BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,

Principal Bench, New Delhi

Original Application No. 251/2022

In re: News item published in The Hindu dated 29.03.2022 titled "Detecting microplastics in human blood"

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S. No.	Particulars	Page No.
1.	**Report** in compliance of order dated 05.04.2022 in OA No. 251/2022, In re: News item published in The Hindu dated 29.03.2022 titled "Detecting microplastics in human blood".	
2.	**Annexure-1:** A copy of Minutes of Meeting on "Committee Meeting in compliance of Hon'ble NGT order in the matter of O.A. No. 251 of 2022" with CIPET/ICMR /NCSCM held on April 19th, 2022.	
3.	**Annexure-2 :** A copy of Hon'ble NGT order dated 05.04.2022.	

(Divya Sinha)
Scientist E
Central Pollution Control Board
Delhi-110032

Date: 10.02.2023
Place: Delhi

CENTRAL POLLUTION CONTROL BOARD
DELHI

Date: 08.02.2023

Report in the matter of Tribunal on its own motion SuoMotu based on the news item published The Hindu titled "Detecting Microplastics in human blood" dated March 29, 2022 (O.A. No. 251/2022)

A. BACKGROUND

Vide order dated 05.04.2022 in aforesaid matter, Hon'ble NGT issued the following directions

Para4: *There is need for further studies, considering the studies already conducted, to be steered by the Committee comprising of CPCB, ICMR, Central Institute of Petrochemicals Engineering & Technology (CIPET), NCSCM, and any other expert institutions as required, under the Nodal coordination of CPCB. Such studies and recommendations/ suggestionsmay cover standards for safe environment, remedial steps to reduce menace of micro plastic and addressing other incidental issues. CPCB may incur expenditure on studies and other incidents out of Environmental Compensation funds*

B. ACTION TAKEN REPORT

Three meetings of the Committee members representingCPCB, *ICMR, CIPET&, NCSCM*were held on April 19, July 27 & August 5, 2022 respectively through Video Conferencing.Issues related to microplastics were discussed during the Meetings. The Minutes of the Meetings are enclosed at Annexure I. Detailed assessment of the work done by individual organization as well as available information on Microplastics has been completed and the outcome of the same is enumerated below:

1.0 About Microplastics

Microplastics is used extensively to describe plastic particles with an upper size limit of 5 mm (UNEP). Occurrence of microplastics has been reported from oceans, sediments, surface water, ground water, wastewater, tap water, bottled water, air, food products, aquatic organisms, and human (Microplstics in Drinking Water WHO 2019). Based on their origin; microplastics can be categorized into primary and secondary microplastics. Primary microplastics are intentionally manufactured in size < 5 mm to be used in various applications such as cosmetics, clothing and other textiles, fishing nets, etc. (Mai et al.

2018). Secondary microplastics originate from the breakdown of discarded plastic waste by solar radiation, mechanical degradation, microbial action etc. (Rodrigues et al. 2018; Wagner and Lambert 2018).

These microplastic particles may be of various shapes such as fragments, pellets, beads, and fibres. (Figure1.1). Further classification of microplastics on the type of plastic and its density is given in Table 1.1

Figure 1.1: Micrographs showing different types of microplastics: (a&b) fragments, (c&d) fibre/line, (e&f) film (g) foam and (h) pellet.

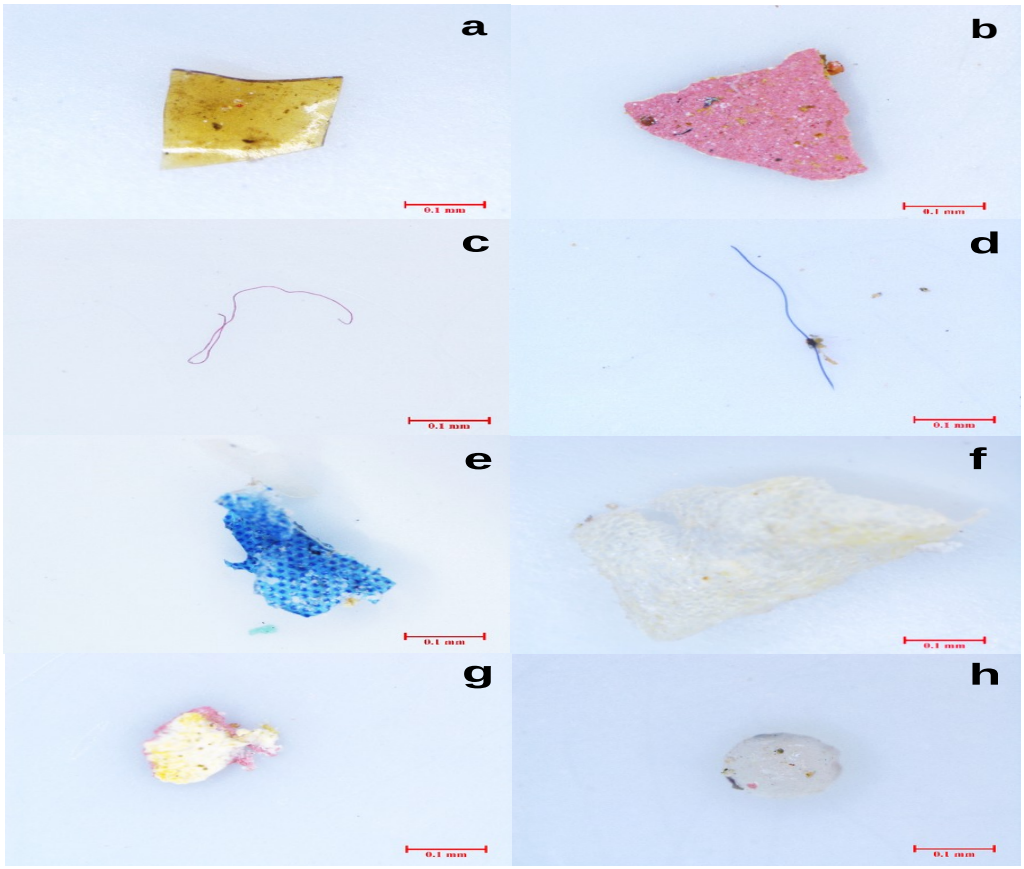
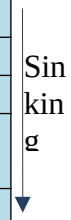


Table 1.1: Type & Density of Microplastics

Common Polymers of Microplastics	Common applications	Specific Gravity
Polyethylene (PE)	Plastic bags, six-pack rings,	0.91-0.94

Flo
ati
ng

	gear	
Polypropylene (PP)	Rope, bottle caps, gear, strapping	0.90-0.92
Polystyrene (expanded) (PS)	Bait boxes, floats, cups	0.01-1.05
Seawater		~1.02
Polystyrene (PS)	Utensils, containers	1.04-1.09
Polyvinyl Chloride (PVC)	Film, pipe, containers	1.16-1.30
Polyamide or nylon	Gear, rope	1.13-1.15
Polyethylene terephthalate (PET)	Bottles, strapping, gear	1.34-1.39
Polyester resin + glass fibres	Textiles	>1.35
Cellulose acetate	Cigarette filters	1.22-1.24



2.0 Sampling & Analysis of Microplastics

There is currently no standard method for sampling and analysis of microplastics in the environment. ISO is currently working on the subject (WHO Report :Microplastics in Drinking Water: 2019)

Sampling and analysis of microplastics, based on available literature, involves the following three steps:

a) Sampling;
b) Sample extraction and isolation &
c) Identification, characterization and quantification

2.1 Sampling

Microplastic samples can be acquired using trawl nets drawn across the surface of the water, or through collection of water samples from which the particles are extracted later.

2.2 Sample Extraction

Sample purification usually involves filtration, followed by some sort of extraction process such as density separation, in which samples are mixed with a liquid of defined density, allowing microplastic particles to float and heavier particles to sink. Further purification may require chemical or enzymatic methods to remove organic or inorganic contaminants (biofouling). The extent of the preparation is dependent on the nature of the samples: dirtier samples will require more preparation.

2.3 Analysis

2.3.1 Count of Microplastics

The simplest and the most common technique to quantify the microplasticsparticles is the optical microscopy where quantification is achieved through manual counting.Though this technique is simple, it poses limitations in terms of misidentification and reduced accuracy (underestimation (Loder et al. 2015) / overestimation (Lenz et al. 2015)). However,application of electron microscopic techniques, such as scanning electron microscopy can overcome this limitation up to some extent (Eriksen et al. 2013)

2.3.2 Chemical Composition

Two different approaches are available to determine the chemical composition: spectroscopic&thermoanalytical.

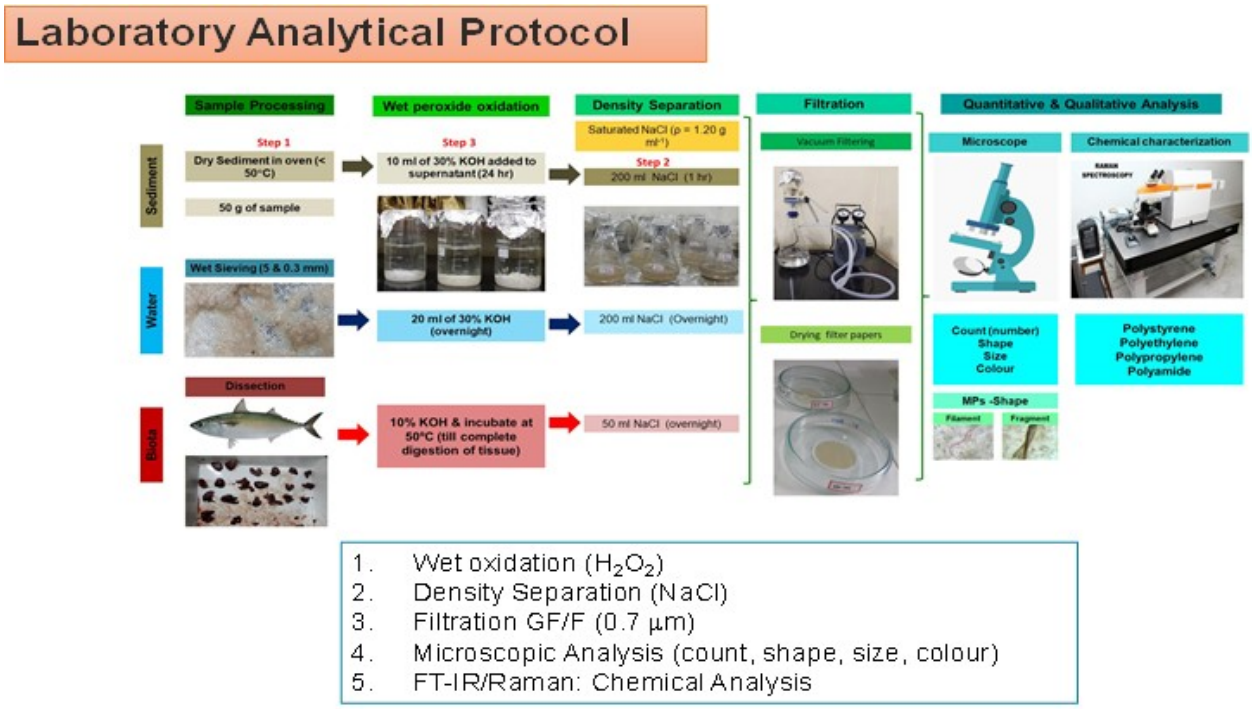
- **Spectroscopic methods**: Used to identify the specific chemical structure of polymers by comparing their absorption or emission spectra with reference spectra. Fourier transform infrared spectroscopy (micro FTIR) Fourier transform infrared spectroscopy and Raman spectroscopy are utilized for this purpose.
- **Thermo-analytical methods**, the sample ispyrolysed under inert conditions, so that specific decomposition products of the individual polymers can be analyzed. Pyrolysis-gas chromatography/mass spectrometry (GC/MS) can provide information on additives as well as the polymer

2.4. Sampling & Analysis Methods followed in India

2.4.1 Ministry of Earth Sciences (National Center for Coastal Research (NCCR))

(a) Sampling Methods

(b) Sample Extraction & analysis



1. Wet oxidation (H_2O_2)
2. Density Separation (NaCl)
3. Filtration GF/F (0.7 µm)
4. Microscopic Analysis (count, shape, size, colour)
5. FT-IR/Raman: Chemical Analysis

2.4.2 CIPET

(a) Sample extraction techniques:

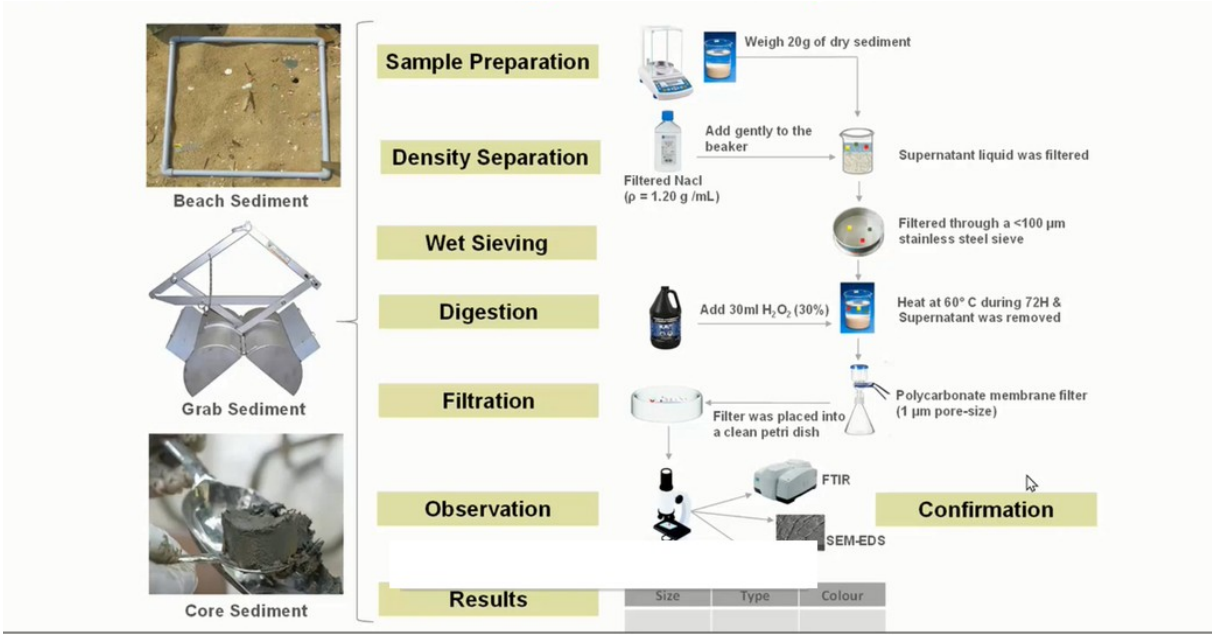
- Quality Control (Running blank samples)
- Preparation of salt solution:
- Density Separation
- Wet Peroxide Oxidation
- Sieving
- Vacuum Filtration

