



ENVIS-IITM NEWSLETTER

Indian Institute of Tropical Meteorology, Pune
Atmospheric Pollution and Climate Change

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Microplastics - an emerging new threat to the ecosystem



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Editorial

Invention of plastic has been a double-edged sword for the planet Earth. Though it has played a key role in the progress of mankind, technological and otherwise; it has also been one of the most harmful chemical pollutant destroying Earth's delicate ecosystems. Researchers have been studying the negative effect of plastics on human and animal health as well as on entire ecosystem for decades. Recently the alarming discovery of microplastics i.e. plastic particles less than 5mm in size has concerned scientists and authorities equally. Several studies have reported finding these tiny particles in all ecosystems on Earth including pristine and remote, inhabited areas. This newsletter will help citizens understand the mechanism of microplastics formation, their dissemination in the ecosystem as well as the detrimental effects of microplastics on human and animal health. This will help us implement mitigation measures well in advance to counter this emerging new threat.

-Dr B S Murthy

Microplastics

Microplastics are tiny plastic particles less than 5mm in size that result from both; the commercial product development and the breakdown of larger plastics. As a pollutant, microplastics can be harmful to the human and animal health, environment, our ocean and aquatic life. Microplastics also act as an air pollutant and can travel long distance from the source.



Categories & Sources:

Microplastics can be divided into two categories i.e. primary and secondary microplastics.

Primary Microplastics –

Primary microplastics are tiny particles designed for commercial use, as well as microfibers shed from the clothing. They are directly released into the environment as small particles. It is estimated that primary microplastics represent around 15-31% of total microplastics in the oceans.

Synthetic clothes are a major source of primary microplastics with 35% of primary microplastics originating from it. Another important source is

vehicle tyres; abrasion of tyres produces about 28% of primary microplastics. Microplastics are also added intentionally in personal care products, for example micro-beads i.e. tiny pieces of polyethylene plastic are added as exfoliates to health and beauty products, cleansers, toothpastes and facial scrubs. Early estimates suggest these sources amount to 2% of total primary microplastics present in the environment.



Secondary Microplastics –

Secondary microplastics are the plastic particles that result from the breakdown of larger plastic items, such as water bottles, plastic bags or fishing nets. This breakdown can be caused by exposure to the environmental factors, such as solar radiations and ocean waves. These tiny particles easily pass through water filtration systems and end up in the water bodies, posing a potential threat to aquatic life. Secondary microplastics account for 69-81% of microplastics found in the oceans.

Interestingly, while studying the origin of the particles, researchers found that many of microplastic particles are not new, but it's from what we've already dumped into the environment over several decades.



Harmful effects of Microplastics

Ecological effects

Microplastics can have potentially long-term detrimental effects on the environment and living organisms. They are found in increasing quantities in the ocean all over the world. According to a report by United Nations, there are as many as 51 trillion microplastics particles in the oceans, almost 500 times more than stars in our galaxy.



Microplastics pose a health risk to all animals including humans. Microplastics present in the oceans can be ingested by marine animals; which then accumulate and can end up in humans through the food chain. Till date, numerous studies have found microplastics particles in various food items, drinks, and even tap water.

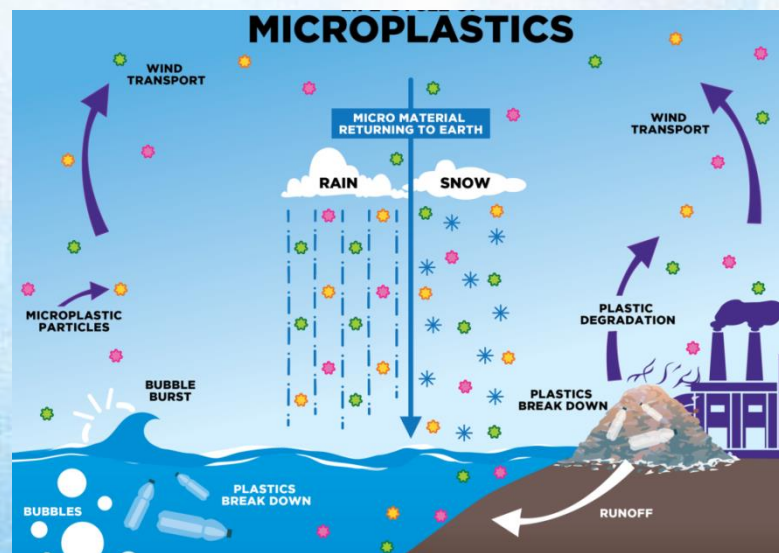
Effect on Climate

Microplastics are found in the most remote places on land and in the ocean as well as in our food. Recent studies around the world have

confirmed they are also present in the air we breathe. Since these are tiny particles, they are light enough to be transported by the wind over large distances. Researchers have also found microplastics in remote regions of Earth such as mountains, Arctic snow and in several ecological conservation areas.



