

File No.: HSM-11/36/2022-HSM
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT FOREST, & CLIMATE CHANGE

Indira Paryavaran Bhawan,
Jal wing, Second floor,
Aliganj, Jor Bagh Road,
New Delhi-110003
Dated: 16th December, 2024

To,
The Registrar General,
Principal Bench,
National Green Tribunal,
Copernicus Marg, New Delhi-110001

Subject: Interim Comprehensive Report by Ministry of Environment Forest and Climate Change in the matter of Original Application No. 251/2022 In re : News item published in The Hindu dated 29.03.2022 titled "Detecting microplastics in human blood"- before Hon'ble NGT, Principal Bench, New Delhi-reg

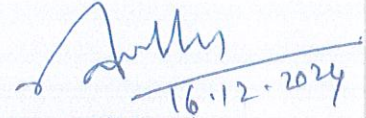
Sir,

In compliance of the order dated 31.01.2024, passed by the Hon'ble National Green Tribunal in Original Application No. 251/2022 In re : News item published in The Hindu dated 29.03.2022 titled "Detecting microplastics in human blood", an interim comprehensive report is filed for your consideration.

This issues with the approval of the Competent Authority.

Enclosure: As above

Yours Sincerely,


16.12.2024

डॉ० अमित लोव (Dr. Amit Love)
DR. AMIT LOVE Scientist-'E'
SCIENTIST-'E'/ADDITIONAL DIRECTOR
पर्यावरण वन एवं जलवायु परिवर्तन मंत्रालय
Ministry of Environment Forest & Climate Change
भारत सरकार / Govt. of India
नई दिल्ली / New Delhi

Interim Comprehensive Report by Ministry of Environment Forest and Climate Change in the matter of Original Application No. 251/2022 In re : News item published in The Hindu dated 29.03.2022 titled “Detecting microplastics in human blood”- before Hon’ble NGT, Principal Bench, New Delhi-reg.

1. Hon’ble National Green Tribunal vide order dated 31st January 2024 had passed the following directions-

“.....13. We, for the time being, accept the above Action Plan submitted by MoEF&CC and direct that the concerned departments as given in Action Plan shall take steps for execution of the said Action Plan and would endeavor to achieve the objective within six months from today. Secretary, MoEF&CC will monitor the progress of Action Plan and resolve the inter-Ministerial issues, if any.

14. The concerned departments shall submit Progress/Compliance Report as per Action Plan with MoEF&CC within 15 days after expiry of six months from today.

15. Thereafter, MoEF&CC shall collect all the Reports, prepare a comprehensive Report and submit the Report with Registrar General of



this Tribunal within next one month i.e., by 15.09.2024.....”

The copy of the order dt. 31.01.2024 is annexed as **Annexure-I**.

2. Pursuant to the order passed by the Hon'ble National Green Tribunal, vide Office Memorandum dated 06th March 2024, MoEF&CC had separately also requested the concerned Ministries/Department/Body to share a progress/compliance report with the Ministry by 16th August 2024. A reminders were also sent on 29th May 2024, 4th October 2024 and 25th October 2024, in this regard. The copy of the reminder email is annexed as **Annexure-II**.

3. In order to review the steps taken by all concerned Ministries/Department/Bodies in compliance to the directions of the Hon'ble National Green Tribunal dated 31.01.2024, a meeting was convened on 7th November 2024 under the chairpersonship of Additional Secretary, Ministry of Environment, Forest & Climate Change (MoEF&CC), Government of India. The list of participants is enclosed as **Annexure-III**.



4. Presentation was made by Ministry of Environment, Forest and Climate Change giving status of the Compliance/Progress Reports received from concerned Ministries/Department/Bodies. The presentation is enclosed at **Annexure-IV**.

5. After detailed deliberations, the following actions were agreed:

i. The remaining concerned Ministries/Department/Bodies were asked to submit their compliance report latest by **22nd November 2024**. [Action: **Central Pollution Control Board, Ministry of Textiles, Ministry of Road Transport and Highways, Ministry of Earth Science, Department of Water Resources, River development and Ganga Rejuvenation, Ministry of Jal Shakti,**]

ii. The compliance reports already submitted will be reviewed by MoEF&CC, if required, additional information may be obtained. [Action:MoEF&CC]

iii. The concerned Ministries/Department/Bodies may also, if required, submit additional information in order to achieve the objectives of the



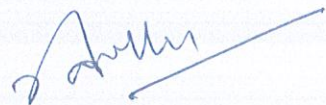
action plan provided by them and mentioned in the NGT order dt. 31.01.2024. **[Action: All concerned Ministries/Department/Bodies]**

iv. Subject to any further updation, as required, an Interim Report will be filed by MoEF&CC in the meantime, giving the present status of the action plans as submitted by concerned Ministries/Department/Bodies. **[Action:MoEF&CC]**

The copy of the minutes of meeting is annexed at **Annexure- V**.

6. The Ministry of Environment, Forest, and Climate Change has prepared an Interim Comprehensive Report as per progress report shared by the following concerned Ministries/Departments/Bodies, as per order dated 31.01.2024:

- i. ICMR – National Institute for Research in Environmental Health, **(Appendix-A)**
- ii. Ministry of Heavy Industries, GoI, **(Appendix-B)**
- iii. Department Of Chemicals and Petrochemicals,GoI, **(Appendix-C)**
- iv. Department Of Pharmaceuticals, GoI, **(Appendix-D)**



- v. Central Drugs Standard Control Organization (CDSCO)/ Department of Health and Family Welfare (DoH&FW) (**Appendix-E**)
- vi. Department For Promotion of Industry and Internal Trade, GoI, (**Appendix- F**)
- vii. Ministry of Housing and Urban Affairs,GoI, (**Appendix-G**)
- viii. Ministry of Environment, Forest and Climate Change,GoI (**Appendix-H**)
- ix. Department of Drinking Water and Sanitation,GoI, (**Appendix-I**)
- x. Department of Water Resources, River development and Ganga Rejuvenation,GoI (**Appendix-J**)
- xi. Department of Fisheries, GoI, (**Appendix-K**)
- xii. Ministry of Earth Science, GoI (**Appendix-L**)
- xiii. National Cadet Corps (**Appendix-M**)

7. The inputs are still awaited from the following concerned Ministries, Departments, and Bodies on the action plans outlined in the items listed below, as per the order dated 31.01.2024:

- (i) Central Pollution Control Board on Items No. 1 to 7 11 to 14, and 24 regarding uniform procedure for sampling and analysis of microplastics,



preliminary listing of monitoring source of generation of microplastics, microplastic leakage pathways, bioassays, compilation of technologies for microplastic removal -meeting with stakeholders, awarding and execution of work.


(ii) Ministry of Textiles, GoI, on Item No. 15 regarding sustainable design and manufacturing of textiles.

(iii) Ministry of Road Transport and Highways, GoI, on Item No. 15 regarding road surfaces.

(iv) Department for Promotion of Industry and Internal Trade, GoI, on Item No. 15 concerning laundry detergents.

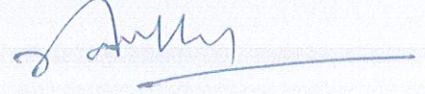
(v) Department of Drinking Water and Sanitation on Item No. 20 concerning clean drinking water supply to all citizens in the country.

(vi) National Centre for Sustainable Coastal Management on Item No. 24 regarding training and capacity building, including microplastic monitoring, analysis.



8. The item-wise progress/compliance report submitted by the concerned Ministries, Departments, and Bodies is attached in the table provided as

Annexure-VI.



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Ministry of Environment Forest & Climate Change
भारत सरकार / Govt. of India
नई दिल्ली / New Delhi

Item No. 03

Court No. 2

**BEFORE THE 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”

Date of hearing: 31.01.2024

**CORAM: HON’BLE MR. JUSTICE SUDHIR AGARWAL, JUDICIAL MEMBER
HON’BLE DR. A. SENTHIL VEL, EXPERT MEMBER**

Respondent: Mr. Paritosh Anil, Advocate with Dr. Amit Love, Additional Director, MoEF
& CC (Through VC)

ORDER

1. The proceedings in this Original Application (hereinafter referred to as ‘**OA**’) were initiated *suo-moto*, taking note of a news item titled “Detecting microplastics in human blood” published in daily newspaper ‘The Hindu’ dated 29.03.2022. The media report said that in absence of enforcement of environmental norms with regard to detection of microplastics in human blood, small particles of plastic enters blood cells of human through food and have adverse health impact on the people.

2. The matter was examined by Tribunal on 05.04.2022. It was observed that strict compliance of environmental norms for protecting the people from adverse health impact due to presence of microplastics in blood cells is necessary and it is also pertinent to have a study to be conducted whether the existing policies of enforcement of environmental norms need to be re-visited so as to protect people from health hazards due to the above problem. Tribunal also referred to the proceedings in Southern Zone Bench of Tribunal at Chennai, wherein *suo-moto* cognizance was taken on similar matters in **OA 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 titled as ‘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 analyzing microplastics in ground water in the context of landfill leachate and analysis through National Centre for Sustainable Coastal Management, (hereinafter referred to as ‘NCSCM’), Chennai.

3. To avoid conflicting orders, the said matters were transferred to Principal Bench of this Tribunal for being dealt alongwith the present matter. The titles of the said matters were 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. Tribunal also found that a further study is required for which a Committee was constituted comprising CPCB, Indian Council of Medical Research (hereinafter referred to as ‘ICMR’), Central Institute of Petrochemicals Engineering and Technology (hereinafter referred to as ‘CIPET’) and NCSCM and any other expert institutions as required under nodal co-ordination of CPCB.

5. Pursuant to order dated 05.04.2022, a Report dated 13.02.2023 was filed by CPCB. The report acknowledges that Microplastics both

primary and secondary, pollute drinking water sources primarily through discharge of sewage/waste water treatment plant effluent and surface runoff. As sewage/waste water treatment plants are not equipped for the complete removal of Microplastics, effluent released from these plants contains substantial quantity of Microplastics. Upon mixing of this effluent with fresh water sources, Microplastics become part of fresh/drinking water supply chain. 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. These further contribute towards Microplastics generation in the water they carry. Treated bottled water is also reported to contain Microplastics. In air, suspended Microplastics 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. Soil can get affected from plastics through various means such as plastic mulch films, municipal waste, sewage sludge, fertilizers coated with plastics. A significant positive correlation has been seen between the rate of sludge applied onto the soil and concentration of Microplastics particles in the soil. Microplastics concentrations have been detected in the air at dumpsites in India. Microplastics is also being reported in human saliva, blood, placenta, colon, stool and lungs.

6. CPCB Report dated 13.02.2023 was considered by Tribunal on 01.03.2023. The conclusion recorded in the Report were noticed in para 4 of the order are as under:

“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 uniformly 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, doseresponse 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 conducted 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***
22. **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

- 23. *End-of-pipe interventions, wastewater, stormwater, and road runoff management and treatment, to retain the emitted microplastics before these reach water bodies.***
- 24. *Maximizing clean drinking water supply to all citizens in the country***
- 25. *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***
- 26. *Training and capacity building including microplastic monitoring, analysis, health impact studies may be taken up for effective implementation of aforementioned points.”***

7. Tribunal found that Report is based on scientific basis and can be acted upon subject to objections, if any. Report showed clear potential of particulates of Microplastics entering blood cells of human beings which can have adverse health impact. There was need for further remedial action for enforcing ‘Sustainable Development’ and ‘Precautionary Principle’ by way of preventive and remedial measures to utilize anticipated harm to environment and public health pending further scientific investigations for laying down standards, as suggested in the Report.

8. This Tribunal in para 8 referred to the observations made by Supreme Court in ***Vellore Citizens’ Welfare Forum vs. Union of India,***

(1996) 5 SCC 647 and, thereafter, issued further directions in para 9 of the order, as under:

“9. Thus, while proposed studies may be undertaken expeditiously and completed at the earliest, interventions need to be immediately introduced as short-term measures in future designing and manufacturing of products which are potential threat for generating MP like Textiles, Tyres, and Complementary Products (laundry detergents, road surfaces, and vehicles), manufacture and sale of certain personal care and cosmetic products containing MP, household, commercial, or industrial washing machines. Such other measures as may be identified may also be taken. For this purpose, the concerned Ministries need to consider the above report of CPCB and subject to any objections to the report which may be raised before the Tribunal, interventions may be introduced at the earliest, preferably within four months from today by the Secretary, MoEF&CC in consultation with CPCB, ICMR, Central Institute of Petrochemicals Engineering & Technology (CIPET), NCSCM, and any other expert institutions as required.”

9. Pursuant to above order, Ministry of Environment, Forest and Climate Change (hereinafter referred to as **‘MoEF&CC’**) has filed its Report dated 21.11.2023, wherein it has referred to CPCB’s Report as also World Health Organization’s (hereinafter referred to as **‘WHO’**) Report of 2019. In para 8 of Report of MoEF&CC, issues highlighted in WHO Report have been crystalized as under:

- *Plastic polymers being insoluble, they are unlikely to be absorbed from the gastrointestinal (GI) tract and generally do not interact with biological matrices.*
- *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.*
- *Investigation of potential risks related to particles indicate that it is possible that 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 and evidence suggests that microplastics pass through the GI tract into the faeces.

- *Currently a paucity of information to quantitatively assess any potential risk associated with exposure to microplastic particles. Most toxicological tests of microplasties have focused on aquatic organisms or ecotoxicology.*
- *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.*
- *Routine monitoring of microplastics in drinking-water is not recommended at this time, as there is no evidence to indicate a human health concern.”*

10. Thereafter, conclusions which emerged from WHO Report, have been culled down in para 9 as under:

“9. *After detailed deliberations, the following emerged based on conclusions drawn in the report:*

(a) Proposed studies on human health effects of microplastics, standardization of methodology for sampling and analysis microplastics, availability of technologies for removal of microplastics and standard development.

(i) Long term studies on health effects of microplasties and ecotoxicological studies under Indian conditions need to be performed using standardized methodologies, before development of any environmental standards, as required, based upon scientific data.

(ii) Central Pollution Control Board to coordinate with the expert institutions /technical experts, if required beyond those mentioned in the pro-forma, for development of uniform methodology and availability of technologies for removal of microplastics. Central Pollution Control Board may also involve expert institutions/technical experts, beyond those mentioned in the Ministry wise pro-forma, as required.

(iii) Indian Council of Medical Research along with the Central Pollution Control Board and other relevant

institutions may initiate long-term under Indian conditions, keeping in view national and international literature available on the topic. It was noted that causal relationship between micro plastics and adverse health effects has not been shown. WHO report of 2109 has also mentioned the same.

(b) Source directed interventions

(i) The concerned Ministries/bodies, to consider source directed interventions as per pro-forma, based upon principle sustainable development and scientific evidence on micro plastic releases, and submit comments and action plans, ns appropriate. It was noted that the report does not provide data on releases of microplastics form these sectors under Indian conditions.

(c) Waste management, end-of-life interventions and other best practices

(i) The conclusions covered in the NGT order dated 1st March 2023 and the report of the Committee is to be considered by all the concerned Ministries, as per the NGT order, keeping in view ongoing initiatives.

11. In the light of the above, MoEF&CC has prepared an action plan, specifying obligations/duties/performance to be shown by different departments on various aspects and the said action plan has been filed as annexure III to the Report which reads as under:

“Ministry – wise action plan vide order dated 9th October 2023 of Hon’ble NGT in Original Application no. 251/2022 on “Detecting micro plastic in Human Blood”

S. No	Conclusions of the Report prepared by CPCB, ICMR, CIPET and NCSCM	Concerned Ministries/ Department/ Body	Action Plan/Action Taken
1.	<i>Uniform procedure for sampling & analysis may be developed by organizations involved in microplastic analysis (CIPET, NCSCM, MoES-NCCR) which can be adopted uniformly across</i>	<i>CPCB to develop uniform procedure for sampling and analysis along with Central Institute of Petrochemicals,</i>	<i>CPCB had two meetings with representatives of the concerned organizations (NCCR, CIPET, NEERI, IITR, ICMR-NIREH, NCSCM), on 9.11.2023 and 17.11.2023 pursuant to the meeting held on 26th October 2023</i>

	<i>the country till the time ISO standard is finalized.</i>	<i>Engineering & Technology (CIPET), National Centre for Sustainable Coastal Management (NCSCM) and National Centre for Coastal Research (NCCR)</i>	
2.	<i>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.</i>	<i>CPCB, CIPET/DCPC, NCSCM/MoEFCC, NCCR/MoES, CSIR- IITR and CSIR-NEERI</i>	<i>Points 2-6, 13, 14, 20</i> <ul style="list-style-type: none"> • <i>Preliminary listing of all points to be monitored.</i> • <i>Proposed SOP for monitoring</i> • <i>Compilation of technologies for microplastic removal</i> • <i>Meeting with stakeholders</i> • <i>Awarding of work</i> • <i>Execution of work</i>
3.	<i>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</i>	<i>As above</i>	<i>As above</i>
4.	<i>Source monitoring, transfer end use of all possible sources listed in Table 3.1 of the report to be covered. Emphasis to be laid on such areas for which no information is available.</i>	<i>As above</i>	<i>As above</i>
5.	<i>Regular monitoring of various water quality parameters to be conducted to provide insight into the presence and concentration of microplastics in</i>	<i>As above</i>	<i>As above</i>

	<i>environmental matrices (water, sediments, biota)</i>		
6.	<i>Microplastic leakages and pathways may be monitored in order to identify further sources and hotspots of microplastics.</i>	<i>As above</i>	<i>As above</i>
7.	<i>Uniform procedure for sampling & analysis as finalized by this Committee may be adopted for such studies till the time ISO Standards are finalized.</i>	<i>CPCB, CIPET/DCPC, NCSCM/ MoEFCC, NCCR/MoES, CSIR- IITR and CSIR-NEERI</i>	<i>Covered in 1</i>
8.	<i>Health impact of emerging contaminants and long term studies are required to establish Cause effect relationship of microplastics on human health</i>	<i>Nodal agency Indian Council of Medical Research- National Institute of Environmental Health Research /DHR, CPCB, CIPET/DCPC, NCSCM/ MoEFCC, NCCR/MoES</i>	<i>a compilation of studies on presence of microplastics/ emerging contaminants in human body will be made for chalking out the methodology/ scope of work with respect to studying cause effect relationship for physiological impacts, dose-response assessment etc.</i>
9.	<i>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.</i>	<i>As above</i>	<i>As above</i>
10.	<i>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:</i> <i>• Estimation of the</i>	<i>As above</i>	<i>As above</i>

	<p><i>duration and frequency of human exposure to microplastics. Microplastic monitoring as required may be conducted for the same.</i></p> <ul style="list-style-type: none"> • <i>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.</i> 		
11.	<p><i>Bioassays may be conducted to assess the Eco-toxicological impact of micro plastics on animal life.</i></p>	<p>CPCB, CSIR-IITR, CSIR-NEERI</p>	<p><i>Bioassays to assess CSIR IITR provided list of already available bioassays which can be used to assess the Eco-toxicological impact of micro plastics on animal life on payment basis:</i></p> <ol style="list-style-type: none"> <i>1.Daphnia sp. Acute Immobilisation test (OECD TG 202)</i> <i>2.Fish, Acute Toxicity Test (OECD TG 203)</i> <i>3.Earthworm, Acute Toxicity Test (OECD TG 207)</i> <i>4. Daphnia magna Reproduction Test (OECD TG 211) –</i> <i>5. Earthworm Reproduction Test (OECD TG 222)</i> <i>6. Fish early life stage toxicity test (OECD TG 210)</i> <i>7. Freshwater Alga and Cyanobacteria, Growth Inhibition Test (OECD TG 201) –</i> <i>8. Avian Acute Oral Toxicity Test (OECD TG 223)</i> <i>9. Avian Acute dietary Toxicity Test (OECD TG 205)</i>
12.	<p><i>Standards development</i></p>	<p>CPCB,</p>	<p><i>Post completion of activities</i></p>

	<i>(Source & ambient) for microplastics may be taken up following establishment of the cause-effect relationship of microplastics on human health</i>	<i>ICMR/DHR</i>	<i>listed in item 2 to 11</i>
13.	<i>Available technologies to be assessed for their efficacy for removal of microplastic</i>	<i>CPCB, CIPET/DCPC, NCSCM/ MoEFCC, NCCR/MoES, CSIR- IITR and CSIR-NEERI</i>	<i>Points 2-6, 13, 14, 26</i> <i>•Preliminary listing of all points to be monitored.</i> <i>•Proposed SOP for monitoring</i> <i>•Compilation of technologies for microplastic removal</i> <i>•Meeting with stakeholders</i> <i>•Awarding of work</i> <i>•Execution of work</i>
14.	<i>Technologies to be developed for removal of micro plastics from Air & Soil</i>	<i>As above</i>	<i>As above</i>
15.	<i>Source-directed interventions,</i> <i>Sustainable design and manufacturing of textiles, tyres, and complementary products (laundry detergents, road surfaces, and vehicles), to minimize the tendency of products to contribute to microplastics generation;</i>	<i>• Ministry of Textiles,</i> <i>• Department of Promotion and Industry and Internal Trade,</i> <i>• Ministry of Heavy Industries,</i> <i>• Ministry of Road Transport and Highways, Department of Chemicals and Petro-Chemicals</i>	<i>The concerned Ministries/bodies, to consider source directed interventions as per pro-forma, based upon principle sustainable development and scientific evidence on micro plastic releases, and submit comments and action plans, as appropriate. It was noted that the report does not provide data on releases of microplastics form these sectors under Indian conditions.</i>
16.	<i>Restrictions on microplastics in the manufacture and sale of certain personal care and</i>	<i>• CDSCO/ Department of Health and Family Welfare</i>	<i>As per information provided by Drug Controller General (India). the Restrictions on the use of microplastics in</i>

	cosmetic products containing microplastics	<ul style="list-style-type: none"> Department of Pharmaceuticals 	the manufacture and sale of certain personal care and cosmetic products are available in Amendment No. 2, November 2017 (Fourth Revision) of IS 4707 Part 2, 2017 under Classification of Cosmetic Raw Materials and Adjuncts. As per S. No. 1373 of Annex-A, Plastic microbeads: 5 mm or less, water-insoluble, solid plastic particles used to exfoliate or cleanse in rinse-off personal care products are not recognized as safe for use in Cosmetics.
17.	Product requirements for household, commercial, or industrial washing machines. For instance, Australia and France have introduced measures to phase in micro fibre filters on new washing machines	Department of Promotion and Industry and Internal Trade	The concerned Ministries/bodies, to consider source directed interventions as per pro-forma, based upon principle sustainable development and scientific evidence on micro plastic releases, and submit comments and action plans, as appropriate. It was noted that the report does not provide data on releases of microplastics from these sectors under Indian conditions.
18.	<p>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;</p> <ul style="list-style-type: none"> Reducing the amount of plastic waste that enters landfills and dumpsites through the implementation of waste reduction policies and initiatives, such as wasteto-energy programs and increased recycling. Microplastics can also be 	<ul style="list-style-type: none"> Department of Drinking Water and Sanitation, Ministry of Housing and Urban Affairs, MoEFCC 	<ul style="list-style-type: none"> Already, the Ministry of Environment, Forest and Climate Change, Government of India, have taken steps for reducing pollution caused by littered and unmanaged plastic waste, along with State Governments, local bodies and Central Pollution Control Board and State Pollution Control Board and Pollution Control Committees. In order to reduce pollution caused by littered and unmanaged plastic waste, the Ministry has banned identified single use plastic

	<p><i>reduced by supporting the development and use of biodegradable plastic alternatives</i></p>		<p><i>items which have high littering potential and low utility and extended producer responsibility on plastic packaging is being implemented. Identified single use plastic items, which have low utility and high littering potential, have already been prohibited, with effect from 1st July, 2022, vide Plastic Waste Management Amendment Rules, 2021 notified on 12th August 2021.</i></p> <ul style="list-style-type: none"> • <i>The Ministry of Environment, Forest and Climate Change notified the Guidelines on Extended Producer Responsibility (EPR) for plastic packaging vide Plastic Waste Management (Amendment) Rules, 2022, on 16th February 2022. The Guidelines stipulate mandatory targets on EPR, recycling of plastic packaging waste, reuse of rigid plastic packaging and use of recycled plastic content. The guidelines provide for moving towards sustainable plastic packaging and reducing the plastic foot print. The implementation of ban on identified single use plastic items coupled with extended producer responsibility on plastic packaging will reduce pollution caused by littered and unmanaged plastic waste.</i> • <i>The single use plastic ban has triggered development of innovative eco-</i>
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		<p><i>alternatives, new business models, increase in the manufacturing capacity and uptake of eco-alternatives, at scale. Already, Startups and manufacturers are manufacturing eco-alternatives such as cutlery made bagasse and rice and wheat bran, straws made from dried coconut leaves, straws made from paper, at scale. In keeping with the development of eco-alternatives, Bureau of Indian Standard has notified Indian Standard IS 18267 for Food Serving Utensil Made from Agri By-Products. Reduction in the use of single plastic items is one of the key focus areas under Mission LiFE - Lifestyles For Environment - launched by Hon'ble PM at COP 26 of UNFCCC at Glasgow in 2021.</i></p> <ul style="list-style-type: none"> • <i>The Guidelines for Extended Producer Responsibility (EPR) on plastic packaging were notified in February 2022 for environmentally sound management of plastic packaging till end of its life by producers, importers and brandowners, who introduce the plastic packaging in the market. For ease of doing business the EPR framework is implemented through a centralized online portal.</i> • <i>The Guidelines stipulate mandatory targets on EPR, recycling of plastic packaging waste, reuse of</i>
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		<p><i>rigid plastic packaging and use of recycled plastic content. The guidelines provide steps for moving towards sustainable plastic packaging and reducing the plastic foot print. The EPR Guidelines also provide for sustainable plastic packaging and implementation of new models for waste collection such as Deposit Refund System and buy back model have been given a boost through the EPR Guidelines.</i></p> <ul style="list-style-type: none"> • <i>Due to the clear framework laid down by EPR Guidelines notified in February 2022, and on account of effective implementation, till date 31401 Producers, Importers and Brand Owners (PIBOs) and 2290 Plastic Waste Processors (PWPs) have registered on the centralized EPR portal developed by CPCB, as opposed to 300 in 2021. The cumulative EPR obligation of registered PIBOs for the year 2022-23 is around 3.07 million tonnes for the year 2022-23, which is a significant proportion of plastic waste generated in the country.</i> • <i>As per the EPR portal dashboard, EPR certificates for around 4.6 million tonnes of plastic packaging waste have been generated by plastic waste processors after processing of plastic packaging waste, of which,</i>
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		<p>already around 3.32 million tonnes of EPR certificates have been exchanged with producers, importer and brand-owners.</p> <ul style="list-style-type: none"> • The following steps have been taken to strengthen implementation of Plastic Waste Management Rules, 2016 and to implement ban on identified single use plastic items: <ul style="list-style-type: none"> (i) All thirty-six States/UTs have constituted the Special Task Force under the chairpersonship of the Chief Secretary/Administrator for elimination of identified single use plastic items and effective plastic waste management. A National Level Taskforce has also been constituted by the Ministry for taking coordinated efforts to eliminate identified single use plastic items and effective implementation of Plastic Waste Management Rules, 2016. Four meetings of the National Task Force have been held. (ii) Twenty-Four State /UT Governments and concerned Central Ministries/ Departments have already developed a comprehensive action plan for elimination of single use plastic and implement it in a time bound manner. (iii) Directions have been issued under Section 5 of the Environment (Protection) Act, 1986 for setting up of institutional mechanism for enforcement of provisions of Plastic Waste Management
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		<p>Rules, 2016 to all State Pollution Control Boards/ Pollution Control Committees. Directions have also been issued to Ecommerce companies, leading single use plastic sellers/users, and plastic raw material manufacturers with respect to phasing out of identified single use plastic items. Separately, custom authorities have been asked to stop the import of banned SUP items</p> <p>(iv) For effective monitoring of ban on identified single use plastic items and plastic waste management in the country the following online platforms are in operation (a) National Dashboard on for monitoring of comprehensive action plan implementation, (b) CPCB Monitoring Module for Compliance on Elimination of Single Use Plastic, and (c) CPCB Grievance Redressal App.</p> <p>(v) Regular enforcement drives have been undertaken by CPCB, SPCBs/PCCs to implement ban on identified single use plastic items and on plastic carry bags having thickness less than one hundred twenty microns.</p> <p>(vi) In order to provide assistance to MSME enterprises transitioning away from single use plastic items to ecoalternatives, Ministry of Micro, Small and Medium Enterprises has made provisions in their ongoing schemes. A National Expo on eco-alternatives to banned single use plastics items and Conference of</p>
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			Startups - 2022 was organized jointly with Government of Tamil Nadu in Chennai on 26-27th September 2022 to raise awareness on alternatives. Awareness generation and capacity building programmes have been organized for elimination of single use plastics.
19.	End-of-pipe interventions, wastewater, stormwater, and road runoff management and treatment, to retain the emitted microplastics before these reach water bodies.	<ul style="list-style-type: none"> • Department of Water Resources, River development and Ganga Rejuvenation, • Department of Drinking Water and Sanitation • Ministry of Housing and Urban Affairs 	
20.	Maximizing clean drinking water supply to all citizens in the country	Department of Drinking Water and Sanitation	Central Government is implementing Jal Jeevan Mission.
21.	Other Best practices as listed below for minimizing microplastics in environment may be followed: 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.	<ul style="list-style-type: none"> • Department of Drinking Water and Sanitation, • Ministry of Housing and Urban Affairs. • Department of Water Resources, River development 	MoEFCC has included the activity of putting barriers for stopping ingress of plastic waste into water bodies under the template of Comprehensive action plan shared with states and UTs for effective plastic waste management and elimination of single use plastics

		and Ganga Rejuvenation,	
22.	Support sustainable fishing practices to reduce the amount of microplastic entering rivers from fishing equipment.	• Department of Fisheries	
23.	Implementation of Clean-up efforts for beaches and rivers	Ministry of Earth Science and MoEFCC, NCC	Pan India beach clean up activities have been carried out at more than 150 beaches since 2017 and to be continued through the adoption of beaches by local institutions/universities/colleges/NGOs/agencies for regular clean up and monitoring. Swachh Sagar Surakhshit Sagar and Puneet Sagar Campaign has been undertaken.
24.	Training and capacity building including microplastic monitoring, analysis, health impact studies may be taken up for effective implementation of aforementioned points.”	CPCB, DCPC/CIPET, MoEFCC/ NCSCM, MoES/NCCR	Short term and long term trainings to be implemented by NCSCM. MoES – Workshop has been planned in February 2024 to provide detailed training on sampling and analysis of microplastics to various stakeholders. Several dissertation students/research scholars have been trained in microplastic analysis. CPCB will also provide training as per training schedule.

