series of training sessions that we conducted recently for waste workers from several ULBs (urban local bodies) in Agra and Patna, we laid out an array of everyday objects and asked the workers to identify which ones were made of plastics," says Bharati Chaturvedi, Founder-Director of Chintan, a Delhi-based NGO working on waste management. "Many were unable to identify polyester clothing, fleece jackets, or even disposable masks as plastic," she adds.

I wonder – as consumers, would we have performed any better?

Cover image credit: Harsha K R via Flickr.
Brightly coloured saris sold by street vendors are often made of synthetic fibers like rayon which are cheap and easily available

But it's not just textiles that can confound people; did you know that non-woven plastic bags that feel like cloth are also made of plastics? These bags, which are soft and air permeable like cotton bags, are made of spun and bonded polypropylene fibres. Unfortunately, their usage has soared across India since the single-use plastic ban was announced, as they can be much cheaper than genuine cotton cloth bags.

The same fibers, along with polyester fibers are also used in making fake fur and as stuffing in toys and pillows. Yes, that stuff inside your child's soft toy is usually not cotton; it's a bouncy cloud of plastic.

Besides this, most paper cups, plates, boxes, and even snack food packaging that are labeled 'eco-friendly' may not be so. This is because most of these products are lined with non-biodegradable polyethene or biodegradable poly-lactic acid plastic films to keep them waterproof.

Image by Anusha Krishnan

Watch what you chew or smoke or brew or eat

Chewing gum is probably one of the most surprising products that contains plastic. Although traditional chewing gum bases were made of natural tree resins such as chicle, today, most gum bases contain petroleum-based plastics such as polyethylene and polyvinyl acetate which are FSSAI-approved (Food Safety and Standards Authority of India; sub-regulations 2.7.3 of the Food Safety and Standards (Food Products Standards & Food Additives) Regulations, 2011).

Another unlikely place where plastics turn up are in cigarettes. The filters in cigarettes are made of a non-biodegradable plastic called cellulose acetate, that ends up in cigarette butts. In 2019, cigarette butts were one of the most littered plastic items along with plastic food wrappers, bottles, and bottle caps found on beaches and in the oceans. Floating cigarette butts are often eaten by fish and birds and are toxic to them. Cigarette butts are deemed hazardous waste as they are known to leak heavy metals, organic toxins, and microplastics, all of which are toxic and sometimes even lethal to plants, fish, frogs, and other organisms.

In our kitchens, plastics lurk not only as coatings on non-stick cookware as polytetrafluoroethylene or Teflon, but also in teabags which are often made of polypropylene, the same material used to manufacture nonwoven plastic bags. But perhaps the most disturbing fact about plastics' presence in the kitchen, is that it's also there in our food. It is clear that that much of what we eat – fish and poultry, and even fruits and vegetables like apples and carrots, contain microplastics. There's even evidence of microplastics in human poop and that unborn children are exposed to microplastics while still in the womb.

Heal thyself with plastic?

Recently, the health and medical sector made headlines because of the huge amounts of biomedical plastic waste that was ending up in the world's oceans as a result of the COVID-19 pandemic. Most commonly, one would associate plastics in medicine with personal protective equipment – masks, face shields, and single-use polythene gloves – or testing kits with cartridges and sample collection tools made of sterile plastics.

But plastics' versatile natures make them highly useful for many other applications in health and medicine. Several plastics such as polythene, polypropylene, and polycarbonates are widely used in medical implants such as intraocular lens and orthopedic implants like hip or knee replacements; while this isn't too surprising, what is astounding is that a whole heart has also been replaced (temporarily) by a plastic pneumatic pump.

A monkey at the Chamundeshwari temple chewing on a cigarette packet. Not only does cigarette packaging contain plastic, but the cigarette butts contain cellulose acetate, which are known to be harmful to wildlife. **Photo by Romana Klee/Flickr**

In dentistry, the easily moldable nature and cheap cost of acrylics make these plastics ideal as bases for dentures – a fact that gives the term ‘plastic smile’ a wholly literal meaning.

However, one of the more startling uses of plastics is in medication like pills; were you aware that some pills, especially those labeled ‘slow release’ or with ‘enteric coatings’ are encased in plastics? Thin films of cellulose acetate phthalate, ethylcellulose, methyl acrylate polymers and several other plastics are used to mask unpleasant smells, protect drugs from degrading, and ensure that the medications in tablets are released in a timely manner for maximum effectiveness.