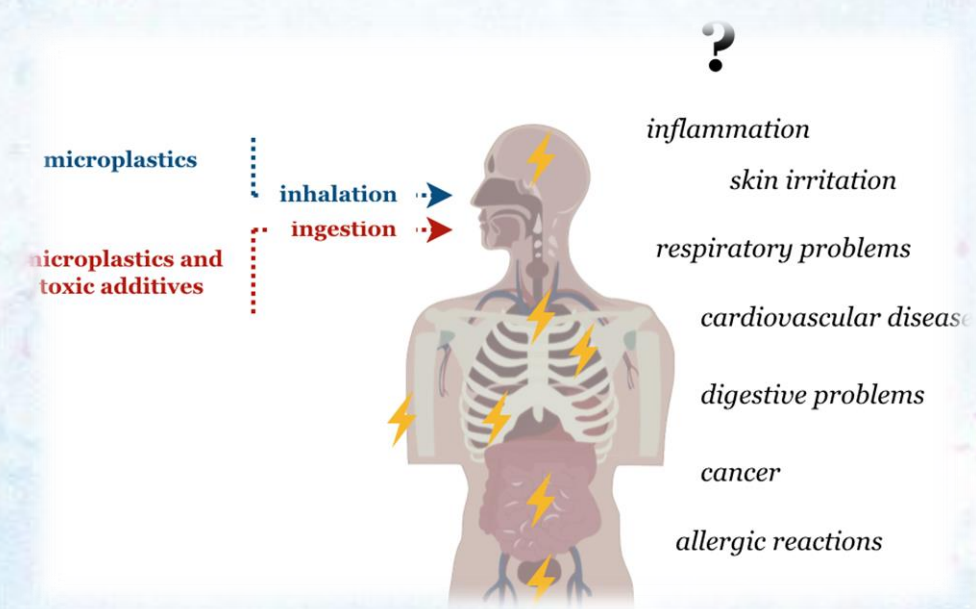
Though it is still not clear what role microplastics play in large scheme of things; in a recent study it is found that, overall, airborne microplastics are efficient at scattering sunlight, suggesting a cooling effect on the climate. However, they can also absorb radiation emitted by the Earth, and thus contribute, in a very small way, to the greenhouse effect as well. Study shows the influence of microplastics on global climate is currently very small, and a cooling effect dominates.



Physiological effects

Human Health: Though the effect of microplastics on human health is still being studied, several laboratory studies suggests that human exposure to microplastics could lead to oxidative stress, DNA damage and inflammation, among other health problems.

Particularly, when inflammation becomes chronic, it can pave the way to very serious health problems. However, it's not only the plastic particles themselves that are potentially harmful: the surface of micro plastics in the environment are colonised by micro-organisms, some of which have been identified as human pathogens.



Many microplastics are small enough to be inhaled straight into lungs and can be harmful when they get into the airways. They can cause swelling and damage to windpipe and to the tissue of lungs, resulting in mild chest pain as well as shortness of breath. Over time, microplastics can build up and damage the air sacs (alveoli) in the lungs. This can increase the risk of developing lung conditions such as emphysema and lung cancer.