12. We find that the Action Plan though *ex-facie* appears to be quite detailed but there is no timeline provided therein, as to how the concerned departments are required to proceed in a prescribed time frame so as to achieve objective and purpose, for which Action Plan has been prepared. Further, we do not find time-bound approach to bring out source-based and ambient standards for Microplastics and

subsequently their regulation and enforcement. Further, the Action Plan should have periodic monitoring mechanism.

13. We, for the time being, accept the above Action Plan submitted by MoEF&CC and direct that the concerned departments as given in Action Plan shall take steps for execution of the said Action Plan and would endeavor to achieve the objective within six months from today. Secretary, MoEF&CC will monitor the progress of Action Plan and resolve the inter-Ministerial issues, if any.

14. The concerned departments shall submit Progress/Compliance Report as per Action Plan with MoEF&CC within 15 days after expiry of six months from today.

15. Thereafter, MoEF&CC shall collect all the Reports, prepare a comprehensive Report and submit the Report with Registrar General of this Tribunal within next one month i.e., by 15.09.2024 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.

16. Registrar General, if finds necessary, shall place the matter before Tribunal for consideration and further orders.

17. With the above directions, this OA is disposed of.

Sudhir Agarwal, JM

Dr. A. Senthil Vel, EM

January 31, 2024
Original Application No. 251/2022
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Annexure-II



neha <nehapatankarenv@gmail.com>

Reminder: Order of National Green Tribunal Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood"-Reg.

Amit Love <amit.love@nic.in>

Wed, May 29, 2024 at 4:29 PM

To: mishra@nccr.gov.in, robin oceanl <robin.oceanl@gmail.com>, Dr S Manivanan <vks.mani@cdsco.nic.in>, Shakuntala <m.shakuntala@cdsco.nic.in>, Nilesh Pawar <nilesh.pawar85@dof.gov.in>, Raman Sharma <raman.sharma@neeri.res.in>, NELAPATLAASHOK <nelapatla.ashokbabu@gov.in>, "J.B. Ravinder Deputy Adivser, CPHEEO, Min. of Urban Development" <jb.ravinder@nic.in>, Krishna Kanth <kkpulicherla.dst@gov.in>, PRAJAKTA L VERMA <prajakta.v@ias.nic.in>, Sanjay Chattopadhyay <sanjay.c59@gov.in>, Shiv Mohan <shiv.dixit@gov.in>, yadav hq <yadav.hq@icmr.gov.in>, DIVYA SINHA <divyasinha.cpcb@nic.in>, spriitd@gmail.com, Dr Shiv <s.praghuvanshi@nmcg.nic.in>, "Mangalaa K.R." <mangalaa.kr@gov.in>, larpm centre <larpm@cipet.gov.in>, SECRETARY DST <dstsec@nic.in>

Cc: nehapatankarenv <nehapatankarenv@gmail.com>, secy-ipp <secy-ipp@nic.in>, "Dr. Rajeev Singh Raghuvanshi" <dci@nic.in>, director@iitrindia.org, DIRECTOR NEERI <director@neeri.res.in>, Director NCSCM <director@ncscm.res.in>, Director General <dg@cipet.gov.in>, "MS, CPCB" <mssc.cpcb@nic.in>, "Dr. Abhilaksh Likhi" <secy-fisheries@gov.in>, Debashree Mukherjee <secy-mowr@nic.in>, Shri Anurag Jain <secyurban@nic.in>, Shri Kamran Rizvi <shioff@nic.in>, Office of Secretary DHR <secy-dhr@gov.in>, SECRETARY MORT&H <secy-road@nic.in>, "Dr. Arunish Chawla" <secy-pharma@nic.in>, Dr M Ravichandran <secretary@moes.gov.in>, Apurva Chandra <secyhfw@nic.in>, Office of Secretary CPC <sec.cpc@nic.in>, Satyendra Kumar <satyendra.kumar07@nic.in>, Naresh Pal Gangwar <asnpg.mefcc@gov.in>, Mr Tanmay Kumar <tanmay.kumar-rj@gov.in>, Chairman CPCB <ccb.cpcb@nic.in>, Ms Leena Nandan <secy-moef@nic.in>, Rachna Shah <secy-textiles@nic.in>

Sir/Madam,**REMINDER I**

This has reference to the trailing mail and OM dated 06.03.2024 on the aforementioned subject.

1. The Honorable National Green Tribunal, Principal Bench, New Delhi, disposed of the matter on 31st January 2024, **directing the concerned Ministries to undertake the execution of the Action Plan provided in the order within six months from the date of the order.** Additionally, it is mandated that the Progress/Compliance Report be submitted to the Ministry of Environment, Forest, and Climate Change within 15 days after the expiration of the six-month period.
2. In view of the above, it is kindly requested that the Progress report in compliance with National Green Tribunal order dated 31st January 2024, may be shared with Ministry of Environment Forest and Climate Change as per prescribed timelines **i.e. by 16th August 2024**, in order to comply with the orders of Hon'ble NGT.
3. Copy of the OM dated 06.03.2024 and order dt. 31.01.2024, is attached herewith for your kind perusal and consideration.

Dr. Amit Love
Scientist 'E' / Additional Director
Ministry of Environment, Forest and Climate Change
Government of India

Sir/Madam,

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The undersigned is directed to forward herewith an OM dated 06.03.2024 on the above mentioned subject for necessary compliance.

Thanks & Regards,
Neha Patankar
Associate (Legal)

Ministry of Environment, Forest & Climate Change
Government of India

2 attachments

 **NGT order dt. 31-01-2024-2.pdf**
350K

 **OM dated 06.03.2024--2.pdf**
862K

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neha <nehapatankarenv@gmail.com>

Reminder: Order of National Green Tribunal Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood"-Reg.

Amit Love <amit.love@nic.in>

Fri, Oct 25, 2024 at 12:31 PM

To: mscbcpcb <mscb.cpcb@nic.in>, secy-textiles <secy-textiles@nic.in>, secy-road <secy-road@nic.in>, seccpc <sec.cpc@nic.in>, secy-mowr <secy-mowr@nic.in>, secretary <secretary@moes.gov.in>

Cc: nehapatankarenv <nehapatankarenv@gmail.com>, Satyendra Kumar <satyendra.kumar07@nic.in>, Mr Naresh Gangwar <asnpg.mefcc@gov.in>, TANMAY KUMAR <tanmay.kumar-rj@gov.in>, Chairman CPCB <ccb.cpcb@nic.in>, Ms Leena Nandan <secy-moef@nic.in>

Reminder**Sir/Madam,**

This has reference to the trailing mail and OM dated 06.03.2024 on the aforementioned subject.

1. The Hon'ble National Green Tribunal, Principal Bench, New Delhi, disposed of the matter on 31st January 2024, **directing the concerned Departments to undertake the execution of the Action Plan provided in the order within six months from the date of the order and submit a Progress/Compliance Report to the Ministry of Environment, Forest, and Climate Change.** Based upon the Report submitted by the concerned departments, the Ministry of Environment, Forest, and Climate Change had to file a comprehensive Report by 15th September 2024.

2. Vide OM dated 06th March 2024, it has been requested to the concerned Ministries/Department/Body to share a progress/compliance report with the Ministry by 16th August 2024. Additionally, a reminder was also sent on 29th May 2024 and 4th October 2024, in this regard.

3. In view of the above, it is **again requested** that the progress/compliance Report in compliance with **National Green Tribunal's order dated 31st January 2024**, may be shared with the Ministry of Environment Forest and Climate Change **by the following Ministries/Department/Body by 1st November 2024**, in order to comply with the orders of Hon'ble NGT. The item number of the action plan as per NGT order has been mapped with the concerned Ministries/Department/Body as per table given below for ease of reference.

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Sr.no.	Ministries/Department/Body
Item no. 1 to 7, 11 to 14	<ul style="list-style-type: none"> • Central Pollution Control Board
Item no. 15 & 16	<ul style="list-style-type: none"> • Ministry of Textiles • Ministry of Road Transport and Highways • Department of Chemicals and Petrochemicals
Item no. 18 to 19	<ul style="list-style-type: none"> • Department of Water Resources, River development and Ganga Rejuvenation
Item No. 23	<ul style="list-style-type: none"> • Ministry of Earth Sciences

The other concerned Ministries/Department/Body mapped in the order of NGT have shared thier compliance reports, **the above-mentioned concerned Ministries/Departments/Bodies have yet to submit their compliance reports as per NGT order.**

4. ICMR-National Institute for Research in Environmental Health has shared a report, wherein a compilation of studies on presence of microplastics/ emerging contaminants in the human body has been made for chalking out the methodology/ scope of work with respect to studying cause-effect relationship for physiological impacts, dose response assessment etc. Copy of the report is also attached for ease of reference.

5. Copy of the OM dated 06.03.2024, order of Hon'ble NGT dt. 31.01.2024 and the report by ICMR-NIREH , is attached herewith.

Regards

Dr. Amit Love
 Scientist 'E' / Additional Director
 Ministry of Environment, Forest and Climate Change
 Government of India

----- Forwarded message -----

From: **Amit Love** <amit.love@nic.in>

Date: Fri, Oct 4, 2024 at 5:49 PM

Subject: Reminder III : Order of National Green Tribunal Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood"-Reg.

To: mscbcpcb <mscb.cpcb@nic.in>, secy-textiles <secy-textiles@nic.in>, secy-road <secy-road@nic.in>, shioff <shioff@nic.in>, secpc <sec.cpc@nic.in>, secydw <secydw@nic.in>, secy-mowr <secy-mowr@nic.in>, secretary <secretary@moes.gov.in>

Cc: Satyendra Kumar <satyendra.kumar07@nic.in>, Mr Naresh Gangwar <asnpg.mefcc@gov.in>, Ms Leena Nandan <secy-moef@nic.in>, nehapatankarenv <nehapatankarenv@gmail.com>

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Sir/Madam,

This has reference to the trailing mail and OM dated 06.03.2024 on the aforementioned subject.

1. The Hon'ble National Green Tribunal, Principal Bench, New Delhi, disposed of the matter on 31st January 2024, **directing the concerned Departments to undertake the execution of the Action Plan provided in the order within six months from the date of the order and submit a Progress/Compliance Report to the Ministry of Environment, Forest, and Climate Change.** Based upon the Report submitted by the concerned departments, the Ministry of Environment, Forest, and Climate Change had to file a comprehensive Report by 15th September 2024.

2. Vide OM dated 06th March 2024, it has been requested to the concerned Ministries/Department/Body to share a progress/compliance report with the Ministry by 16th August 2024. Additionally, a reminder was also sent on 29th May 2024, in this regard.

3. In view of the above, it is again requested that the progress/compliance Report in compliance with National Green Tribunal's order dated 31st January 2024, may be shared with the Ministry of Environment Forest and Climate Change by the following Ministries/Department/Body **by 11th October 2024**, in order to comply with the orders of Hon'ble NGT. The item number of the action plan has been mapped with the concerned Ministries/Department/Body as per table given below for ease of reference.

Sr.no.	Ministries/Department/Body
Item no. 1 to 7, 11 to 14	<ul style="list-style-type: none"> Central Pollution Control Board
Item no. 15 & 16	<ul style="list-style-type: none"> Ministry of Textiles Ministry of Heavy Industries Ministry of Road Transport and Highways Department of Chemicals and Petrochemicals
Item no. 18 to 19	<ul style="list-style-type: none"> Department of Drinking Water and Sanitation Department of Water Resources, River development and Ganga Rejuvenation
Item No. 23	<ul style="list-style-type: none"> Ministry of Earth Sciences

4. Copy of the OM dated 06.03.2024 and order dt. 31.01.2024, is attached herewith

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for your perusal.

Regards

Dr. Amit Love
Scientist 'E' / Additional Director
Ministry of Environment, Forest and Climate Change
Government of India

3 attachments



OM dated 06.03.2024--2-1.pdf

862K



NGT order dt. 31-01-2024-2-1.pdf

350K



ICMR NIREH Report_NGT (251-2022).pdf

3143K

LIST OF PARTICIPANTS**Dated : 07.11.2024**

Sr.no.	Name	Designation & Organization
1.	Shri Bidur Kant Jha	Director(NT), Ministry of Road Transport and Highways
2.	Shri Anjani Prasad Singh	Scientist-E, National River Conservation Directorate, Ministry of Jal Shakti
3.	Shri Ankit Jain	Asst. Advisor, Ministry of Housing and Urban Affairs
4.	Dr. Ravi Kumar	DGHS, Ministry of Health and Family Welfare
5.	Dr. Kuber Nath Ram	DGHS, Ministry of Health and Family Welfare
6.	Dr. Anil Kumar Vijayan	Scientist-E, Ministry of Earth Science
7.	Dr. Priyanka Kundra	Senior Medical Officer, National Centre for Disease Control, Ministry of Health and Family Welfare
8.	Shri Ajay Pandit	Joint Mission Director, National Textiles Technical Mission, Ministry of Textiles
9.	Dr. Geetika Yadav	Scienstist-E, Division of NCD, Indian Council of Medical Research
10.	Dr. Ritika Saha	Deputy Drugs Controller, Central Drugs Standard Control Organization
11.	Dr. Divya Sinha	Scientist-F, Central Pollution Control Board
12.	Ms. Vandana	Director, Department of Chemicals and Petrochemicals
13.	Dr. Satyendra Kumar	Director, ministry of Environment, Forest and Climate Change
14.	Dr. Amit Love	Scienstist-E, Ministry of Environment Forest and Climate Change

Meeting regarding order of National Green Tribunal,
Principal Bench in Original Application no. 251 of 2022 on
'Detecting micro plastic in Human Blood'

Date: 7th November 2024

Hon'ble National Green Tribunal vide order dated 31st January 2024
had passed the following directions-

“.....13. We, for the time being, accept the above Action Plan submitted by MoEF&CC and direct that the concerned departments as given in Action Plan shall take steps for execution of the said Action Plan and would endeavor to achieve the objective within six months from today. Secretary, MoEF&CC will monitor the progress of Action Plan and resolve the inter-Ministerial issues, if any.

14. The concerned departments shall submit Progress/Compliance Report as per Action Plan with MoEF&CC within 15 days after expiry of six months from today.

15. Thereafter, MoEF&CC shall collect all the Reports, prepare a comprehensive Report and submit the Report with Registrar General of this Tribunal within next one month i.e., by 15.09.2024.....”

Status as on date: 30.10.2024

- OM dated 6th March 2024 was sent to Concerned Ministries/Department/Bodies to share the progress/compliance report by 16th of August 2024.
- Reminder mails sent on 29th May 2024, 4th October 2024 and 25th October 2024.
- Progress/Compliance Report received from:
 - Ministry of Housing and Urban Affairs,GoI,
 - Ministry of Heavy Industries, GoI,
 - ICMR – National Institute for Research in Environmental Health,
 - Department Of Pharmaceuticals, GoI
 - Department of Drinking Water and Sanitation,GoI,
 - Department For Promotion of Industry and Internal Trade,GoI,
 - Department Of Chemicals and Petrochemicals,GoI,
 - Department of Fisheries, GoI,
 - Drugs Controller of India

Progress/Compliance Report still awaited from following concerned Ministries/Department/Bodies on following points

•Central Pollution Control Board (CIPET,NCSCM,MoES-NCCR):

- Uniform procedure for sampling & analysis which can be adopted uniformly across the country till the time ISO standard is finalized.
- Source generation of microplastics, quantum of microplastics generated from the identified sources including industries, waste management, waste water treatment, ocean activities etc.
- Microplastic concentration for sludge, specifically when it is converted to compost for land application is not available.
- Source monitoring, transfer, end use.
- Regular monitoring of various water quality including microplastics in environmental matrices (water, sediments, biota).
- Monitoring of microplastic leakages and pathways for identification of sources and hotspots.
- Results of bioassays conducted to assess the Eco-toxicological impact of micro plastics on animal life.
- Standards development (Source & ambient) for micro plastics.
- Available technologies to be assessed for their efficacy for removal of micro plastic.

Cont. .

- Technologies to be developed for removal of micro plastics from Air & Soil.
- Training and capacity building including microplastic monitoring, analysis, health impact studies may be taken up for effective implementation of aforementioned points.

Ministry of Textiles and Ministry of Road Transport and Highways:

- Source-directed interventions:
 - Sustainable design and manufacturing of textiles, tyres, and complementary products (laundry detergents, road surfaces, and vehicles), to minimize the tendency of products to contribute to microplastics generation.

Ministry of Earth Science:

- Implementation of Clean-up efforts for beaches and rivers.

Department of Water Resources, River development and Ganga Rejuvenation

- End-of-pipe interventions, wastewater, stormwater, and road runoff management and treatment, to retain the emitted microplastics before these reach water bodies.

- Other Best practices as listed below for minimizing microplastics in environment may be followed:
 - 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.

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WAY FORWARD

- Interim Report to be filed before Hon'ble NGT containing inputs/comments received from the concerned Ministries/Department/Bodies.
- Progress/Compliance Report to be provided **by 20th November 2024** to the Ministry by following Ministries/Department/Bodies:
 - Central Pollution Control Board
 - Ministry of Textiles
 - Ministry of Road Transport and Highways
 - Ministry of Earth Science
 - Department of Water Resources, River development and Ganga Rejuvenation

THANKYOU

Minutes of the meeting held on 07.11.2024 regarding order of Hon'ble National Green Tribunal dt. 31.01.2024 in Original Application no. 251/2022 In Re: News item published in The Hindu dated 29.03.2022 titled "Detecting microplastics in human blood" "Detecting microplastic in Human Blood"

1. A meeting was convened on 7th November 2024 at 12:15 hrs at Indira Paryavaran Bhawan, New Delhi under the chairpersonship of Additional Secretary, Ministry of Environment, Forest & Climate Change (MoEF&CC), Government of India to review the steps taken by all concerned Ministries/Department/Bodies in compliance to the directions of the Hon'ble National Green Tribunal dated 31.01.2024, in the matter Original Application no. 251/2022 In Re: News item published in The Hindu dated 29.03.2022 titled "Detecting microplastics in human blood" .The list of participants is enclosed as **Annexure I**.
2. Hon'ble National Green Tribunal vide order dated 31st January 2024 had passed the following directions-

".....13. We, for the time being, accept the above Action Plan submitted by MoEF&CC and direct that the concerned departments as given in Action Plan shall take steps for execution of the said Action Plan and would endeavor to achieve the objective within six months from today. Secretary, MoEF&CC will monitor the progress of Action Plan and resolve the inter-Ministerial issues, if any.

14. The concerned departments shall submit Progress/Compliance Report as per Action Plan with MoEF&CC within 15 days after expiry of six months from today.

15. Thereafter, MoEF&CC shall collect all the Reports, prepare a comprehensive Report and submit the Report with Registrar General of this Tribunal within next one month i.e., by 15.09.2024.....”

The copy of the order dt. 31.01.2024 is annexed as **Annexure-II**.

3. Pursuant to the order passed by the Hon'ble National Green Tribunal, vide Office Memorandum dated 06th March 2024, MoEF&CC had also requested the concerned Ministries/Department/Body to share a progress/compliance report with the Ministry by 16th August 2024.
4. Presentation was made by Ministry of Environment, Forest and Climate Change giving status of the Compliance/Progress Reports received from concerned Ministries/Department/Bodies. The presentation is enclosed at **Annexure-III**.
5. After detailed deliberations, the following actions were agreed:
 - i. The remaining concerned Ministries/Department/Bodies were asked to submit their compliance report latest by **22nd November 2024**. [Action:

Central Pollution Control Board, Ministry of Textiles, Ministry of Road Transport and Highways, Ministry of Earth Science, Department of Water Resources, River development and Ganga Rejuvenation, Ministry of Jal Shakti,]

- ii. The compliance reports already submitted will be reviewed by MoEF&CC, if required, additional information may be obtained. **[Action:MoEF&CC]**

- iii. The concerned Ministries/Department/Bodies may also, if required, submit additional information in order to achieve the objective of the action plan provided by them and mentioned in the NGT order dt. 31.01.2024. **[Action: All concerned Ministries/Department/Bodies]**

- iv. Subject to any further updation, as required, an Interim Report will be filed by MoEF&CC in the meantime, giving the present status of the action plan as submitted by concerned Ministries/Department/Bodies. **[Action:MoEF&CC]**

Annexure-VI

Sr.no.	Conclusions of the Report prepared byCPCB, ICMR,CIPET and NCSCM	Concerned Ministries/Department/Body
(1)	(2)	(3)
8.	Health impact of emerging contaminants and long term studies are required to establish Cause effect relationship of microplastics on human health	Indian Council of Medical Research -National Institute of Environmental Health Research (ICMR-NIREH) /DHR (Appendix-A)
9.	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.	
10.	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: <ul style="list-style-type: none"> • Estimation of duration and frequency of human exposure to 	

	<p>microplastics. Microplastic monitoring as required may be conducted for the same.</p> <ul style="list-style-type: none"> 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. 	
15.	<p>Source-directed interventions,</p> <p>Sustainable design and manufacturing of textiles, tyres, and complementary products (laundry detergents, road surfaces, and vehicles), to minimize the tendency of products to contribute to microplastics generation</p>	<ul style="list-style-type: none"> Ministry of Heavy Industries (Appendix- B), Department of Chemicals and Petro-Chemicals (Appendix- C)
16.	<p>Restrictions on microplastics in the manufacture and sale of certain personal care and 14 cosmetic products containing microplastics</p>	<ul style="list-style-type: none"> Department of Pharmaceuticals (Appendix-D) Central Drugs Standard Control Organization

		(CDSCO)/ Department of Health and Family Welfare (DoH&FW) (Appendix-E)
17.	Product requirements for household, commercial, or industrial washing machines. For instance, Australia and France have introduced measures to phase in micro fibre filters on new washing machines.	<ul style="list-style-type: none"> • Department of Promotion and Industry and Internal Trade (Appendix-F)
18.	<p>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;</p> <ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Ministry of Housing and Urban Affairs (Appendix-G) • Ministry of Environment Forest & Climate Change (Appendix-H) • Department of Drinking Water and Sanitation, (Appendix-I)

	<ul style="list-style-type: none"> • Microplastics can also be reduced by supporting the development and use of biodegradable plastic alternatives. 	
19.	End-of-pipe interventions, wastewater, stormwater, and road runoff management and treatment, to retain the emitted microplastics before these reach water bodies.	<ul style="list-style-type: none"> • Ministry of Housing and Urban Affairs (Appendix-G) • Department of Drinking Water and Sanitation(Appendix-I), • Department of Water Resources, River development and Ganga Rejuvenation (Appendix-J)
21.	Other Best practices as listed below for minimizing microplastics in environment may be followed: Install physical barriers such as screens and filters on STP/WWTP	<ul style="list-style-type: none"> • Ministry of Housing and Urban Affairs (Appendix-G) • Department of Water Resources, River development and Ganga Rejuvenation, (Appendix-J)

	systems to help reduce the amount of microplastics that enter rivers, lakes, and oceans.	
22.	Support sustainable fishing practices to reduce the amount of microplastic entering rivers from fishing equipment.	<ul style="list-style-type: none"> • Department of Fisheries (Appendix-K)
23.	Implementation of Clean-up efforts for beaches and rivers	<ul style="list-style-type: none"> • Ministry of Earth Science (Appendix-L) • Ministry of Environment Forest & Climate Change (Appendix-H) • National Cadet Corps (Appendix-M)
24.	Training and capacity building including microplastic monitoring, analysis, health impact studies may be taken up for effective implementation of aforementioned points.”	<ul style="list-style-type: none"> • Ministry of Earth Sciences/NCCR (Appendix-L)

*Brief note on the matter***Background**

Hon'ble National Green Tribunal (NGT) of India on its own motion suo moto based on the news item published in *The Hindu* titled "Detecting Microplastics in human blood" dated March 29, 2022 (OA No. 251/2022) issued the following directions *vide* its order dated 05.04.2022:

"Para 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."