Although the realization that one often swallows plastics along with tablets may discomfit many, such plastics serve important purposes and are usually ingested in very small non-toxic amounts.

Thoughtless little substitutions

However, over time, many natural materials in our lives have been thoughtlessly substituted with plastic alternatives. Consider for example, that Indian markets are flooded with plastic brooms, which (in my opinion as a consumer) are poor substitutes for the local soft grass brooms or stiff coconut leaf brooms.

Such substitutes have even seeped into traditional ceremonies such as the ‘vettala paaku’ (also called Thamboola/Thamboolam) in south India, where women exchange betel leaves, betel nuts, and flowers along with cloth, kumkum (the red powder dye used in forehead bindis), turmeric powder, and gifts during religious or social occasions. Thirty years ago, the cloth would have been cotton or silk, kumkum and turmeric would be wrapped in little paper packets, and the gifts would likely be some home-made sweets or special foods bundled in banana or Sal leaf plates. Now, the cloth is mostly a polyester synthetic, the kumkum and turmeric powders come in brightly coloured, shiny plastic sachets or brittle plastic boxes, and the gifts are given in plastic boxes, cups, or plates.

This trend has not just hit south India, but is a pan-Indian phenomenon. In Darjeeling, the guardian deity of the Tiger Hill, Sinchel ko Singha Devi, is offered a ‘Shola Shringar’ kit of 16 items ranging from jewelery and bindis to flowers and cloth during the puja season in March and April. In 2019, the Himalayan Cleanup conducted by the Scavengers youth group revealed the plastic waste crisis faced by the Senchal Mandir, which is located within the Senchal Wildlife Sanctuary, because of this tradition.

“Earlier, Shola Shringar items would be made of natural materials, but now, almost every one of these 16 items is made of plastic – plastic earrings, bangles, necklaces; even the cloth offered is usually a synthetic textile,” says Priyadarshinee Shrestha, Team Leader at WWF-India’s Khangchendzonga Landscape, and Secretary, Indian Mountain initiative.

In 2021, the Sinchel Singha Devi Sthan Committee reported that four sacks of non-biodegradable waste were collected in just two weeks from the Shola Shringar. “Such events worsen the issue of plastic waste in the hills, where waste management is already a challenge. We’re working with the priests and religious communities to stem this flow of plastic by letting people know that the Devi does not want plastic offerings. Hopefully, this will encourage them to bring offerings made of natural items," she adds. In an effort to help with this transition, local women's groups have been skilled to make the Shringar from all-natural elements to replace the plastic ones.

Being aware

With plastics skulking in unpredictable places, it's not just consumers who need to be aware of these hidden plastics; waste workers also need to be trained to recognize unlikely plastics, plastics that don't conform to the general norm of what plastics look like.

A series of training sessions to do just this was undertaken by Chintan in partnership with the CounterMEASURE project – a joint initiative of the United Nations Environment Programme (UNEP) and the Government of Japan. The CounterMEASURE project aims to study how plastic wastes flow into rivers, specifically the Ganges in India, and work towards generating resources such as city-specific policy recommendations, awareness building, and training modules to stem this flow.

Synthetic fleece blankets, also called 'velvet' blankets in a shop in Amritsar, which was once famous for its woolens.
Photo by Shankar S/Flickr.

“Our trainings in Agra and Patna showed us that such modules are necessary in order to equip waste workers with the required skills and knowledge to do their jobs effectively, especially with respect to plastic waste,” says the Chintan team.

However, for such training to be effective, the importance of recognising plastics as plastics again comes back to us as consumers, who are also producers of waste. If we cannot do so, household segregation of waste, which is the bedrock of successful waste management, will falter and undermine the system.

Perception surveys conducted by The Energy Research Institute (TERI) and the International Forum for Environment, Sustainability, and Technology (iFOREST) – both of which have also partnered with CounterMEASURE – have revealed that although people in cities like Mumbai, Haridwar, Rishikesh, Prayagraj, and Agra view plastic pollution as a problem, many do not know of proper waste segregation practices and recycling processes. Even worse, many respondents in Agra view plastics as ‘easy to dispose of’ which highlights how unaware they are to the true state of plastic pollution in the world. Furthermore, most are unaware of alternatives to plastics that are as cheap, and easily or widely available.