(b) Qualitative analysis:

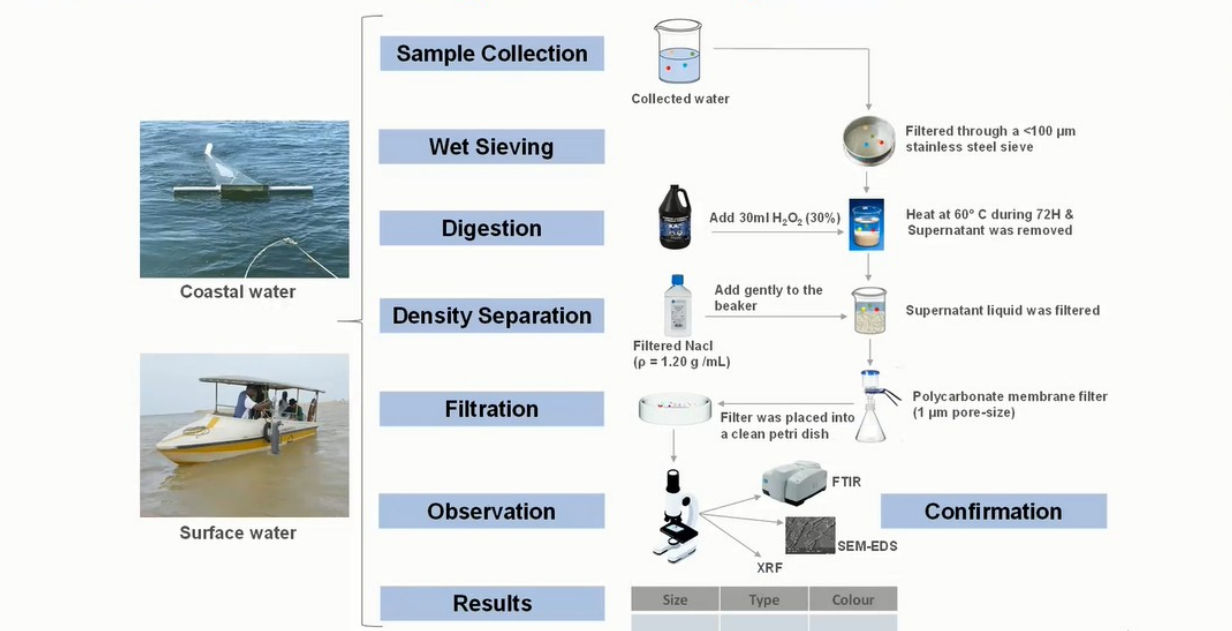
- Optical Microscope: The analysis is done through different magnification ranges i.e. 5x,10x and 20x to for various shape and sizes of microplastics.
- Micro-FTIR: In this technique, the spectra obtained by of targeted microplastics are analysed through the peaks obtained and analysing them through the functional group.
- Pyrolysis GC-MS: The thermal technique is used for the knowledge of degradation products of the microplastics found in the sample.
- Number of microplastic samples found in per litre of sample in each location was analysed along with various shapes and colours.

2.4.3 NCSCM

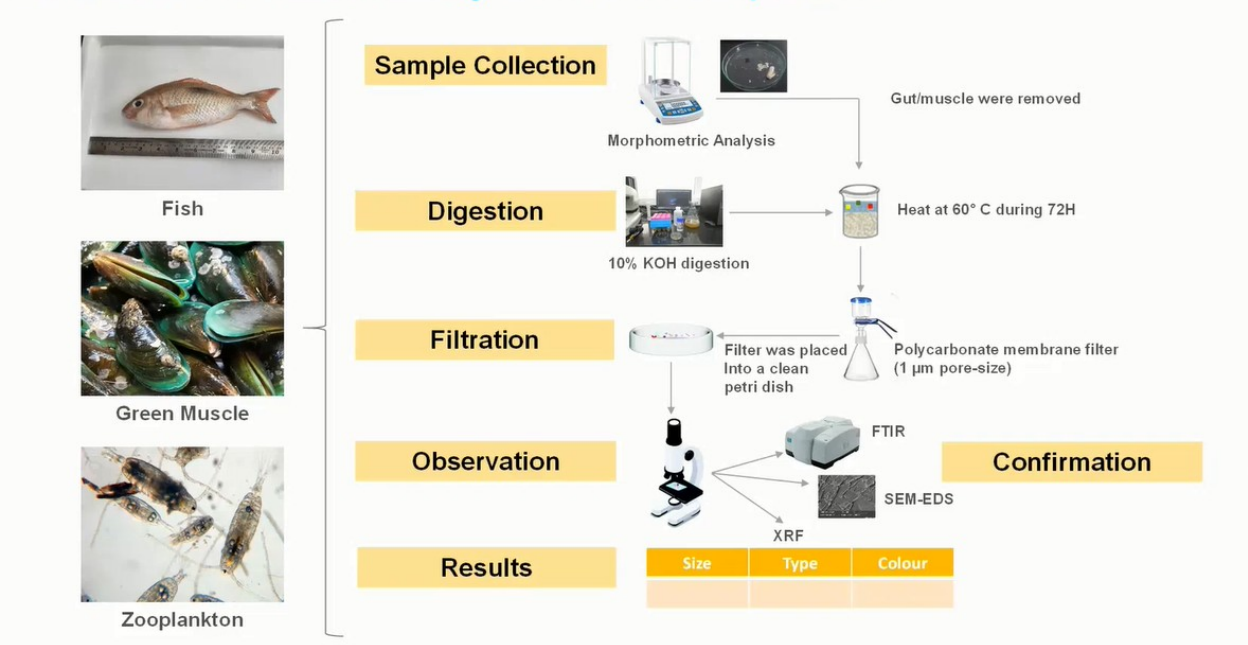
(a) Sample Extraction & analysis (Sediments)



(b) Microplastic Analysis in Water



a. Microplastics analysis in Biota



2.5 Observations

(a) Sampling and analytical methods adopted by different institutions in India are similar with minor variations

(b) Standard method for Sampling & Analysis developed by BIS/ISO is essential to formalize further action on monitoring reports.

3.0 Assessment of Microplastics

Microplastics (both primary and secondary) pollute drinking water sources primarily through discharge of sewage/wastewater treatment plant effluent and surface run-off. There are large numbers of industries that use (primary) microplastics for various applications, such as medicines, cosmetics etc. After their use, these primary microplastics get washed off and become a part of the domestic wastewater (Singh et al. 2021). As the sewage/wastewater treatment plants are not equipped for the complete removal of microplastics, the effluent released from these plants contains substantial quantity of microplastics (Amrutha and Warrier 2020). Upon mixing of this effluent with the freshwater sources, microplastics become part of the fresh/drinking water supply chain (Magnusson and Noren 2014; Novotna et al. 2019). It is also important to note that many components of water treatment plants and water distribution system are usually made up of plastic materials, such as high density polyethylene, polyvinyl chloride, polypropylene etc. (Mintenig et al. 2019) and hence, these further contribute towards microplastic generation in the water they carry.The treated bottled water is also reported to contain microplastics (Mason et al. 2018;Pivokonsky et al. 2018). Nevertheless, the smallest microplastic particle reported in case of drinking water is 1 µm (WHO 2019). Evidence suggests that it is the bottling process and/or packaging of the plastic bottles/caps that largely contributes to the generation of microplastics.

In the air, suspended microplastic particles have been isolated from various places, such as, urbanized city centres, indoor households, and remote outdoor regions. As there is wide range of microplastics' size, it is highly likely that these particles are inhaled by the humans (Jenner et al. 2022).

Soil can get affected from plastics through various means such as plastic mulch films, municipal so waste, sewage sludge, fertilizers coated with plastics etc. (McCormick et al.2014; Blasing and Amelung 2018; Liu et al. 2018). A significant positive correlation has been seen between the rate of sludge applied onto the soil and concentration of microplastic particles in the soil (Zhang et al. 2020).

Various organizations including CIPET, NCSCM, NCCR (MoES), NPC & CPCB have conducted microplsatic monitoring. Further international organization including UNEP, WHO and OECD have worked extensively on Microplastics and published comprehensive Reports. Based on aforementioned Sources of generation of microplastics, transfer media and end use areas have been identified. Further details of microplastics(concentration, type etc) for these areas have been compiled. Details are given in Table 3.1

Table 3.1 : Sources of Generation &Analysis& of Microplastics

S.N.	**Class**	**Category**	**Subcategory**	**Description**	**Analysis data**	**Reference**
1.	**Generation**					

S.N.	Class	Category	Subcategory	Description	Analysis data	Reference
	of Microplastics					
a	Industry	(i)During production	Toothpaste		NA	UNEP
			Cosmetics	Microbeads in skin care	NA	UNEP
			Printer , ink, spray, injection moulding		NA	UNEP
			Plastic production	Emissions/ spillages	NA	UNEP
			Ship breaking		NA	UNEP
			Cigarette filters		NA	UNEP
		(ii)During Usage	Synthetic textiles	Use & washing	100 microfibers/L	UNEP,OECD
			Horticulture	Plastic Sheeting / Tube	NA	UNEP
			Road Transport	Tyre & Road wear particles	NA	OECD, WHO
			Paint from Building & Ships		NA	OECD
			Bottled Water	Caps & bottle	Section 3.1	WHO
			Synthetic Soles of Shoes		NA	WHO
b	Improper waste management	(i) Land Litter		Degradation under specific temp & UV rays	NA	UNEP, WHO
		(ii)Dumpsites		Degradation under specific temp & UV rays	NA	UNEP, WHO

S.N.	**Class**	**Category**	**Subcategory**	**Description**	**Analysis data**	**Reference**
		(iii)Marine litter		Degradation under specific temp & UV rays	NA	UNEP
c	Ocean Activities			Fishing Nets, Boxes, Rope, galley waste;	NA	UNEP, MoES
				Aquacuture - nets, floating	NA	UNEP
				Coastal Tourism	NA	UNEP NCSCM
				Offshore Oil & Gas Platform	NA	UNEP
d	Outflow from sewage treatment plant			Waste water treatment plant can effectively remove microplastics , but in most area adequate sewage treatment systems not provided	NA	WHO
e	Agricultural Runoff			When waste water sludge is used as compost	NA	WHO
f	Stormwater drains			Carrying Road dust	NA	WHO
g	Leachate			Leachate	Section 3.2	CPCB
2	**Transfer of Microplastics**					
a	Surface Water				Section 3.3	CPCB, NPC
b	Soil / Beach Sediment				Section 3.4	MoES, NCSCM
c	Sludge				NA	
d	Fish				Section 3.5	MoES **NCSCM**
e	Ocean				Section	MoES,

S.N.	**Class**	**Category**	**Subcategory**	**Description**	**Analysis data**	**Reference**
	water				3.6	NCSCM
3	**End use**					
a	Ground Water				Section 3.7	CPCB. WHO
b	Drinking Water			Microplastics have been identified in drinking-water as small as 1 µm, based on the smallest particle size detected by current methods. Large particles occur less frequently than small particles. The predominant particle shapes are fragments and fibres. The predominant plastic types are PET and PP	Table 3.1	WHO
c	Ambient Air			Tyre & Road wear dust	Section 3.8	WHO, CPCB

3.1: Drinking Water & Bottled Water

(a) WHO

Table 3.2 : MP comncentration in Tap Water / Bottled Water

Author	Water type	Lower size bound (µm)	Particles/L in sample (average)	Particles/L in blanks (average)
Oßmann et al.	Bottles (mineral water)	1	3074-6292	384

	•Glass •Single use PET •Reusable PET		2649 4889	
Pivokonsky et al. (2018)	DWTP from surface water sources (3 sites	1	628 338 369	<5% of counts in samples
Schymanski et al. (2018)	Bottles •Single use •Returnable •Glass •Beverage carton	5-20	 14 118 50 11	14±13
Mason, Welch and Neratko (2018)	Bottled	6.5-100 Lower bound based on microscope and software	315	23.5
Strand et al. (2018)	Tap from ground-water sources	10-100	0.2, 0.8 and 0.0 (LoD = 0.3)[4]	Unknown
Mintenig et al. (2019)	Tap from ground-water sources.	20	0.0007	0.67 particles/ L 0.3 fibres/L
Uhl, Eftekhardadkhah, and Svendsen (2018)	Tap from 24 sources	60	Average not reported since only a single result above LoQ (that result was 5.5)	0.5 (LoQ = 4.1 LoD= 0.9)
Mason, Welch and Neratko (2018)	Bottled	>100	10.4	4.15
Strand et al. (2018)	Tap from ground-water sources	>100 (10 µm sieve size)	0.312 (LoD = 0.58)	0.26
Kosuth, Mason and Wattenberg (2018)	Tap from unspecified sources	100 lowest reported	5.45	0.33 (based on 5 particles in 30 blanks (ea. 500mL))

3.2 Leachate from Dumpsite

Table 3.3. : Leachate (CPCB)

Location	Type of water	Microplastics concentration (particles/ L)	Reference
South China	Leachate	3 to 25 particles/L	Wan et al. 2022
Suzhou, China	Leachate	235.4 ± 17.1 particles /L	Sun et al. 2021
China	Leachate	0.42 to 24.58 particles/L	He et al. 2019
Shanghai, China	Leachate	4 ± 13 particles/L	Su et al. 2019
Lahti, Finland	Leachate	1.97 particles/L	Praaghet al. 2018
Alfsnes, Iceland	Leachate	4.51 particles/L	Praaghet al. 2018
Kodungaiyur, India	Leachate	0.75 to 16.2 particles/L	CPCB
Perungudi, India	Leachate	0.8 to 32 particles/L	CPCB