The suo-moto notice of NGT was marked to Secretary DHR and DG ICMR and ICMR-NIREH Bhopal represented DG ICMR. A total of 4 (virtual) meetings took place among the committee members (CIPET, ICMR, and NCSCM) under the chairpersonship of Central Pollution Control Board (CPCB), Delhi. ICMR-NIREH, Bhopal attended all the meetings and provided inputs on the subject matter. NIREH further helped in the report preparation by CPCB through providing comments on the draft report. Report was finally submitted to Hon'ble NGT on 10.02.2023 by CPCB, Delhi. Next hearing was scheduled on 09.08.2023, following which 3 more (virtual) meetings took place among the committee members to discuss various issues and action plan shared by Ministry of Environment, Forest and Climate Change (MoEF&CC) on 20.10.2023 with the concerned Ministries/ Departments/Bodies. ISO standards:24187 were reviewed for finalization of analysis methods. Further, standard operating procedure (SOP) for sampling of microplastics, developed by National Centre for Coastal Research (NCCR), was also reviewed and comments were provided.

Subsequently, Action Plan was filed by MoEF&CC to Hon'ble NGT specifying obligations / duties / performance to be shown by different ministries / departments on various aspects. Consequently, the Hon'ble NGT, Principal Bench, New Delhi, disposed off the matter on 31.01.2024, directing that concerned ministries / departments shall take steps for execution of the Action Plan given in the order and shall endeavour to achieve the objective within six months from the date of the order. Referring to the order of Hon'ble NGT, MoEF&CC issued an OM dated 06.03.2024 to share the report within the prescribed timeline *i.e.* 16th Aug, 2024 on the specified objective.

As per the specified action plan for ICMR-NIREH, a compilation of studies on presence of microplastics in human body was to be made for chalking out the methodology/ scope of work with

respect to studying cause effect relationship for physiological impacts, dose response assessment *etc.* To comply with the action plan, this report was prepared by ICMR-NIREH Bhopal for submission to MoEF&CC in compliance to the order of Hon'ble NGT.

Key points of the report prepared by ICMR-NIREH, Bhopal are as follows:

Since no study has been carried out by ICMR – NIREH on human health, this report has been prepared based on the literature survey of research articles published in various international journals.

In this report:

- Evidences of micro/nano plastics' presence in human body have been collated and compiled.
- The methodology for detection of these particles in human system has also been detailed with the emphasis on developing a standard methodology to be adopted across the globe.
- Six major human physiological systems were studied wherein the presence of microplastics has been reported. These include digestive system, respiratory system, circulatory system, excretory system, reproductive system, and endocrinology system. Most of the investigations in this aspect were found to be carried out *in vitro* involving cytotoxic and genotoxic studies.
- Further, role of micro/nanoplastics as efficient carriers of a number of chemical and biological contaminants has also been reviewed and discussed in detail in this report.
- Regarding toxicity assessment of micro/nanoplastics, there are very few studies and significant number of studies is required to be done.

Chronological events of the matter:

Date	Events
March 29, 2022	A news article titled "Detecting Microplastics in human blood" was published in 'The Hindu' newspaper, highlighting the presence of microplastics in human blood.
April 5, 2022	Based on the news article, the Hon'ble National Green Tribunal (NGT) initiated a suo moto case (OA No. 251/2022) to address the issue of microplastics.
April 5, 2022	The NGT ordered the formation of a committee comprising CPCB, ICMR, CIPET, NCSCM, and other experts to conduct further studies on microplastics, develop standards for safe environments, and propose remedial measures to reduce microplastic pollution.
April 2022 – February 10, 2023	The committee, led by CPCB, held four virtual meetings to discuss the issue. ICMR-NIREH actively participated and contributed to the report preparation process.
February 10, 2023	The CPCB submitted the final report on microplastics to the NGT, incorporating inputs from ICMR-NIREH.
August 9, 2023	The NGT held a hearing on the microplastics case.
October 20, 2023	The MoEF&CC shared a draft action plan template with concerned ministries, departments, and bodies.
November 9, 2023	The committee conducted a virtual meeting to discuss the ISO standards:24187 and issues of cost and availability of filter paper
November 17, 2023	The committee conducted a virtual meeting to standardize a uniform procedure for the sampling and analysis of microplastics and deliberate upon the Action Plan shared by MoEF&CC
November 21, 2023	The Ministry of Environment, Forest, and Climate Change (MoEF&CC) submitted an action plan to the NGT, outlining the responsibilities of different ministries and departments in addressing microplastic pollution.
January 16, 2024	The committee conducted a virtual meeting to discuss the methodology prepared by National Centre for Coastal Research (NCCR) for microplastics' sampling and analysis.
January 31, 2024	Hon'ble NGT disposed off the case, directing concerned ministries and departments to implement the action plan within six months.
March 6, 2024	Director, MoEF&CC issued an office memorandum setting a deadline of August 16, 2024, for submitting reports on microplastics as specified in Action Plan.
[Recent]	ICMR-NIREH prepared a report on the presence of microplastics in the human body, focusing on cause-effect relationship, physiological impacts, and dose-response assessment.

**Micro/nanoplastics and Human Health: Synthesis of Evidence on
Repercussions and Toxicity Potential**

In compliance to the order of

Hon'ble National Green Tribunal (NGT)

Original Application No. 251/2022

Submitted to



Ministry of Environment, Forest, and Climate Change

Jorbagh Road, New Delhi – 110 003

Submitted by



ICMR – National Institute for Research in Environmental Health

Bhopal Bypass Road, Bhauri, Bhopal – 462 030, Madhya Pradesh

PREFACE

Hon'ble National Green Tribunal (NGT) of India on its own motion suo moto based on the news item published in *The Hindu* titled "Detecting Microplastics in human blood" dated March 29, 2022 (OA No. 251/2022) issued the following directions *vide* its order dated 05.04.2022 (*Annexure I*):

Para 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.

In compliance to this, an Action Plan was drafted and filed by Ministry of Environment, Forest and Climate Change (MoEF&CC) to Hon'ble NGT specifying obligations / duties / performance to be shown by different ministries / departments on various aspects (*Annexure II*). Subsequently, the Hon'ble NGT, Principal Bench, New Delhi, disposed off the matter on 31st January 2024, directing that concerned ministries / departments shall take steps for execution of the Action Plan given in the order and shall endeavour to achieve the objective within six months from the date of the order (*Annexure II*).

Referring to the order of Hon'ble NGT, MoEF&CC directed to share the report as per the prescribed timeline on the specified objective (*Annexure III*). As per the specified action plan for ICMR-NIREH, a compilation of studies on presence of microplastics/ emerging contaminants in human body was to be made for chalking out the methodology/ scope of work with respect to studying cause effect relationship for physiological impacts, dose response assessment *etc.* To comply with the action plan, this report has been prepared by Dr. Rajnarayan R. Tiwari (Director & Scientist 'G', ICMR-NIREH Bhopal) and Dr. (Ms.) Surya Singh (Scientist 'C', ICMR-NIREH Bhopal) for submission to MoEF&CC in compliance to the order of Hon'ble NGT.

SUMMARY

Micro/nanoplastics are the pervasive emerging contaminants which are found in various environmental matrices. These particles are mostly the result of breakdown of large sized plastic particles, apart from some amount of targeted manufacturing for desired purposes. Since these particles are present in atmosphere, hydrosphere, lithosphere, as well as biosphere; it is likely that humans are also exposed to these contaminants through ingestion, inhalation, and dermal contact. Recently, there have been several reports which documented the presence of these particles in human body organs, human biological fluids, and human excreta; which substantiates the exposure of human to these small plastic particles. Therefore, it becomes necessary to explore and assess the impacts that these particles might pose on the human body.

In this report, evidences of micro/nano plastics' presence in human body have been collated and compiled. The methodology for detection of these particles in human system has also been detailed with the emphasis on developing a standard methodology to be adopted across the globe. Since these particles have been found to invade human body, their impacts were also studied and synthesized. Six major human physiological systems were studied wherein the presence of microplastics has been reported. These include digestive system, respiratory system, circulatory system, excretory system, reproductive system, and endocrinology system. Most of the investigations in this aspect were found to be carried out *in vitro* involving cytotoxic and genotoxic studies. Further, micro/nanoplastics also act as efficient carriers of a number of chemical and biological contaminants, in which environmental parameters and physico-chemical properties of micro/nanoplastics do play a significant role. This property of micro/nanoplastics has also been analysed and discussed in detail in this report. As far as toxicity assessment of micro/nanoplastics is concerned, there are very few studies and significant number of studies are required to be done. Considering all these aspects, it was understood that the field of micro/nanoplastics is evolving and there is immense scope to work in this area. Few important areas, which are indispensable to comprehend the human health impacts of micro/nanoplastics, have been outlined in the end of the report.

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1. Background

Micro/nanoplastics (MNPs) are the tiny plastic (polymer) particles having upper size limit of 5 mm. As per the international standard (ISO 24187), microplastics are defined from 5 mm up to the size range of 1 μm and nanoplastics are the particles below 1 μm . Researchers have reported that MNPs are ubiquitous emerging contaminants, which are present in variety of environmental matrices, such as water, air, soil, and even at the remotest locations on the earth such as Arctic and Antarctica. Mismanagement of plastic waste present in environment is the primary cause of microplastics' generation. The unscientifically dumped plastic waste accumulated over land sources, agricultural land, stagnant water bodies, and wastewater effluent / sludge, finds its way into the rivers and other water bodies. It has been estimated that approximately 70-80% of plastic waste from land based sources, which is approximately 1.15 – 2.41 million tonnes, is carried away by the rivers, which ultimately ends up in the oceans. In the total microplastic pool of the environment, 69 – 81% of the microplastics do originate *via* secondary origin, *i.e.* through the breakdown of large size plastic particles. Rest of the amount is contributed by the sources where microplastics are intentionally manufactured in small size for various commercial purposes. Prevalent units used to express microplastics' abundance in water, sediment, and biota are particles/ m^3 (or particles/L), particles/ m^2 , and particles/individual, respectively.

As contaminants present in environment affect the human in various ways, MNPs also hold the potential to impact human body. Presence of MNPs has been reported in various human organs (such as kidney, colon, lungs *etc.*), receptors (hair, skin *etc.*), and its biological fluids (blood, breast milk, urine, semen *etc.*). Presence of MNPs inside the human body and its fluids indicates that these particles have the ability to cross biological barriers and reach up to the distant organs. MNPs may reach up to the human organs through 3 routes, *viz.* inhalation, ingestion, and dermal. Since micro/nanoplastic particles are present in atmosphere in abundance, these get an easy way through nasal pathway to reach up to the human body (respiratory system). Similarly, presence of MNPs in water, fruits and vegetables, processed food items, salt, and sugar *etc.* becomes the source of these particles in human digestive system. Dermal route of exposure involves application of various cosmetic products, having microplastic beads, on skin, hairs, *etc.*

Another peculiar feature of MNPs is that these particles occur in wide variety of size, shape, colour, and chemical composition. Properties of these particles also vary with the age,

as older MNPs are exposed to varied environmental conditions which bring significant physical and chemical changes in structural composition, for *e.g.* change in functional groups, crystallinity, density *etc.* Understanding the variation due to these features is also crucial for assessing the risks imposed due to MNPs. In order to explicitly elucidate the effects of these particles on human body, a number of studies are being carried out in animal models as well as human. However, in this report, only the studies which have been carried out in human system, either *in-vitro* or *in-vivo*, are included. This report will attempt to synthesize the evidence regarding MNPs' presence in human body and its repercussions on various physiological systems. The consequences of variation in physical and chemical properties of MNPs are also discussed with special reference to human cell line studies. Nevertheless, preliminary evidences of the toxicity assessment about MNPs shall also be examined.

2. Evidence of micro/nanoplastics' presence in human body

MNPs are the pervasive emerging contaminants, which have invaded almost every environmental matrix. Consequent to this, these contaminants have reached up to the human system in varied concentrations through food, air, and water and invaded up to the level of tissues. Reported presence of MNPs in human biological system is compiled in Table 1. As on date, MNPs have been reported in the human digestive system (saliva, liver, colon), respiratory system (lungs), circulatory system (heart), excretory system (kidney), and reproductive system (testis, placenta). Apart from it, these particles have also been reported from various body receptors (hairs and skin), biological fluids (blood, breast milk, semen, sputum), and excreta (urine, stool) (Table 1). Presence of MNPs in different physiological systems of human body confirm the exposure of human to this contaminant through various pathways *viz.* inhalation, ingestion, and dermal. Invasion of MNPs in human body has led scientists across the globe to investigate the probable impacts that these particles might pose onto the humans.

Table 1. Reported presence of micro/nanoplastics in human organs, biological fluids / tissues, body receptors, and excreta

Human body / Biological fluids / Body receptors	No. of human subjects / samples	Analytical technique used*	Quantity / concentration reported	Size range	Predominant morphology	Predominant chemical class of MNPs**	References
Human organs							
Heart	15 subjects (38 samples)	LDIR	---	20 – 469 μm	---	PET, PU, PE	Yang <i>et al.</i> 2023 a
Kidney	10	Raman Spectrometer	17 items in 7 samples	---	---	PE, PS	Exacoustos <i>et al.</i> 2023
Testis	6	Pyr-GC/MS and LDIR	11.6 \pm 15.52 items / g	20 – 100 μm	Fragment	PS, PVC, PE, PP	Zhao <i>et al.</i> 2023
Liver (Cirrhotic)	6 (4 ♂ + 2 ♀)	Raman spectroscopy	3.2 – 9.9 items / g	3 – 29.5 μm	Fragment	PS, PVC, PET, PMMA, PP	Horvatits <i>et al.</i> 2022
Lungs	11 subjects (6 ♂ + 5 ♀), 13 samples	μ FTIR	39 items in 13 samples (0.69 \pm 0.84 items / g)	Length: 12 – 2475 μm Width: 4 – 88 μm	Fibre, fragment, film	PP, PET	Jenner <i>et al.</i> 2022
Lungs	20 (7 ♂ + 13 ♀)	Raman spectroscopy	31 items in 13 samples	Fragments: 1.6 – 5.56 μm ; Fibres: 8.12 – 16.8 μm	Fragment, fibre	PE, PP	Amato-Lourenco <i>et al.</i> 2021
Colon	11 (6 ♂ + 5 ♀)	FTIR	331 items / individual (28.1 \pm 15.4 items / g)	0.8 – 1.6 mm	Fibre	PC, PA, PP	Ibrahim <i>et al.</i> 2020

Human body / Biological fluids / Body receptors	No. of human subjects / samples	Analytical technique used*	Quantity / concentration reported	Size range	Predominant morphology	Predominant chemical class of MNPs**	References
Human biological fluids / tissues / cells							
Placenta	62	Pyr-GC/MS	126.8 ± 147.5 µg/g	---	Particles , fibres	PE, PVC, Nylon	Garcia <i>et al.</i> 2024
Thrombus	26	Raman microspectroscopy	87 items in 16 thrombi	2.1 – 26 µm	Block-shaped	LDPE	Wu <i>et al.</i> 2023
Saphenous vein tissue	5 (3 ♂ + 2 ♀)	µFTIR	20 items in 4 samples 14.99 ± 17.18 items / g	16 – 1074 µm	Irregular, fiber	PVAc, Nylon	Rotchell <i>et al.</i> 2023
Enclosed body fluids (whole blood, cerebrospinal fluid, effusions, & cyst fluids)	104 subjects	Raman microspectroscopy	23 items in whole blood, pelvic cyst fluid, and effusions	19.66 – 103.27 µm	Fragmented or irregular shape	PP, PS, PTFE, PA, LDPE, PVA	Guan <i>et al.</i> 2023
Placenta	17	LDIR	2.70 ± 2.65 items / g	20 – 307 µm	Fragment, fibre, films	PVC, PP	Zhu <i>et al.</i> 2023
Placenta and meconium	18 placenta & 12 meconium samples	LDIR	Placenta: 18 items / g Meconium: 54.1 items / g	20 – 50 µm	---	PA, PU	Liu <i>et al.</i> 2023
Semen	30	Pyr-GC/MS and LDIR	0.23 ± 0.45 items / mL	21.76 – 286.71 µm	Fragment, fiber, film	PE, PVC	Zhao <i>et al.</i> 2023
Semen	10	Raman microspectroscopy	16 items in 6 samples	2 – 6 µm	Spheric or irregular	PP, PE, PET, PS, PVC, PC	Montano <i>et al.</i> 2023

Human body / Biological fluids / Body receptors	No. of human subjects / samples	Analytical technique used*	Quantity / concentration reported	Size range	Predominant morphology	Predominant chemical class of MNPs**	References
Bronchoalveolar lavage fluid (BALF)	17	LDIR	25.86 items / g	20 – 100 μm	Irregular	PU, Silicone	Lu <i>et al.</i> 2023
	18	LDIR	0.2 – 140.9 items / g	20 – 80 μm	Fibre	PE, PET, PP	Qiu <i>et al.</i> 2023
	44 (32 ♂ + 12 ♀)	μFTIR	9.18 ± 2.45 items / 100 mL	140 μm – 9.96 mm	Fibre	Rayon, PES	Baeza-Martinez <i>et al.</i> 2022
Breast milk	34	Raman microspectroscopy	58 items in 34 samples	2 – 12 μm	Fragment, sphere	PE, PVC, PP	Ragusa <i>et al.</i> 2022
Blood	22	Pyr-GC/MS	1.6 μg / mL	≥ 700 nm	---	PET, PE, PS	Leslie <i>et al.</i> 2022
Blood	20	μFTIR	1.84 – 4.65 μg / mL	Length: 127.99 ± 293.26 μm Width: 57.88 ± 88.89 μm	Fragment	PE, ethylene propylene diene, ethylene-vinyl- acetate/alcohol	Leonard <i>et al.</i> 2024
Sputum	22 (17 ♂ + 5 ♀)	LDIR and FTIR	39.5 items in 10 mL	20 – 500 μm	Fibre	PU, PES, PE	Huang <i>et al.</i> 2022
Sputum	8 (Indoor)	LDIR	134.3 items / g	---	Fibre	PVC, PA	Jiang <i>et al.</i> 2022
	8 (Outdoor)		102.9 items / g				
Nasal lavage fluid	8 (Indoor)	LDIR	2.6 items / g	---	Fibre	PVC, PA	Jiang <i>et al.</i> 2022

Human body / Biological fluids / Body receptors	No. of human subjects / samples	Analytical technique used*	Quantity / concentration reported	Size range	Predominant morphology	Predominant chemical class of MNPs**	References
	8 (Outdoor)		0.8 items / g			PA, PE	
Lung tissues with ground glass nodules	50 (16♂ + 34♀)	μFTIR	16 items in 50 samples	Length: > 20 μm	Fibre	PES, Rayon, PET, acrylic	Chen <i>et al.</i> 2022 b
Placenta (in vaginal delivery)	6	Raman microspectroscopy	12 items in 4 samples	5 – 10 μm	Fragment	PP	Ragusa <i>et al.</i> 2021
Placenta (in cesarean delivery) and Meconium	2	FTIR	Samples tested positive for microplastics	> 50 μm	---	PE, PP, PS, PU	Braun <i>et al.</i> 2021
Human body receptors							
Head hair	2000 subjects	micro-Raman spectroscopy	> 3.5 items / individual	100 – 250 μm	Fibers	PE, PET, PP, PS	Abbasi and Turner 2021
Hand skin	(1000 ♂+ 1000 ♀),		2 items / individual				
Face skin	8000 samples		2.1 items / individual				
Saliva			0.33 items / individual				
Human excreta							
Urine	10	Raman Spectrometer	9 items in 7 samples	---	---	PE, PS	Exacoustos <i>et al.</i> 2023
	6 (3 ♂ + 3 ♀)	Raman microspectroscopy	7 items in 6 samples	4 – 15 μm	Fragment	PVC, PP, PE	Pironti <i>et al.</i> 2023

Human body / Biological fluids / Body receptors	No. of human subjects / samples	Analytical technique used*	Quantity / concentration reported	Size range	Predominant morphology	Predominant chemical class of MNPs**	References
Stool	24 (24 ♂+ 0 ♀)	μFTIR	1 – 36 items / g	20 – 800 μm	---	PP, PET	Zhang <i>et al.</i> 2021
	8 (3♂+ 5 ♀)	μFTIR	20 items / 10 g	50 – 500 μm	Fragment, film	PP, PET	Schwabl <i>et al.</i> 2019

*Pyr-GC/MS: Pyrolysis – gas chromatography / mass spectrometry; LDIR: Laser direct infrared spectroscopy; FTIR: Fourier transform infrared spectroscopy;

**PVC – Polyvinyl chloride, PP – Polypropylene, PE – Polyethylene, PVAc – Polyvinyl acetate, PS – Polystyrene, PET – Polyethylene terephthalate, PU – Polyurethane,

PES – Polyester, PMMA – Polymethyl methacrylate, PC – Polycarbonate, PA – Polyamide

(♀ represents female; ♂ represents male)

3. Methodology for micro/nanoplastics' determination in human body samples

Micro/nanoplastics determination in human system may include human organs, body receptors, excretory materials, and/or biological fluids. The entire process includes sample collection, storage, digestion, and filtration, followed by detection through analytical instruments (Figure 1). In the reported literature, human organ samples were obtained during the surgical procedure of respective organs; and biological fluids, body receptors, and excreta samples were collected from study participants through obtaining informed consent.

For human body organs (such as, heart, kidney, testis, liver *etc.*), the general procedure is to digest the sample using oxidative bleaching agent (*e.g.* H₂O₂), alkaline agent (*e.g.* KOH), or enzymatic solution. After digestion, the samples are generally homogenized and washed before performing filtration process. In case of liver samples, defatting process was also carried out using acetone. Density separation process was performed only in case of human lung samples after sample digestion using enzymatic mixture. For filtration, researchers have used different membranes / filters, such as 1 μm PTFE membrane, silver membrane filter, 0.02 μm Al₂O₃ membrane, or 0.45 μm cellulose membrane. Detection was performed using laser direct infrared spectroscopy (LDIR), Raman spectrometer, or μFTIR spectroscopy (Table 1).

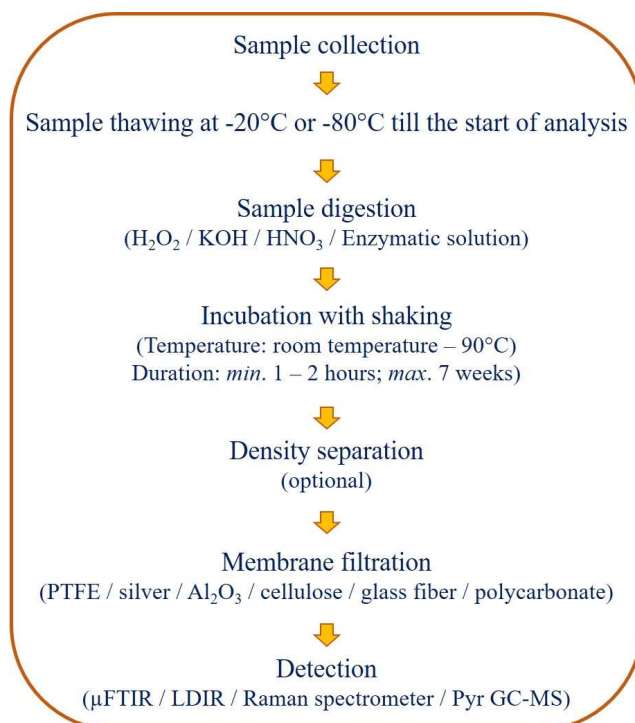


Figure 1. Micro/nanoplastics' determination in human body samples as per the reported literature

Similar kind of procedure has been followed by the researchers in case of microplastics determination in human body receptors (hair / skin) and human excreta (urine / stool), where samples were digested using either KOH or H₂O₂ and incubated for a certain time period. Digestion process was followed by membrane filtration and detection of microplastic particle using Raman or FTIR spectroscopy.

In order to determine the MNPs in human biological fluids, such as, blood, semen, placenta, breast milk, sputum *etc.*, procedures have been followed by researchers with little modifications. In most of the cases, process starts with incubation of samples with acid (HNO₃) / alkali (KOH) / oxidative bleaching agent (H₂O₂) at temperature below 90°C for varying time duration (such as, 3 hours to 7 weeks). Once the incubation or digestion of sample is complete, which is determined by the absence of any visible tissue, the hydrolysed sample is filtered using suitable material. These filter materials included stainless steel membrane (13 µm), glass fibre filter (0.7 µm), Al₂O₃ filter (0.02 µm), silver membrane (0.45 µm), 1.6 µm filter membrane, 0.45 µm filter paper, and polycarbonate membrane filter in various studies. The chemical characterization of micro/nanoplastic particles in human biological samples were carried out using Pyrolysis (Pyr) GC-MS, LDIR, Raman spectrometer, or µFTIR spectroscopy (Table 1).

Although there are several researches of detecting micro/nanoplastics in human body, there are variations in the methodology used. Nevertheless, it primarily depends upon the type of sample matrix being studied, for *e.g.*, it is reasonable that liver samples owing to the presence of fat, may need a different digestion procedure compared to lung or any other human sample. The fundamental procedure of micro/nanoplastics' isolation is same among all the matrices, *viz.* digestion, incubation, separation, and filtration. However, the choice of filter paper and selection of their corresponding pore size varied among the researchers. Hence, there is need of a standard methodology which could be adopted at a global scale. It would also help to compare the results generated out of different studies.

4. Impact of micro/nanoplastics on human physiological systems

Impacts of MNPs on human physiological functions are currently under investigation and therefore it is difficult to reach up to any conclusion. Most of the studies have been carried out in animal models; while a few are targeted for the human cell lines. For the purpose of understanding, studies carried out on micro/nanoplastics may be divided

according to human physiological system, such as, digestive system, respiratory system, excretory system, *etc.*

4.1 Digestive system

A study carried out in the human digestive tract cells using polystyrene (PS) microplastics revealed interesting findings. In this study, human colonic epithelial cells (CCD841CoN) and small intestinal epithelial cells (HIEC-6) were exposed to varied size range of PS particles for different time duration. Particularly, small size particles were up-taken by both the cell types upon increasing the exposure time up to 24 h; however, no significant effect was observed on the cell viability. As far as cell apoptosis is concerned, PS microplastics did not induce any significant response up to concentration as high as 100 µg/mL, while, change in response of ROS and mitochondrial membrane potential was observed. Upon introduction of PS particles in the cell, stress response was noticed, which with increasing exposure time, restored to the normal level. Study further demonstrated that nano-size particles (0.1 µm) are more prone to enter inside the cells leading to oxidative stress, while micron-size particles are accumulated in the intercellular space and cell membranes resulting in adverse effects on mitochondrial electron transport. Effect of PS particles was also studied in the human colorectal epithelial cell line (HRT-18) where increased cytotoxicity was observed with increasing exposure time (6, 24, and 48 h) to microplastic particles. Enhanced release of IL-8 in cell culture medium further confirmed the toxic response posed by particles. Apart from PS, polyethylene (PE) particles were also utilized to study the effects on intestinal epithelial Caco-2 cells. Concentration dependant cytotoxicity was observed, and 30.5 µm and 6.2 µm particle size resulted in decreased cell viability.

Negative impact on digestion process was reported by Tamargo *et al.*, where effects on human colonic microbiota were studied in a simulated gastrointestinal system. Study found that exposure to PET microplastic particles alters the regular balance of human gut microbiota along with introducing unfamiliar bacterial groups. Inhibitory effects on the growth of probiotics (*Lactobacillus* spp.) upon exposure to microplastics were also confirmed by Chen *et al.* Moreover, these particles also act as substrate for biofilm formation by the microbial species present in the system. This phenomenon may not only pose negative consequences on the digestive process; rather, it might also lead to negative health outcomes.