Since awareness is the first step towards change, being alert to where and how plastics are used can empower our decisions, as consumers, on product choice. Nevertheless, consumers can only do so much if our choices are limited, especially when faced with product packaging. While we can consciously choose natural products over plastics in our lives, what can we do if these or other essentials come packaged in plastics?

At this point, corporate responsibility comes into play. Companies packaging their products in plastics must also move towards alternative options or take up responsibility for tackling the pollution that their continued use of plastic packaging produces. Although most large corporations loudly advertise their efforts towards such goals, tangible outcomes have been underwhelming, as can be seen with Unilever’s attempts to justify the continued usage of plastic sachets.

If we are to tackle the issues of plastic pollution that currently plague our lives, we must be more careful about how this infinitely handy, yet troublesome substance is used.

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Where the plastic things are: Unexpected plastic products in our lives
By Anusha Krishnan
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PLASTIC RECYCLING
What works, what doesn’t?

BY DEVAYANI KHARE

Plastics today are blighted as their impact on the environment has now been exposed. But it was not always so.

In 1869, the first synthetic polymer made of cellulose, cotton fibre and camphor was created as an alternate material for ivory billiard balls and piano keys. This early prototype - named celluloid - marked the transition from natural, exploitative products such as ivory, tortoiseshell and horn, to inexpensive, human-manufactured materials. In 1907, the first fully synthetic non-flammable plastic, bakelite, was developed as a substitute for shellac, a natural electrical insulator. Bakelite was durable, heat-resistant, could be mass-produced and paved the way for the electrification of nations. That’s how the plastic revolution began.

During World War II, as the availability of metal, wood, glass, and paper dwindled, plastic production increased. Synthetic plastics offered unimagined advantages over traditional materials. Plastics replaced the bonding agent in the plywood construction of military planes and were used for many aircraft parts. Vinyl plastic-based paints and varnishes provided a protective coating for military craft, both in air and on water. Nylon replaced silk in ropes, parachutes, body armour, and helmet liners. Acrylic sheets also known as plexiglass were used instead of glass in aircraft windows. Buttons, batons, radios, razors, toiletry containers and cockpit housings - plastics were everywhere!

Credits: Marco Verch Professional Photography (CC BY via Flickr)
Only 9% of all plastics ever produced have been recycled. Plastics have a lower recycling value compared to other materials such as glass, metal, cloth and paper.

As versatile as their military applications were, plastics also became crucial for industrial machinery, household appliances, and other consumer products. Plastics, with the help of additives, were versatile, durable, affordable and disposable. For all its convenience, the actual cost of plastic on the planet, its biodiversity, and human health hadn't been calculated.

It wasn't until the 1960s that plastic pollution was first recorded in the ocean by scientists studying plankton - large plastic gyres or garbage patches were found to be disrupting ecological cycles. Later, Rachel Carson's book 'Silent Spring' brought to attention the adverse effects of synthetic chemicals in the environment. Since then, media coverage on plastics has exploded. Articles range from 'are we panicking too much?' to 'we're not doing enough about plastics'. In December 2017, disturbing footage of the effect of plastics on wildlife and human health featured in the Blue Planet II documentary sparked a strong anti-plastic revolution.

Plastic recycling techniques

In our fight against plastics, we often forget the inconvenient truth of why this material became as popular and pervasive as it has. It is versatile, durable, affordable and disposable - these very advantages have made it difficult to find alternatives for, phase out, or recycle plastics today. Although plastic production occurred at breakneck speed, fuelled by wartime shortages, recycling innovations have been slow and challenging, compounded by the huge variety of plastics in circulation.

Here are some of the key recycling techniques today:

Biological Recycling

Organisms in soil or water, like microbes, bacteria, fungi and worms, can break down some plastic polymers. Biological recycling involves the anaerobic (sans oxygen) metabolisation of organic polymers for energy by these plastic-munching organisms. In laboratory settings, enzymes have also been shown to break down plastics. After this process is complete, the only by-products are heat, carbon dioxide, and water vapour, with some part of the biopolymer being converted from organic carbon into humus, much like composting.

However, reported instances of biological recycling are incomplete and slow, and at present, can hardly tackle the scale of the problem of plastic pollution. Speeding up these processes, or making them more efficient has proven difficult. Even if researchers could optimise and scale them up, they would need to be cost-effective enough to compete with virgin-plastic manufacture and chemical recycling methods. There are miles to go before biological processes can play even a small part in the entire landscape of plastic recycling.