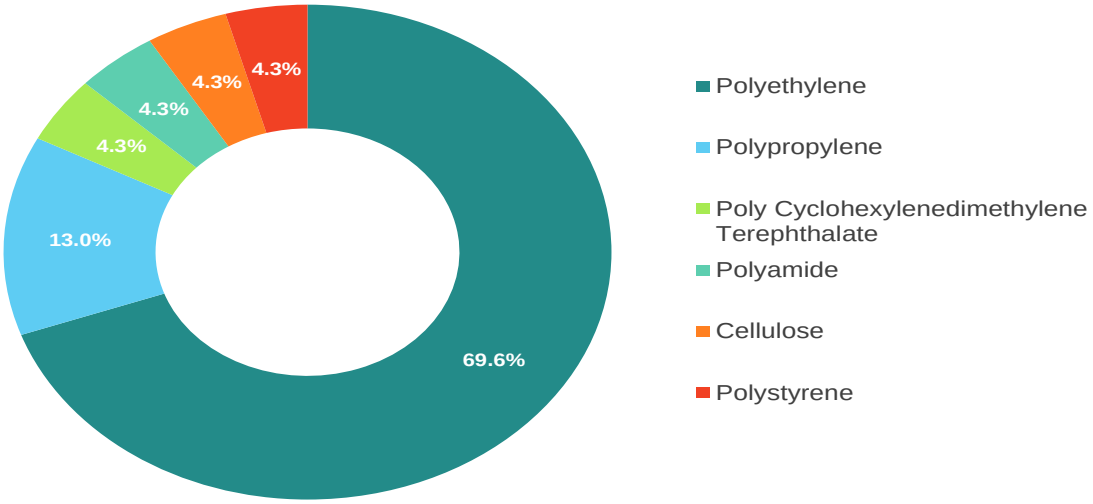


Figure 3.1 : Percentage composition of different types of plastics found in Leachate (CPCB)

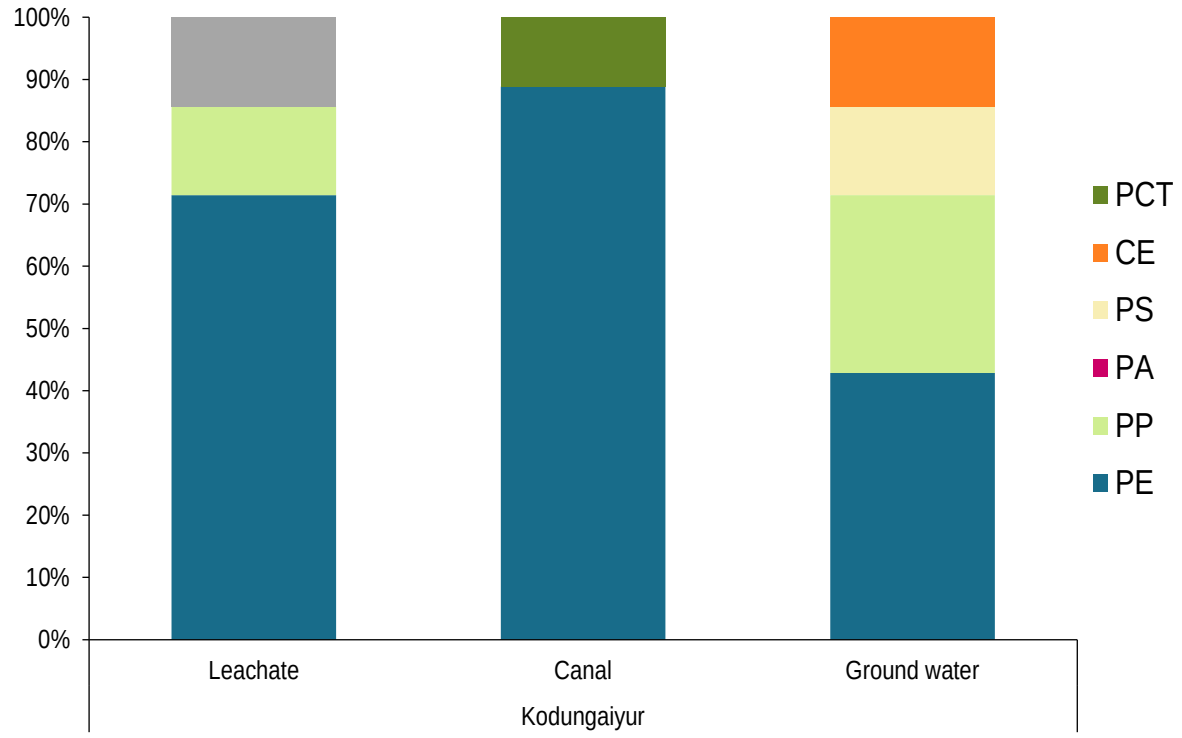


Figure 3.2: Percentage composition of microplastics in leachate, canal and groundwater samples around in dumpsite (CPCB)

3.3 Surface water

Table 3.4 Microplastics in Surface Water (WHO)

Location	Results reported (particles/L)	Sieve size (µm)	Study
Groundwater, Germany	Average:[b]0.7×10^{-3} Range:[b]$0\text{-}7\times10^{-3}$	3	Minteniget al. 2019
Three Gorges Reservoir, China	Average: 4.7 Range: 1.6 – 12.6	48	Di and Wang, 2018
Dongting Lake and Hong Lake, China	Averages: 1.2 and 2.3 Ranges: 0.9-2.8 and 1.3-4.7	50	Wang et al. 2018
Wuhan, China	Range: 1.6-8.9	50	Wang et al. 2017
Rhine river, Switzerland, France, Germany, Netherlands	Average: 0.0056	300	Mani et al. 2015
Western Lake Superior, USA	Average: 0.00026	333	Hendrickson, Minor, and Schreiner, 2018

Figure 3.3 Microplastics identified in the River
(Sizes of Plastic like Particles in Water Samples in percentage in four cities)(NPC)

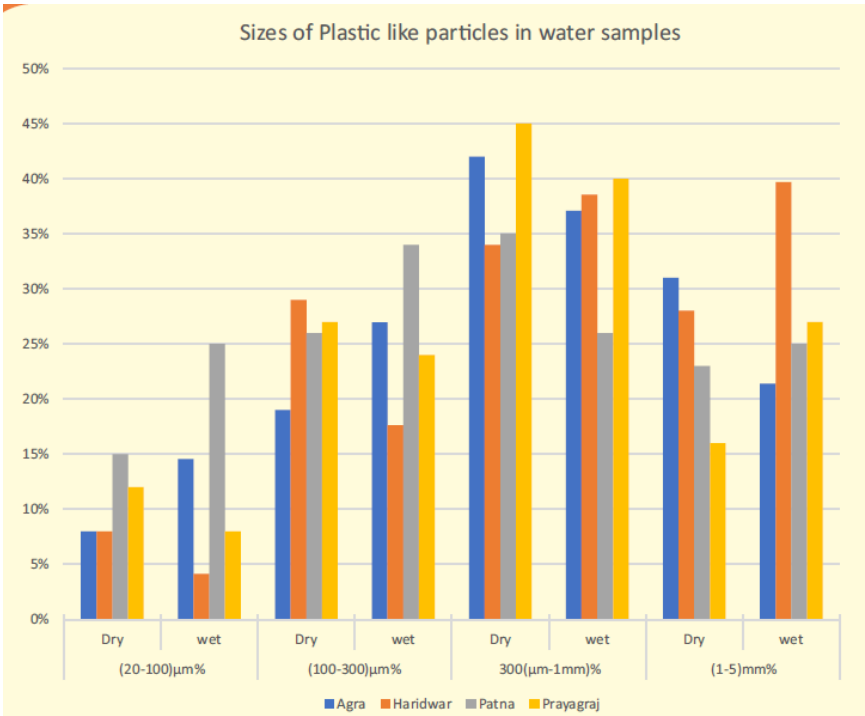
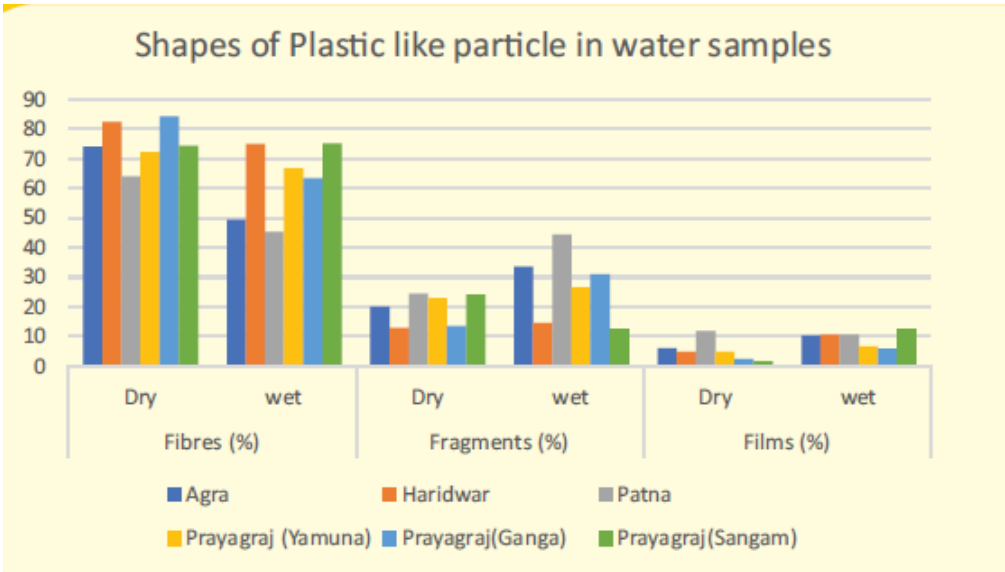
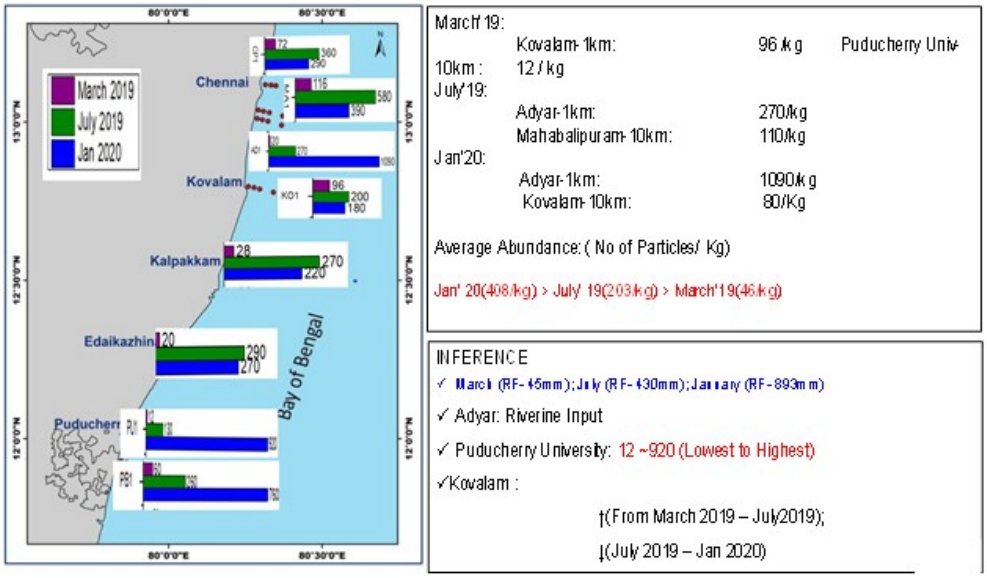


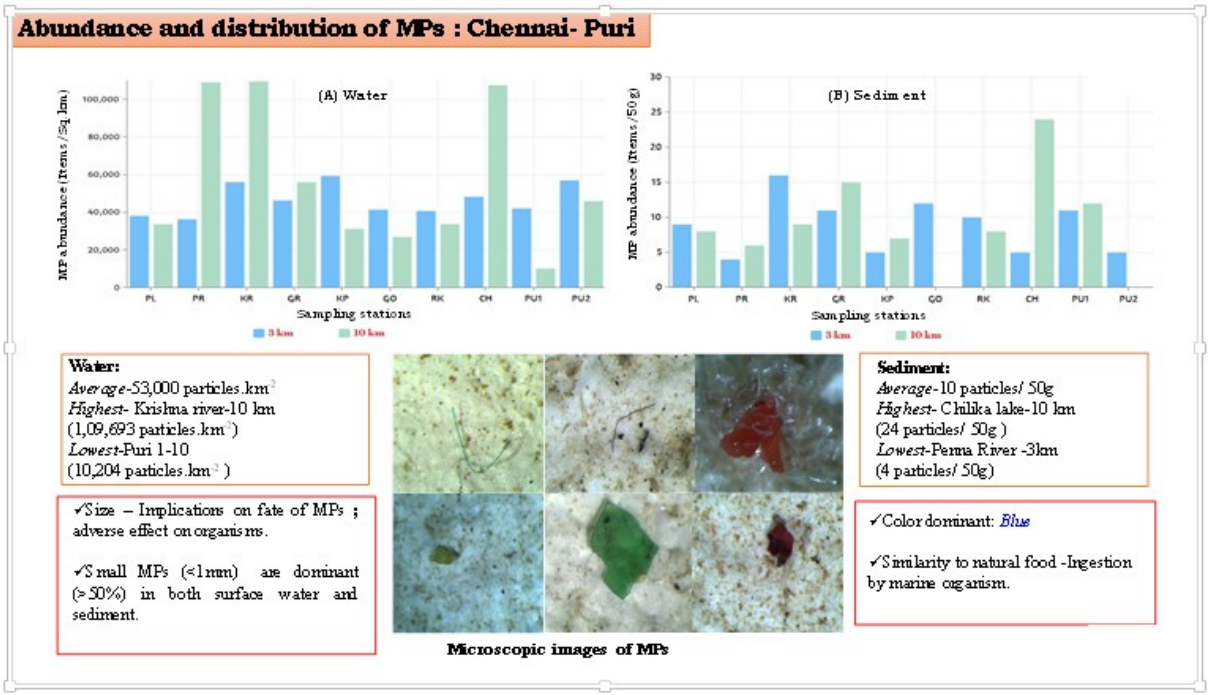
Figure 3.4 Microplastics identified in the River
(Shapes of Plastic like Particles in Water Samples amongst Fibres/Fragments/Films in percentage in four cities) (NPC)



Section 3.4 :Beach Sediment/ Deep Sea Sediments
(a) Figure3.5 Microplastics (MoES- NCCR)
(Microplastic sediments –Chennai-Puducherry)



(b) Figure3.6Microplastics (MoES- NCCR)
(Microplastic sediments –Chennai-Puri)