Another interesting finding in the study of Tamargo *et al.* was change in the structure of microplastic particles after exposure to simulated digestive process. The crystalline nature of the particle showed gradual conversion towards amorphous nature, thus indicating structural degradation of the particle during the digestion process. Krasucka *et al.* also reported similar findings, where *in-vitro* digestion of PS and HDPE resulted in morphological as well as chemical changes in the exposed particles. However, in contrast to these findings, Chen *et al.* reported that digestion process does not affect the physical and/or chemical nature of microplastics. No change in morphology (hole / roughness / corrosion marks / deformation stress *etc.*) or chemical properties (new peaks / shift peak / weakened peak) of the PE, PP, PS, PVC, and PET particles was observed when exposed to digestion process. Similar findings to that of Chen *et al.* had also been reported by Stock *et al.*, where PE, PP, PVC, PET, and PS particles were exposed to artificial digestion process. Scanning electron microscopic (SEM) images confirmed that digestive juices had no effect on the physical characteristics of the microplastic particles. Microplastic particles, being resistant, are not decomposed in the gastrointestinal tract.

These investigations indicate that microplastics do have the ability to pose negative impact on human digestive system if exposed for long; however, in light of the contradictory results of various studies, it is evident that more in-depth studies are required to be conducted to arrive onto something conclusive.

4.2 Respiratory system

Ubiquitous presence of MNPs with different chemical compositions in the atmosphere is indicative of the fact that human respiratory system is exposed to a wide variety of MNPs' type, size, as well as shape. Researches have been carried out in the human cell lines and airway organoids. However, most of the toxicity studies on human cell lines have been carried out using PS micro- and nanoplastics. A researcher carried out *in-vitro* studies of 40 nm PS nanoplastics' (PS-NPs) exposure on the two human lung epithelial cells *viz.* bronchial epithelium transformed with Ad12-SV40 2B (BEAS-2B) and human pulmonary alveolar epithelial cells (HPAEPiC). Results indicated that PS-NPs reduced cell viability of lung epithelial cells in dose-dependent manner. Moreover, increased level of lactose dehydrogenase (LDH) and decreased expression of cell proliferation markers in PS-NPs exposed cells further inferred that nanoplastics negatively affect the lung cells. Study further found that exposed cells had changed expression of genes and increased production of

reactive oxygen species (ROS), malondialdehyde (MDA), and superoxide anion content *etc.* which happen as a result of oxidative stress in the cells. Apoptosis and epithelial barrier dysfunction were also reported making cells more susceptible to allergic reactions. These evidences suggest that continuous and long-term exposure to plastic particles may result in cell/tissue damage and ultimately lung diseases.

Impact of micron size PS particles on human lung cells has also been studied by Dong *et al.* and Goodman *et al.* Human lung epithelial cells, BEAS-2B, were selected for determining association of microplastics exposure and cell toxicity at concentration of 1 – 1000 $\mu\text{g}/\text{cm}^2$. Loss in cell viability was observed after 24 h of exposure to PS-MPs at concentration of 1000 $\mu\text{g}/\text{cm}^2$. Change in morphology of exposed cells was also observed. BEAS-2B cells exposed to ≥ 10 $\mu\text{g}/\text{cm}^2$ PS-MPs got shrunk and converted to rounded shape. Study further revealed that even low levels of PS-MPs have the potential to disrupt the pulmonary epithelial barrier owing to reduced protein expression; which can lead to serious chronic obstructive pulmonary dysfunction (COPD). These findings were also substantiated by Yang *et al.* using PS-NPs. Goodman *et al.* studied the effect of PS-MPs (1 and 10 μm) on human alveolar A549 cells. However, this study reported contrasting results to that of Dong *et al.* and Yang *et al.* where it was shown that cell viability was not lost even at the highest dose of 100 $\mu\text{g}/\text{mL}$. Moreover, cell proliferation was found affected causing slow start followed by slow continued rate resulting in approximately 70% loss in final cell numbers. Such changes can result in dysfunction of tissues leading to serious repercussions on lungs.

Apart from PS, few of the researchers have also used PE particles to assess the effects on human A549 cell lines. These particles too reduced the cell viability at concentration of 1000 $\mu\text{g}/\text{mL}$, however, did not exhibit any impacts on ROS generation. Similarly, Zhang *et al.* exposed human alveolar epithelial A549 cells to the environmental concentrations of PET NPs and found internalization of PET particles inside the cells, resulting in oxidative stress. However, observed effects on cell apoptosis and mitochondrial membrane potential were low. Li *et al.* studied the transformations of PE, PP, PVC, PET, and PS NPs in the alveolar fluid and effects on lung surfactant film using molecular dynamics simulation. Study revealed that PP and PVC NPs were dissolved immediately upon adsorption of lung surfactant onto their surfaces, which implicates their increased bioavailability and thereby toxicity. However, PE, PET, and PS NPs remained stable in the system. Another study attempted to correlate the presence of microplastics in lungs with etiology of pulmonary ground glass nodules (GGNs), which are the manifestations of malignant / benign lesions. Comparatively higher amount of

microfibers were reported in lung tissue samples with GGNs, than in the normal lung tissues; which develops a possibility that microplastics may be an inducing factor for the development of GGNs in lungs. However, further research is warranted to establish this fact.

4.3 Circulatory system

An *in-vitro* study over the human peripheral blood lymphocytes conducted by Cobanoglu *et al.* have shown that presence of PE microplastic particles in human blood might lead to genotoxic and cytotoxic impacts. The particle size studied ranged from 10 μm to 45 μm . The study found that even small concentration of microplastics *viz.* 25 – 50 $\mu\text{g/mL}$ might lead to genomic instability. It indicates that there is the possibility of chronic impacts owing to continued exposure to microplastics. Another study has shown that proteins present in the human blood plasma have strong affinity towards the nanoplastics and it resulted in the multi-layered corona. These coronated plastic particles attract other nanoplastics through protein-protein attraction, which finally results in coalescence in nanoplastics. This interaction, ultimately, resulted in the conformational changes and denaturation of proteins turning them as bio-incompatible. Thus, these coronated nanoplastics have the possibility to induce genotoxic and cytotoxic impacts in the human blood cells. These studies help to understand that presence of micro- / nanoplastics inside the human body may cause long-term impacts.

4.4 Excretory system

Similar to digestive and respiratory system, *in-vitro* studies have also been carried out in human excretory system. To our knowledge, the first study on uptake of PS nanoparticles (44 nm) in human renal cortical epithelial (HRCE) cells was reported by Monti *et al.*; however, this study was intended to get insights over biocompatibility and endocytosis pathways of PS-NPs in order to explore the targeted drug delivery. This study revealed that PS-NPs are uptaken by HRCE cells with no toxic effects on cell cycle progression / cell viability. Later, human kidney proximal tubular epithelial cells (HK-2) were studied for the effects upon exposure to PS-MPs. Exposure led to uptake of PS-MPs by the HK-2 cells, which further resulted in increased mitochondrial ROS, stress in endoplasmic reticulum, and elevated markers of inflammation. Human embryonic kidney cells (HEK 293) and human hepatocellular liver cells (Hep G2) were also exposed to PS-MPs of 1 μm size. Considerable effect on cell viability was not seen as approximately 94% cells remained viable even after exposure to 100 $\mu\text{g/mL}$ of PS-MPs; however, cell proliferation was negatively affected. Minimal effect on cell viability owing to exposure of PS-MPs was also confirmed in HK-2

cells, where concentration up to 300 µg/mL was used. Noteworthy findings of this study were internalization of PS-MPs inside the cells, change in morphological structure, and decline in net metabolic activity of exposed kidney and liver cells within a 24-72 h time frame. Such changes in exposed cells indicate that microplastics do cause alterations in the cellular activities, which upon continued exposure may hinder cells from performing their regular functions leading to anomalous growth and development. Chen *et al.* also used HEK 293 cells to investigate the association of nephrotoxicity with PS-MPs of 3.54 µm (3 – 300 ng/mL). Contrary to Goodman *et al.*, this study found reduction in cell viability of HEK 293 cells exposed to 30 and 300 ng/mL for 24 h. Apart from internalization of MPs and change in morphological structure, this study also provided evidence for apoptosis and autophagy in the exposed cells. It further showed that PS-MPs can induce inflammatory responses, damage the protective renal barrier, and induce nephrotoxicity even at low concentration of 3 ng/mL.

4.5 Reproductive system

Researches on the human reproductive systems are very few and most of the studies published on the impacts of microplastics are based on mice/rat or other animal models. Enyoh *et al.* employed density functional theory and artificial neural network to understand the toxic effects of 10 types of nanoplastic particles, *viz.* PC, PET, PS, PVC, PU, PMMA, PE, PA, PP, and polychloropene (PCP) on the human placenta. The highest toxic effects on the metabolic and excretory functions of placenta were found to be due to PC, PET, and PS NPs, owing to inhibition of key enzymes. Contino *et al.* attempted to estimate the effect of PS-NPs, having size of 50 nm and 100 nm, on the metabolic activities of human spermatozoa. In this study, semen samples were collected and a total of six samples were exposed to 50 nm and 100 nm PS-NPs (3 samples to each size of NPs). The motility, membrane integrity, acrosome damage, DNA fragmentation, male infertility oxidative system analysis, ROS production, HSP70s expression, and mitochondrial activity were studied in the exposed spermatozoa. Findings indicate that in most of the cases, 50 nm PS particles at concentration of 1 µg/mL posed negative impact on the spermatozoa. Moreover, increase in ROS was observed due to the presence of both 50 nm and 100 nm particles.

4.6 Endocrinology system

There are very few studies on direct impacts of MNPs on human endocrinological system. Since, a number of chemicals / plasticizers / additives are inevitable components of the plastics, many studies have discussed the effects of these components on human. One of

the studies investigated the impact of leached particles of virgin, recycled, and unrecycled polyvinyl chloride on reporter gene assays through *in-vitro* study. Here, leaching was done under the environmentally relevant conditions in order to simulate ambient environmental leaching. The effects were studied on the human breast cancer cell lines, *viz.* MDA-kb2 with endogenous androgen receptors (AR) and glucocorticoid receptors (GR); and T47D-KBluc with endogenous oestrogen receptors (ER). Study found that AR and GR were not activated upon exposure to different types of leachates of polyvinyl chloride; however, indication of competition for binding to ER was noticed. An interesting finding was the higher toxicity of polyvinyl chloride, which was leached for 24 and 48 hours as compared to that leached for 96 hour.

Some other studies indicated towards the impact of microplastics and associated additives on the disruption of endocrine functions. In order to reduce adverse health outcomes of BPA; analogues such as bisphenol S (BPS) and bisphenol F (BPF) are now used in plastic manufacturing. However, these analogues have also been found to disrupt endocrine functions leading to activation of peroxisome proliferator-activated receptor γ (PPAR γ). Polybrominated diphenyl ether (PBDE) is another additive, which is often used in variety of plastic products as flame retardant. Upon exposure to microplastic particles having PBDEs, these additives may accumulate in blood, breast milk, and fat tissues. These have been shown to affect endocrinological system, especially, estrogen and thyroid hormones. Impact on thyroid hormones might be the reason that children exposed to higher concentration of PBDEs during their birth were found to score less in the mental and physical development tests. Saradha and Mathur have also documented that microplastics having persistent organic pollutants and endocrine disrupting chemicals cause thyroid dysfunction along with the metabolic and developmental abnormalities.

5. Micro/nanoplastics as carrier of contaminants

The micro/nanoplastics are not only harmful per se, but act as source and sink for many other contaminants as well. Micro/nanoplastics themselves act as source of various chemicals, additives, and pigments which are added during the manufacturing process of the plastics. Further, these particles also adsorb variety of inorganic and organic contaminants such as persistent organic pollutants, metals/metalloids, pesticides, pharmaceuticals, microorganisms *etc.* and hence also act as the sink. Several authors have reported that micro/nanoplastics act as an important carrier for transportation of heavy metals, particulate

matter, persistent organic pollutants, *etc.* Moreover, the sorption depends on various factors such as, physicochemical properties of the polymer, surrounding environment, atmospheric temperature, humidity, salinity, weathering, and ageing processes *etc.* As microplastics get weathered with time due to the effect of various environmental factors, their ability to transport contaminants also gets affected which further enhances threat for the drinking water sources. Additionally, plastic debris gain more surface area upon weathering, thus generating oxygen groups that collectively affect their polarity, roughness, charge, and porosity; thereby enhancing the adsorption capacity. Surface charge, surface area, functional groups, and acid-base characteristics also influence the sorption of contaminants on the microplastics' surface.

Colonization of microorganisms over microplastics present in the aquatic system is another important aspect that has been looked into. Microplastic surfaces are known to promote the survival and growth of a wide variety of microorganisms. Various antibiotic-resistant genes as well as human pathogens have been detected on the surface of microplastic particles. The first report of microplastic colonization by microbes appeared in the 1970s, where white plastic pellets were found to be associated with diatoms and hydroids. Virsek *et al.* have reported the presence of bacterial fish pathogen *Aeromonas salmonicida* (*syn Haemophilus piscium*) on the surface of microplastics. The reason behind the attachment of microbes on the microplastics is that any solid surface present in an aquatic environment is prone to absorb a variety of nutrients that attract the microbes. Excess of nutrients over the microplastic particles acts as hotspots and it may also develop competition among the microbes to obtain it. The microbes laden microplastics when ingested by humans, have the potential to cause various health related issues such as, endocrine disruption, cytotoxicity *etc.*

The biofilm formation is also found responsible for the adsorption of metals over the microplastics' surface. It has been shown that all the metals, irrespective of space and time, do get adsorbed on the microplastics. Later it was suggested that this accumulation might be controlled by the biofilm formation, and the distribution of biofilm is similar among the variety of plastics. Therefore, it allows all types of metals to get adsorbed on most of the plastics.

5.1 Effect of environmental parameters on the contaminant transport capacity of micro/nanoplastics

Many environmental parameters affect the contaminant transport capacity of the micro/nanoplastics, such as, pH, temperature, salinity, organic matter, *etc.* (Fig. 3). pH is one

of the important factors to consider as it has been reported that high pH results in decreased sorption of some antibiotics and surfactants on the surface of metals, while decreasing pH has opposite effect. Increase in pH results in high concentration of hydroxide (OH^-) ions. Interaction of OH^- ion with the various ionic forms of the contaminant decides the sorption behaviour. The ionic strength of the medium is another important parameter that represents the charge associated with it. This property might increase or decrease the sorption depending upon the ionic strength of the medium, type of contaminant involved, as well as synergistic and/or antagonistic interaction with other parameters. The mechanism involved here is the shrinkage of the plastic polymer upon increasing the ionic strength, which causes a reduction in the pore size as well as the number of adsorption sites, thereby reducing the adsorption. Solar radiation also results in the breaking of bonds in the polymers, which increases the surface area and pore size of the microplastics, thereby allowing more adsorption of organic moieties over microplastics.

Temperature and salinity are other environmental parameters which affect the sorption of contaminants on the microplastics. The vander Waals force among the molecules is the deciding factor, as it decreases upon increasing the temperature owing to faster mobility and solubility of molecules at higher temperatures which results in enhanced sorption (Table 2). Contrary to this, it has also been seen that after a certain point, high temperature also reduces surface tension which ultimately results in low sorption of contaminants. As far as salinity is concerned, it might not affect the freshwater sources directly; however, it affects the microplastics' contaminant carrying ability in marine environment. Thus, microplastics which pass on from marine environment to surface / ground water resources through mixing, sea-water intrusion, and/or through biotic species, are of concern. It has been reported that with increasing salinity, lubricating oil gets adsorbed more on the polyethylene and polystyrene microplastics because of the ease of the outer-sphere surface complexation provided by the salts. Enhancement in the sorption capacity of contaminants over microplastics upon increasing the salinity implies that microplastics occurring in the marine environment are more prone to carry the contaminants. However, this effect varies in the case of metals. The adsorption capacity for few metals decreases with increase in salt content, while it increases for others (Table 2). It has been postulated that competition for the sorption sites on the microplastic pellets is the determining factor for sorption. Influence of salinity also results in alteration in the agglomeration behaviour of microplastics which further influences the size and area related properties.

Table 2. Environmental parameters affecting sorption of contaminants on the microplastics
(Reproduced from Singh et al. 2022)

Type of microplastic	Type of contaminant sorbed	Change in parameter	Impact on contaminant sorption on MPs	References
pH				
Polystyrene	Metalloid (Arsenic)	Increase (pH 3 → 7)	Decreased	Dong et al. 2020b
Polyethylene	Pesticides (Carbendazim, Difterex)	Increase (pH 2 → 6)	Decreased	Wang et al. 2020a
	Pesticides (Malathion)	Increase (pH 2 → 3)	Increased	
	Pesticides (Diflubenzuron, Difenconazole)	Increase (pH 2 → 6)	Increased	
Polytetrafluoroethylene	Metalloid (Arsenic)	Increase (pH 3 → 7)	Decreased	Dong et al. 2019
Polystyrene	Broad spectrum antimicrobial and endocrine disrupting chemical (Triclosan)	Increase (pH 3 → 6)	Increased	Li et al. 2019
		Increase (pH 6 → 12)	Decreased	
Polystyrene, Polyvinylchloride	Antibiotic (Tylosin)	Increase (pH 3 → 7)	Decreased	Guo et al. 2018
Polyethylene, Polypropylene,	Antibiotic (Tetracycline)	Increase	Increased	Xu et al. 2018 b

Type of microplastic	Type of contaminant sorbed	Change in parameter	Impact on contaminant sorption on MPs	References
Polystyrene		(pH 2 → 6)		
Polyethylene	Antibiotic (Sulfamethoxazole)	Increase (pH 2 → 12)	Increased (slightly)	Xu et al. 2018 c
Polyethylene, Polystyrene	Lubrication oil	Increase (pH 1 → 10)	Independent of pH	Hu et al. 2017
Polyethylene (virgin and beached)	Metals (Ag, Cd, Co, Ni, Pb, Zn)	Increase (pH 4 → 10)	Increased	Turner and Holmes 2015
	Metal (Cr)		Decreased	
	Metal (Cu, Hg)		Unclear	
Polyethylene, Polystyrene	Surfactant (Perfluorooctanesulfonic acid)	Decreasing	Increased	Wang et al. 2015
High density polyethylene	Metals (Cd, Co, Ni, Pb)	Increasing	Increased	Holmes et al. 2014
	Metals (Cr)		Decreased	
Ionic Strength				
Polystyrene	Polycyclic hydrocarbons (Naphthalene)	Up to 0.5 mM	Increased	Hu et al. 2020
		5 mM – 50 mM	Decreased	
Polystyrene	Metalloid (Arsenic)	Increased	Decreased	Dong et al. 2020b
Polyethylene	Pesticides (Carbendazim, Dipterex, Malathion, Diflubenzuron, Difenconazole)	Increased	Increased	Wang et al. 2020a
Polytetrafluoroethylene	Metalloid (Arsenic)	Increase (0 M → 1 M)	Decreased	Dong et al. 2019
Polystyrene	Antibiotic (Oxytetracycline)	Increased	Decreased	Zhang et al. 2018
Polystyrene,	Antibiotic (Tylosin)	Increase	Increased	Guo et al. 2018

Type of microplastic	Type of contaminant sorbed	Change in parameter	Impact on contaminant sorption on MPs	References
Polyvinylchloride, Polypropylene, Polyethylene		(0 M → 0.1 M) Increase (> 0.1 M)	Decreased	
Salinity				
Polyethylene, Polystyrene, Polypropylene, Polyamide, Polyvinylchloride	Antibiotics (Ciprofloxacin, Amoxicillin)	Presence of salt	Decreased	Liu et al. 2019; Li et al. 2018a
Polyethylene	Antibiotic (Sulfamethoxazole)	Increase (0.05% → 3.5%)	Independent of salinity	Xu et al. 2018 c
Polypropylene	Brominated flame retardants (Tris-(2,3-dibromopropyl) isocyanurate (TBC) and Hexabromocyclododecanes (HBCDs))	Increase (0.05% → 14%) Increase (14% → 21%)	Increased Decreased	Liu et al. 2018
Polyethylene, Polystyrene	Lubrication oil	Increase (0.001 → 0.1 mol/L)	Increased	Hu et al. 2017
Polyethylene, Polyvinylchloride	Pesticide (DDT)	Presence of salt	Decreased	Bakir et al. 2014
High density polyethylene	Metals (Cd, Co, Ni)		Decreased	
	Metals (Cr)	Increasing	Increased	Holmes et al. 2014
	Metals (Cu, Pb)		Independent of Salinity	
Temperature				

Type of microplastic	Type of contaminant sorbed	Change in parameter	Impact on contaminant sorption on MPs	References
Polystyrene	Broad spectrum antimicrobial and endocrine disrupting chemical (Triclosan)	Increase (15°C → 45°C)	No effect	Li et al. 2019
Polytetrafluoroethylene	Metalloid (Arsenic)	Increase (15°C → 35°C)	Decreased	Dong et al. 2019
Polypropylene	Brominated flame retardants (Tris-(2,3-dibromopropyl) isocyanurate (TBC) and Hexabromocyclododecanes (HBCDs))	Increase (5°C → 15°C)	Increased	Liu et al. 2018
		Increase (15°C → 45°C)	Decreased	
Dissolved Organic Matter (DOM)				
Polyethylene, Polypropylene, Polystyrene	Antibiotic (Tetracycline)	Addition of DOM (fulvic acid)	Decreased	Xu et al. 2018 b
Polyethylene	Antibiotic (Sulfamethoxazole)	Addition of DOM (0 → 20 mg/L)	No significant effect	Xu et al. 2018 c
Polyethylene	Pharmaceuticals and personal care products (Carbamazepine, triclosan, 17 α -ethinyl estradiol)	Addition of DOM	Decreased	Wu et al. 2016

Wu *et al.* studied the transport of some personal care products and pharmaceuticals through polyethylene. It was found that the presence of dissolved organic matter significantly reduces the sorption capacity of microplastics for these contaminants (Table 2). It happens because of the competition between organic matter and contaminants to get the sorption sites on microplastics. Moreover, there is also a possibility of the sorption of contaminants over the organic matter. In such a scenario, adsorption of contaminant laden organic material over the microplastics may pose further risk. Nevertheless, some environmental factors help in reducing the sorption of organic compounds over microplastics. For example, interaction of microplastic particles with oxygen enhances the surface polarity in particles which reduces the adsorption of organic moieties. Similarly, weathering processes result in increased crystallinity of microplastic particles thereby helping in reducing the adsorption.

Environmental factors not only play a significant role in the transfer of chemical contaminants through microplastics; rather colonization of microbial communities over the surface of microplastics is also affected considerably by the changes in environmental parameters. One of the reasons is that plastic surfaces are comparatively more stable than other natural materials and hence provide a stable base to microbes. Further, biogeography and seasonal variation in temperature and/or salinity have an important role in deciding the type of communities colonizing over the microplastics. A summarized list of various environmental parameters affecting the sorption of contaminants over microplastics is shown in Table 2.

5.2 Effect of physico-chemical properties of micro/nanoplastics on their contaminant transport capacity

Physico-chemical properties of micro/nanoplastics such as chemical composition, crystal structure, size, colour, density, *etc.* have a profound impact on their contaminant transport ability (Table 3). In general, microplastics possess higher sorption capacity for hydrophobic contaminants. Hydrophobic contaminants are usually lipophilic, and hence tend to sorb more on the microplastics, compared to the hydrophilic contaminants. Specifically, these are found to dominate for sorption onto the polyethylene, polystyrene, and polyvinylchloride. Polyaromatic hydrocarbons (PAHs) are the typical hydrophobic pollutants in the environment. Strong interaction between PAHs and micro- or nanoscale plastics has been evidenced in aquatic environment. Hydrophobic interaction also plays an important role in the sorption behaviour of polychlorinated biphenyls (PCBs) such as diaclor, diconal,

educare *etc.* over the microplastics. It has been shown that the sorption of PCBs on polyethylene plastic films was significantly higher than that of polystyrene and polyvinyl chloride. Later, these chemical laden microplastics may get transferred to aquatic biota and further into the food chain through ingestion, sorption, and/or respiration. Therefore, it is important to understand the interaction behaviour of microplastics as well as contaminants. The sorption isotherms of various microplastics provide insights into their sorption behaviour. Sorption isotherms of polyethylene were found to be highly linear, which indicated that the sorption behaviour tended towards sorption into the bulk polymer. However, the sorption isotherms of polystyrene were nonlinear and $\pi - \pi$ interaction played a crucial role in the adsorption. The sorption isotherms of perfluorooctanesulfonic acid and perfluorooctanesulfonamide on the three different types of microplastics, *viz.* polyethylene, polystyrene, and polyvinylchloride, were highly linear, which revealed that the dominant interaction process was partitioning rather than hydrophobicity.

The porous and non-porous nature of microplastics is also important to determine its interaction with the contaminants. Some microplastics are non-porous (such as polyethylene) while others may be meso-porous (such as polystyrene). The non-porous nature of polyethylene results in higher sorption capability for hydrophobic organic compounds. On the other hand, the high sorption affinity of polystyrene for PAHs is attributed to the amorphous structure. Similarly, it has also been reported that crystalline structure of microplastics reduces the adsorption of contaminants. The reason, crystalline structures resist adsorption while amorphous structures favour it, lies in the fact that it takes huge amounts of energy to destabilize the well oriented polymer chains of crystalline structures. Similarly, the surface polarity of microplastics is another property that has an influence. The strength of interaction of the contaminants with the microplastics can be determined by the surface polarity of the microplastics, such as hydrophobic organic contaminants adhere more to the non-polar surfaces and *vice-versa*. Further, high surface area and small size can also enhance the adsorption capacity owing to more availability of active sites for adsorption.

Table 3. Physico-chemical properties of microplastics affecting contaminant transport
(Reproduced from Singh et al. 2022)

Type of microplastic	Type of contaminants sorbed	Change in parameter	Impact on contaminant sorption on MNPs	References
Particle size				
Polystyrene	Broad spectrum antimicrobial and endocrine disrupting chemical (Triclosan)	Decrease	Increased	Li et al. 2019; Wang et al. 2018;
Polypropylene	Brominated flame retardants (Tris-(2,3-dibromopropyl) isocyanurate (TBC) and Hexabromocyclododecanes (HBCDs))	Decrease	Increased	Liu et al. 2018
Polypropylene	Fungicide (Difenoconazole)	Decrease	Increased	Goedecke et al. 2017
Ageing				
Polypropylene	Broad spectrum antimicrobial and endocrine disrupting chemical (Triclosan)	Increase	Increased	Wu et al. 2020
Polypropylene	Benzene, toluene, ethylbenzene, and xylene (BTEX)	Increase	Independent of ageing	Muller et al. 2018
Polystyrene	BTEX	Increase	Decreased	
Polypropylene	Fungicide (Difenoconazole)	Increase	Increased	Goedecke et al. 2017
Resin pellets (along beaches)	Pesticide (DDT)	Increase	Increased	Antunes et al. 2013
Polypropylene	Polyaromatic hydrocarbon (Phenanthrene)	Increase	Increased	Karapanagioti and Klontza 2008
Colour				

Type of microplastic	Type of contaminants sorbed	Change in parameter	Impact on contaminant sorption on MNPs	References
Microplastics	Polychlorinated biphenyls, Polyaromatic hydrocarbons	Black or any dark colour	Increased	Frias et al. 2013; Antunes et al. 2013
Density				
Microplastics	Chemicals	Low density	Increased	Lee et al. 2018;
		High density	Decreased	Fries and Zarfl 2012; Karapanagioti and Klontza 2008

The density of the microplastics influences sorption behaviour as well. The sorption process can be evaluated in terms of diffusion coefficients. Higher diffusion coefficient results in more sorption and *vice-versa*. It has been demonstrated in a study that pollutants have low diffusion coefficients in high-density polyethylene while high diffusion coefficient in low-density polyethylene, resulting in higher sorption of contaminants over low-density polyethylene compared to high-density polyethylene. This is so because high-density polyethylene has minimal branching as compared to low-density polyethylene making it more rigid and less permeable leading to low diffusion of contaminants. It is also reported that dark coloured microplastic particles tend to sorb more contaminants compared to their uncoloured counterparts. This is because of the fact that dark coloured microplastics contain higher amount of additives, such as polyurethane, which promote sorption. Cellular membrane like structure of these additives helps the contaminating molecules to penetrate deeper inside the polymeric substance, thus making it possible for them to be carried away along with the microplastics.