Mechanical Recycling

This process of recovering plastic waste involves manual scavenging or mechanical processing of dry waste. Waste is collected, sorted, washed, dried, ground up, made into granules or pellets and compounded. Due to the degradation of quality with every cycle (most plastics can only go through 3-7 cycles), mechanical recycling creates a closed loop, with end-result plastics that aren't suitable for all purposes.

Plastic bottles are often scavenged, crushed and aggregated by the informal waste sector before being shipped off to mechanical recycling centres.
Credits: Hans Braxmeier via Pixabay

Chemical Recycling

Most chemical recycling methods today follow 3 routes to treat plastic waste:

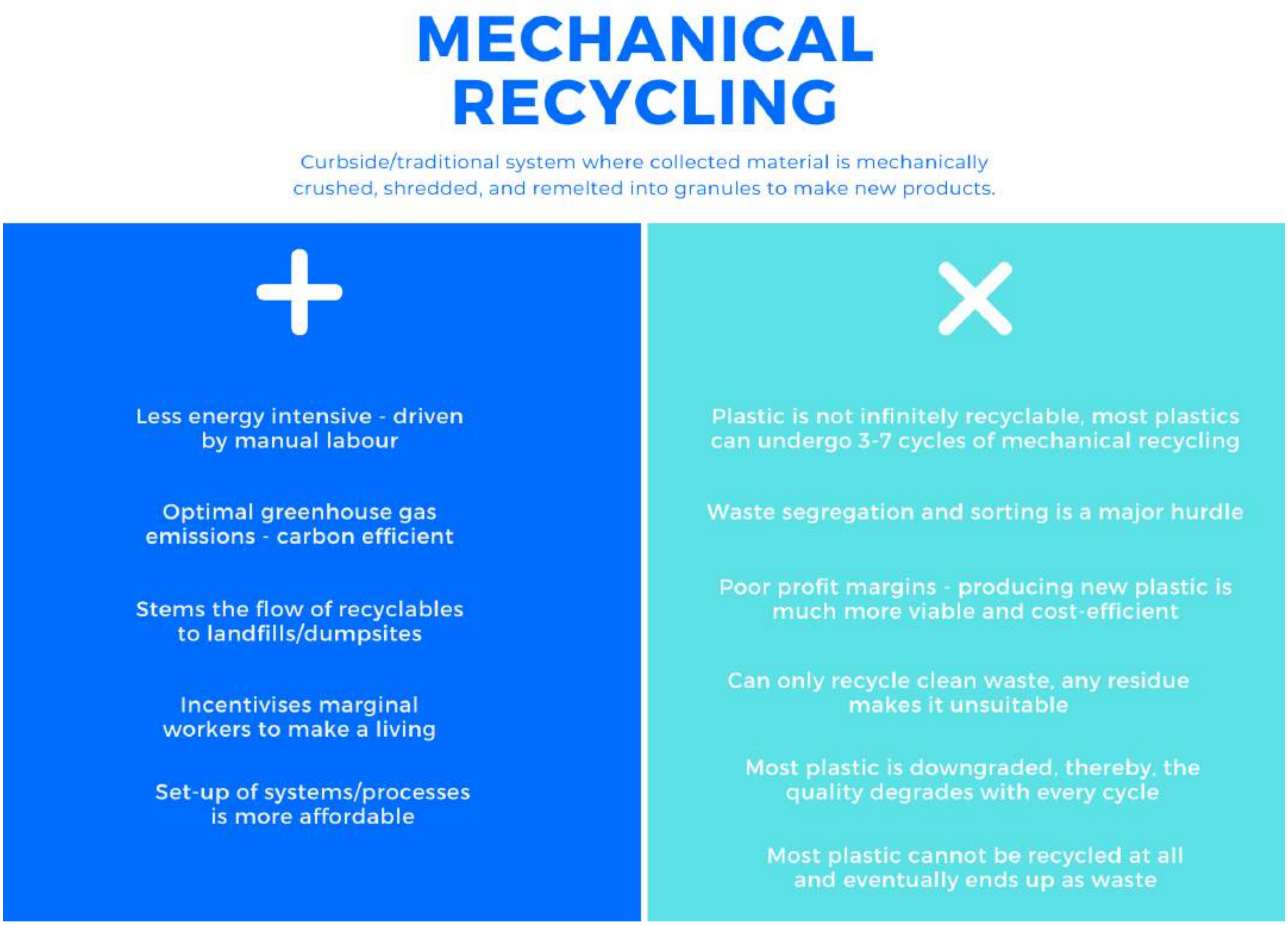
- **Dissolution**: sorted plastic waste is liquefied using heat or chemical solvents without altering its chemical structure. Polymers are extracted to make new recycled plastic, often with chemical additives.