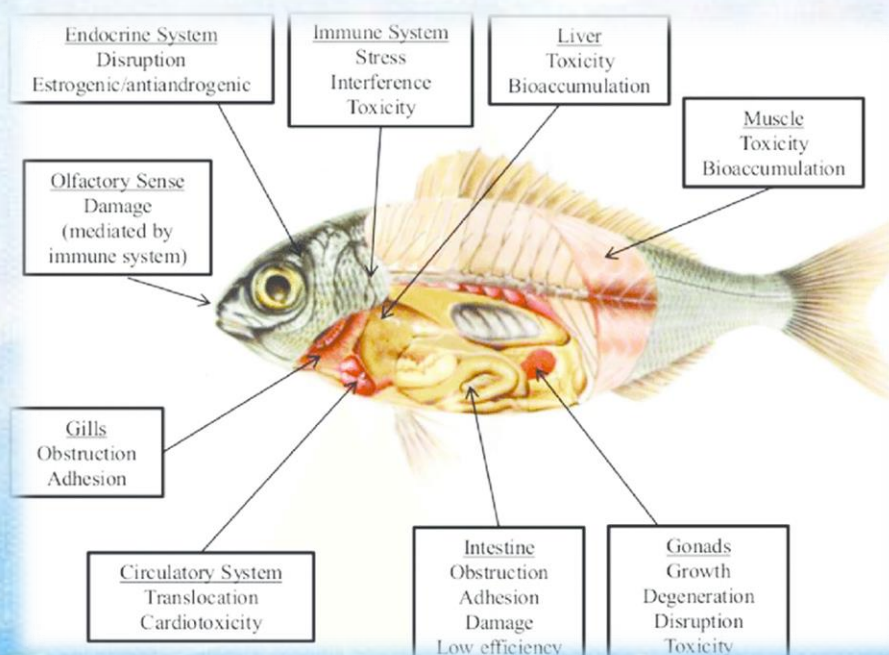
Some of the smallest microplastics can even get into the bloodstream. Combined with plaque and other pollutant particles like PM_{2.5} building up in the bloodstream, microplastics can further contribute to hardening

of arteries i.e. atherosclerosis; and blockages that can lead to the heart coronary artery disease and attacks.

Moreover, it is found that microplastics also carry other harmful pollutants on their surface. In big cities with the highest concentrations of microplastics, many of these particles adsorb pollutants like polycyclic aromatic hydrocarbons (PAHs) that result from the production of chemicals, smoking cigarettes, and burning fuel in cars and factories.

Inhaling pollutant-covered microplastics has been linked to other health effects, such as - Eye irritation, nausea, vomiting and disorientation, kidney and liver damage, cancer of the skin, lungs, bladder, liver etc.

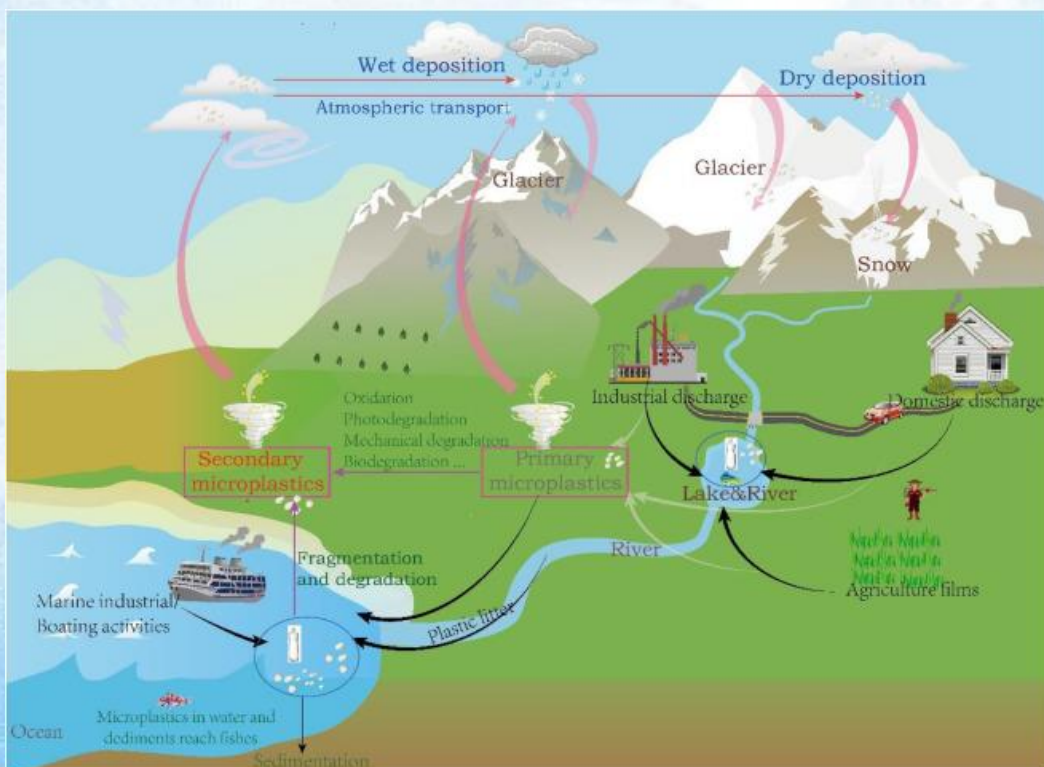
Effect on Animal Health: Since microplastics end up in the food chain, they have been detected in several animals, from tiny crustaceans to birds and whales. The microplastics enter the food chain via small animals present at the base of the food chain. The microplastics accumulate in the bodies of such small animals over the period of time. When larger animals consume these small animals, the amount of microplastics in large animals increases exponentially. This also magnifies its harmful effects. Microplastics can block the digestive tract in some species, leading them to starvation. Microplastics may also leach harmful chemicals into the bloodstream of animals that could potentially cross the blood-brain barrier and lead to neurological damage.