Ageing is another important parameter that affects the contaminant transport ability of the microplastics (Table 3). Ageing of the microplastics results in various oxidation processes that alter the composition as well as the structure of the particles in terms of crystal structure, size, exposed surface area, *etc.* Sorption isotherms of various contaminants over microplastic particles have shown that crystal structure gets disturbed upon ageing, resulting in a more non-crystalline domain, which requires very low energy to disturb the polymer chain to adsorb the contaminants. The hydrogen bond among oxygen-containing functional groups is an important interaction, which could be generated on the surface of microplastics during the ageing process; hence, the sorption capacity of aged microplastics is found to be significantly higher than that of the virgin material. It has also been shown that aged fragments accumulate metals to a greater extent without reaching equilibrium, while virgin plastics attain equilibrium at a faster rate, thus accumulating less. Overall, ageing has been found to enhance the contaminant transport capacity of the microplastics. In contradiction to this, Muller et al. reported that ageing does not play any role in the sorption process of polypropylene (semi-crystalline), while in case of polystyrene (amorphous) ageing results in low sorption of BTEX (benzene, toluene, ethylbenzene, and xylene). The reason for low sorption of BTEX onto the aged polystyrene is reported to be the formation of an oxidized surface layer which increases surface polarity and thus, reduces the sorption of non-polar BTEX. Therefore, different microplastics may behave differently upon ageing, and chemical

composition of the contaminants as well as that of the microplastics themselves, play an important role in this.

6. Framework for microplastics' toxicity assessment

Ongoing researches have shown that microplastics do have potential to affect human health in various ways. Nevertheless, toxicity potential depends upon various properties of microplastic particles, such as, size, shape, colour, chemical composition, presence of additives / chemicals, crystallinity, surface roughness, aging *etc.* In order to estimate the toxicity potential of microplastics, Agathokleous *et al.* proposed that 'dose' of the microplastic is one of the most important factors to consider. The default linear-no-threshold model (*viz.* negative effects increase linearly starting from a zero dose) generally considered for estimating microplastics' risks is not suitable as evidences suggest that it is the 'dose of microplastics' and 'susceptibility of the particular organism', which determine the impact that microplastics may pose. Moreover, hormetic dose-response relationship has also been seen in many instances where opposite effects were observed between high (beyond threshold) and low (below threshold) doses, also known as biphasic dose-response relationship. For example, the dose of microplastic (single stress) that induced negative effects on an organism; showed positive effects upon exposure of organism to multiple stressors. It might be due to the fact that microplastics trap other contaminants making them less available to the organism thus reducing their impacts. However, there are several inconsistencies on this aspect among researchers as some found virgin microplastics non-toxic and toxic impacts only due to the adsorbed contaminants; while others found that toxicity is majorly due to the plastic particles rather than the dissolved fraction of the contaminants. Here it is important to mention that dose-response studies have mostly been carried out in the aquatic organisms and plants; while human studies are lacking. Therefore, extensive research in this area is essential.

7. Conclusion and scope for future work

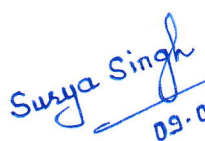
This report summarized the ongoing researches related to microplastics' presence in human body. Focus was given onto collating the information regarding occurrence of micro/nanoplastic particles in various organs, biological fluids, and other body parts of human. Physiological impacts of these particles have also been seen and it was found that MNPs are capable to pose cytotoxic and genotoxic effects.

Research in the field of micro/nanoplastics is evolving and being carried out globally by various researchers on different aspects; however, there are certain areas where

comparatively more focus needs to be given. Undoubtedly it is important to quantify, characterize, and document the presence of micro/nanoplastics in varied environmental matrices and human body; but it is equally important to study the physiological impacts of these particles on human body. This might involve *in-vitro* / *in-vivo* studies based on cytotoxicity and/or genotoxicity. Moreover, establishing a standard methodology for the quantification and detection of micro/nanoplastics is also essential. Key areas that require attention are given in the following points:

- a. Micro/nanoplastic particles vary widely in chemical composition; therefore, human health studies need to be carried out involving different types of particles. Studies based on any single type of chemical composition cannot provide information about the others, as generalizations cannot be made based on the information of only one type of particle.
- b. Size and shape of micro/nanoplastic particles are also important as it influence the extent of invasion into the human tissues. Therefore, consideration of morphological characteristics of the particles for human health studies is essential. Moreover, studies on nanoplastics (particles < 1 μm) which are more prone to invade deeper into the human tissues are lacking owing to requirement of significantly advanced level of instrumentation and infrastructural facilities.
- c. Effects of virgin and aged particles are need to be investigated, as change in composition with aging and exposure to various environmental conditions are expected.
- d. Determination of the toxicity potential of micro/nanoplastics along with various contaminants is another important aspect to look into.
- e. Micro/nanoplastics' dose response and toxicity-exposure assessment studies are currently lacking because these particles are expected to pose considerably long-term impacts. Nevertheless, there is no standard protocol to carry out such studies.

As one of the emerging contaminants, research on micro/nanoplastics' is crucial due to significant gaps in understanding the cause-effect relationship.


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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

Item No. 03

Court No. 2

**BEFORE THE 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”

Date of hearing: 31.01.2024

**CORAM: HON’BLE MR. JUSTICE SUDHIR AGARWAL, JUDICIAL MEMBER
HON’BLE DR. A. SENTHIL VEL, EXPERT MEMBER**

Respondent: Mr. Paritosh Anil, Advocate with Dr. Amit Love, Additional Director, MoEF
& CC (Through VC)

ORDER

1. The proceedings in this Original Application (hereinafter referred to as ‘**OA**’) were initiated *suo-moto*, taking note of a news item titled “Detecting microplastics in human blood” published in daily newspaper ‘The Hindu’ dated 29.03.2022. The media report said that in absence of enforcement of environmental norms with regard to detection of microplastics in human blood, small particles of plastic enters blood cells of human through food and have adverse health impact on the people.

2. The matter was examined by Tribunal on 05.04.2022. It was observed that strict compliance of environmental norms for protecting the people from adverse health impact due to presence of microplastics in blood cells is necessary and it is also pertinent to have a study to be conducted whether the existing policies of enforcement of environmental norms need to be re-visited so as to protect people from health hazards due to the above problem. Tribunal also referred to the proceedings in Southern Zone Bench of Tribunal at Chennai, wherein *suo-moto* cognizance was taken on similar matters in **OA 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 titled as ‘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 analyzing microplastics in ground water in the context of landfill leachate and analysis through National Centre for Sustainable Coastal Management, (hereinafter referred to as ‘NCSCM’), Chennai.

3. To avoid conflicting orders, the said matters were transferred to Principal Bench of this Tribunal for being dealt alongwith the present matter. The titles of the said matters were 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. Tribunal also found that a further study is required for which a Committee was constituted comprising CPCB, Indian Council of Medical Research (hereinafter referred to as ‘ICMR’), Central Institute of Petrochemicals Engineering and Technology (hereinafter referred to as ‘CIPET’) and NCSCM and any other expert institutions as required under nodal co-ordination of CPCB.

5. Pursuant to order dated 05.04.2022, a Report dated 13.02.2023 was filed by CPCB. The report acknowledges that Microplastics both

primary and secondary, pollute drinking water sources primarily through discharge of sewage/waste water treatment plant effluent and surface runoff. As sewage/waste water treatment plants are not equipped for the complete removal of Microplastics, effluent released from these plants contains substantial quantity of Microplastics. Upon mixing of this effluent with fresh water sources, Microplastics become part of fresh/drinking water supply chain. 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. These further contribute towards Microplastics generation in the water they carry. Treated bottled water is also reported to contain Microplastics. In air, suspended Microplastics 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. Soil can get affected from plastics through various means such as plastic mulch films, municipal waste, sewage sludge, fertilizers coated with plastics. A significant positive correlation has been seen between the rate of sludge applied onto the soil and concentration of Microplastics particles in the soil. Microplastics concentrations have been detected in the air at dumpsites in India. Microplastics is also being reported in human saliva, blood, placenta, colon, stool and lungs.

6. CPCB Report dated 13.02.2023 was considered by Tribunal on 01.03.2023. The conclusion recorded in the Report were noticed in para 4 of the order are as under:

“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 uniformly 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, doseresponse 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 conducted 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***
22. **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

- 23. *End-of-pipe interventions, wastewater, stormwater, and road runoff management and treatment, to retain the emitted microplastics before these reach water bodies.***
- 24. *Maximizing clean drinking water supply to all citizens in the country***
- 25. *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***
- 26. *Training and capacity building including microplastic monitoring, analysis, health impact studies may be taken up for effective implementation of aforementioned points.***

7. Tribunal found that Report is based on scientific basis and can be acted upon subject to objections, if any. Report showed clear potential of particulates of Microplastics entering blood cells of human beings which can have adverse health impact. There was need for further remedial action for enforcing ‘Sustainable Development’ and ‘Precautionary Principle’ by way of preventive and remedial measures to utilize anticipated harm to environment and public health pending further scientific investigations for laying down standards, as suggested in the Report.

8. This Tribunal in para 8 referred to the observations made by Supreme Court in ***Vellore Citizens’ Welfare Forum vs. Union of India,***

(1996) 5 SCC 647 and, thereafter, issued further directions in para 9 of the order, as under:

“9. Thus, while proposed studies may be undertaken expeditiously and completed at the earliest, interventions need to be immediately introduced as short-term measures in future designing and manufacturing of products which are potential threat for generating MP like Textiles, Tyres, and Complementary Products (laundry detergents, road surfaces, and vehicles), manufacture and sale of certain personal care and cosmetic products containing MP, household, commercial, or industrial washing machines. Such other measures as may be identified may also be taken. For this purpose, the concerned Ministries need to consider the above report of CPCB and subject to any objections to the report which may be raised before the Tribunal, interventions may be introduced at the earliest, preferably within four months from today by the Secretary, MoEF&CC in consultation with CPCB, ICMR, Central Institute of Petrochemicals Engineering & Technology (CIPET), NCSCM, and any other expert institutions as required.”

9. Pursuant to above order, Ministry of Environment, Forest and Climate Change (hereinafter referred to as **‘MoEF&CC’**) has filed its Report dated 21.11.2023, wherein it has referred to CPCB’s Report as also World Health Organization’s (hereinafter referred to as **‘WHO’**) Report of 2019. In para 8 of Report of MoEF&CC, issues highlighted in WHO Report have been crystalized as under:

- *Plastic polymers being insoluble, they are unlikely to be absorbed from the gastrointestinal (GI) tract and generally do not interact with biological matrices.*
- *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.*
- *Investigation of potential risks related to particles indicate that it is possible that 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 and evidence suggests that microplastics pass through the GI tract into the faeces.

- *Currently a paucity of information to quantitatively assess any potential risk associated with exposure to microplastic particles. Most toxicological tests of microplasties have focused on aquatic organisms or ecotoxicology.*
- *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.*
- *Routine monitoring of microplastics in drinking-water is not recommended at this time, as there is no evidence to indicate a human health concern.”*

10. Thereafter, conclusions which emerged from WHO Report, have been culled down in para 9 as under:

“9. *After detailed deliberations, the following emerged based on conclusions drawn in the report:*

(a) Proposed studies on human health effects of microplastics, standardization of methodology for sampling and analysis microplastics, availability of technologies for removal of microplastics and standard development.

(i) Long term studies on health effects of microplasties and ecotoxicological studies under Indian conditions need to be performed using standardized methodologies, before development of any environmental standards, as required, based upon scientific data.

(ii) Central Pollution Control Board to coordinate with the expert institutions /technical experts, if required beyond those mentioned in the pro-forma, for development of uniform methodology and availability of technologies for removal of microplastics. Central Pollution Control Board may also involve expert institutions/technical experts, beyond those mentioned in the Ministry wise pro-forma, as required.

(iii) Indian Council of Medical Research along with the Central Pollution Control Board and other relevant

institutions may initiate long-term under Indian conditions, keeping in view national and international literature available on the topic. It was noted that causal relationship between micro plastics and adverse health effects has not been shown. WHO report of 2109 has also mentioned the same.

(b) Source directed interventions

(i) The concerned Ministries/bodies, to consider source directed interventions as per pro-forma, based upon principle sustainable development and scientific evidence on micro plastic releases, and submit comments and action plans, ns appropriate. It was noted that the report does not provide data on releases of microplastics form these sectors under Indian conditions.

(c) Waste management, end-of-life interventions and other best practices

(i) The conclusions covered in the NGT order dated 1st March 2023 and the report of the Committee is to be considered by all the concerned Ministries, as per the NGT order, keeping in view ongoing initiatives.

11. In the light of the above, MoEF&CC has prepared an action plan, specifying obligations/duties/performance to be shown by different departments on various aspects and the said action plan has been filed as annexure III to the Report which reads as under:

“Ministry – wise action plan vide order dated 9th October 2023 of Hon’ble NGT in Original Application no. 251/2022 on “Detecting micro plastic in Human Blood”

S. No	Conclusions of the Report prepared by CPCB, ICMR, CIPET and NCSCM	Concerned Ministries/ Department/ Body	Action Plan/Action Taken
1.	<i>Uniform procedure for sampling & analysis may be developed by organizations involved in microplastic analysis (CIPET, NCSCM, MoES-NCCR) which can be adopted uniformly across</i>	<i>CPCB to develop uniform procedure for sampling and analysis along with Central Institute of Petrochemicals,</i>	<i>CPCB had two meetings with representatives of the concerned organizations (NCCR, CIPET, NEERI, IITR, ICMR-NIREH, NCSCM), on 9.11.2023 and 17.11.2023 pursuant to the meeting held on 26th October 2023</i>

	<i>the country till the time ISO standard is finalized.</i>	<i>Engineering & Technology (CIPET), National Centre for Sustainable Coastal Management (NCSCM) and National Centre for Coastal Research (NCCR)</i>	
2.	<i>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.</i>	<i>CPCB, CIPET/DCPC, NCSCM/MoEFCC, NCCR/MoES, CSIR- IITR and CSIR-NEERI</i>	<i>Points 2-6, 13, 14, 20</i> <ul style="list-style-type: none"> • <i>Preliminary listing of all points to be monitored.</i> • <i>Proposed SOP for monitoring</i> • <i>Compilation of technologies for microplastic removal</i> • <i>Meeting with stakeholders</i> • <i>Awarding of work</i> • <i>Execution of work</i>
3.	<i>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</i>	<i>As above</i>	<i>As above</i>
4.	<i>Source monitoring, transfer end use of all possible sources listed in Table 3.1 of the report to be covered. Emphasis to be laid on such areas for which no information is available.</i>	<i>As above</i>	<i>As above</i>
5.	<i>Regular monitoring of various water quality parameters to be conducted to provide insight into the presence and concentration of microplastics in</i>	<i>As above</i>	<i>As above</i>

	<i>environmental matrices (water, sediments, biota)</i>		
6.	<i>Microplastic leakages and pathways may be monitored in order to identify further sources and hotspots of microplastics.</i>	<i>As above</i>	<i>As above</i>
7.	<i>Uniform procedure for sampling & analysis as finalized by this Committee may be adopted for such studies till the time ISO Standards are finalized.</i>	<i>CPCB, CIPET/DCPC, NCSCM/ MoEFCC, NCCR/MoES, CSIR- IITR and CSIR-NEERI</i>	<i>Covered in 1</i>
8.	<i>Health impact of emerging contaminants and long term studies are required to establish Cause effect relationship of microplastics on human health</i>	<i>Nodal agency Indian Council of Medical Research- National Institute of Environmental Health Research /DHR, CPCB, CIPET/DCPC, NCSCM/ MoEFCC, NCCR/MoES</i>	<i>a compilation of studies on presence of microplastics/ emerging contaminants in human body will be made for chalking out the methodology/ scope of work with respect to studying cause effect relationship for physiological impacts, dose- response assessment etc.</i>
9.	<i>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.</i>	<i>As above</i>	<i>As above</i>
10.	<i>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:</i> <i>• Estimation of the</i>	<i>As above</i>	<i>As above</i>

	<p><i>duration and frequency of human exposure to microplastics. Microplastic monitoring as required may be conducted for the same.</i></p> <ul style="list-style-type: none"> • <i>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.</i> 		
11.	<p><i>Bioassays may be conducted to assess the Eco-toxicological impact of micro plastics on animal life.</i></p>	<p>CPCB, CSIR-IITR, CSIR-NEERI</p>	<p><i>Bioassays to assess CSIR IITR provided list of already available bioassays which can be used to assess the Eco-toxicological impact of micro plastics on animal life on payment basis:</i></p> <ol style="list-style-type: none"> <i>1.Daphnia sp. Acute Immobilisation test (OECD TG 202)</i> <i>2.Fish, Acute Toxicity Test (OECD TG 203)</i> <i>3.Earthworm, Acute Toxicity Test (OECD TG 207)</i> <i>4. Daphnia magna Reproduction Test (OECD TG 211) –</i> <i>5. Earthworm Reproduction Test (OECD TG 222)</i> <i>6. Fish early life stage toxicity test (OECD TG 210)</i> <i>7. Freshwater Alga and Cyanobacteria, Growth Inhibition Test (OECD TG 201) –</i> <i>8. Avian Acute Oral Toxicity Test (OECD TG 223)</i> <i>9. Avian Acute dietary Toxicity Test (OECD TG 205)</i>
12.	<p><i>Standards development</i></p>	<p>CPCB,</p>	<p><i>Post completion of activities</i></p>

	<i>(Source & ambient) for microplastics may be taken up following establishment of the cause-effect relationship of microplastics on human health</i>	<i>ICMR/DHR</i>	<i>listed in item 2 to 11</i>
13.	<i>Available technologies to be assessed for their efficacy for removal of microplastic</i>	<i>CPCB, CIPET/DCPC, NCSCM/ MoEFCC, NCCR/MoES, CSIR- IITR and CSIR-NEERI</i>	<i>Points 2-6, 13, 14, 26</i> <ul style="list-style-type: none"> • <i>Preliminary listing of all points to be monitored.</i> • <i>Proposed SOP for monitoring</i> • <i>Compilation of technologies for microplastic removal</i> • <i>Meeting with stakeholders</i> • <i>Awarding of work</i> • <i>Execution of work</i>
14.	<i>Technologies to be developed for removal of micro plastics from Air & Soil</i>	<i>As above</i>	<i>As above</i>
15.	<i>Source-directed interventions,</i> <i>Sustainable design and manufacturing of textiles, tyres, and complementary products (laundry detergents, road surfaces, and vehicles), to minimize the tendency of products to contribute to microplastics generation;</i>	<ul style="list-style-type: none"> • <i>Ministry of Textiles,</i> • <i>Department of Promotion and Industry and Internal Trade,</i> • <i>Ministry of Heavy Industries,</i> • <i>Ministry of Road Transport and Highways, Department of Chemicals and Petro-Chemicals</i> 	<i>The concerned Ministries/bodies, to consider source directed interventions as per pro-forma, based upon principle sustainable development and scientific evidence on micro plastic releases, and submit comments and action plans, as appropriate. It was noted that the report does not provide data on releases of microplastics form these sectors under Indian conditions.</i>
16.	<i>Restrictions on microplastics in the manufacture and sale of certain personal care and</i>	<ul style="list-style-type: none"> • <i>CDSCO/ Department of Health and Family Welfare</i> 	<i>As per information provided by Drug Controller General (India). the Restrictions on the use of microplastics in</i>

	cosmetic products containing microplastics	<ul style="list-style-type: none"> Department of Pharmaceuticals 	the manufacture and sale of certain personal care and cosmetic products are available in Amendment No. 2, November 2017 (Fourth Revision) of IS 4707 Part 2, 2017 under Classification of Cosmetic Raw Materials and Adjuncts. As per S. No. 1373 of Annex-A, Plastic microbeads: 5 mm or less, water-insoluble, solid plastic particles used to exfoliate or cleanse in rinse-off personal care products are not recognized as safe for use in Cosmetics.
17.	Product requirements for household, commercial, or industrial washing machines. For instance, Australia and France have introduced measures to phase in micro fibre filters on new washing machines	Department of Promotion and Industry and Internal Trade	The concerned Ministries/bodies, to consider source directed interventions as per pro-forma, based upon principle sustainable development and scientific evidence on micro plastic releases, and submit comments and action plans, as appropriate. It was noted that the report does not provide data on releases of microplastics from these sectors under Indian conditions.
18.	<p>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;</p> <ul style="list-style-type: none"> Reducing the amount of plastic waste that enters landfills and dumpsites through the implementation of waste reduction policies and initiatives, such as wasteto-energy programs and increased recycling. Microplastics can also be 	<ul style="list-style-type: none"> Department of Drinking Water and Sanitation, Ministry of Housing and Urban Affairs, MoEFCC 	<ul style="list-style-type: none"> Already, the Ministry of Environment, Forest and Climate Change, Government of India, have taken steps for reducing pollution caused by littered and unmanaged plastic waste, along with State Governments, local bodies and Central Pollution Control Board and State Pollution Control Board and Pollution Control Committees. In order to reduce pollution caused by littered and unmanaged plastic waste, the Ministry has banned identified single use plastic

	<p><i>reduced by supporting the development and use of biodegradable plastic alternatives</i></p>		<p><i>items which have high littering potential and low utility and extended producer responsibility on plastic packaging is being implemented. Identified single use plastic items, which have low utility and high littering potential, have already been prohibited, with effect from 1st July, 2022, vide Plastic Waste Management Amendment Rules, 2021 notified on 12th August 2021.</i></p> <ul style="list-style-type: none"> • <i>The Ministry of Environment, Forest and Climate Change notified the Guidelines on Extended Producer Responsibility (EPR) for plastic packaging vide Plastic Waste Management (Amendment) Rules, 2022, on 16th February 2022. The Guidelines stipulate mandatory targets on EPR, recycling of plastic packaging waste, reuse of rigid plastic packaging and use of recycled plastic content. The guidelines provide for moving towards sustainable plastic packaging and reducing the plastic foot print. The implementation of ban on identified single use plastic items coupled with extended producer responsibility on plastic packaging will reduce pollution caused by littered and unmanaged plastic waste.</i> • <i>The single use plastic ban has triggered development of innovative eco-</i>
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		<p><i>alternatives, new business models, increase in the manufacturing capacity and uptake of eco-alternatives, at scale. Already, Startups and manufacturers are manufacturing eco-alternatives such as cutlery made bagasse and rice and wheat bran, straws made from dried coconut leaves, straws made from paper, at scale. In keeping with the development of eco-alternatives, Bureau of Indian Standard has notified Indian Standard IS 18267 for Food Serving Utensil Made from Agri By-Products. Reduction in the use of single plastic items is one of the key focus areas under Mission LiFE - Lifestyles For Environment - launched by Hon'ble PM at COP 26 of UNFCCC at Glasgow in 2021.</i></p> <ul style="list-style-type: none"> • <i>The Guidelines for Extended Producer Responsibility (EPR) on plastic packaging were notified in February 2022 for environmentally sound management of plastic packaging till end of its life by producers, importers and brandowners, who introduce the plastic packaging in the market. For ease of doing business the EPR framework is implemented through a centralized online portal.</i> • <i>The Guidelines stipulate mandatory targets on EPR, recycling of plastic packaging waste, reuse of</i>
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		<p><i>rigid plastic packaging and use of recycled plastic content. The guidelines provide steps for moving towards sustainable plastic packaging and reducing the plastic foot print. The EPR Guidelines also provide for sustainable plastic packaging and implementation of new models for waste collection such as Deposit Refund System and buy back model have been given a boost through the EPR Guidelines.</i></p> <ul style="list-style-type: none"> • <i>Due to the clear framework laid down by EPR Guidelines notified in February 2022, and on account of effective implementation, till date 31401 Producers, Importers and Brand Owners (PIBOs) and 2290 Plastic Waste Processors (PWPs) have registered on the centralized EPR portal developed by CPCB, as opposed to 300 in 2021. The cumulative EPR obligation of registered PIBOs for the year 2022-23 is around 3.07 million tonnes for the year 2022-23, which is a significant proportion of plastic waste generated in the country.</i> • <i>As per the EPR portal dashboard, EPR certificates for around 4.6 million tonnes of plastic packaging waste have been generated by plastic waste processors after processing of plastic packaging waste, of which,</i>
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		<p>already around 3.32 million tonnes of EPR certificates have been exchanged with producers, importer and brand-owners.</p> <ul style="list-style-type: none"> • The following steps have been taken to strengthen implementation of Plastic Waste Management Rules, 2016 and to implement ban on identified single use plastic items: <ul style="list-style-type: none"> (i) All thirty-six States/UTs have constituted the Special Task Force under the chairpersonship of the Chief Secretary/Administrator for elimination of identified single use plastic items and effective plastic waste management. A National Level Taskforce has also been constituted by the Ministry for taking coordinated efforts to eliminate identified single use plastic items and effective implementation of Plastic Waste Management Rules, 2016. Four meetings of the National Task Force have been held. (ii) Twenty-Four State /UT Governments and concerned Central Ministries/ Departments have already developed a comprehensive action plan for elimination of single use plastic and implement it in a time bound manner. (iii) Directions have been issued under Section 5 of the Environment (Protection) Act, 1986 for setting up of institutional mechanism for enforcement of provisions of Plastic Waste Management
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		<p>Rules, 2016 to all State Pollution Control Boards/ Pollution Control Committees. Directions have also been issued to Ecommerce companies, leading single use plastic sellers/users, and plastic raw material manufacturers with respect to phasing out of identified single use plastic items. Separately, custom authorities have been asked to stop the import of banned SUP items</p> <p>(iv) For effective monitoring of ban on identified single use plastic items and plastic waste management in the country the following online platforms are in operation (a) National Dashboard on for monitoring of comprehensive action plan implementation, (b) CPCB Monitoring Module for Compliance on Elimination of Single Use Plastic, and (c) CPCB Grievance Redressal App.</p> <p>(v) Regular enforcement drives have been undertaken by CPCB, SPCBs/PCCs to implement ban on identified single use plastic items and on plastic carry bags having thickness less than one hundred twenty microns.</p> <p>(vi) In order to provide assistance to MSME enterprises transitioning away from single use plastic items to ecoalternatives, Ministry of Micro, Small and Medium Enterprises has made provisions in their ongoing schemes. A National Expo on eco-alternatives to banned single use plastics items and Conference of</p>
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			<i>Startups - 2022 was organized jointly with Government of Tamil Nadu in Chennai on 26-27th September 2022 to raise awareness on alternatives. Awareness generation and capacity building programmes have been organized for elimination of single use plastics.</i>
19.	<i>End-of-pipe interventions, wastewater, stormwater, and road runoff management and treatment, to retain the emitted microplastics before these reach water bodies.</i>	<ul style="list-style-type: none"> • <i>Department of Water Resources, River development and Ganga Rejuvenation,</i> • <i>Department of Drinking Water and Sanitation</i> • <i>Ministry of Housing and Urban Affairs</i> 	
20.	<i>Maximizing clean drinking water supply to all citizens in the country</i>	<i>Department of Drinking Water and Sanitation</i>	<i>Central Government is implementing Jal Jeevan Mission.</i>
21.	<p><i>Other Best practices as listed below for minimizing microplastics in environment may be followed:</i></p> <p><i>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.</i></p>	<ul style="list-style-type: none"> • <i>Department of Drinking Water and Sanitation,</i> • <i>Ministry of Housing and Urban Affairs.</i> • <i>Department of Water Resources, River development</i> 	<i>MoEFCC has included the activity of putting barriers for stopping ingress of plastic waste into water bodies under the template of Comprehensive action plan shared with states and UTs for effective plastic waste management and elimination of single use plastics</i>

		and Ganga Rejuvenation,	
22.	Support sustainable fishing practices to reduce the amount of microplastic entering rivers from fishing equipment.	• Department of Fisheries	
23.	Implementation of Clean-up efforts for beaches and rivers	Ministry of Earth Science and MoEFCC, NCC	Pan India beach clean up activities have been carried out at more than 150 beaches since 2017 and to be continued through the adoption of beaches by local institutions/universities/colleges/NGOs/agencies for regular clean up and monitoring. Swachh Sagar Surakhshit Sagar and Puneet Sagar Campaign has been undertaken.
24.	Training and capacity building including microplastic monitoring, analysis, health impact studies may be taken up for effective implementation of aforementioned points.”	CPCB, DCPC/CIPET, MoEFCC/ NCSCM, MoES/NCCR	Short term and long term trainings to be implemented by NCSCM. MoES – Workshop has been planned in February 2024 to provide detailed training on sampling and analysis of microplastics to various stakeholders. Several dissertation students/research scholars have been trained in microplastic analysis. CPCB will also provide training as per training schedule.