- **Depolymerisation**: Sometimes referred to as chemolysis or solvolysis, this process uses different combinations of chemistry, solvents and heat to break down polymers into monomers. Monomers are the building blocks of polymers. An additional step helps isolate and extract contaminants, after which the monomers are fed back into the normal plastic production processes as secondary raw material.

- **Conversion**: a process by which mixed plastic waste is broken down into oil- or gas-like feedstock or raw materials, that is then used to produce chemicals including plastics. If conversion occurs in the presence of oxygen, it is known as gasification. In the absence of oxygen, the process is known as pyrolysis.

Both processes break down polymer chains to make hydrocarbons such as diesel, kerosene, waxes, and naphtha, and (in principle) can be used to recycle multilayer packaging and other mixed plastics. These yield high-quality products, though an additional step is required to isolate and remove contaminants. The produced oil or gaseous feedstock (re)enters the chemical production chain as secondary raw material to replace newly extracted fossil feedstock. In principle, industries claim that chemical recycling results in plastics of similar quality to virgin plastics made from traditional fossil resources.

Here are some of the pros and cons of the two major recycling processes:



Mechanical and Chemical Recycling Infographics: Devayani Khare

CHEMICAL RECYCLING

Involves splitting the polymer chains or the molecular structure of plastics, to provide a substitute for crude oil, naphtha or fuels.

+	×
Lesser carbon footprint than fossil-fuel based processes	Highly energy intensive - driven by industrial processes
Can recycle material with little or no commercial value, and that cannot be recycled via mechanical processes	Chemical plants are expensive to set-up and operate
Upcycles the material back to premium, virgin-like quality: and can undergo further recycling and up-cycling	Needs toxic chemicals, like acids and solvents to dissolve the plastics. The by-products & waste pose an environmental hazard
Enables an infinite life for plastics, and a truly circular economy	All waste does not have the same calorific value, and poor quality material may make chemical processes less than optimal, with poor quality end products - both will affect the economic viability of recycling
If optimised, can provide better profit margins, and curb the production of new plastic	

On the surface, these seem like viable, promising recycling solutions. Yet why has there been severe backlash from global environmental organisations against them?

Circular Economy & Carbon Lock-In - perpetuating a cycle of fossil-fuel dependence

Most recycling innovations seek to address the challenge of plastic pollution by enabling a transition to a fully circular model. The term 'circular economy' is often used to promote chemical recycling or breaking down polymers into viable, low-polluting fuel sources, with promises to create an infinitely recyclable loop of virgin plastic, In other words, a circular economy creates a continuous supply chain for plastics.

Though few people realise the link between plastics and big oil or petrochemical industries - here's the truth - most plastics are derived from fossil fuels.

Recycling technology that circulates plastics in an endless loop would result in a vicious 'carbon lock-in' - where our dependence on fossil fuel resources is continually reinforced through technology (recycling processes), infrastructure (recycling plants), institutions (corporations and government) and behaviour (consumption patterns).

This past decade, as per a study published in September 2021, oil companies have been investing in fossil-fuelled plastic production at an unprecedented rate, as they have in plastic recycling technology.

For instance, PureCycle Technologies for end-of-life polypropylene was developed by a scientist at Procter & Gamble (P&G), among the world's top 10 plastic polluting corporations. (Source: The 2021 Global Brand Audit by Break Free From Plastic). Similarly, Reuters reported on how companies like Shell, DoW, Unilever, responsible for massive levels of plastic pollution, have backed recycling projects.

Ironically, most of these recycling endeavours have flopped. Claims about chemical recycling have fallen far short of the mark, and several chemical recycling plants worldwide have had to shut down as they were not viable.

In August 2020, the Global Alliance for Incinerator Alternatives (GAIA) published a report that investigated the claims of chemical recycling processes and concluded that most processes are severely polluting, energy-intensive, prone to technical failures and release chemical toxins into the environment. Nor has chemical recycling been proven to transform unsorted garbage into high-quality fuel and clean plastic resin. If oil is the end product, which needs to be burned for fuel, it doesn't actually curb greenhouse gas emissions or the production of virgin plastic.