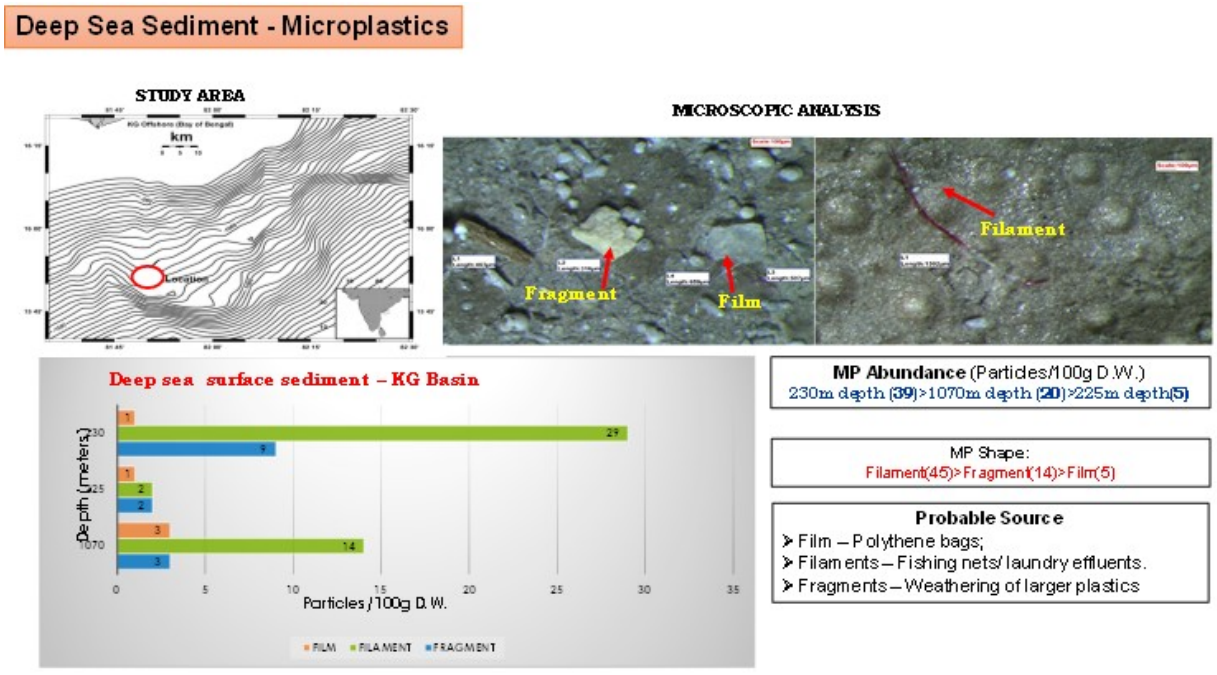
(c) Beach sediments (NCSCM)

Abundance of microplastics in terms of numbers of particles and their range, in the beach sample reported from different parts of the world and long the Tamil Nadu coast () Table 3.5

S.No.	Location	Range	Mean ±	Reference

1.	Charleston, Harbor, USA	42 to 1196/m^2	413.8 ± 76.7/ m^2	Grayet al. 2018
2.	Winyah Bay, USA	51 to 441/m^2	221.0 ± 25.6/ m^2	Grayet al. 2018
3.	Guanbara Bay, Brazil	12 to 1300/m^2	-	Carvalho and BaptistaNeto , 2016
4.	Bostanu, Persian Gulf	-	1258 ± 291/kg	Najiet al. 2016
5.	Gorsozan, Persian Gulf	-	122 ± 23/kg	Najiet al. 2016
6.	Norther Gulf on Mexico	-	50.6 ± 9.96/ m^2	Wessel et al.2016
7.	South Korea	2 to 92,217/m^2	8205/m^2	Lee et al. 2013
8.	Chile	1 to 169/m^2	30 ± 2.6/m^2	Hidalgo-Ruz and Thiel, 2013
9.	Easter Island	-	800 ± 320/m^2	Hidalgo-Ruz and Thiel, 2013
10.	South Korea	-	976 ± 405/m^2	Heoet al. 2013
11.	Mumbai, India	12 to 960/m^2	68.8/m^2	Jayasiriet al. 2013
12.	Otzias beach, Eastern Mediterranean	20 to 1218/m^2	575/m^2	Kaberiet al. 2013
13.	Portugal coast	1 to 137/m^2	26.6 ± 32.5/m^2	Martins and Sobral, 2011
14.	Malta, Central Mediterranean	0 to 1462/m^2	33.3/m^2	Martins and Sobral, 2011
15.	Belgium	-	91.9/kg	Claessenset al. 2011
16.	Hawaiian Archipelago	4 to 17,645/m^2	-	McDermid and McMullen, 2004
17.	Tamil Nadu Coast, India	2 to 178/m^2	46.6 ± 37.2/m^2	R. Karthik et al.

Figure 3.7 Deep Sea MicroplasticConcentration (MoES)



Section 3.5 Microplastics in Fish

Figure 3.8Microplastics in Biota (MoES)

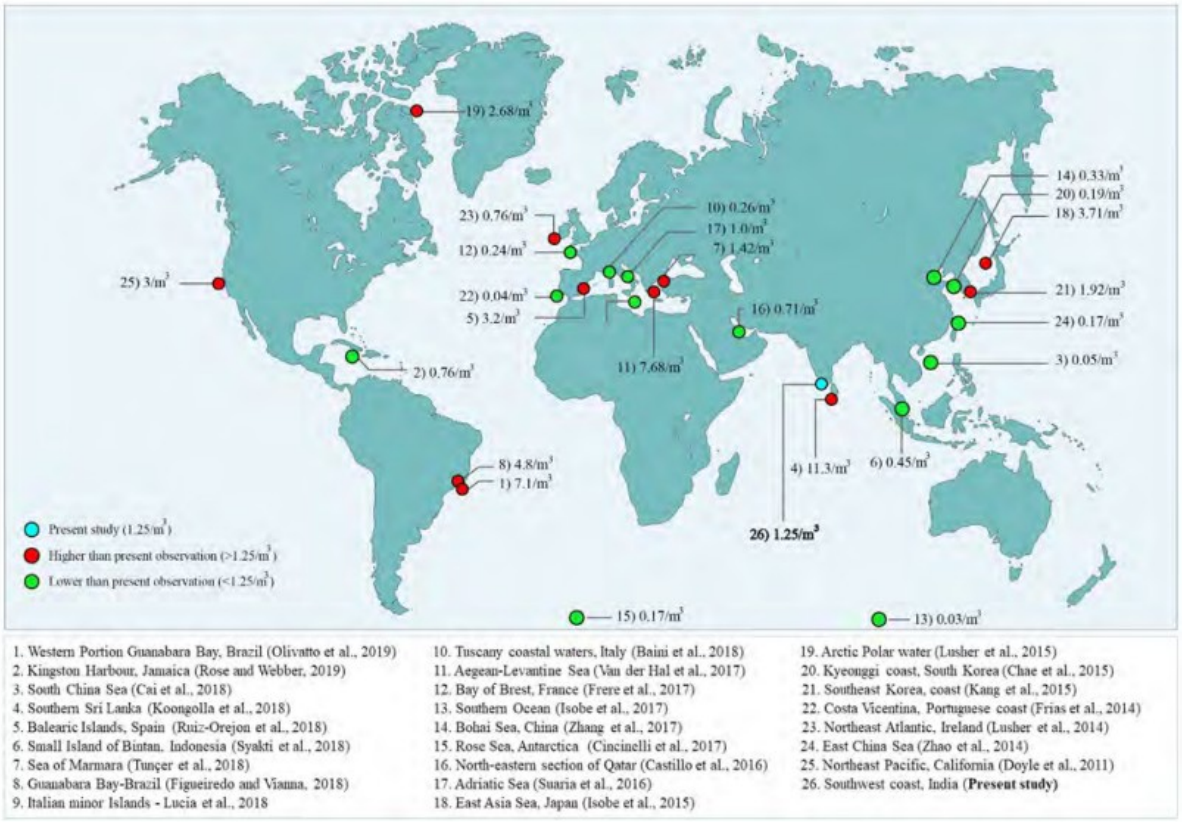
MPs in biota - Chennai coast

- 7- Finfish & 3- Shellfish
- Average ingestion of MPs was higher in Shellfish (28.2±10.9 Nos./Ind.) than finfish (1.3±1.1 Nos./Ind.)
- Shape - Dominant - Fibres.
- Dominant size range - 1-1000 µm
- Red MPs (finfish), black MPs(Shellfish) are predominant
- Major polymers - Polyamide (PA), Polyethylene (PE), and Polypropylene (PP)

Section 3.6 Coastal Water

Abundance ranged between 0.22 and 3.58 particles/m3 with an average of 1.25 ± 0.88 particles/m3 (n = 14) (NCSCM).

Figure 3.9Microplastics in Coastal Water (Global distribution of mean microplastic particles (particles/m') in the coastal waters and comparison)



Section 3.7 Microplastics in Groundwater

Table 3.6:Microplastics in Groundwater (CPCB)

Location	Type of water	Microplastics concentration (particles/ L)	Reference
South China	Leachate	3 to 25 particles/L	Wan et al. 2022
Suzhou, China	Leachate	235.4 ± 17.1 particles /L	Sun et al. 2021
China	Leachate	0.42 to 24.58 particles/L	He et al. 2019
Shanghai, China	Leachate	4 ± 13 particles/L	Su et al. 2019
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Kodungaiyur, India	Leachate	0.75 to 16.2 particles/L	CPCB study 2022
Perungudi, India	Leachate	0.8 to 32 particles/L	CPCB study 2022
South China	Groundwater	11 to 17 particles/L	Wan et al. 2022
Australia	Groundwater	16 to 97 particles/L	Samandraet al. 2022
Karst, US	Groundwater	15.2 particles/L	Pannoet al. 2019
Kodungaiyur, India	Groundwater	0.87 particles/L	CPCB study 2022
Perungudi, India	Groundwater	2.1 particles/L	CPCB study 2022

Section 3.8 Microplastics in Ambient Air

Table 3.7: Microplastics concentrations detected in the air at Dumpsites in India vsMicroplastics measured at different locations across the globe(CPCB)

Location	Samples Type	Method	Microplastics conc. (particles/m^3)	Reference
Shanghai, China	Urban megacity	KB-120F type intelligent middle flow total suspended particulate sampler	0–4.18	Liu et al. 2019a
Paris, France	Indoor and outdoor of Residential area of Paris city	Simple vacuum filtration array	0.3–1.5	Driset al. 2017
Asaluyeh County, Iran	Industrial area	ECHO PM ambient filter sampler	0.3–1.1	Abbasiet al. 2019
West Pacific Ocean	Coastal area	KB-120F type intelligent middle flow total suspended particulate sampler	0.13 ± 0.24	Liu et al. 2019a
Cal State University, USA	Across 100 km of coastal Southern California, Semi-urbanized landscape	Simple vacuum filtration array	0.7–19.6	Gaston et al. 2020
Kodungaiyur, Chennai, India	Urban area,landfill site	High Volume Air Sampler	0.37–0.92 (PM10) 0.50–0.97 (PM2.5)	CPCB study 2022
Perungudi, Chennai, India	Urban area, landfill site	High Volume Air Sampler	0.22–0.72 (PM10) 0.50–3.88 (PM2.5)	CPCB study 2022

3.9 Observations

- Quantification of Microplastic generation at source has not been done for most of the Sources
- Variation in Microplastic concentrations units reported by different organizations observed
- Most of the monitoring has been done in Coastal Areas

4.0 Risk Assessment

Microplastics can present several unique challenges for traditional human health risk assessment approaches. Findings of World Health Organization and ICMR are highlighted in this section

4.1 WHO

WHO in its report on Microplastics in Drinking water: WHO Report 2019" has highlighted the following issues

- Microplastics can present several unique challenges for traditional human health risk assessment approaches. Plastic polymers are generally considered to be of low toxicity. Being insoluble, they are unlikely to be absorbed from the gastrointestinal (GI) tract and generally do not interact with biological matrices, although particle size may influence absorption and toxicity (i.e. smaller particles may represent a greater hazard). However, plastics can contain additives and unbound monomers, which may leach out either into the surrounding water environment prior to human consumption or potentially, into the GI tract to become bioavailable under some circumstances. Further, plastic particles can sorb chemicals from the environment, some of which are of toxicological concern.
- Investigation of potential risks related to particles indicate that it is possible that some smaller plastic particles may be able to pass through the gut wall and translocate to tissues remote from the mucosa, although this may not necessarily translate to a health risk. Humans have always ingested particles and have ingested plastic particles for decades with no related indication of adverse health effects. In addition, a good deal of evidence suggests that microplastics pass through the GI tract into the faeces.
- There is currently a paucity of information to quantitatively assess any potential risk associated with exposure to microplastic particles Most toxicological tests of microplastics have focused on aquatic organisms or ecotoxicology. No epidemiological or human studies on ingested microplastics

have been identified. Data from studies on laboratory animals are scant and inadequate to confirm human health risk assessment of microplastics ingestion. **There are no studies on the impacts of ingested microplastics on human health and there are only a limited number of animal studies of questionable reliability and relevance**

- There is currently no evidence to suggest a human health risk from microplastic associated biofilms in drinking-water**.** The risks from pathogens in microplastic-associated biofilms is considered far lower than the well-established risk posed by the high concentrations and diversity of pathogens present in human and livestock waste, which often make their way into drinking-water sources with inadequate treatment
- **Routine monitoring of microplastics in drinking-water is not recommended at this time, as there is no evidence to indicate a human health concern**

4.2 **ICMR**

ICMR has informed that they have not carried out any study on impact of microplastics on human health so far. However, as per the study carried out so far, Microplastics have been reported in human saliva, blood, placenta , colon, stool and lungs. Overview of the findings of the study carried out on impact of Microplastics on human health , as reported by ICMR, is given below:

	No. of Studies	No. of Human Samples	MP Reported	Impact on Human Health
Blood	1	22	1.6 microgm/mL	Not reported
Placenta	1	6	12 particles in 4 out of 6 samples tested	Not reported
Lungs	2	13 (First Study)	0.69±0.85 gm/L of Lung tissue; 39 particles in 11/13 samples tested	Not reported
		20 (Second study)	37 particles in 13 out of 20 samples tested	Not reported
Stool	2	8 (First Study)	2 particles per gm of Stool	Not reported
		24 (Second study)	1-36 particles per gm of stool	Not reported
Saliva	1	2000	No. of sample in which MP reported: 650;	Not reported

			Avg. concentration: -0.33 MP/individual	
Genotoxic& cytotoxic effects of MP in Human blood	In-vitro	2	Size studied: 10-45 microm; Concentration – 25,50, 100, 250, 500 microg/L; Type:PE	Genomic instabilities were reported
Cytotoxic effect of MP with metal nano particles in human celebral& epithelial cells	In-vitro		Size studied: 3-16 microm; Concentration – 50 microg/L-10 mg/L; Type:PE&PS	Oxidative stress was reported

It was further informed by ICMR that studies are only about the presence of microplastics in human body and not about their physiological or psychological impact. Studies showing genotoxic& cytotoxic impacts are invitro studies conducted on only two individuals. Health impact of emerging contaminants are chronic and long term studies are required to establish Cause effect relationship. It would not be appropriate to set standards for drinking water for microplastics without establishing the cause-effect relationship

4.3 Observations

- Further studies are required understand the uptake and impact of microplastics on human health
- Influence of particle size, shape and chemical composition of microplastics to be studied in detail
  Studies are also required to assess the impact of associated chemicals & biofilm on human health

5. Remediation techniques:

5.1 Available technology for Microplastic removal

Microplastic treatment technologies are in the nascent stage. Removal methods in case of air and soil matrices have not been reported yet. Treatment technology options for microplastics in water include the

- Conventional Water treatment system: In the conventional water treatment technology, primary and secondary treatment processes help in the removal of microplastics 50 – 98% of microplastics could be removed during primary treatment and 0.2 – 14% during secondary treatment (Sun et al. 2019). Microplastic concentration can be significantly reduced by ultrafiltration and reverse osmosis (Ziajahromi et al. 2017). Combination of secondary and tertiary treatment processes has also been useful in the removal of microplastics.