12. We find that the Action Plan though *ex-facie* appears to be quite detailed but there is no timeline provided therein, as to how the concerned departments are required to proceed in a prescribed time frame so as to achieve objective and purpose, for which Action Plan has been prepared. Further, we do not find time-bound approach to bring out source-based and ambient standards for Microplastics and

subsequently their regulation and enforcement. Further, the Action Plan should have periodic monitoring mechanism.

13. We, for the time being, accept the above Action Plan submitted by MoEF&CC and direct that the concerned departments as given in Action Plan shall take steps for execution of the said Action Plan and would endeavor to achieve the objective within six months from today. Secretary, MoEF&CC will monitor the progress of Action Plan and resolve the inter-Ministerial issues, if any.

14. The concerned departments shall submit Progress/Compliance Report as per Action Plan with MoEF&CC within 15 days after expiry of six months from today.

15. Thereafter, MoEF&CC shall collect all the Reports, prepare a comprehensive Report and submit the Report with Registrar General of this Tribunal within next one month i.e., by 15.09.2024 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.

16. Registrar General, if finds necessary, shall place the matter before Tribunal for consideration and further orders.

17. With the above directions, this OA is disposed of.

Sudhir Agarwal, JM

Dr. A. Senthil Vel, EM

January 31, 2024
Original Application No. 251/2022
R

File No. : HSM-11/36/2022-HSM
Government of India
Ministry of Environment, Forest and Climate Change
(Hazardous Substances Management Division)

6th Floor, Jal Wing
Indira Paryavaran Bhawan,
Jorbagh Road, Aliganj
New Delhi – 110 003
Date: 6th March, 2024

OFFICE MEMORANDUM

Subject: Order of National Green Tribunal, Principal Bench in Original Application no. 251/2022 on “Detecting micro plastic in Human Blood”- Reg.

1. This has reference to Original Application No. 251 of 2022 in Re: News item published in The Hindu dated 29.03.2022 titled “Detecting microplastics in human blood”. The Hon’ble National Green Tribunal, Principal Bench, New Delhi, disposed off the matter on 31st January 2024, directing that concerned Ministries shall take steps for execution of the Action Plan given in the order and shall endeavor to achieve the objective within six months from the date of the order. The concerned Ministries/Departments shall submit Progress/Compliance Report to the MoEF&CC within 15 days after expiry of six months. Copy of the order is enclosed for ease of reference.
2. Earlier, Ministry of Environment, Forest and Climate Change had shared the draft action plan template on 20th October 2023 with the concerned Ministries/ Departments/Bodies. MoEF&CC had been following up regularly on this matter. Two review meetings were also held on 26th October 2023 and 30th January 2024. The relevant documents are enclosed for ease of reference.
3. Accordingly, it is requested that Progress report in compliance with National Green Tribunal order dated 31st January 2024, may be shared with Ministry of Environment Forest and Climate Change as per prescribed timelines i.e. by 16th August 2024. The progress in the matter will be reviewed by this Ministry periodically.

This issues with the approval of Competent Authority.



(Dr. Satyendra Kumar)
Director

Email: satyendra.kumar07@nic.in

To:
Concerned Ministries/Departments/Bodies
As per list

Copy for kind Information:

- i. PPS to Secretary (EF&CC)
- ii. PPS to AS(TK)
- iii. PPS to AS (NPG)

List

- i. The Secretary, Department for Promotion of Industry and Internal Trade, J667+H77, Rafi Ahmed Kidwai Marg Rajpath, Road Area, Central Secretariat, New Delhi, Delhi 110011, email: secy-ipp@nic.in
- ii. The Secretary, Ministry of Textiles, Technology Bhawan, New Mehrauli Road, New Delhi-110016, email: secy-textiles@nic.in
- iii. The Secretary, Department of Chemicals and Petrochemicals, Shastri Bhawan, A-Wing, Dr.Rajendra Prasad Road, New Delhi-110001, email: sec.cpc@nic.in
- iv. The Secretary, Department of Health and Family Welfare, A-Wing Nirman Bhawan, New Delhi-110001, email: secyhfw@nic.in
- v. The Secretary, Ministry of Earth Sciences, Prithvi Bhavan, Lodhi Road, New Delhi 110003, Email: secretary@moes.gov.in
- vi. The Secretary, Department of Pharmaceuticals, Ministry of Chemicals & Fertilizers, Department of Pharmaceuticals, 'B' Wing, Janpath Bhawan, New Delhi. email: secy-pharma@nic.in
- vii. The Secretary, Ministry of Road Transport and Highways, Transport Bhawan, 1, Parliament Street New Delhi-110001 email: secy-road@nic.in
- viii. The Secretary, Department of Health Research and Director General, Indian Council of Medical Research, 2nd Floor, IRCS Building, 1, Red Cross Road, New Delhi – 110001, email: secy-dhr@gov.in
- ix. The Secretary, Ministry of Heavy Industries, Government of India, Udyog Bhawan, Rafi Marg, New Delhi - 110011 New Delhi, email: shioff@nic.in
- x. The Secretary, Department of Drinking Water and Sanitation, C Wing, 4th Floor, Pandit Deendayal Antyodaya Bhawan, CGO Complex Lodhi Road, New Delhi – 110003, email: secy-mowr@nic.in
- xi. The Secretary, Ministry of Housing and Urban Affairs, Nirman Bhawan, C-Wing, Rajpath Area, Central Secretariat, New Delhi, Delhi 110011 email: secyurban@nic.in

xii. The Secretary, Department of Water Resources, River Development & Ganga Rejuvenation, Shram Shakti Bhawan, Rafi Marg, New Delhi – 110001 email: secy-mowr@nic.in

xiii. The Secretary, Department of Fisheries, Room no.- 220, Krishi Bhavan, New Delhi, Delhi 110001 email: secy-fisheries@gov.in

xiv. The Chairman, Central Pollution Control Board, Parivesh Bhawan, East Arjun Nagar, Delhi- 110032. Email: mscb.cpcb@nic.in

xv. The Director General, Central Institute of Petrochemicals Engineering & Technology, CIPET Head Office, T.V.K. Industrial Estate, Guindy, Chennai - 600 032, email: dg@cipet.gov.in

xvi. The Director, National Centre for Sustainable Coastal Management, 267M+97X, NCSCM Rd, Anna University, Kotturpuram, Chennai, Tamil Nadu 600025, email: director@ncscm.res.in

xvii. Director, National Environmental Engineering Research Institute, Nagpur, email: director@neeri.res.in;

xviii. Director, Indian Institute of Toxicological Research, Lucknow, email: director@iitrindia.org

xix. Drugs Controller General of India, Delhi. Email: dci@nic.in

No. 16(21)/2024-Coord.
Government of India
Ministry of Heavy Industries

Udyog Bhawan, New Delhi
Dated: 11th October, 2024

OFFICE MEMORANDUM

Sub: Order of the NGT Principal Bench in Original Application No. 251/2022 on "Detecting Microplastic in Human Blood" - reg.

The undersigned is directed to refer to Ministry of Environment, Forest & Climate Change's email dated 4th October, 2024 on the subject mentioned above and to state that the manufacturing of vehicles, tyres etc. does not pertain directly to the mandate of this Ministry. However, this Ministry has shared the aforesaid NGT's Order with Automobile Industry Associations for doing the needful, as deemed appropriate at their end.

2. This issues with the approval of competent authority.



(R S Meena)

Under Secretary to the Govt. of India

Ph. 011-23061045

email: rohtas.meena@nic.in

Ministry of Environment Forest & Climate Change,
(Kind Attn.: Dr. Amit Love, Scientist 'E'/ Additional Director),
New Delhi.
Email: amit.love@nic.in

Action Taken on NGT Order

DCPC's comments have been sought on points 15 and 16 of the NGT Order dated 31st January, 2024. In this regard, it is pertinent to note that the products mentioned in these points are not within the jurisdiction of DCPC but under M/o Textiles, DPIIT etc. While the comments of CIPET on the said points are being forwarded, MoEFCC is requested to take comments from the concerned Ministries/ Departments on the same.

No.	Conclusion of the Report	Comments of/ Action Taken by CIPET
15.	Source-directed interventions. Sustainable design and manufacturing of textiles, tyres, and complementary products (laundry detergents, road surfaces, and vehicles), to minimize the tendency of products to contribute to microplastics generation.	<p>One of the main sources of microplastic pollution is textiles. Microplastics derived from textiles are commonly referred to as microfibres due to their shape. While synthetic fibres are often associated with microplastic pollution, natural fibres can also shed microfibres. Various textile components such as coatings, buttons, and glitter are additional sources of microplastic pollution, contributing to the release of diverse shapes of microplastics into the environment. Annually, an estimated 0.2 to 0.5 million tonnes of microplastics are released into the world's oceans due to synthetic fabrics.</p> <p>Possible solutions:</p> <ol style="list-style-type: none"> a. Microfibre filtration – installing dedicated microfibre filters in washing machines can capture microfibres before they enter the environment. Liquid detergents are recommended vis-à-vis powdered ones, as powdered detergents increase friction and lead to greater fibre breakage. b. Textile waste management – proper collection and end-of-life treatment of textiles is crucial for preventing secondary microplastic pollution. For instance, most microplastics from textile waste are trapped in wastewater sludge. Innovative solutions, such as nutrient recovery from sludge while preventing microplastic dispersal, are needed to mitigate the environmental impact. c. Waste Management of non-wovens (technical textiles) – non-wovens comprising of spun-bonded PP-based fibers often end up as microplastics at low gsm upon aging.

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16.	Restrictions on microplastics in the manufacture and sale of certain personal care and cosmetic products containing microplastics.	<p>One of the major sources of microplastics in the aquatic environment is cosmetic products containing microbeads, which are small plastic particles added as abrasives or exfoliants. These microbeads present in most personal care and cosmetic products vary in size, colour, and chemical composition depending on the specific product and its intended use. In addition to microbeads, other types of microplastics found in personal care and cosmetic products include plastic glitters, which are often added to products for their aesthetic appeal, and plastic-based thickeners, used to improve the texture and consistency of products.</p> <p>Possible solutions:</p> <ol style="list-style-type: none"> a. Using biodegradable or natural materials as alternatives to microbeads in cosmetic products, as some countries and companies have already done, can be a proactive way to prevent marine pollution from microbeads.
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Signed by

Sudhir Kumar Tevatia

Date: 28-10-2024 16:45:12

सं० / No. 31026/26/2023-Policy
भारत सरकार / Government of India
रसायन एवं उर्वरक मंत्रालय / Ministry of Chemicals and Fertilizers
औषध विभाग / Department of Pharmaceuticals

शास्त्री भवन, नई दिल्ली
Shastri Bhawan, New Delhi
Dated the 1st July, 2024

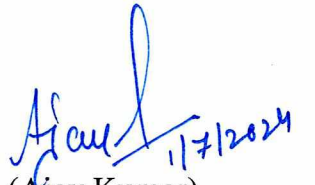
कार्यालय ज्ञापन / OFFICE MEMORANDUM

Subject:- Order of National Green Tribunal Principal Bench in Original Application no. 251/2022 on "Detecting Microplastic in Human Blood"- reg.

The undersigned is directed to refer to this Department OM of even no. dated. 10.11.2023 and M/o Environment Forest and Climate Change email dated 29.05.2024 along with NGT order dt. 31.01.2024 wherein this Department has been requested to provide Progress/Compliance Report with time line against the following action point: - *Restrictions on microplastics in the manufacture and sale of certain personal care and cosmetic products containing microplastic.*

2. In this regard, it is submitted that the above action comes under the purview of CDSCO/DoH&FW. Accordingly, inputs in this regard may be sought from CDSCO/DoH&FW.

3. This has the approval of the Competent Authority.


(Ajay Kumar)
Section Officer
Tel. No. 23385765

To

Dr. Amit Love
Scientist 'E' / Additional Director
Ministry of Environment, Forest and Climate Chang
Indira Paryavaran Bhawan
Jor Bagh Road, New Delhi-110003.
Email: amit.love@nic.in

NOTE

Subject: Meeting regarding the order of National Green Tribunal, Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood-reg.

With reference to an email dated 21.10.2023 received from Hazardous Substances Management Division, Ministry of Environment, Forest and Climate Change (MoEF & CC) with the meeting notice and the meeting was held on 26.10.2023 on the above subject. The nominated officers from CDSCO attended the meeting and explained about the provisions of the Drugs & Cosmetics Act 1940, Cosmetics Rules 2020, and Standards of Indian Standard (IS) 4707, Part 1 & Part 2.

In this regard, the Chairperson of the meeting desired that the same input in writing be submitted to the Ministry of Forest and Climate Change by email before 10.11.2023.

The following inputs from the Cosmetics Division are as follows:

Definition of Cosmetics:

As per the Drugs and Cosmetics Act 1940, Section 3 (aaa) "Cosmetic means any article intended to be rubbed, poured, sprinkled or sprayed on, or introduced into, or otherwise applied to, the human body or any part thereof for cleansing, beautifying, promoting attractiveness, or altering the appearance, and includes any article intended for use as a component of cosmetic".

Grant/Renewal of Cosmetics Manufacturing License:

As per Cosmetics Rules 2020, the Concerned State Licensing Authority grants Cosmetics Manufacturing License for the manufacture of Cosmetics.

Grant of Import Registration Certificate:

CDSCO (HQ), issues an Import registration certificate for the import of cosmetics under Cosmetics Rules, 2020.

Standards of Cosmetics:

The Import and manufacture of Cosmetics should comply with the specifications prescribed under the Ninth Schedule or any other standards of quality and safety, applicable to it, and other provisions under the rules. In case, the cosmetic is not included under the Ninth Schedule, it shall meet the requirements under these rules and specifications and standards applicable to it in the country of origin.

Indian Standard (IS) 4707:

This standard describes the Classification of Cosmetic Raw Materials and Adjuncts. There are two parts and are as follows:

Part 1: This Part specifies the colourants which are generally recognized as safe (GRAS) for use in cosmetics. The list also includes colourants which are intended for use in toiletry preparations.

Also, the list of substances excluded from the scope of the Directive is mentioned in Annex A (Clause 4.2).

Part 2: This standard specifies the list of raw materials generally not recognized as safe for use in cosmetics.

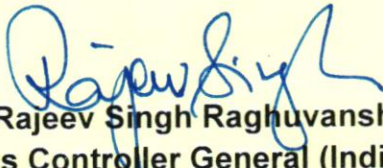
The raw materials and adjuncts prescribed in this standard have been classified as follows:

- a) Annex A — Ingredients which must not form part of the composition of cosmetic products.
- b) Annex B — Ingredients which cosmetic products must not contain except subject to restrictions and conditions laid down.
- c) Annex C — Preservatives (with restrictions) which cosmetic products may contain.
- d) Annex D — U.V. filters which cosmetic products (with restrictions) may contain.

The Restrictions on the use of microplastics in the manufacture and sale of certain personal care and cosmetic products are available in Amendment No. 2, November 2017 (Fourth Revision) of IS 4707 Part 2: 2017 under Classification of Cosmetic Raw Materials and Adjuncts.

As per S. No. 1373 of Annex- A, Plastic microbeads: 5mm or less, water-insoluble, solid plastic particles used to exfoliate or cleanse in rinse-off personal care products are not recognized as safe for use in Cosmetics.

Submitted for the kind consideration of the Ministry.


(Dr. Rajeev Singh Raghuvanshi)
Drugs Controller General (India)

F. No. P-29014/5/2024-LEI
Government of India
Ministry of Commerce & Industry
Department for Promotion of Industry and Internal Trade
(Light Engineering Industry Division)

Vanijya Bhawan, New Delhi
Date : 14th June, 2024

OFFICE MEMORANDUM

Subject : Order of National Green Tribunal Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood"-Reg.

The undersigned is directed to refer email dated 29.05.2024 from MoEFCC on the above-mentioned subject and to say that the after consultation with the Bureau of Indian Standards (BIS), comments with regards to Action Plan / Action Taken with regards to pt. No 17 on Washing Machines are as follows -.

Sl No.	Conclusions of the Report prepared by CPCB, ICMR, CIPET and NCSCM	Concerned Ministries / Department/ Body	Action taken or Action Plan
17	Product requirements for household, commercial, or industrial washing machines. For instance, Australia and France have introduced measures to phase in micro fibre filters on new washing machines	Department of Promotion and Industry and Internal Trade	<p>a) The Quality Control Order (QCO) for Electrical Appliances for domestic clothes washing, 2023 has been notified on 07.03.2024 by DPIIT.</p> <p>b) BIS has formulated Indian Standard IS 302-2-7:2024 on Safety of Household and Similar Electrical Appliances Part 2, Particular Requirements, Section 7 (Domestic Electric Clothes Washing Machines). This Indian Standard is based on the International Standard IEC 60335-2-7.</p> <p>c) As per the information obtained from the internet, the standards adopted in Australia and France are also based on IEC 60335-2-7, and do not currently include requirements related to microfiber filters. However, the governments of France and Australia have issued regulatory orders mandating that all new washing machines in France must be equipped with a microfiber filter starting from the year 2025.</p> <p>d) The requirements related to incorporation of microfiber filters in the standard is being considered in the next meeting of concerned technical committee of BIS.</p>

2. This issues with the approval of competent authority.

DK Meena
14/06/2024
(Dheeraj Kumar Meena)

Under Secretary to the Government of India
Email: dheeraj.meena17@gov.in

Dr. Amit Love
Scientist 'E' / Additional Director
Ministry of Environment, Forest and Climate Change
Email: amit.love@nic.in

F.No. 22/04/2023-SBM-II (E – 9169747)
Government of India
Ministry of Housing and Urban Affairs
SBM - Urban

Nirman Bhawan, New Delhi
Date 14th August, 2024

OFFICE MEMORANDUM

Subject: Comments on National Green Tribunal's Order dated 31.01.2024 "Detecting microplastic in Human Blood" – reg.

The undersigned is directed to refer to OM No. HSM-11/36/2022-HSM dated 06.03.2024 from Ministry of Environment, Forest and Climate Change (MoEFCC) enclosing NGT's order dated 31.01.2024 on the above mentioned subject.

2. The NGT in its order dated 31.01.2024 has mentioned about 24 action points, out of which point number 18 (related to SWM), 19 and 21 (related to UWM) have been allocated to MoHUA along with other Ministries. The comments on the points relevant to SBM Division are as under:

Point no.	Conclusions of the Report prepared by CPCB, ICMR, CIPET and NCSCM	Action plan with time line
18.	<p>End-of-life interventions, effective solid & plastic waste management practices, to prevent waste leaking into the environment and potentially contributing to micro plastics generation including the following;</p> <ul style="list-style-type: none"> 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. 	<p>Municipal solid waste management is a State subject and function of ULBs. It is the responsibility of the State Governments / ULBs to plan, design, execute and operate MSWM projects in the urban areas of the Country.</p> <p>Swachh Bharat Mission – Urban 2.0 of the Ministry aims to encourage ULBs and States to comply with and carry out their responsibilities as per the provisions of Solid Waste Management Rules, 2016 and Plastic Waste Management Rules along with amendments through Additional Central Assistance (ACA) as per the operational guidelines of SBM-U 2.0 for Municipal Solid Waste Management including to setup processing facilities like waste to electricity plants.</p>
19.	<p>End-of-pipe interventions, wastewater, storm water, and road runoff management and treatment, to retain the emitted micro plastics before these reach water bodies.</p>	<p>Municipal waste water, storm water management are State subjects and functions of ULBs. It is the responsibility of the State Governments / ULBs to plan, design, execute and operate such projects in the urban areas of</p>

21.	<p>Other Best practices as listed below for minimizing micro plastics in environment maybe followed:</p> <p>Install physical barriers such as screens and filters on STP / WWTP systems to help reduce the amount of micro plastics that enter rivers, lakes and oceans.</p>	<p>the Country. Ministry of Housing and Urban Affairs facilitates in framing broad policies, advisories and guidelines on Waste water & Storm water management and provides Additional Central Assistance (ACA) under AMRUT Mission for selected cities / towns and under Swachh Bharat Mission (Urban) 2.0 for Used Water Management in towns with less than 1 lakh population. Whether the plants established by ULBs are equipped to handle micro-plastics can be verified through pure engineering process evaluation.</p>
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14.8.2

(Binod K Yadav)

Under Secretary to the Govt. of India
Tele No. 23062565

To:
Dr. Amit Love
Scientist 'E' / Additional Director
Ministry of Environment, Forest and Climate Change

Ministry of Environment Forest and Climate Change

Sr.no.	Item No.	Actions taken
(18)	<p>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;</p> <ul style="list-style-type: none"> • 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 	<p>The Ministry of Environment, Forest and Climate Change, Government of India, have taken steps for reducing pollution caused by littered and unmanaged plastic waste, along with State Governments, local bodies and Central Pollution Control Board and State Pollution Control Board and Pollution Control Committees.</p> <ul style="list-style-type: none"> • In order to reduce pollution caused by littered and unmanaged plastic waste, the Ministry has banned identified single use plastic items which have high littering potential and low utility and extended producer responsibility on plastic packaging is being implemented. Identified single use plastic items, which have low utility and high littering

		<p>potential, have already been prohibited, with effect from 1st July, 2022, vide Plastic Waste Management Amendment Rules, 2021 notified on 12th August 2021.</p> <ul style="list-style-type: none">• The Ministry of Environment, Forest and Climate Change notified the Guidelines on Extended Producer Responsibility (EPR) for plastic packaging vide Plastic Waste Management (Amendment) Rules, 2022, on 16th February 2022. The Guidelines stipulate mandatory targets on EPR, recycling of plastic packaging waste, reuse of rigid plastic packaging and use of recycled plastic content. The guidelines provide for moving towards sustainable plastic packaging and reducing the plastic foot print. The implementation of
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		<p>ban on identified single use plastic items coupled with extended producer responsibility on plastic packaging will reduce pollution caused by littered and unmanaged plastic waste.</p> <ul style="list-style-type: none">• The Plastic Waste Management Rules, 2016, as amended, provide the statutory framework and the prescribed authorities for enforcement of the rules, including ban on identified single use plastic items, which became effective from 1st July 2022. Further, States and Union Territories have been asked to undertake regular enforcement drives to implement ban on identified single use plastic items and on plastic carry bags having thickness less than one hundred twenty microns,
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		<p>covering fruit and vegetable markets, wholesale markets, local markets, flower vendors, units manufacturing plastic carry bags etc. States and UTs have also been asked to undertake random checking at border checkpoints to stop inter-state movement of banned single use plastic items.</p> <ul style="list-style-type: none">• The single use plastic ban has triggered development of innovative eco-alternatives, new business models, increase in the manufacturing capacity and uptake of eco-alternatives, at scale. Already, Startups and manufacturers are manufacturing eco-alternatives such as cutlery made bagasse and rice and wheat bran, straws made from dried coconut leaves, straws made from paper, at scale. In
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		<p>keeping with the development of eco-alternatives, Bureau of Indian Standard has notified Indian Standard IS 18267 for Food Serving Utensil Made from Agri By-Products. Reduction in the use of single plastic items is one of the key focus areas under Mission LiFE - Lifestyles For Environment - launched by Hon'ble PM at COP 26 of UNFCCC at Glasgow in 2021.</p> <ul style="list-style-type: none">• The Guidelines for Extended Producer Responsibility (EPR) on plastic packaging were notified in February 2022 for environmentally sound management of plastic packaging till end of its life by producers, importers and brandowners, who introduce the plastic packaging in the market. For ease of doing
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		<p>business the EPR framework is implemented through a centralized online portal.</p> <ul style="list-style-type: none">• The Guidelines stipulate mandatory targets on EPR, recycling of plastic packaging waste, reuse of plastic packaging and use of recycled plastic content. The guidelines provide steps for moving towards sustainable plastic packaging and reducing the plastic foot print. The EPR Guidelines also provide for sustainable plastic packaging and implementation of new models for waste collection such as Deposit Refund System and buy back model have been given a boost through the EPR Guidelines.• Due to the clear framework laid down by EPR Guidelines notified in February 2022, and
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		<p>on account of effective implementation, till date 31401 Producers , Importers and Brand Owners (PIBOs) and 2290 Plastic Waste Processors (PWPs) have registered on the centralized EPR portal developed by CPCB, as opposed to 300 in 2021. The cumulative EPR obligation of registered PIBOs for the year 2022-23 is around 3.07 million tonnes for the year 2022-23, which is a significant proportion of plastic waste generated in the country.</p> <ul style="list-style-type: none">• As per the EPR portal dashboard, EPR certificates for around 4.6 million tonnes of plastic packaging waste have been generated by plastic waste processors after processing of plastic packaging waste, of which,
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		<p>already around 3.32 million tonnes of EPR certificates have been exchanged with producers, importer and brand-owners.</p> <ul style="list-style-type: none">• The following steps have been taken to strengthen implementation of Plastic Waste Management Rules, 2016 and to implement ban on identified single use plastic items:<ul style="list-style-type: none">(i) All thirty-six States/UTs have constituted the Special Task Force under the chairpersonship of the Chief Secretary/Administrator for elimination of identified single use plastic items and effective plastic waste management. A National Level Taskforce has also been constituted by the Ministry for taking coordinated efforts to eliminate identified single use
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		<p>plastic items and effective implementation of Plastic Waste Management Rules, 2016. Four meetings of the National Task Force have been held.</p> <p>(ii) Twenty-Four State /UT Governments and concerned Central Ministries/ Departments have already developed a comprehensive action plan for elimination of single use plastic and implement it in a time bound manner.</p> <p>(iii) Directions have been issued under Section 5 of the Environment (Protection) Act, 1986 for setting up of institutional mechanism for enforcement of provisions of Plastic Waste Management Rules, 2016 to all State Pollution Control Boards/ Pollution Control Committees. Directions have also been issued to Ecommerce companies, leading single use</p>
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		<p>plastic sellers/users, and plastic raw material manufacturers with respect to phasing out of identified single use plastic items. Separately, custom authorities have been asked to stop the import of banned SUP items.</p> <p>(iv) For effective monitoring of ban on identified single use plastic items and plastic waste management in the country the following online platforms are in operation (a) National Dashboard on for monitoring of comprehensive action plan implementation, (b) CPCB Monitoring Module for Compliance on Elimination of Single Use Plastic, and (c) CPCB Grievance Redressal App.</p> <p>(v) Regular enforcement drives have been undertaken by CPCB, SPCBs/PCCs to implement ban on identified single use plastic items</p>
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		<p>and on plastic carry bags having thickness less than one hundred twenty microns.</p> <p>(vi) In order to provide assistance to MSME enterprises transitioning away from single use plastic items to ecoalternatives, Ministry of Micro, Small and Medium Enterprises has made provisions in their ongoing schemes. A National Expo on eco-alternatives to banned single use plastics items and Conference of 2022 was organized jointly with Government of Tamil Nadu in Chennai on 26-27th September 2022 to raise awareness on alternatives. Awareness generation and capacity building programmes have been organized for elimination of single use plastics.</p>
23.	Implementation of Clean-up efforts for beaches and rivers	India's coastline of more than 7,500 km reflects our vast ocean resources. Most importantly, the