Despite innovations and patents, the informal sector - which manually scavenges and sorts waste, plays a key role in much of the recycling in developing countries like India.
Credit: Mumtahina Rehman via Pixabay

Innovations in Recycling

As per the Organisation for Economic Co-operation and Development (OECD), only 14-18% of global plastic waste is being recycled. Though so many of our products are recyclable, in truth, most countries lack the infrastructure to do so. Hopefully, that is poised to change in this next decade.

Between 2010-2019, the European Patent Office (EPO) recorded a sharp increase in patents filed for waste recycling technologies. Over 9000 patents were filed for chemical recycling technologies with 2,300 more for plastic-to-monomer recycling; 4,500 patents for mechanical recycling; and 1,500 patents for emerging technologies such as biological methods. Worldwide, the US and EU accounted for 60% of patenting activity in plastic recycling and alternative plastics technologies, with Japan coming in third. With so many recycling patents filed by the Global North, the Global South stands to inherit technologies that may not always be as viable for their economy or environment and may ignore existing infrastructure and systems.

Could innovations overcome the challenges in recycling we've faced so far? Has our scepticism of recycling technologies made it more difficult for newer technologies to emerge, experiment and evolve into viable, cost-effective solutions? Time will tell.

Technology, however, cannot fix the problem of leakages - the pathways by which plastics end up in terrestrial or aquatic ecosystems. "In India, leakages from the recycling sector are huge, often unaddressed, and are not much talked about. Inventorying and mapping material recovery facilities, with respect to plastics is crucial," says Swati Sambyal, an independent waste management expert. "Where does material flow to after it has been produced? Who collects it once it has served its purpose? Is it collected by an aggregator or via the formal collection system? What value does it have? If it doesn't have much value, it will be discarded - these rejects form a really large part of the leakages. Only an entire value chain analysis can help determine how eco-friendly or circular the whole recycling system is," continues Sambyal.

The CounterMeasure projects run under the United Nations Environment Programme (UNEP), funded by the Government of Japan, have partnered with several on-ground organisations to identify leakage pathways of plastics, especially those that end up in the Ganges river in India. Such baseline data will not just inform the action needed to counter plastic pollution, but also the policies that ensure lesser plastic finds its way into our rivers, and ultimately, our oceans.

Recycling Reponsibility - consumers versus corporations

With increased demand, expanding markets in different geographies, the convenience of use and transport, the use of plastics has burgeoned. Despite awareness about the effect of plastics on biodiversity, ecosystems, climate change, and human health, the oil and petrochemical industry is far from assuming responsibility.

Instead, over the past decade, industries have done much to shift the blame to consumers. Consumers' throwaway mentality, individual carbon audits, pledges to curb single-use plastics, upcycling and zero-waste lifestyles are being touted as solutions, while petrochemical industries continue with business as usual. While individual choice and habits will go some way towards addressing the problem, the change needs to start with businesses and corporations.

Recycling is just a way of addressing the symptom, not the cause.

The answer does not lie in producing more disposable, recyclable packaging, nor addressing plastics at the end of their lifecycle but in rethinking the very materials we use.

In 2016, India followed in the footsteps of many countries and expanded its first Extended Producer's Responsibility (EPR) framework to hold producers accountable for their plastic production and packaging.

On 18th January 2022, the Ministry of Environment, Forest, and Climate Change (MOEFCC) issued the new EPR rules that specify the quantity of waste to be managed by producers, importers and brand owners who generate plastic packaging waste. It also mandates that producers of plastic packaging materials operating in India must collect all of their produce by 2024. Yet if the delays and dilutions of the past six years are anything to go by, the implementation of this policy will be a mammoth challenge.

But the EPR framework is a step in the right direction. If local administrations push for compliance, companies commit to finding plastic-free alternatives, and consumers strive to make better choices, we might be able to turn the tide on plastics in the years to come. The time for change and action is NOW!

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By Devayani Khare
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The CounterMEASURE project works to identify sources and pathways of plastic pollution in river systems in Asia, particularly the Mekong and the Ganges. These articles are aimed at raising awareness about the issue of plastic pollution at different scales: societies, industries, governments, and ecosystems.