- Microbial Degradation (Biodegradation): Environmental friendliness, cheap cost and low energy input, as well as a reduced carbon footprint, are all advantages of biodegradation. Plastics can be used by microorganisms as carbon and nitrogen sources, allowing them to survive and reproduce.

- Photodegradation/ Photocatalytic degradation: Photocatalytic degradation of typical microplastics can be carried out by UV light radiation and degradation for various sizes of microplastics will be studied.

5.2 Observations

- Available technologies for removal of microplastics need to be studied in detail to assess their efficacy
- Research studies to be conducted for removal of microplastics from air & soil

6.0 Initiatives taken to reduce Microplastics

- The Microbead-Free Waters Act has been notified inUS which prohibits the manufacture and distribution of nonprescription drugs that are also cosmetics and that contain plastic microbeads for the purposes of exfoliating or cleansing any part of the human body. Common examples of rinse-off nonprescription drugs that are also cosmetics include, but are not limited to, anti-cavity (fluoride) toothpastes, acne scrubs, anti-bacterial soaps, and anti-dandruff shampoos
- **BIS 2017 :** Plastic microbeads of diameter 5 mm or less, that are insoluble in water, and solid plastic particles used to exfoliate or cleanse in personal care products have been listed in the banned list
- **Plastic Waste Management (Second Amendment) Rules, 2022:**
  a. Banned all single-use plastics from 1st July 2022.
  b. mandate to increase the thickness of plastic carry bags to over 120 microns from December 31.
  c. Banned imports of solid plastic waste from March 2019

C. Conclusions

1. Independent studies regarding microplastics have been conducted by various organizations in the country including CPCB, MoES-NCCR, NCSCM, NPC and CIPET . Further international studies have been conducted by WHO, UNEP , OECD and others.
2. The studies have primarily focussed on monitoring microplastics (concentration, polymer type, colour, shape) in various environmental matrices.
3. Occurrence of microplastics has been reported in oceans, sediments, surface water, ground water, wastewater, tap water, bottled water, air, food products, aquatic organisms, and human beings
4. There is currently no standard method for sampling and analysis of microplastics in the environment. ISO is currently working on the subject
5. Sampling and analytical methods adopted by different institutions in India are similar with minor variations.Variation in Microplastic concentrations units reported by different organizations has been observed
6. Uniform procedure for sampling & analysis may be developed by organizations involved in microplastic analysis (CIPET, NCSCM, MoES-NCCR) which can be adopted uniformily across the country till the time ISO standard is finalized.
7. Source of generation of microplastics including industries, waste management , waste water treatment, ocean activities etc. have been identified. However, exact quantum of microplastics generated from the identified source has not been determined.
8. Microplastic concentration in transfer media is available for soil/beach sediment, surface water bodies, biota and ocean water. Microplastic concentration for sludge , specifically when it is converted to compost for land application is not available
9. Microplastic concentration in end use areas including ambient air, drinking water and ground water is available.
10. Source monitoring, transfer end use of all possible sources listed in Table 3.1 to be covered. Emphasis to be laid on such areas for which no information is available.
11. Regular monitoring of various water quality parameters to be conducted to provide insight into the presence and concentration of microplastics in environmental matrices(water, sediments, biota)
12. Microplastic leakages and pathways may be monitored in order to identify further sources and hotspots of microplastics.
13. Uniform procedure for sampling & analysis as finalized by this Committee may be adopted for such studies till the time ISO Standards are finalized

14. Studies conducted on the matter have reported about the presence of microplastics in human body. Physiological or psychological impact has not been reported in these studies.
15. Health impact of emerging contaminants and long term studies are required to establish Cause effect relationship of microplastics on human health
16. The aforementioned studies should cover different type, concentration and shapes of microplastics. Impact of chemicals /biofilms associated with Microplastics on human health to be covered. The studies may include the following:
    - Estimation of the duration and frequency of human exposure to microplastics. Microplastic monitoring as required may be conducted for the same
    - Once the exposure assessment is done precisely, dose-response assessment may be carried out, where the minimum concentration (of microplastics) responsible for any observable effect (on human) shall be assessed..

17. **Bioassays** may be conducetd to assess the Eco-toxicological impact of microplastics on animal life.
18. Standards development (Source & ambient) for microplastics may be taken up following establishment of the cause-effect relationship of microplastics on human health
19. Available technologies to be assessed for their efficacy for removal of microplastics.
20. Technologies to be developed for removal of microplastics from Air & Soil
21. **Source-directed interventions,**
    - Sustainable design and manufacturing of textiles, tyres, and complementary products (, laundry detergents, road surfaces, and vehicles), to minimise the tendency of products to contribute to microplastics generation;
    - Restrictions on microplastics in the manufacture and sale of certain personal care and cosmetic products containing microplastics.
    - Product requirements for household, commercial, or industrial washing machines. For instance, Australia and France have introduced measures to phase in microfibre filters on new washing machines

9. **End-of-life interventions,** effective solid & plastic waste management practices, to prevent waste leaking into the environment and potentially contributing to microplastics generation including the following;

    (a) Reducing the amount of plastic waste that enters landfills and dumpsites through the implementation of waste reduction policies and

initiatives, such as waste-to-energy programs and increased recycling.Microplastics can also be reduced by supporting the development and use of biodegradable plastic alternatives

10. **End-of-pipe interventions,** wastewater, stormwater, and road runoff management and treatment, to retain the emitted microplastics before these reach water bodies.
11. Maximizing clean drinking water supply to all citizens in the country
12. Other Best practices as listed below for minimizing microplastics in environment may be followed:
    - **(a)** Install physical barriers such as screens and filters on STP/WWTP systems to help reduce the amount of microplastics that enter rivers, lakes, and oceans.
    - **(b)** Support sustainable fishing practices to reduce the amount of microplastic entering rivers from fishing equipment.
    - (c) Implementation of Clean-up efforts for beaches and rivers

13. Training and capacity building including microplastic monitoring, analysis , health impact studies may be taken up for effective implementation of aforementioned points

Figure 6.1 : Best practices for litter management in marine

Minutes of Meeting on "Committee Meeting in compliance of Hon'ble NGT order in the matter of O.A. No. 251 of 2022" with CIPET/ICMR /NCSCM held on April 19th , 2022

A Committee meeting was held virtually via video conferencing on April 19, 2022 in compliance of Hon'ble NGT order in the matter of O.A. No. 251 of 2022 for study of microplastics impact on environment and human health. The meeting was coordinated by UPC-II division, CPCB, Delhi. Various stakeholders including representative of CIPET, ICMR, and NCSCM participated in the meeting (List of participants is placed as **Annexure-I**).

DH UPC-II briefly explained directions of NGT for the study to be conducted which covers standards for safe environment, remedial steps to reduce menace of micro plastic and addressing other incidental issues.

She also explained the steps taken by CPCB with regards to microplastics which mainly include assessment of microplastic with NCSCM in Ground Water & Ambient Air in compliance of NGT's order O.A. no. 99 of 2021. She also informed about the study undertaken by National Productivity Council on assessment of microplastics in river Ganga. It was further informed that Ministry of Science and Technology has constituted a committee and working on methods for removal of micro-plastics from water. It was proposed that the as the objective of the two Committees are interlinked, this committee may include representation from NEERI and DST.

The report submitted in O.A. No. 99 of 2021 was shared by CPCB with committee members and it was emphasized that study to should focus on identification of source of micro-plastic in water bodies, standardisation of monitoring techniques, risk assessment or health impact of micro plastics, methods of remediation and mitigation measures.

Dr. Mohanty from CIPET informed about the various studies being conducted regarding micro plastics are given below:

- Estimation of micro plastics in Tapi and Damanganga under Indo-Norway joint project(INOPOL) in Gujarat region in which it was observed t that land based resources are main contributor for the micro plastics.

- Standards for micro plastics determination being developed by ISO are at draft stage.
- Study for estimation of Micro plastic due to Compostable plastic is under way.

She also said that the CIPET can undertake study related to analysis of microplastic in water, soil, oceans etc part can be taken care by CIPET. Effect of microplastics on water content can be correlated with the releavant ISO Standards.

Dr Raj Narayan Tiwari from ICMR, Bhopal informed that they have taken up the studies for identification of micro plastic in different matrices in Bhopal. He further informed that articles published in Journals which highlight genotoxicity and cytotoxicity due to Microplastica. However health related studies due to microplastics in India have not been carried out so far.

Mr. Mrinal K. Biswas, RD Kolkata, CPCB discussed that the study shall be conclusive and it should include source, quality, quantity, impact on environment & human health and finally development of the standards for micro plastics. He also pointed out that the current available studies as well as journals are required to be considered for framing of action plan for the study to be carried out. Apart from that, study is required to be done in short term and long term manner to propose standards for microplastics.

Mr Robin form NCSCM, informed that they are working in coastline riverine system of India for characterisation, quantification and ecotoxical aspects of microplastics. He said leakage study i.e. quantity of micro plastic from leachate, landfills and sewage entering into nearby water body and ground water are required to be conducted in this field.

Further Ms. Divya Sinha -DH, UPC-II concluded the discussions and informed that the study shall cover inventorization, method of analysis, risk assessment or health impact of micro plastics, standards for treated sewage, drinking & ground water and methods of remediation and mitigation measures. She also informed that the standard for micro plastics in air is being developed by Air Quality Division CPCB.It was also important to identify which type plastics contribute maximum to the

generation of micro plastics

All the group members were requested to share the information and studies carried out in field of micro plastics with the Committee as well as provide any further inputs on the subject . Mr Mrinal K Biswas RD Kolkata was requested to to prepare draft Action Plan covering the Action Points discussed during the meeting as identifying the roles to be assigned to different organization. The same shall be circulated to the Committee members for finalization

The meeting ended with vote of thanks to the chair.

Annexure-I

List of Participants

S.N.	Name and Designation
1.	Dr. Raj Narayan Tiwari, Director, ICMR-NIREH, Bhopal
2.	Dr.R.S.Dhaliwal, Scientist G & Head, NCD, ICMR Hqrs
3.	Dr. Smita Mohanty, Director & Head (Principal Scientist) CIPET Bhuwneshwar
4.	Dr Robin , NCSCM Chennai
5.	Ms. Divya sinha Additional Director & I/c UPC-II, CPCB
6.	Mr. Mrinal Kanti Biswas Scientist "E" & Regional Director, CPCB
7.	Ms. Yogesh Chandra Scientist- B, CPCB

Sl.No	Action Point Description			Responsible Organization	Timeline (tentative)
1	Compilation of existing information on Microplastics	a	Committee members shall share information available with them	CPCB CIPET ICMR NCSCM	30.4.22
		b	Compilation of information	CPCB- RD Kolkata	7.5.22
		c	Identification of Gap Areas	CPCB – RD Kolkata	7.5.22
2	Standardization of methodology for monitoring, characterization & analysis of microplastics. Parameters for characterization to include size, type of plastic etc. Instruments required for monitoring / analysis and testing protocols to be delineated			CIPET/ NCSCM	15.5.22
3	Assessment of microplastics covering source, transfer media & end use. Available information as per Section 1 above shall be compiled and emphasis shall be on areas not covered as well as at the end use points. Number of samples to be collected shall be limited by the available infrastructure for monitoring as well as time			Assessment to be carried out by CIPET/ NCSCM – depending upon the available infrastructure. CPCB/Concerned SPCB/PCC to provide requisite support for the monitoring. Assessment to be coordinated & Report to be prepared by CPCB – RD Kolkata	15.6.22
	Source Monitoring	a	Source emissions from industries /activities - Identification of specific industrial sectors contributing to microplastics through literature survey and monitoring microplastics at source		
		b	Leachate from		

			dumpsite/ landfill site		
		c	Sewage treatment plant inlet / outlet		
	Transfer media	c	Surface Water bodies		
		e	Soil		
		f	Marine water		
		g	Fish		
	End- use	f	Water Supply plants (Inlet & Outlet)		
		g	Ground water		
		h	Ambient Air		
4	Source identification of microplastics based on Assessment report			CPCB	
5	Risk Assessment : To be carried out based on the Assessment report specifically w.r.t microplastic concentration at end use point .Parallelly reports in media on adverse impact of microplastics may be reviewed and study taken up as per requirement. Recommendation of safe level of microplastics in drinking water based on literature survey/ experimental studies			ICMR / BIS	15.6.22
6	Development of treatment methods for remediation of microplastics from water / wastewater.			NEERI/ DST/ CPCB	15.6.22
7	Recommendation of measures for reduction of microplastics in environment based on Assessment report including the following: • Measures for Control of coastal zone/ deep sea pollution due to marine litter • Developing regulatory & market based instruments for preserving riverine and marine ecosystems			CPCB	15.7.22
8	Identification of areas were standards have to be notified (drinking water standards, effluent discharge standards & ambient air quality standards)			CPCB	31.7.22
9	Training of SPCBs/PCC/CPCB staff on monitoring and analysis of microplastics &			CIPET / NCSMS	31.7.22

	including identification of measures/ for strengthening of laboratory infrastructure (Parallel activity)		
10	Submission of report to MoEF&CC	CPCB	15.8.22

Minutes of Meeting on "Second Committee Meeting in compliance of Hon'ble NGT order in the matter of O.A. No. 251 of 2022" with CIPET/ICMR /NCSCM held on July 27th , 2022

Second Committee meeting was held virtually via video conferencing on July 27, 2022 for study of micro plastics impact on environment and human health. Various stakeholders including representative of CIPET, ICMR, and NCSCM participated in the meeting (List of participants is placed as **Annexure-I**).