		<p>Indian Ocean is the only ocean named after a country, that is, India.</p> <p>Litter especially in the form of plastics in the marine environment are a major concern and growing international problem and a number of studies have shown their harmful impact on marine biodiversity, ecosystems, fisheries, human health and economy. Usually, wastes from land-based sources make up the major share of marine litter.</p> <p>In this context, India, being a signatory of UN "Coastal Clean Seas" campaign, a number of activities have been adopted that have direct relevance with the "Swachh Bharat" vision and has proved highly useful. These initiatives are a broad approach to support efforts to prevent pollution from both land-based and offshore activities, in line with Sustainable</p>
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		<p>Development Goal 14 and its target 14.1, which seeks, by 2025, to “prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution”. Considering the dangers of plastic waste, India has implemented a nationwide ban on single-use plastic from July 01, 2022.</p> <p>The "International Coastal Clean Up Day" is celebrated globally on the third Saturday of September, every year. This year on 17th September 2022, the Government of India along with other voluntary organizations, and the local society will run a cleanliness campaign "Swachh Sagar, Surakshit Sagar/Clean Coast Safe Sea" along India's entire coastline. Efforts will be undertaken to collect scientific data and information on Marine Litter in various matrices, such as coastal waters, sediments, biota,</p>
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		<p>and beaches.</p> <p>This campaign will include Ministry of Earth Sciences (MoES), Ministry of Environment Forest and Climate Change (MoEFCC), National Service Scheme (NSS), Indian Coast Guard, National Disaster Management Authority (NDMA) along with various departments of centre and state governments, non-government organisations and educational institutions.</p> <p>This year's event also coincides with the celebrations of Azadi Ka Amrit Mahotsav in 75th year of the country's independence; The coastal cleanup drive will be carried out at 75 beaches across the country with 75 volunteers for every kilometre of the coastline.</p>
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		<p>The "Swachh Sagar, Surakshit Sagar/Clean Coast Safe Sea" campaign is a 75-day citizen-led campaign for improving ocean health through collective action. The campaign started on July 3rd, 2022 and has 3 strategic underlying goals that target transformation and environmental conservation through behavior change. The three underlying goals of the campaign are to 1. Consume Responsibly 2. Segregate waste at home and 3. Dispose Responsibly. The campaign will culminate with the largest beach cleaning event on Sept 17, 2022 (International Coastal Cleanup Day) covering 75 beaches across India's 7500+km coastline.</p> <p>In terms of implementation, during the month of July there will be an attempt to raise awareness about the degradation caused by plastic and the danger to ecological balance from deteriorating ocean</p>
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		<p>health. In August, the campaign will create engagement, especially among the youth on innovating to solve for the problem of plastic waste. In September, the focus will be on action – bringing people to clean up the beach as a symbolic gesture to pledge against the use of plastic.</p> <p>Key audiences for the campaign include local communities that rely on oceans and beaches for livelihood, school and college students, youth and citizens in-general. The campaign will combine both virtual and physical formats for delivering key messages and engaging the target audience in adopting lifestyle and behavioral changes that promote environmental sustainability. Examples of virtual activities include quizzes, pledges and challenges. Physical activities will include the actual beach clean-up along with rallies, skits and</p>
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		<p>contests etc.</p> <p>A mobile app “Eco Mitram” has been launched to spread awareness about the campaign and also for the common people for voluntary registration for the beach cleaning activity on the 17th September 2022.</p> <p>It is the first-of-its-kind and longest running coastal cleanup campaign in the world with highest number of people participating in it. Through this campaign, a mass behavioural change among the masses is intended by raising awareness about how plastic usage is destroying our marine life.</p>
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No. S-18020/97/2023-SBM-DDWS
Government of India
Ministry of Jal Shakti
Department of Drinking Water & Sanitation
Swachh Bharat Mission (Grameen)

6th Floor, Pt. Deendayal 'Antyodaya Bhawan'
CGO Complex, Lodhi Road
New Delhi - 110003
Dated: 16.10.2024

OFFICE MEMORANDUM

Subject: Order of National Green Tribunal, Principal Bench in Original Application No.251/2022 on "Detecting micro plastic in Human Blood" - regarding.

The undersigned is directed to refer to Ministry of Environment, Forest and Climate Change's email dated 04.10.2024, on the subject cited above and to enclose the inputs of Department of Drinking Water and Sanitation at Annexure-I.

2. This issues with the approval of the Competent Authority.


(Krishanu Mukherjee)

Under Secretary to the Government of India
Email: krishanu.83@nic.in
Phone: 2436 4907

To
Ministry of Environment, Forest and Climate Change
(Dr. Amit Love, Scientist 'E'/Additional Director)
Jorbagh Road, Aliganj
New Delhi - 110003

Copy to: - Dr. Satyendra Kumar, Director, M/o EFCC, for information

Sl. No.	Conclusions of the Report prepared by CPCB, ICMR, CIPET and NCSCM (as mentioned in Para 11 of the NGT Order dt 31.1.2024)	Concerned Ministries/ Department/ Body	Action Plan/Action Taken (Response of DDWS)
18	<p>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;</p> <p>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.</p> <p>Microplastics can also bereduced by supporting the development and use of biodegradable plastic alternatives</p>	<ul style="list-style-type: none"> • Department of Drinking Water and Sanitation, • Ministry of Housing and Urban Affairs, • MoEFCC 	<p>As sanitation is a State subject, Swachh Bharat Mission (Grameen) [SBM(G)], a Centrally Sponsored Scheme, is implemented by the States/UTs to improve sanitation status in rural area. This Department provides technical and financial support to all States and UTs under SBM(G) to supplement their effort to this effect.</p> <p>Having achieved Open Defecation Free (ODF) status in rural areas, SBM(G) Phase-II is being implemented to sustain ODF status and to improve rural cleanliness through solid and liquid waste management activities in which Plastic waste management in rural India is one of the components. For effective management of plastic waste, focus has been given to generate public awareness on harmful impacts of Single Use Plastic (SUP) and the three R's of the plastic management chain - Refuse, Reduce and Reuse.</p> <p>To this effect, DDWS also advised all the States/UTs for taking necessary action for creating awareness on harmful effects of SUP and shunning use of SUP and adoption of environ friendly products.</p> <p>As per the SBM(G) Phase-II operational guideline, for Solid Waste Management (SWM), States/UTs have been advised to make arrangement for Solid Waste Management (Bio-degradable and non-biodegradable) system for Household and all public Places (including the primary schools, Panchayat Ghar and Anganwadi canter). SWM system inter alia includes</p>

			<p>Collection, Transportation, Segregation, Storage, and management of solid wastes including plastic wastes.</p> <p>For bio-degradable waste management, activities such as household level/community level compost pits and bio-gas plant under Gobardhan is being undertaken.</p> <p>For plastic wastes, SBM(G) supports setting up of collection, segregation, storage and transportation arrangements at village level and creation of Plastic Waste Management Units at District/Block level. Under the programme it has been suggested for use of end-of-life plastics in cement factories/road construction and for establishing linkages with local recyclers for recycling of plastic waste.</p> <p>As reported by States & UTs on SBM(G) IMIS, over 3800 Blocks are covered with Plastic Waste Management Units and Urban Material Recovery Facilities.</p>
19	End-of-pipe interventions, wastewater, and road management treatment, to retain the emitted microplastics before these reach water bodies.	<ul style="list-style-type: none"> • Department of Water Resources, River Development and Ganga Rejuvenation • Department of Drinking Water and Sanitation, • Ministry of Housing and Urban Affairs 	<p>Under SBM(G), wastewater is divided into two different streams in rural areas – greywater and black water. SBM(G) Phase II prioritizes the management of greywater preferably by simple techniques and on-site technologies i.e. near the source itself, using sustainable and economical technologies, such as, soak pit, leach pit, magic pit or kitchen garden. However, where the above technologies are not feasible, Greywater management systems such as WSP, CW, DEWATs, Phytoid, etc. are taken up.</p> <p>As reported by States & UTs on SBM(G) IMIS, 17,85,089 community soak pits and 1,62,981 greywater management system have been constructed as on 16th October, 2024.</p>

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Appendix-J



neha <nehapatankarenv@gmail.com>

Fwd: Order of National Green Tribunal, Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood"-Reg.

Amit Love <amit.love@nic.in>

Thu, Dec 5, 2024 at 3:32 PM

To: nehapatankarenv <nehapatankarenv@gmail.com>

Regards

Dr. Amit Love
Scientist 'E' / Additional Director
Ministry of Environment, Forest and Climate Change
Government of India

===== Forwarded message =====

From: ap.singh71 ap.singh71 <ap.singh71@gov.in>

To: "Amit Love"<plastics-mefcc@nic.in>, "Amit Love"<amit.love@nic.in>

Cc: "Pradeepkumar Agrawal"<pk.agarwal@ias.gov.in>, "Anand Mohan"<js-nrcd@gov.in>,
"NELAPATLAASHOK"<nelapatla.ashokbabu@gov.in>

Date: Thu, 05 Dec 2024 15:10:30 +0530

Subject: Fwd: Order of National Green Tribunal, Principal Bench in Original Application no. 251/2022 on
"Detecting microplastic in Human Blood"-Reg.

===== Forwarded message =====

Sir/Madam,

No specific information is available with NRCD; however, NRCP has so far covered 57 rivers spreading over 17 States/UTs in the country with a sanctioned cost of Rs.8931.49 crore, and inter-alia, a sewage treatment capacity of 2941 million litres per day (MLD) has been created. In the sewage treatment process, bigger-sized floating plastics with sewage are screened along with other materials in STP. Operation and maintenance of STPs is the responsibility of States/ Union Territories.

Regards,
AP Singh
Director/ Scientist-E
NRCD
MOJS

===== Forwarded message =====

From: NEHA PATANKAR <neha.patankar@govcontractor.in>

To: "ap.singh71 ap.singh71"<ap.singh71@gov.in>

Date: Thu, 05 Dec 2024 14:38:47 +0530

Subject: Fwd: Order of National Green Tribunal, Principal Bench in Original Application no. 251/2022 on
"Detecting microplastic in Human Blood"-Reg.

===== Forwarded message =====

162 of 183

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===== Forwarded message =====

From: Amit Love <amit.love@nic.in>

To: "secy-ipp"<secy-ipp@nic.in>, "secy-textiles"<secy-textiles@nic.in>, "seccpc"<sec.cpc@nic.in>, "secyhfw"<secyhfw@nic.in>, "secretary"<secretary@moes.gov.in>, "secy-pharma"<secy-pharma@nic.in>, "secy-road"<secy-road@nic.in>, "secy-dhr"<secy-dhr@gov.in>, "shioff"<shioff@nic.in>, "secy-mowr"<secy-mowr@nic.in>, "secyurban"<secyurban@nic.in>, "secy-fisheries"<secy-fisheries@gov.in>, "ccbcpb"<ccb.cpcb@nic.in>, "director"<director@iitrindia.org>, "dci"<dci@nic.in>, "dg"<dg@cipet.gov.in>, "director"<director@ncscm.res.in>, "director"<director@neeri.res.in>, "ameena"<ameena@gov.in>, "secy-dg"<secy-dg@icmr.gov.in>, "Member CPCB"<mccb.cpcb@nic.in>

Cc: "NEHA PATANKAR"<neha.patankar@govcontractor.in>, "bidurkantjha"<bidurkant.jha@gov.in>, "ap.singh71 ap.singh71"<ap.singh71@gov.in>, "drkumarravi"<dr.kumarravi@gov.in>, "drkubernathram"<dr.kubernathram@delhi.gov.in>, "anilkumarv"<anilkumar.v@gov.in>, "priyankakundra"<priyanka.kundra@lhmc-hosp.gov.in>, "ajaypandit"<ajay.pandit@nic.in>, "yadavhq"<yadav.hq@icmr.gov.in>, "rikta.saha"<rikta.saha@cdsco.nic.in>, "divyasinha"<divyasinha.cpcb@nic.in>, "satyendrakumar07"<satyendra.kumar07@nic.in>, "Mr Naresh Gangwar"<asnpg.mefcc@gov.in>, "TANMAY KUMAR"<tanmay.kumar-rj@gov.in>, "Chairman CPCB"<ccb.cpcb@nic.in>, "Ms Leena Nandan"<secy-moef@nic.in>

Date: Thu, 14 Nov 2024 12:10:31 +0530

Subject: Order of National Green Tribunal, Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood"-Reg.

===== Forwarded message =====

Thanks & Regards,
Neha Patankar
Associate (Legal)
Ministry of Environment, Forest & Climate Change
Government of India

A. P. Singh
Scientist -E
National River Conservation Directorate
Ministry of Jal Shakti
Telefax No. 24362186

[Quoted text hidden]

5 attachments**OM dated 14.11.2024-.pdf**

1945K

**Minutes of the meeting held on 07.11.2024 pdf.pdf**

465K

**Annexure-I (List of Participants).pdf**

21K

**Annexure-II (Copy of NGT order dt. 31.01.2024).pdf**

232K

**Annexure-III (Presentation by MoEFCC).pdf**

355K

F.No: J-1603527/2/2024-DOF [E-23625]
Government of India
Ministry of Fisheries, Animal Husbandry & Dairying
Department of Fisheries

Chandralok Building, Janapat, New Delhi-110001,
Dated the 17th January, 2024

OFFICE MEMORANDUM

Subject: Order of National Green Tribunal Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood- reg.

The undersigned is directed to refer to Ministry of Environment, Forest and Climate Change (MoEF& CC) email dated 10th January 2023 regarding the action plan to support sustainable fishing practices to reduce the amount of microplastic entering rivers from fishing equipment and compliance of Hon'ble National Green Tribunal, Principal Bench, orders dated 1st March 2023 and 9th October 2023 and convey that the matter has been examined in the Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying with following comments:

- i. India is third largest fish producing country in the world and contributes about 8 % to the total global fish production. The total fish production of India during 2022-23 is estimated at 17.54 million metric tonnes with a contribution of 13.13 MMT from the Inland sector and 4.32 MMT from marine sector. India is also a major producer of fish through aquaculture and ranks second in the world. Fisheries contribute 1.29 percent to India's economy. India has also become a major global player in fish trade, with total seafood exports amounting to over 1.73 million tonnes, valued at over US\$ 8.09 billion during 2022-23.
- ii. Fisheries and aquaculture had always played an important role in the food and nutritional security, livelihoods and economic prosperity of India. Further, fisheries are a major source of employment and livelihoods for millions of fishermen and households, who also generate further multiplier employment in the ancillary activities like fish processing and marketing. Government of India had been keen on the sustainable harvest for perpetuity of fisheries resources.
- iii. The fisheries resources from the Indian waters are harvested using different types of craft gear combinations. The major crafts used are of three different categories namely mechanized, motorized and non-motorized. The mechanized sector include trawlers, gill-netters and inboard vessels. Most of the crafts in the mechanized sector use machines for both propulsion and operation of the gear. The motorized sector exclusively consists of crafts fitted with outboard engines. The non-motorized sector consists of traditional vessels made up of wood, fibre glass, thermo coal etc. and do not use any machine power either for propulsion or for operation of the gear. Major gears used for fisheries sector are trawl nets, gill nets, bag nets, hooks & lines, seines and traps.

- iv. Further, most of the artisanal fishers typically operate small boats, often non-motorized or with limited engine power. Their fishing gear is traditional and often handmade, like nets, traps, and lines.
- v. Historically, fishing gear relied on non-synthetic materials like cotton, flax, and hemp. However, the advent of large-scale plastic production in the 1950s led to a shift towards synthetic fibers due to their affordability, durability, strength, and ease of handling. Compared to traditional materials like cotton or hemp, synthetics like nylon, polyethylene, and polypropylene offer significant advantages. They are lighter, cheaper, easier to handle, and resist rot and abrasion resistant, allowing for longer gear life and improved efficiency. For resource-constrained fishers, in particular, these qualities are crucial. The high cost and limited practicality of natural alternatives simply make them less viable options. While the environmental impact of microplastics is a growing concern, unfortunately, no readily available and affordable substitute currently matches the performance and practicality of synthetic fishing gear. Global quest for the sustainable solutions as well as research efforts are underway to develop promising alternatives to synthetic fishing gear.
- vi. In this regard, it may be informed that Fisheries Sector in India primarily operates at a small-scale and traditional level. Further, it is relevant to mention that the subject matter of 'Fisheries' falls under the 'Entry 21' of the State list, under Seventh Schedule of the Constitution. This empowers states to have the legislative power to make laws regarding the conservation, development, and regulation of fisheries within their territorial jurisdiction. Therefore, it may be noted that the role of this Department is limited to be advisory in nature.
- vii. Recognizing the urgent threat of microplastic pollution, the Department of Fisheries has issued an advisory to all States/UTs (Copy enclosed).

This issue with the approval of the Competent Authority.

Encl: As above


Dr. Nilesh Anil Pawar)
Deputy Director (Aquatic Quarantine)
Tel: 91-11 2331 0351
Email: nilesh.pawar85@dof.gov.in

Ministry of Environment, Forest and Climate Change
Kind Attn: Dr. Amit Love,
Scientist 'E'/ Additional Director
Email: amit.love@nic.in

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F.No: j-1603527/2/2024-DOF [E-23625]

Government of India
Ministry of Fisheries, Animal Husbandry & Dairying
Department of Fisheries

Krishi Bhawan, New Delhi

Dated: 17th January, 2023

To,

The Secretary/Principal Secretary (Fisheries),
All State Government and UTs

Subject: Advisory to support sustainable fishing practices to reduce the amount of microplastic entering rivers from fishing equipment-reg

Sir/Madam,

I am directed to refer to the Orders of National Green Tribunal (NGT) Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood" dated 1st March 2023 and 9th October 2023 (Copy enclosed) received from the Ministry of Environment, Forest and Climate Change (MoEF & CC), Government of India.

2. Vide order dated 1st March 2023, NGT had directed that interventions given in the Joint Committee of CPCB, ICMR, CIPET and NCSCM need to be immediately introduced as short-term measures in further designing and manufacturing of the products which are potential threat for generating micorplastics.

3. In compliance with the Hon'ble NGT's directives, the Ministry of Environment, Forest and Climate Change (MoEF & CC) shared a comprehensive report prepared by CPCB, ICMR, CIPET and NCSCM. This report w.r.t. Original Application No. 251/2022 on "Detecting Micro-plastic in Human Blood," outlines specific action plans for various Ministries/Departments. The specific action to 'support sustainable fishing practices to reduce the amount of micro-plastic entering rivers from fishing equipment' is proposed for fisheries sector.

4. Recognizing the urgent threat of microplastic pollution, the Department of Fisheries in all the States/UTs are advised to:

- i. ensure sustainable fishing practices being followed to reduce the amount of micro-plastic entering rivers from fishing implements and
- ii. raise awareness among fishers on micro-plastic sources in fishing activities, its impact on human health and mitigation strategies for reclamation of such polluted waters.

This issues with the approval of competent authority.

(A. Antony Xavier)

Fisheries Development Commissioner

Tel:011-23386379 Email: fdc-india@dof.gov.in

Copy to:

Commissioner/Director (Fisheries), All State Governments and UT Administrations

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Appendix-L



neha <nehapatankarenv@gmail.com>

Fwd: Updates on Action Plan: Order of National Green Tribunal, Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood"-Reg.

Amit Love <amit.love@nic.in>

Thu, Nov 14, 2024 at 2:35 PM

To: nehapatankarenv <nehapatankarenv@gmail.com>

Regards

Dr. Amit Love
Scientist 'E' / Additional Director
Ministry of Environment, Forest and Climate Change
Government of India

===== Forwarded message =====

From: Anil Kumar Vijayan <anilkumar.v@gov.in>

To: "Amit Love"<amit.love@nic.in>

Cc: "Prashant Srivastava"<srivastava.pks@gov.in>, "Mangalaa K.R."<mangalaa.kr@gov.in>

Date: Thu, 14 Nov 2024 13:10:07 +0530

Subject: Updates on Action Plan: Order of National Green Tribunal, Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood"-Reg.

===== Forwarded message =====

Kindly ignore the previous mail. the attachment was missing.

Dear Sir,
Greetings from MoEF&CC.

This has reference to the meeting held on 7th November 2024 at Indira Paryavaran Bhavan, New Delhi, on the subject mentioned above. I am forwarding the updates on the action plan herewith.

The major updates are as follows:

(1) with respect to **SI.No.23** of action plan are: Mega beach clean up campaign was held at more than 80 Beaches co-ordinated by MoES. A report on the same is being prepared by NCCR which shall be shared with MoEF&CC shortly.

(2) With reference to the action point on SI.No.24 of the action plan: NCCR had conducted a workshop on "Road Map for Marine Litter Policy for India and Indo-Japan Collaboration research activity on marine litter" wherein the Blue Print for National Marine Litter Policy has been prepared and released by Secretary, MoES. Further, a research paper on the marine litter policy was published in the Marine Pollution Bulletin journal (attached for your reference). In this article, four targets are proposed (1) Target I - measures for addressing the land-based sources (2) Target II - beaches – a source and sink for litter (3) Target III - measures for addressing the sea-based sources (4) Target IV - source mitigation measures. To achieve these targets, 20 strategies are also proposed in the blue print.

This issues with the approval of competent authority.

शुभकामनाओं सहित / With best regards
अनिल कुमार विजयन / Anil Kumar Vijayan

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अनिल कुमार विजयन / ANIL KUMAR VIJAYAN. Ph.D
वैज्ञानिक ई / SCIENTIST E
पृथ्वी विज्ञान मंत्रालय, भारत सरकार.
MINISTRY OF EARTH SCIENCES, GOVT.OF INDIA
पृथ्वी भवन, लोधी रोड, नई दिल्ली-110003
PRITHVI BHAVAN, LODHI ROAD, NEW DELHI-110003

TEL (Off): +91-11-2466 9719
Alternate email: anilkumarvijayan@yahoo.com
anilkumarvijayan@gmail.com
URL: www.moes.gov.in

From: "Amit Love" <amit.love@nic.in>
To: "secy-ipp" <secy-ipp@nic.in>, "Rachna Shah" <secy-textiles@nic.in>, "Office of Seceratry CPC" <sec.cpc@nic.in>, "Apurva Chandra" <secyhfw@nic.in>, "Dr M Ravichandran" <secretary@moes.gov.in>, "Dr. Arunish Chawla" <secy-pharma@nic.in>, "SECRETARY MORTH" <secy-road@nic.in>, "Office of Secretary DHR" <secy-dhr@gov.in>, "Shri Kamran Rizvi" <shioff@nic.in>, "Debashree Mukherjee" <secy-mowr@nic.in>, "Shri Srinivas Katikithala" <secyurban@nic.in>, "Dr. Abhilaksh Likhi" <secy-fisheries@gov.in>, "Chairman CPCB" <ccb.cpcb@nic.in>, director@iitrindia.org, "Dr. Rajeev Singh Raghuvanshi" <dci@nic.in>, "Director General" <dg@cipet.gov.in>, "Director NCSCM" <director@ncscm.res.in>, "DIRECTOR NEERI" <director@neeri.res.in>, "Ashok" <ameena@gov.in>, "DG ICMR" <secy-dg@icmr.gov.in>, "MS, CPCB" <mscb.cpcb@nic.in>
Cc: "NEHA PATANKAR" <neha.patankar@govcontractor.in>, "Bidur Kant" <bidurkant.jha@gov.in>, "Sh Anjani Prasad Singh" <ap.singh71@gov.in>, "dr kumarravi" <dr.kumarravi@gov.in>, "Kuber Nath Ram" <dr.kubernathram@delhi.gov.in>, "Anil Kumar Vijayan" <anilkumar.v@gov.in>, "Priyanka Kundra" <priyanka.kundra@lhmc-hosp.gov.in>, "Ajay Pandit" <ajay.pandit@nic.in>, "yadav hq" <yadav.hq@icmr.gov.in>, "Rikta Saha" <rikta.saha@cdsco.nic.in>, "DIVYA SINHA" <divyasinha.cpcb@nic.in>, "Satyendra Kumar" <satyendra.kumar07@nic.in>, "Naresh Pal Gangwar" <asnpg.mefcc@gov.in>, "Mr Tanmay Kumar" <tanmay.kumar-rj@gov.in>, "Chairman CPCB" <ccb.cpcb@nic.in>, "Ms Leena Nandan" <secy-moef@nic.in>
Sent: Thursday, November 14, 2024 12:10:31 PM
Subject: Order of National Green Tribunal, Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood"-Reg.

Sir,

The undersigned is directed to forward herewith the minutes of the meeting held on 7th November 2024 at Indira Paryavaran Bhavan, New Delhi, on the subject mentioned above.

Regards,

Regards

Dr. Amit Love
Scientist 'E' / Additional Director
Ministry of Environment, Forest and Climate Change
Government of India

To: CC:===== Forwarded message =====

168 of 183

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From: Amit Love <amit.love@nic.in>
To: "secy-ipp"<secy-ipp@nic.in>, "secy-textiles"<secy-textiles@nic.in>, "seccpc"<sec.cpc@nic.in>, "secyhfw"<secyhfw@nic.in>, "secretary"<secretary@moes.gov.in>, "secy-pharma"<secy-pharma@nic.in>, "secy-road"<secy-road@nic.in>, "secy-dhr"<secy-dhr@gov.in>, "shioff"<shioff@nic.in>, "secy-mowr"<secy-mowr@nic.in>, "secyurban"<secyurban@nic.in>, "secy-fisheries"<secy-fisheries@gov.in>, "ccbcpb"<ccb.cpcb@nic.in>, "director"<director@iitrindia.org>, "dci"<dci@nic.in>
Cc: "Shrawan Kumar"<kumar.shrawan@gov.in>, "NEHA PATANKAR"<neha.patankar@govcontractor.in>, "satyendrakumar07"<satyendra.kumar07@nic.in>, "Mr Naresh Gangwar"<asnpg.mefcc@gov.in>, "Ms Leena Nandan"<secy-moef@nic.in>
Date: Tue, 05 Nov 2024 10:51:53 +0530
Subject: Order of National Green Tribunal, Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood"-Reg.
===== Forwarded message =====

Thanks & Regards,
Neha Patankar
Associate (Legal)
Ministry of Environment, Forest & Climate Change
Government of India

Sir/Madam,

This has reference to trail email regarding the meeting to review the compliance of NGT order dated 31st January 2024 in Original Application no. 251/2022 on "Detecting microplastic in Human Blood" under the chairpersonship of Shri Naresh Pal Gangwar, Additional Secretary, MoEFCC **has been rescheduled at 12.15 PM on 7th November 2024, in Narmada Conference Hall, Ground Floor, Jal Wing, Indira Paryavaran Bhavan, New Delhi.**

The rescheduled date and time may please be noted.