How do microplastics get into the air?

Though plastic recycling industry is gaining traction, it is still in nascent stage. Most of our plastic waste either gets buried in landfills or is incinerated. Since plastic isn't easily degradable it gets fragments into smaller and smaller pieces when any plastic object gets damaged, scraped, or abraded. It eventually reaches a point where microplastics are small and light enough to be swept into the air by wind. These particles then travel through the atmosphere. Once they enter the atmosphere, microplastics can stay airborne for up to six and a half days. Within this time, under the right conditions, plastics can be transported across the major oceans and between continents, either in one trip or by re-suspension over the oceans.

There are other ways by which microplastics can get into the air e.g. in western countries, the main way microplastics get tossed into the air is through road traffic. Car tires, brakes and even road surfaces contain plastic, which can be worn down into microplastics that enter the atmosphere. The turbulence of cars on the road -- the motion of tires, the braking process, the exhaust they emit -- all help churn up plastic on the ground and send it skyward, according to the study.



This happens in the ocean, too, where large clusters of waste form entire plastic islands. They are broken down into microplastics that sit on the top layer of the water, where they are tossed into the air by waves and wind.

There are several other ways microplastics enter the atmosphere, e.g. in large cities through the wind, and in rural areas through soil dust during agricultural processes.

Mitigation measures to reduce microplastics pollution

Since microplastics are another harmful product of plastic intensive lifestyle, unsurprisingly the answer to reduce microplastics pollution is to reduce usage of plastic. A plastic-free lifestyle may seem impossible, but every small choice can make a difference.

Here are a few tips to reduce micro plastics in our life:

- **Install a laundry filter:** Clothing is one of the world's largest sources of pollution. Most of the clothing has polyester or other forms of plastics in it. When washing these clothes, microplastics leaks out into the water. A single load of laundry can release over a million microplastic particles. In order to combat this, the most viable way is to install a filter in washing machine to catch these plastics. Once collected in filter, it can properly be disposed.
- **Stop or reduce single-use plastics:** Reducing or completely avoiding the use of single use plastic is the most efficient way to reduce plastic pollution. Plastic things such as straws, cups, plates, and takeout containers can add up over time. Hence using cups, plates and takeout containers made from biodegradable material is recommended wherever possible.



- Using public transportation. Tire rubber breaks down and pollutes the air and is energetically inefficient. By not using a personal car, one can significantly reduce plastic footprint.
- Reduce your use of products with micro plastic beads in them. Toothpaste and facial scrubs are examples of products that contain micro beads. These beads can pass through filtration systems and travel far distances, even into the water supply. By avoiding these products, you can reduce your own plastic exposure and that of the entire world.

9 TIPS FOR REDUCING YOUR PLASTIC USE



1
Bring your own shopping bag



2
Carry a reusable water bottle



3
Bring your own cup



4
Pack your lunch in reusable containers



5
Say no to disposable straws and cutlery



6
Use compostable produce bags



7
Slow down and dine in



8
Store leftovers in glass jars



9
Use BioBags instead of plastic bags



INDIAN INSTITUTE OF TROPICAL METEOROLOGY (IITM), PUNE
Environmental Information System (ENVIS) Resource Partner
 (Ministry of Environment, Forest & Climate Change, Govt. of India)
PARADISE ENGLISH MEDIUM SCHOOL & JR. COLLEGE

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www.iitmenvis.nic.in

+91-20-2590-4212

iitm-env@nic.in

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EDITORIAL TEAM

Dr B S Murthy (ENVIS Co-ordinator)

Dr R Latha (Senior Scientist)

Dr Priyank Nimje (Program Officer)

Bhagyashri Katre (I.T. Officer)

Gaurav Shinde (Information Officer)

Sapana Taral (Data Entry Operator)

Indian Institute of Tropical Meteorology

Dr. Homi Bhabha Road, Pashan Pune – 411008, India

Phone : +91-20-2590-4212 | www.iitmenvis.nic.in | iitm-env@nic.in