RD Kolkata, CPCB made brief presentation on research gap in Indian scenario based on the research document shared by CIPET, ICMR, and NCSCM. Gaps in Standardization of Qualitative and Quantitative techniques, gaps in Matrices covered under the published literature from various Geographical regions, were highlighted during the presentation. Presentation made is enclosed as **Annexure-II.**

Further discussions regarding need for future research was held by the members and DH UPC-II requested to all the group members to make brief presentation in next meeting as per details given below:

- RD Kolkata, CPCB
  - Methodology for development of standards covering sample requirement
  - Source of micro plastic
  - Areas of monitoring
  - Requirement for sampling methods and analysis
  - Capacity building
  - Availability and Gaps
- CIPET and NCSM
  - Available resources of monitoring sampling and analysis
  - Possible coverage for monitoring with existing resources
  - Institutional mechanism to fulfill additional sampling/analysis requirements, if any.
- ICMR
  - Existing studies on impact of micro plastic on human health
  - Identification of areas for further intervention to assess impact of micro plastic on human health.

The meeting ended with vote of thanks to the chair.

Annexure-I

List of Participants

S.N.	Name and Designation
1.	Dr. Raj Narayan Tiwari, Director, ICMR-NIREH, Bhopal
2.	Dr. Surya Singh ICMR-NIREH, Bhopal
3.	Dr.R.S.Dhaliwal, Scientist G & Head, NCD, ICMR Hqrs
4.	Dr. Smita Mohanty, Director & Head (Principal Scientist) CIPET Bhuwneshwar
5.	Dr Robin , NCSCM Chennai
6.	Ms. Divya sinha Additional Director & I/c UPC-II, CPCB
7.	Mr. Mrinal Kanti Biswas Scientist "E" & Regional Director, CPCB
8.	Ms. Yogesh Chandra Scientist- B, CPCB

Minutes of Meeting on "Third Committee Meeting in compliance of Hon'ble NGT order in the matter of O.A. No. 251 of 2022" with CIPET/ICMR /NCSCM held on August 5th, 2022.

Third Committee meeting was held virtually via video conferencing on August 5th, 2022 in compliance of Hon'ble NGT order in the matter of O.A. No. 251 of 2022 for study of micro plastics impact on environment and human health. Various stakeholders including representative of RD Kolkata, CIPET, ICMR, and NCSCM participated in the meeting (List of participants is attached as ***Annexure-I***).

Mr Mrinal K Biswas, RD Kolkata, CPCB, described the action plan for development of standards for microplastics. He provided examples from other countries which already have their own practices for managing microplastics. RD Kolkata ended their presentation with the proposed execution plan and the roles to be assigned to different organizations, for developing environmental standards. (The presentation is here attached as ***Annexure-II***)

The meeting progressed with the second presentation by NCSCM, where the information about protocol for analysis of microplastic in sediment, water & biota was briefly explained by them. They also explained the importance of surrounding environment from which sample has been taken, for analysis of microplastic.

Last presentation of the meeting was given by ICMR-NIREH Bhopal, where the results from the studies which have already been done on the presence of microplastic and their possible effects on human body, were discussed. Instruments which may be used for estimating the concentration of microplastics were also discussed during the presentation. (The presentation is here attached as ***Annexure-III***)

Ms. Divya Sinha -DH, UPC-II concluded the discussions with request to provide detailed information as annexed below, latest by **22/08/2022**, regarding the efficient methodologies adopted by CIPET & NCSCM for analysis of samples for microplastics in the environment.

The meeting ended with vote of thanks to the chair.

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CIPET and **NCSCM** are required to provide the following information, latest by 22/08/2022, on testing and analysis of microplastics for drinking water, groundwater, compost/leachate samples:

Heads	Drinking water Sample	Groundwater Sample	Compost/leachate Sample
Methodology for testing and analysis			
Instruments Required			
Time period required for analysis			
Cost incurred per sample			
Presence/Coverage area of Organization			
Studies available			

Annexure I

List of Participants	
S. No.	**Name and Designation**
1.	Mr. Mrinal Kanti Biswas Scientist “E”; Regional Director, CPCB
2.	Dr. Raj Narayan Tiwari, Director, ICMR-NIREH, Bhopal
3.	Dr. Surya Singh, ICMR-NIREH, Bhopal
4.	Dr. Smita Mohanty, Director & Head (Principal Scientist), CIPET Bhuwaneshwar
5.	Mr. Himalaya Vardikar, CIPET LARPM, Bhuwaneshwar
6.	Ms. Divya sinha, Additional Director & I/c UPC-II, CPCB
7.	Ms. Yogesh Chandra, Scientist- B, CPCB
8.	Mr. Madnesh Kumar Dubey, Scientist- B, CPCB
9.	Mr. Mayank Raj Purbey, Scientist- B, CPCB

3rd Meeting of the 55 expert committee on "Development of standards for Microplastics"

-By-

Central Pollution Control Board

Regional Directorate, Kolkata

NGT order

- As per the Hon'ble NGT order dated 05.04.2022 pertaining to OA no. 251/2022 of 2022, where it has been directed that:

  *"There is need for **further studies**, considering the studies already conducted, to be steered by the Committee comprising of CPCB, ICMR, Central Institute of Petrochemicals Engineering & Technology (CIPET), NCSCM, and any other expert institutions as required, under the Nodal coordination of CPCB. Such studies and recommendations/ suggestions **may cover standards for safe environment**, **remedial steps** to **reduce menace of micro plastic** and **addressing other incidental issues**. CPCB may incur expenditure on studies and other incidents out of Environmental Compensation funds."*

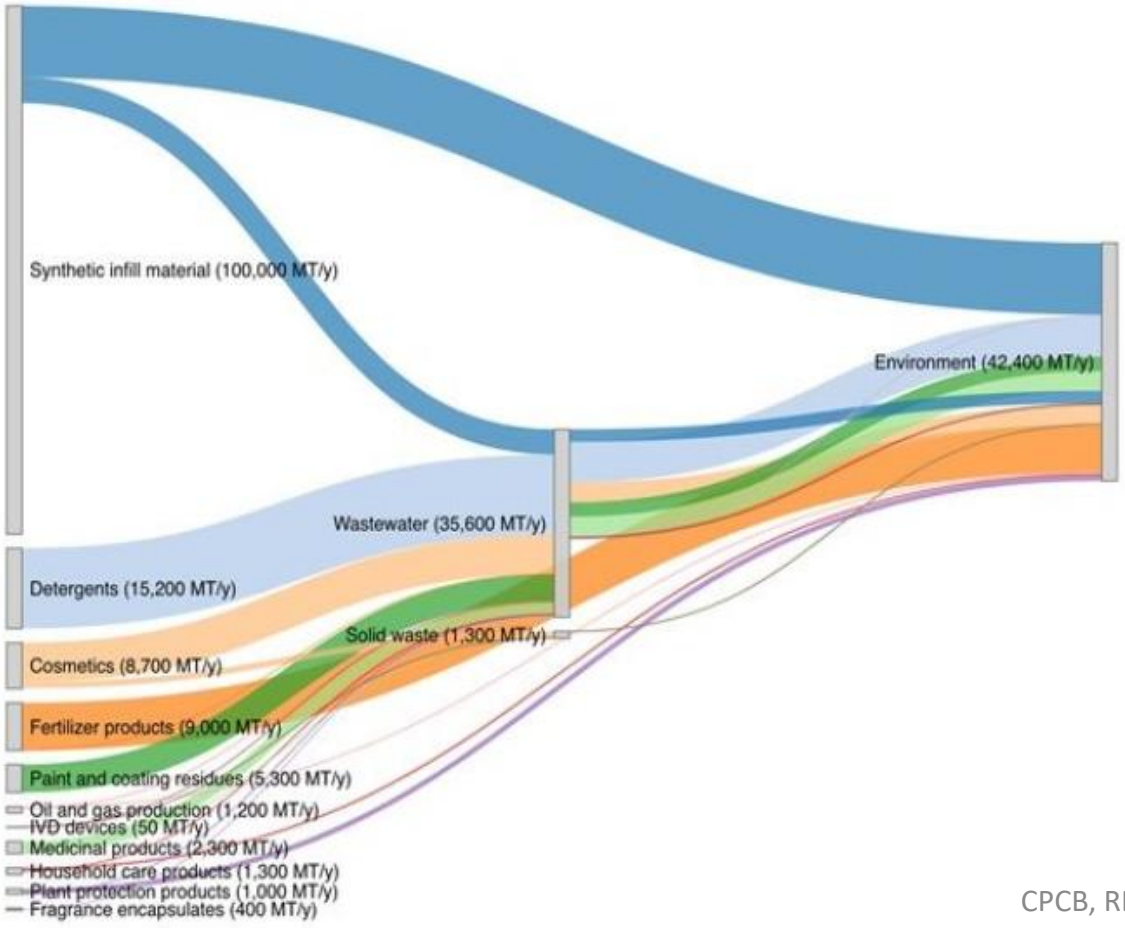
  &

- *" Having regard to the media report that violation of environmental norms in handling of plastics is resulting in serious adverse health effect on human beings, it appears to be necessary to **ensure strict compliance of environmental norms** and to undertake **further study** to consider **whether the existing policies of enforcement of environmental norms need to be revisited in any manner in the interest of human health**."*

International initiatives - EU

Regulations to control the pollution:

- Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)
- Committee for Socio-Economic Analysis (SEAC)



- Sankey plot showing major sources and sinks of primary microplastic emissions in the EU. Emissions to the environment include those to both the aquatic and terrestrial compartment. (Rheinberger et al., 2021)

.....International initiatives till date – Europe

- In 2018, Commission adopted European Strategy for Plastics – a Circular Economy, about €100 million (for 2 yrs) has been allocated for implementation of plastics strategy and R&D projects.
- In January 2019, ECHA(European Chemical Agency) proposed a wide-ranging restriction on microplastics expecting to **prevent** the release of **5,00,000 tonnes of microplastics over 20 years.**
- **Development in 2022…..**

Specific laws with partial objectives	Directives for unintentional formation of microplastics	Production & release into the environment, both directly and indirectly
1. Marine Strategy Framework 2. Fertilising Products Regulation 3. REACH restriction proposal	1. Plastics Waste Framework strategy 2. Waste Framework Directive 3. Marine Strategy Framework Directive	1. Eco-design Directive 2. Waste Framework 3. Urban Waste Water Treatment Sewage Sludge 4. Directive on air quality 5. Industrial Emissions 6. Regulation on tyre labelling 7. Regulation on motor vehicle type approval

…….International initiatives till date – USA

- December 18, 2015, Congress amended the Federal Food, Drug and Cosmetic Act (FD&C Act) by passing the **Microbead-Free Waters Act of 2015**.
  - ❖Prohibits manufacturing, packaging, and distribution of rinse-off cosmetics containing plastic microbeads.
  - ❖This new law also applies to products that are both cosmetics and non-prescription (also called “over-the-counter" or "OTC") drugs, such as toothpastes.

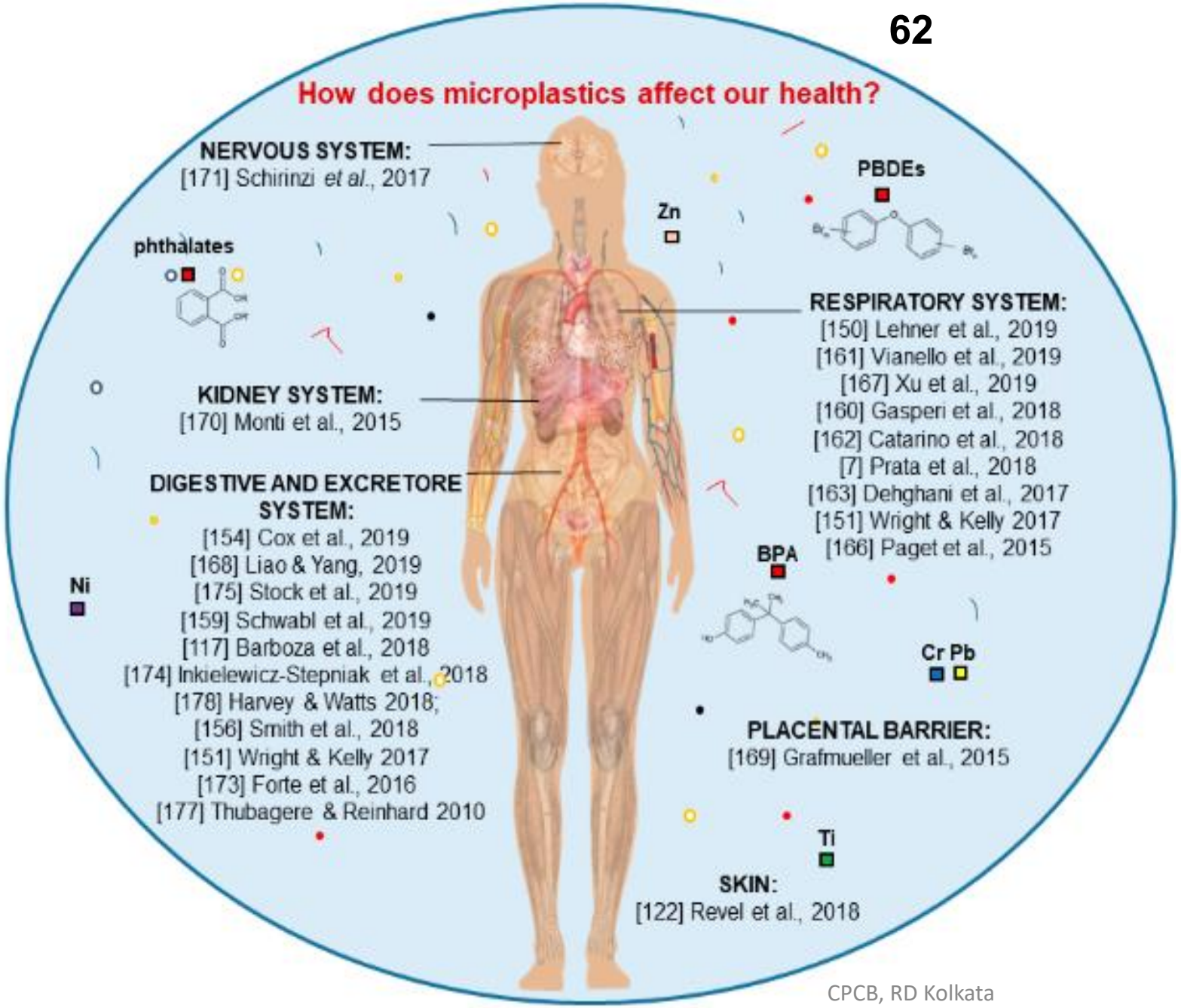
Indian scenario

BIS 2017 : Plastic microbeads of diameter 5 mm or less, that are insoluble in water, and solid plastic particles used to exfoliate or cleanse in personal care products are banned

Plastic Waste Management (Second Amendment) Rules, 2022:

a. Banned all single-use plastics from 1st July 2022.
b. mandate to increase the thickness of plastic carry bags to over 120 microns from December 31.
c. Banned imports of solid plastic waste from March 2019

Why do we need a standard?



Overview of scientific studies focused on the effects of micro and nanoplastics on human health.

Colored squares represent pollutants (organic and inorganic) that could be present in environmental matrices (free or associated with micro and nanoplastics) and that could enter into the human body through different entry routes.

Campanale et al., 2021

Pollutants being carried by MP

Organism exposed to MP

How to develop a standard?

1. Scientific stages

(a) Knowledge of the hazard: involves identification and characterization of microplastic.

(b) Evaluation of the risk: establishes the probability and severity of potential adverse effects of microplastic on health and safety.

(c) Assessment of hazard: determination routes of microplastic exposure and estimation of the number of people exposed.

2. Political and administrative stage

(a) Acceptance to the tolerable risk

(b) Determination to safeguard the public

(c) Consideration of human ecology

(d) Choice of control technology requires both formulations of strategy and selection

(e) Legislation standards consider the existing national legal framework and identify necessary legal strategies.

(f) Economics

Segments for Developing Environmental standard

Segment	Execution plan
1. Identification of priority pollution issue	❑ **Standard methodology for Sampling, processing and analysis** ❑ **Finalization of the matrix: Assessment of Quality & Quantity** A. Water (River, Lakes, Dams, Marine, Leachates & Ground Water B. Solid (Sediments, Sludge, Soil) C. Air (Rural, Urban & fugitive industrial emission) D. Biota (Fishes, Micro invertebrates) E. Packaged foods/drinks F. Existing water and waste water treatment facilities
2. Information on health effects	**ICMR-NIREH**
3. Assessment of exposure	Through Outcome of 1 & 2: A. Major Sources & budgeting B. Quality & Quantity C. Impact (includes risk) on Environment & Human D. Removal efficiencies of existing facilities
4. Strategies for prevention and control	A. Identification & Banning of selective additives usage and processes B. Technological intervention for removal MP and reuse of Plastic C. Issuance of directives restricting production and release D. Source control by legislation and awareness programs E. Promoting alternatives

……Segments for Developing Environmental standard

Segment	Execution plan
5. Legal framework	1. Nature of the decision 2. Scope and development of environmental legislation 3. Content and structure of regulation 4. Institutional consideration 5. Geographical dimension of environmental problems 6. Supporting measures for regulatory strategy
6. Consequences of different approaches to environmental health protection	1. Optimisation of Preventive methods and socio-economic impacts
7. Decision-making process	1. Interaction between science and policy 2. Constraints affecting development of the country 3. Finalization of the standards for **a) Discharge into** i. Inland surface water, ii. Public Sewers, iii. Land for irrigation and iv. Marine coastal areas b) **Acceptable limits** for drinking water supply

Work Distribution for identification & exposure study

❑ Distribution to cover the Matrices, Locations to address the gap

Sl no	Segment	Institutional Distribution	
1	Spatial Analysis of Water, Soil & biota STPs/WTP, Solid waste Dump sites	Eastern Zone: Western Zone: Central Zone: Northern Zone: Southern Zone:	CPCB – RD Kolkata CPCB – RD Vadodara ICMR – NIREH, Bhopal CPCB Delhi NCSCM, Chennai
2.	Air pollution	CPCB Delhi	
3.	Coastal & Marine pollution	NCSCM, Chennai	
4.	Health effect study	ICMR – NIREH, Bhopal	
5.	Cosmetics, Packaged food & drinks	CIPET	

CIPET having adequate infrastructure and network, may initiate sampling and analysis in all the 4 zones (except south), till capacity building is done in other participatory institutes

Matrix and Location wise work plan: River

Sl. no.	Matrix	Segment	Existing study (Approx.) by independent researcher		Proposed representative study area (Water, Sediment & Biota)			
					Control group		Polluted stretch	
			Number	Name	Number	Name	Number	Name
1.	Water, Sediment & Biota, Water intake points	River	9	1. Ganga* 2. Brahmaputra* 3. Meghna 4. Adyar 5. Kosasthalaiyar 6. Multhirappuzhayar 7. Netravati 8. Alakananda 9. Indus * Few locations covered only	1	Umngot /Dawki	17	1.Ganga 2. Damodar 3. Bidyadhari 4. Yamuna 5. Cauvery 6. Mahanadi 7. Godavari 8.Krishna 9. Narmada 10. Tapi 11. Mandovi & Zuari 12. Netravati & Sharavathi 13. Kochi Backwaters 14. Neendakara 15. Perumadhura

Lake

Sl no	Matrix	Segment	Existing study (Approx) by independent researcher		Proposed representative study area (Water, Sediment & Biota)			
					Control group		Polluted stretch	
			Number	Name	Number	Name	Number	Name
2.	Water, Sediment, Biota Water intake points	Lakes	5	1. Veeranam lake, TN 2. Red hills Lake, TN 3.Vembanad lake, Kerala 4. Renuka lake, HP 5. Anchar lake, Northwest Himalaya	2	Kankaria lake, Gujrat Gurudongmer, Sikkim	15	1. Mirik lake, WB 2. Santragachi, WB 3. Ambazari Lake, Maharashtra 4. Puskar Lake, Rajasthan 5. Naraina Lake, Gujarat 6. Dal lake, J&K 7. Bellandur Lake, Bangalore 8. Naini lake, UK 9. Hussain Sagar, Telangana 10. Chilika Lake, Odisha 11. Vembanad lake, Kerala 12. Pulicat Lake, AP 13. Kolleru Lake, AP 14. Upper lake, MP 15. Lower lake, MP

Dam

Sl no	Matrix	Segment	Proposed representative study area (Water, Sediment & Biota)	
			Polluted stretch	
			Number	Name
3.	Water, Sediment & Biota, Water intake points	Dams	10	1. Panchet, WB 2. Mythan, Jharkhand 3. Hirakund, Odisha 4. Nizam Sagar Dam, Telangana 5. Sardar sarovar, Gujarat 6. Tehri, UK 7. Tungavadra, Karnataka 8. Uri Hydroelectric Dam, J& K 9. Gandhi Sagar Dam, MP 10. Kolar Dam, MP 11. Idukki Dam, Kerala 12. Govind Ballabh Pant Sagar Dam , UP 13. Jayakwadi Dam, Maharashtra

Ground water & Marine water

Sl no	Matrix	Segment	Existing study (Approx) by independent researcher		Proposed representative study area (Water, Sediment & Biota)
			Number	Name	Polluted stretch
4.	Water, Sediment & Biota	Ground Water (water extraction point)	2	Chennai, TN Punakayal, TN	State wise, representative data collection considering both urban and rural areas.
	Water, Sediment & Biota	Marine water & Coastal Pollution	41	Karnataka Kerala Tamilnadu Andaman Nicober Lakshyadweep	Sampling point: 1. Transect at every 200km interval along the coastal line of West Bengal, Odisha, AP, Goa, Maharashtra, Gujarat 2. Upto 200m depth contour (continental shelf)

Sl no	Matrix	Segment	Existing study (Approx) by independent researcher		Proposed study area	
					Polluted location	
			Number	Name	Number	Name
5.	Soil, Leachate & affected GW	Solid waste Dumpsite	0	none		State wise 1 or 2 major dumpsite
6.	Air	Urban	4	Chennai, TN Patna , Bihar Nagpur, Maharashtra Varanasi, UP	**As per the ongoing study by CPCB**	
7.	Health effect	Animal study Clinical study Human study	11	Arthropod and fishes	**Plan to be developed by ICMR NIREH**	

Evaluation of existing treatment technologies

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Sl. No.	Treatment	Matrix	Technology wise evaluation (State wise evaluation)	
			Conventional	Advanced
1	Sewage treatment plants	Water & sludge	AL OP ASP TF	SBR MBBR FBAS MBR & others
2	Water treatment plants		State-wise evaluation	State-wise evaluation

Immediate action

Preparation and submission of interim report to Hon'ble NGT:

1. Distribution of microplastics in the environment – based on LIMITED studies in Indian context.
2. Impact on Environment – based on international studies
3. Impact on Human Health – based on international studies
4. Gap analysis & proposed methodology for the study indicating requirement for establishing a strong database, budgeting, impact, prevention and control.

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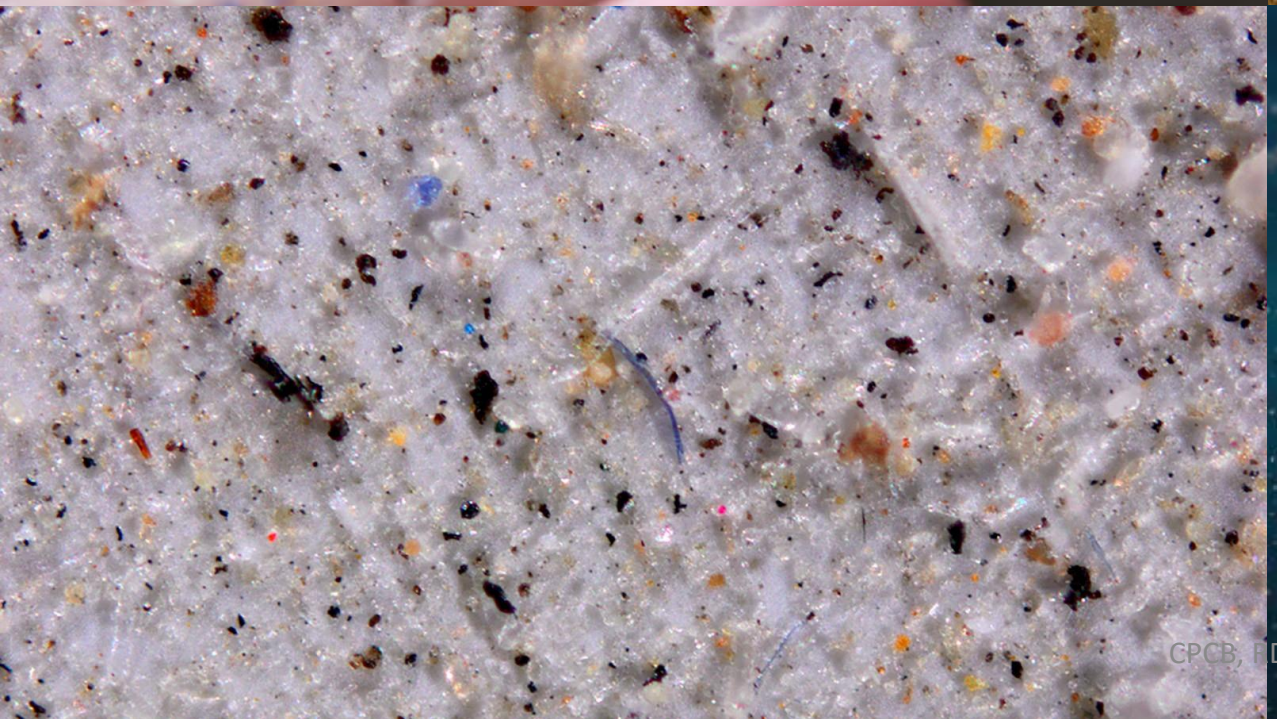
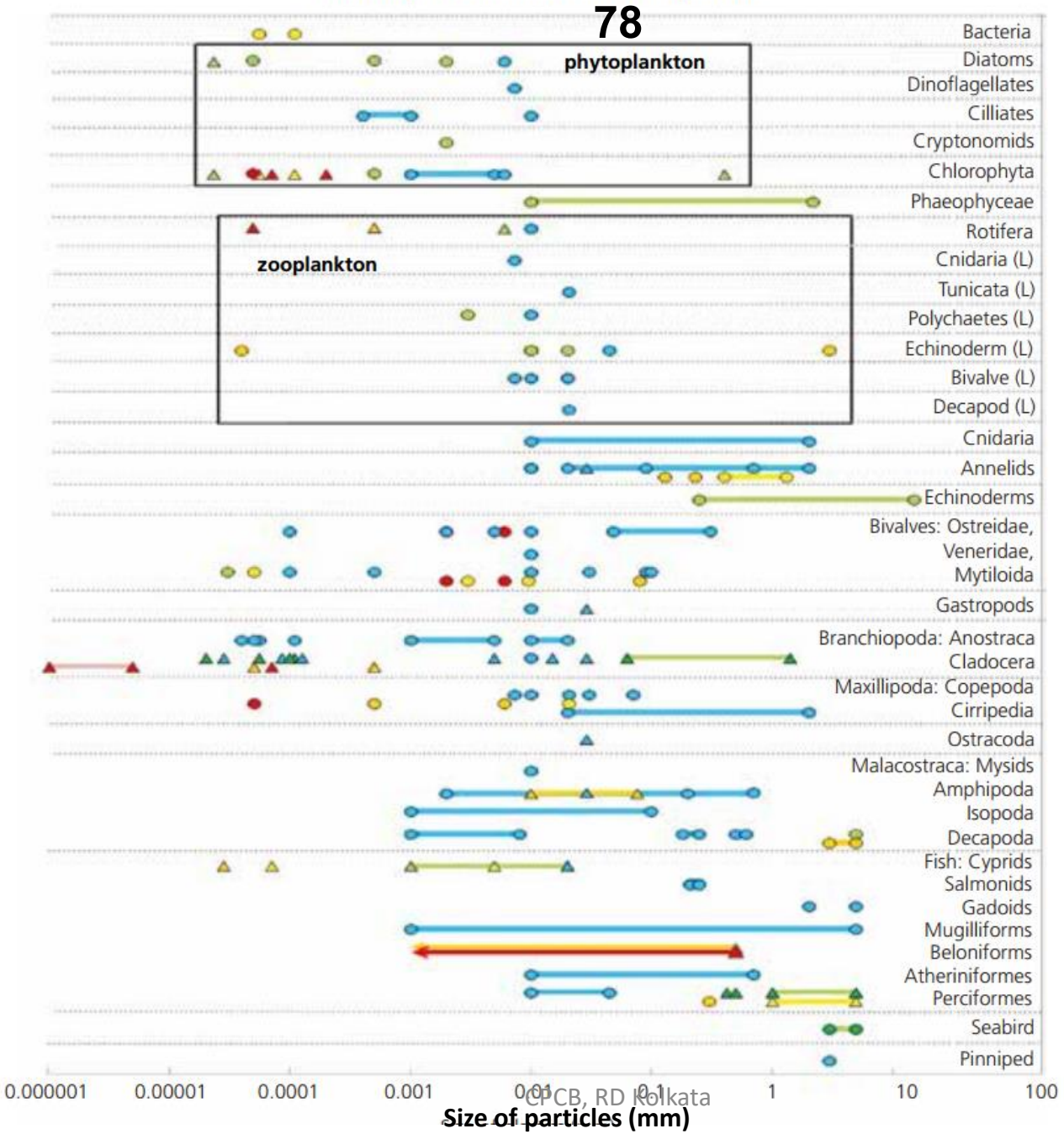


Table 2 Types of pollutants carried by different types of microplastics

Microplastic	Pollutant	Reference
PA	Benzene derivative	Rehse et al. (2018)
PBAT	Heavy metals	Kedzierski et al. (2018)
PE	Lubrication oil	Haghi and Banaee (2017)
	PAH	Oliveira et al. (2013)
	Paraquat	Rochman et al. (2013b)
	PBDE	Llorca et al. (2018)
	PCB	Wang et al. (2015)
	Per- and polyfluoroalkyl substances	Fisner et al. (2017)
	PFOSA	Zhan et al. (2016)
	PPCP	Hu et al. (2017)
	Triclosan	Frydkjær et al. (2017)
PET	Heavy metals	Rochman et al. (2013a)
PP	Heavy metals	Rochman et al. (2013b)
	PAH	Fisner et al. (2017)
PS	Antibiotic	Wen et al. (2018)
	Cadmium	Zhang et al. (2019b)
	Lubrication oil	Llorca et al. (2018)
	PCB	Wang et al. (2015)
	Per- and polyfluoroalkyl substances	Guo et al. (2018)
	PFOSA	Zhan et al. (2016)
	Roxithromycin	Hu et al. (2017)
PVC	17α-Ethinylestradiol	Qu et al. (2018)
	Antibiotic	Sleight et al. (2017)
	Benzene derivatives	Kedzierski et al. (2018)
	Heavy metals	Rochman et al. (2013a)
	Odesmethylvelafaxine	Pascall et al. (2005)
	PCB	Wu et al. (2016)
	PFOSA	Guo et al. (2018)
	Phenanthrene	
	Venlafaxine	
LDPE	Heavy metals	Rochman et al. (2013a)
HDPE	Heavy metals	Holmes et al. (2014)

PBAT polybutylene adipate terephthalate, *HDPE* high-density polyethylene, *PFOSA* perfluorooctanesulfonamide, *PPCP* pharmaceuticals personal care product

Summary of laboratory experiments (published up to the end of December 2016), in which organisms were exposed to micro- and nanoplastics



3RD MEETING OF THE EXPERT COMMITTEE ON MICROPLASTICS

(*w.r.t.* Hon'ble NGT OA No. 251/2022 of 2022)

Convened by

Central Pollution Control Board, Delhi

Presented by

ICMR – National Institute for Research in Environmental Health (NIREH), Bhopal

Human Health Research Scenario

Microplastics have been reported and estimated in:

- Human saliva
- Human blood
- Human placenta
- Human colon
- Human stool
- Human lungs

Human Saliva

Total number of studies till date: 1

No. of human samples: 2000

Instrument: µRaman Spectroscopy

Total number of particles reported: 650

Concentration of MP reported: 0.33 particles / individual

Impact on health: Not reported

Ref. Abbasi et al. 2021, Human exposure to microplastics: A study in Iran

Human Blood

Total number of studies till date: 1

No. of human samples: 22

Instrument: Pyr GC – MS (limitation 700 nm)

Concentration of MP reported: 1.6 µg / mL

Impact on health: Not reported

Ref. Leslie et al. 2022, Discovery and quantification of plastic particle pollution in human blood

Human Placenta 83

Total number of studies till date: 1

No. of human samples: 6

Instrument: µRaman Spectroscopy (limitation 5 µm)

No. of MP particles reported: 12 particles in 4 samples out of 6 tested

Impact on health: Not reported

Ref. Rasuga et al. 2021, Plasticenta: First evidence of microplastics in human placenta

Human Colon

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No. of human samples: 11

Instrument: FTIR Microscope

Concentration of MP reported: 28 ± 15.4 particles / g colon tissue

No. of MP particles reported: 331 particles / individual specimen

Impact on health: Not reported

Ref. Ibrahim et al. 2020, Detection of microplastics in human colectomy specimens

First Study

No. of human samples: 8

Instrument: FTIR microspectroscopy (limitation 50 µm)

Concentration of MP reported: 2 particles / g of stool

Impact on health: Not reported

Second Study

No. of human samples: 24

Instrument: FTIR microspectroscopy

No. of MP particles reported: 1 particle / g - 36 particles / g of stool

Impact on health: Not reported

Ref. Schwabl et al. 2019, Detection of various microplastics in human stool
Zhang et al. 2021, You are what you eat: Microplastics in feces of young men living in Beijing

Human Lungs

First Study

No. of human samples: 13

Instrument: µFTIR Spectroscopy (limitation 3 µm)

Concentration of MP reported: 0.69 ± 0.84 particles / g lung tissue

No. of MP particles reported: 39 particles in 11 samples out of 13 tested

Impact on health: Not reported

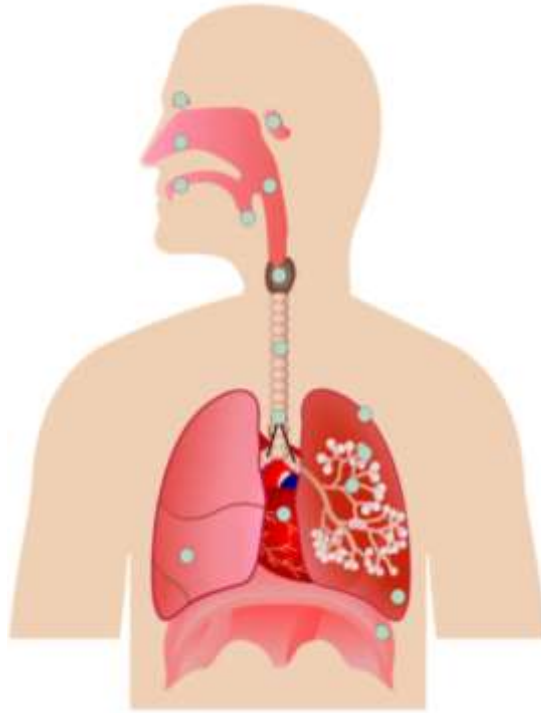
Second Study

No. of human samples: 20

Instrument: Raman Spectroscopy (limitation 20 µm)

No. of MP particles reported: 37 particles in 13 samples out of 20 tested

Impact on health: Not reported



Ref. Jenner et al. 2022, Detection of microplastics in human lung tissue using µFTIR spectroscopy
Amato-Lourenco et al. 2021, Presence of airborne microplastics in human lung tissue

Human Health Research Scenario in the Area of Microplastics

Genotoxic and cytotoxic effects of microplastics in human blood lymphocytes

No. of human samples: 2

Size of microplastic particle studied: 10 – 45 µm

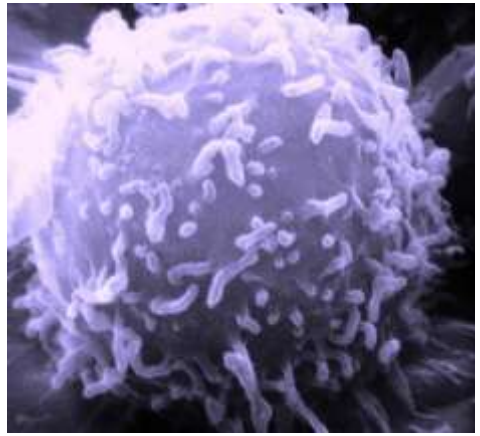
Type of microplastic particle studied: Polyethylene

Concentrations of MP studied: 25, 50, 100, 250, 500 µg/mL of blood

Type of study: *in-vitro*

Result: Genomic instabilities were reported

Mechanism: Unknown



Ref. Cobanoglu et al. 2021, Genotoxic and cytotoxic effects of polyethylene microplastics on human peripheral blood lymphocytes

Human Health Research Scenario in the Area of Microplastics

Cytotoxic effects of microplastics *accompanied by* metal nanoparticles in human cerebral and epithelial cells

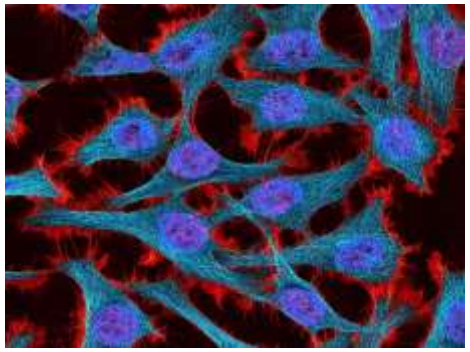
Size of microplastic particle studied: 3 – 16 µm

Type of microplastic particle studied: Polyethylene & polystyrene

Concentrations of MP studied: 50 µg/L to 10 mg/L

Type of study: *in-vitro*

Result: Oxidative stress was reported



Ref. Schirinzi et al. 2017, Cytotoxic effects of commonly used nanomaterials and microplastics in cerebral and epithelial human cells

Key Takeaways..89

Studies are only about the presence of microplastics in human body, NOT about their physiological / psychological impact

Studies showing the genotoxic and cytotoxic impacts of the microplastics are in-vitro studies, conducted over ONLY two individuals

Health impacts of emerging contaminants (e.g. MPs) are chronic. So, long-term studies are required to establish CAUSE-EFFECT RELATIONSHIP

Without establishing cause-effect relationship, it would not be appropriate to set STANDARDS for drinking water having microplastics

Annexure-2

Item No. 06 (Court No. 1)

BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI

(By Video Conferencing)

Original Application No. 251/2022

In re: News item published in The Hindu dated 29.03.2022 titled **"Detecting microplastics in human blood"**

Date of hearing: 05.04.2022

CORAM: HON'BLE MR. JUSTICE ADARSH KUMAR GOEL, CHAIRPERSON
HON'BLE MR. JUSTICE SUDHIR AGARWAL, JUDICIAL MEMBER
HON'BLE MS. JUSTICE PUSHPA SATHYANARAYANA, JUDICIAL MEMBER
HON'BLE PROF. A. SENTHIL VEL, EXPERT MEMBER

ORDER

1. Proceedings have been initiated in light of captioned media report to the effect that in absence of enforcement of environmental norms on the subject, small particles of plastics enter the blood cells of human being through food, having adverse health impact.

2. Having regard to the media report that violation of environmental norms in handling of plastics is resulting in serious adverse health effect on human beings, it appears to be necessary to ensure strict compliance of environmental norms and to undertake further study to consider whether the existing policies of enforcement of environmental norms need to be revisited in any manner in the interest of human health.

3. It appears from the record that the Southern Bench of NGT has taken up Suo Moto based on similar media reports in OA No. 99/2021(SZ), *Tribunal on its own motion Suo Motu based on the news*

item in The Times of India Newspaper, Chennai Edition dt. 05.04.2021, "Chennai, you are breathing micro plastic" vs. The Chief Secretary to Government of Tamil Nadu Chennai and Ors. and OA No. 174/2021(SZ), *Tribunal on its own motion Suo Motu based on the news item in The Times of India Newspaper, Chennai Edition dt. 27.07.2021, "High level of metals PM 2.5 found in city's air you're breathing" vs. The Chief Secretary to Government of Tamil Nadu Chennai and Ors.,* wherein CPCB carried out study on analysing micro plastic in ground water in context of landfills leachate and analysis through National Centre for Sustainable Coastal Management (NCSCM), Chennai. To avoid conflicting orders, the said matters stand transferred to the Principal Bench of this Tribunal for being dealt alongwith the present matter. Counsel appearing in the said matters be informed by e-mail. If they have any objection, they are at liberty to move this Tribunal. Record of the said matters be called for in the form of scanned documents. It is not necessary for the time being to call for the original record which may be retained at Chennai Bench. The date fixed in the said matters will stand deferred to 19.10.2022 on which the present matter will now be listed. The titles of the said matters be now modified as *In re: News Item published in The Times of India, Chennai dated 05.04.2021 titled* ***"Chennai, you are breathing micro plastic"*** in OA No. 99/2021(SZ) and *In re: News Item published in The Times of India, Chennai dated 27.07.2021 titled* ***"High level of metals PM $_{2.5}$ found in city's air you're breathing"*** *in* OA No. 174/2021(SZ).

4. There is need for further studies, considering the studies already conducted, to be steered by the Committee comprising of CPCB, ICMR, Central Institute of Petrochemicals Engineering & Technology (CIPET), NCSCM, and any other expert institutions as required, under the Nodal coordination of CPCB. Such studies and recommendations/ suggestions

may cover standards for safe environment, remedial steps to reduce menace of micro plastic and addressing other incidental issues. CPCB may incur expenditure on studies and other incidents out of Environmental Compensation funds.

5. The report of the study with suggestions for remedial action may be filed before this Tribunal by e-mail by August 31, 2022 with a copy to the Secretary, MoEF&CC as input for consideration of policy on the subject. MoEF&CC may file its action taken report in the matter before the next date by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF.

List for further consideration on 19.10.2022.

A copy of this order along with the media report be forwarded to CPCB, ICMR, CIPET, NCSCM, Chennai and MoEF&CC by e-mail for compliance.

Adarsh Kumar Goel, CP

Sudhir Agarwal, JM

Pushpa Sathyanarayana, JM

Prof. A. Senthil Vel, EM

April 05, 2022
Original Application No. 251/2022
SN