It is requested to kindly make it convenient to attend the meeting.

Regards

Dr. Amit Love
Scientist 'E' / Additional Director
Ministry of Environment, Forest and Climate Change
Government of India

===== Forwarded message =====
From: Amit Love <amit.love@nic.in>
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Date: Mon, 28 Oct 2024 16:34:58 +0530
Subject: Order of National Green Tribunal, Principal Bench in Original Application no. 251/2022 on "Detecting microplastic in Human Blood"-Reg.

===== Forwarded message ===== **335**

Sir/Madam,

The undersigned is directed to forward herewith a meeting notice dated 28th October 2024, on the above mentioned subject.

2. The copy of the Hon'ble NGT order dt. 31st January 2024 is attached herewith for ease of reference.

Regards,

Regards

Dr. Amit Love
Scientist 'E' / Additional Director
Ministry of Environment, Forest and Climate Change
Government of India

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Tide of change: Urgency of a national marine litter policy in India

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ABSTRACT

The rise of plastics in the 20th century revolutionized modern life but inadvertently exacerbated the marine litter crisis. The proliferation of wastes such as single-use plastics has escalated pollution along the coastline, demanding coordinated, decisive, and unified action. While the absence of specific national marine litter policies is concerning, there is growing recognition of urgency to address this issue. A group of experts and stakeholders was involved through a multi-staged workshop to assess the generated information based on scientific evidence and formulate a framework for the National Marine Litter Policy (NMLP). This paper proposes policy options (4 targets & 20 strategies) to address marine litter pollution, especially plastics, and aims to elucidate the urgency and significance of implementing an NMLP as a comprehensive strategy to combat plastics pollution. Implementing dedicated policies and action plans tailored to the unique challenges faced by each country is a vital step towards sustainable oceans.

1. Introduction

The world's oceans cover >70 % of the Earth's surface and are home to a remarkable diversity of life. However, beneath the sparkling surface lies an insidious threat – marine litter. Marine litter encompasses a wide range of materials, including plastics, metals, glass, wood, paper, rubber, and others (Cheshire et al., 2009), which is not confined to remote corners of the globe; it is a global phenomenon. Marine litter is ubiquitously reported and knows no boundaries spreading from the Arctic to the Antarctic, and from the depths of the Mariana Trench to the shores of pristine islands (Cole et al., 2011). Plastics constitute about 85 % of marine litter, and they are one of the most persistent components within it. With the current state of waste management practices, the volume of plastic pollution entering the ocean may triple (23–37 MMT/year) by 2040 (UNEP, 2021).

India's diverse coastline, spanning over 7500 km, is a vital natural asset with diverse coastal ecosystems, providing livelihoods to coastal communities, and contributing to the nation's economy and cultural heritage. However, the escalating threats to coastal ecosystems are further exacerbated by marine litter, particularly plastics, raising concerns about the long-term sustainability of coastal ecosystems and the well-being of coastal communities in India (Lakshmi and Rajagopalan, 2000).

Plastics, being non-biodegradable, accumulate and persist in the marine environment for hundreds of years, consequently, affecting the organisms through ingestion and entanglement (Engler, 2012). This impacts the food web, with potentially dire consequences for both marine life and human health that depend on fisheries. The long-term effects of microplastic consumption on human health are still not fully understood, but it is a growing concern (Campanale et al., 2020). Plastic waste, discarded fishing gear, and other debris are accumulating in seas along the Indian coast, posing significant threats to biodiversity, tourism, fishery, and the livelihoods of millions that depend on the coast (Kumar et al., 2021). Clean-up and response efforts incur significant expenses, with the government and other non-governmental organizations (NGOs) bearing the financial burden.

Despite its emergence as a significant environmental crisis, no country has yet enacted a specific national marine litter policy. This lack of dedicated policies reflects a broader challenge in comprehensively addressing marine pollution. Several factors contribute to the lack of specific marine litter policies. Firstly, marine litter is a complex issue that requires multifaceted solutions spanning across various sectors, including waste management, fisheries, tourism, and shipping. Developing comprehensive policies to address these interconnected challenges requires significant political will, coordination among government agencies, and engagement with stakeholders from the

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private sector and civil society. Moreover, the transboundary nature of marine litter complicates the development of national policies, as pollution can originate from domestic and international sources, carried by ocean currents across borders. Effective management of marine litter requires international cooperation and collaboration to address its root causes and mitigate its impacts collectively. Additionally, the lack of reliable data and scientific understanding of marine litter in many regions hinders the formulation of evidence-based policies.

The purpose of this manuscript is twofold: firstly, to provide a comprehensive understanding of the global and regional efforts to address the marine litter crisis along with its limitations, and secondly, to advocate for the development and implementation of a National Marine Litter Policy (NMLP) in India. By examining the problem from various perspectives and drawing on international and national experiences, we aim to provide policymakers, environmentalists, researchers, and concerned citizens with the framework necessary for formulating the NMLP that can facilitate significant progress. Furthermore, this manuscript discusses key components that such a policy should include to effectively address the issue. The formulation and successful implementation of a national marine litter policy are critically important for rapidly developing nations experiencing accelerated growth in population. Such measures are vital for mitigating the influx of mismanaged plastic debris into the ocean.

2. Materials and methods

The study on the systematic analysis of sources and strategies to limit marine litter has not been done particularly from a governance perspective. The sticking point is the lack of measurable targets and concrete strategies. The National Marine Litter Policy (NMLP) framework was developed through three main approaches. Firstly, the initiation of the ‘Marine Litter and Microplastics’ research programme (MLMP) by the Ministry of Earth Sciences (MoES), Government of India, aimed to gain a scientific understanding of the abundance, distribution, polymer composition, and major sources of litter pollution in marine environmental matrices of the Indian Coast. Secondly, a national-level, multi-staged workshop was conducted with scientists from various research institutes, policymakers, key stakeholders, industrial and academic experts to prepare a roadmap for formulating the NMLP. Finally, a desk study involving consultation of articles, official reports, legal and regulatory framework relating to global and regional plastic waste management was carried out to gather background information essential for constructing a framework for the NMLP.

3. Global efforts to address marine litter

In recent years, global efforts towards mitigating marine litter have gained momentum as the world acknowledges the escalating environmental threat posed by marine litter. Governments, international organizations, non-governmental entities, and the private sector are collaborating to address this issue through various initiatives and strategies. Several international collaborative activities, such as the Commonwealth Litter Programme (CLiP), and Indo-Pacific Ocean Initiatives (IPOI) are actively underway to combat marine litter. Ongoing research initiatives are currently prioritizing the understanding of the sources, pathways, and impacts of marine litter. Innovative technologies and solutions, including ocean clean-up systems and biodegradable materials, are being developed to address the issue at its core. Technological advancements play a crucial role in monitoring and managing marine litter. Satellite imagery, unmanned aerial vehicles (UAVs), and other remote sensing technologies are employed to identify and track floating debris, aiding in more effective clean-up operations. Sharing best practices, data, and expertise helps create a collaborative and unified approach to combatting this global transboundary challenge.

Collaborative agreements at regional and global levels are crucial in addressing transboundary litter issues. In the past few decades, many

global initiatives have been undertaken to protect the marine environment, some of which directly or indirectly address the concern of marine plastic waste. The existing agreements and policies implemented in various countries were screened and visualized in Fig. 1. The major players were identified based on criteria such as major generators of plastic waste, single-use plastics (SUPs), and ocean plastics. Additionally, major importers, and exporters of plastic waste and top countries actively working to tackle the plastic waste were included.

The binding agreements include the London Convention (1972) and Protocol (1996), the Barcelona Convention (1976), the Convention on the Prevention of Marine Pollution by Dumping of wastes and other matter (MARPOL 73/78), the United Nations Convention on the law of the sea (UNCLOS, 1982), Basel Convention (1989), Stockholm Convention concerning plastic additives, United Nations Fish Stocks Agreement (1982), Kunming-Montreal Global Biodiversity Framework – Target 7 of ‘Reducing threats to biodiversity’ (2021). Several aspirational and non-binding agreements include the Honolulu Strategy (2011), the Global Programme of Action for the Protection of the marine environment from land-based activities (GPA, 1995), United Nations Environment Programme’s Environment Assembly resolutions 1–4 (UNEP/EA1–4), UNEP/EA5, UNEP’s global partnership for tackling marine litter (GPML), UNEP’s Clean Seas pact (2017), United Nations Sustainable Development Goals 14.1 (UN SDG, 2015) - “Life below water”, G7’s “Ocean Plastics Charter of Charlevoix Blueprint” (2018), G20 “Osaka Blue Ocean Vision”(2019), ‘Plastic waste partnership’ of Basel convention, FAO’s code of conduct for responsible fisheries, and some of Regional Seas Convention and Action plans. These agreements are purposed to serve as frameworks for coordinated action on a global scale but many limitations necessitate robust national policies, tailoring

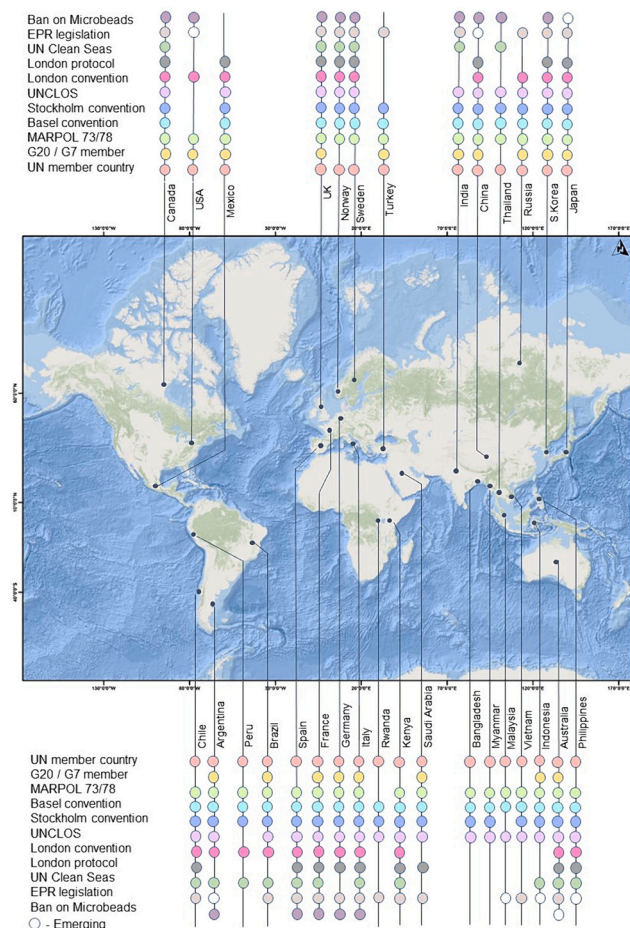


Fig. 1. Legal and regulatory instruments on marine litter in various countries.

solutions to local needs. Since 2000, none of the agreed international policies has included a global, binding, specific, and measurable target limiting plastic pollution (UNEP, 2021) or considered the full life cycle of plastics (Raubenheimer, 2022). At least 40 countries supported the insufficiency of existing international policies and legal frameworks at UNEA-5.1 resulting in adopting a resolution to draft a legally binding agreement by 2024. Some of the regulations primarily focus on pollution from ships and do not comprehensively address other sources of marine pollution, such as land-based runoff, offshore oil and gas activities, or marine litter including plastics. Lacuna on the multilateral agreement to address the prevention or reduction of pollution in shared watercourses. Some are voluntary instruments, meaning that compliance with its principles and guidelines is not legally binding. Limited participation subjected to the country's socioeconomic and political interests, progress in addressing marine pollution may be slow due to challenges in achieving consensus among member states, overlapping mechanisms, and unclear liability mechanisms for pollution incidents, which can make it challenging to hold polluters accountable for their actions while ensuring compensation for damage to the marine environment. Till the 2022 amendment of the London Protocol (LC 44/LP 17), a potential source of microplastics - sewage sludge was listed as one of the acceptable wastes for dumping in the ocean. In 2023, the International Organization for Standardization (ISO) developed standardized methods (ISO 24187: 2023) for detecting and analyzing microplastics to ensure reliable and consistent data across the studies.

4. Overview of India's existing legal framework concerning plastic waste management

The Environmental Protection Act was enacted in 1986 to address the growing concerns over environmental degradation and pollution. It is also called an "Umbrella act" since it provides an overall framework for the protection and conservation of the environment in India. The first major regulation related to plastics was the "Plastics Manufacture, Sale and Usage Rules, 1999 mainly focussing on the manufacture and use of recycled plastic carry bags and containers without much focus on the management aspects. Later in 2011, owing to growing environmental concerns due to the mismanagement of plastic waste, the Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India, introduced the "Plastic Waste (Management and Handling) rules" to manage the generation, handling, recycling, and disposal of plastic waste to minimize its environmental impact and promote sustainable waste management practices. The Bureau of Indian Standards (BIS) has classified plastic microbeads as unsafe for use as an exfoliator or cleanser in rinse-off personal care products as per IS 4707 (Part 2): 2017.

In June 2018, India joined UNEP's "Clean Seas campaign" to fight marine plastic pollution and to contribute towards sustainable oceans. MoEF&CC implemented the phasing out of manufacture and use of non-recyclable multi-layered plastics and enforced a ban on the import of solid plastic scrap into the special economic zones and export-oriented units in 2018 and 2019, respectively.

The Plastic Waste (Management and Handling) rules" were later amended in 2016, 2018, 2021–2024 to strengthen the framework for managing plastic waste. Owing to the doubling of plastic waste generation over the demi-decade (CPCB, 2021) and its persistent mismanagement, the amended rules of 2022 cast Extended Producer Responsibility (EPR) responsibilities on plastic packaging such as its reuse, recycling, use of recycled plastic content, end of life disposal by the producers, importers, and brand owners. They were assigned EPR targets and obligations for 5 years. To streamline the implementation process of EPR, the Environment Ministry in its fourth Amendment to the Plastic Waste Management Rules (2022), notified 'Guidelines on Extended Producer Responsibility for Plastic Packaging' in the Schedule II of the Rules. As per these guidelines, Producers, Importers and Brand Owners (PIBOs) shall have to register through the online centralized portal developed by the Central Pollution Control Board (CPCB) to

improve accountability, traceability, and transparency of fulfillment of EPR Obligations. The environment ministry has banned the production, sale, and usage of identified SUP items with effect from July 2022. To promote reuse and recycling, the minimum thickness of plastic carry bags and sheets was increased to 120 and 50 µm, respectively. CPCB has also provided the guidelines for control of pollution and enforcement of environmental norms for individual establishments and clusters of restaurants, hotels, motels, and banquets related to the generated solid wastes.

India's commitment to implementing global and national policies for sustainable environmental management is reflected in several actions taken towards the reduction in plastics pollution including the ban on SUPs, boosting the recycling sector through EPR targets, and focus on circular economy. 'Lifestyle for the Environment (LiFE) Movement', 'Swachh Bharat Abhiyan', 'National Mission for Clean Ganga', and 'Smart Cities Mission' are key initiatives launched by the Government of India to address various aspects of urban and environmental development. To monitor the beach litter and educate the public on the need for a clean and healthy coast, the Ministry of Earth Sciences in association with the Indian Coast Guard has conducted an International Coastal Cleanup (ICC) Day event or Swachh Sagar Surakshit Sagar (2017–2023) at various parts of India based on a citizen science approach.

5. Results and discussion

5.1. NMLP framework: tailoring solutions to local needs

A National Marine Litter Policy will play a crucial role in addressing marine litter challenges by facilitating tailored solutions, establishing accountability, promoting monitoring and reporting, and fostering a culture of responsibility among stakeholders. The proposed NMLP framework is composed of four targets and 20 strategies (Fig. 2).

5.2. Target 1 - measures for addressing the land-based sources

Land-based sources contribute to >80 % of litter entering the Oceans (Andrady, 2011). Reduction in the litter inputs to the ocean environment is suggested as the most effective mitigation strategy (Jambeck et al., 2015). By examining the problem from various perspectives, the source-specific management proposed measures are as follows:

Strategy 1 – Measures to address mismanaged litter

In India, rivers act as a primary conduit for the transfer of marine litter, particularly plastics, into the seas (Sivadas et al., 2022). Notably, three of the world's top ten rivers that carry plastic waste pass through India (Schmidt et al., 2017). During the dry season, litter and mismanaged plastic accumulate in the catchment area and river bank. Subsequently, this accumulated litter is washed into the ocean during monsoon rains or flash floods, the frequency of which has increased in the last few years due to climate change. The likelihood of plastic leakage into the oceans is higher in densely populated countries with inadequate waste management infrastructure (Meijer et al., 2021). Therefore, ensuring adequate waste management is a prerequisite for preventing plastic leakage. A solid waste management system, comprising effective segregation, collection, and recycling is pivotal for effective management of litter, particularly plastics. Additionally, mitigation measures should include cleaning up existing garbage dumped in the terrestrial environment, especially near water bodies, and implementing measures such as litter netting or chain-link fencing on the river banks to prevent illegal dumping and capture wind-driven mismanaged litter. These measures can collectively contribute significantly to curbing the leakage of plastics into the marine ecosystem.

The deployment of booms or traps for intercepting the leakage of floating debris has been demonstrated to be successful in many parts of the world, including India. Booms should be strategically deployed in the major rivers of India to effectively curb litter leakage. The deployment of coarse screens in minor tributaries and stormwater drains can

wrappers, etc.) and fishing activities (e.g., abandoned nets, rope, styrofoam, etc.) from entering coastal areas. It is recommended to implement spatial planning and zoning of beaches on their intended usage priority. To regulate access to designated beaches, the installation of chain fencing along the backshore area with controlled entry, and exit points may be considered.

The coastal dunes not only act as a natural barrier in protecting the shoreline from erosion but also provide a stable substrate for the dunal plants (Namboothri et al., 2008). The psammophytes can act as a sink for the beached litter (Mancuso et al., 2023), which would otherwise get buried or be carried further inland or out to sea by wind and waves. While the effectiveness of psammophytes in trapping wind-blown beached litter has been well documented (Andriolo et al., 2021; Calderisi et al., 2023), their role in Indian beaches remains understudied. Preserving these habitats is essential for coastal management, emphasizing their additional ecological significance on litter management.

Strategy 3.0 - Beaches for tourism and recreational activities

The tourism and recreational beaches should be equipped with essential infrastructure such as adequate closed dustbins, access to drinking water, well-maintained washrooms with controlled sewage treatment systems, a designated smoking area, and a monitoring office staffed by a beach patrol officer. It is imperative to demarcate an appropriate area for food stalls and other shops, locating them away from the backshore of the beach to ensure efficient beach management. Balloon shooting, a popular recreational activity on Indian beaches, also contributes to beach litter and should be prohibited at the backshore. An area may be designated away from the backshore specifically for such activities, provided that proper waste management protocols are in place. Enforcing the mandatory usage of eco-friendly products in all the beach stalls will contribute to the promotion of sustainable beach practices.

Sub-zoning can be made for public amenities, smoking areas, recreational fishing, surfing, and swimming activities on considering the Water Quality Index (WQI). Many countries (e.g., Mexico, Brazil, France) have successfully implemented smoking bans on beaches, proving it to be an effective and well-accepted measure (Valmayor et al., 2023) for mitigating passive smoking and reducing the litter of non-biodegradable cigarette butts. Similarly, in India, implementing a smoking ban on beaches that lack designated smoking zones could be beneficial. Ban on the sale (e.g., plastic bottles, covers, cutleries) and restricted entry (e.g., food wrappers and pouches, cups, foam plastics syringes, shampoo and detergent covers, toothpaste covers, PVC banners) shall be imposed for identified plastics and liquor bottles inside the beaches, which are reported as frequently occurring plastic litter items in Indian beaches (Mishra et al., 2023).

Strategy 3.1 - Beaches for religious activities

Religious activities at beaches often lead to the generation of litter, such as cloth, garlands, and idols. This is frequently observed in some Indian beaches and contributes to beach litter (Jayasiri et al., 2013; Sathish et al., 2019; Sulochanan et al., 2019).

All regulations applicable to tourism and recreational beaches shall also extend to this category of beaches. The restriction process can be streamlined by disseminating the list of permitted (e.g., natural flowers and other organic items) and prohibited inorganic materials. (e.g., decoratives made of plastics or styrofoam). The revised guidelines for idol immersion outline a comprehensive list of prohibited materials and guide idol makers, organizing committees, and government authorities regarding idol immersion practices in waterbodies (CPCB, 2020).

Strategy 3.2 - Beaches for fishing-related activities

The fishing industry is widely recognized as a significant contributor to marine litter at global, (Kershaw, 2016) and regional scales (Patchaiyappan et al., 2021; Sivadas et al., 2022). A significant amount of litter is generated and accumulates near fishing hamlets and boat docking areas of beaches, due to inadequate waste management infrastructure. Manual cleaning is a necessity for these areas as they are not accessible by mechanized cleaning machines. Boat docking areas should be defined

ensuring sufficient gaps to facilitate cleaning. It is recommended to allocate an exclusive area away from the backshore to facilitate other fishing-related activities of the fishermen. E.g., Net weaving, drying and storing fish, bait preparation, etc. Fisher's associations should be encouraged to participate in maintaining cleaner beaches. Areas within fishing harbours and ports can be classified under this category.

Strategy 3.3 - Restricted activity beaches

Plastic pollution on the nesting beaches may impact the turtle habitats by altering the nest properties such as temperature and soil permeability (Nelms et al., 2016; Pradhan et al., 2024). Certain beach areas are maintained by the government and private organizations which have restricted access to the public. Therefore, sub-zoning can be made for (i) Eco-sensitive beaches – Nesting and hatching of marine organisms, (ii) Private access beaches – beach resorts, hotels, etc. (iii) Restricted entry to public, (iv) Beaches that are monitored by various government agencies such as Indian Navy, Indian Coastal Guard, Department of Atomic energy, etc. These restricted beaches shall be maintained by the appropriate department or agency. All activities that could generate litter at the beaches should be prohibited. Private access beaches shall be subjected to inspection for their cleanliness. The grant on renewal of licenses shall be based on the inspection report.

Strategy 4 - Measures for addressing the Beached litter

Beached litter after extreme weather events (Veerasingam et al., 2016; Gandhi et al., 2021) such as intense rainfall, flash floods, and leftovers of swash and backwash has to be cleaned. Establishing a wing in the local government body such as a corporation, municipality, or panchayat dedicatedly working for beach clean-up at a particular frequency in their respective control limits. Daily clean-up of the litter from the strand line of the beaches after the high tide times particularly on the beaches for tourism, recreational, and religious activity beaches while clean-up operations at the fixed schedule (weekly/fortnightly) on the restricted and fishing activity beaches is recommended. Expanding the use of mechanical beach cleaning machines in the beach clean-up activities of tier-II and tier-III cities. These machines are capable of removing macro litter buried up to 10-in. deep layers of beach sand but remain inefficient in removing the meso and microplastics. Creating "Beach Waste Diversion Programs" to divert organic waste from beaches and coastal areas to composting facilities, reducing the litter load and promoting sustainability.

5.4. Target III - measures for addressing the sea-based sources

Strategy 5 - Fishing and aquaculture activities

'Abandoned, Lost or Discarded Fishing Gear' (ALDFG) or 'Ghost gear' contributes to 10 % of floating debris in the oceans and poses a significant threat to the marine environment and navigation (Macfadyen et al., 2009; Stelfox et al., 2016). India is the second major producer, contributing to 8 % of world fisheries and aquaculture production of aquatic animals (FAO, 2022), and it is estimated that 0.5–0.6 million fishing gear are utilized in the marine industry. The prevalence of fishing activities and the absence of an ALDFG management system adversely impact the marine ecosystems. Apart from fragmentation to secondary microplastics, abandoned nets, traps, and lines indiscriminately entangle marine life, contributing to overfishing, and causing further ecological damage (Macfadyen et al., 2009). In India, ALDFG is widely reported as one of the largest contributors to beach litter by weight, aside from glass bottles and organic debris (Kaviarasan et al., 2022; Mishra et al., 2023; Daniel and Thomas, 2023). The majority of gillnet users discard the damaged fishing nets on the beaches due to a lack of refurbishment options, lack of incentives, and waste collection facilities (Daniel and Thomas, 2023). Currently, India lacks comprehensive data on ALDFG, and its effects on biota are still inadequately researched (Gunasekaran et al., 2024).

To address these issues, a legal framework for the recovery and responsible disposal of fishing gear is highly essential. The Ministry of Fisheries, Animal Husbandry and Dairying in consultation with the Food

and Agriculture Organization (FAO), United Nations Environment Programme (UNEP), International Maritime Organization (IMO), and other Regional Fisheries Management Organizations (RFMOs), should initiate this effort. Programs that incentivize fishermen to retrieve the ALDFG will reduce ghost fishing and marine litter. Introducing tracking systems for fishing gear to monitor and reduce gear loss at sea. This technology can help locate and retrieve lost gear more efficiently (Gilman, 2015). Other measures include discouraging the manufacture and use of monofilament nylon nets, initiating research on alternative materials that could be effective, durable, affordable, and sustainable (Thomas et al., 2020), establishing recycling facility at the fishing harbor to reclaim fishing gear, mandating the return of old or damaged gear at the time of buying new gear along with the schemes of incentivization and disincentivization. The recent advancements in research on biodegradable fishing gear are a significant step towards reducing the environmental impact of fisheries. However, it's essential to ensure that biodegradable alternatives are not only eco-friendly but also durable and effective for fishing purposes.

Strategy 6 - Shipping, offshore oil and gas extraction activities

Measures have to be taken to address the illegal dumping of ship-generated wastes into the ocean, preventing accidental and unintentional leakage into the ocean (Li et al., 2016). Other measures include efficient management of offshore rig and ship-generated wastes, eliminating SUPs and minimizing the usage of plastics in the operations, the inclusion of port reception facilities (PRF), and Waste Reception and Handling Plans. Verification of materials at the time of entry and exit using the bar code scanning, while restraining the entry of identified plastic materials. Training on waste management and marine litter should be made compulsory for crew members. All kinds of ships shall be subjected to quarterly or half-yearly waste audits by professional environmental managers.

5.5. Target IV - source mitigation measures

Strategy 7 - Public participatory approach

The public participatory approach can educate citizens about responsible waste disposal and the consequences of marine litter (UNEP, 2016), fostering a sense of stewardship. Public engagement is vital in distributing the burden of waste management in society. Source segregation and door-to-door collection are mandated in India as per Solid Waste Management Rules, 2016. However, source segregation could not be put into proper practice in most of the cities due to the lack of public cooperation and awareness on the disposal of plastic waste. In contrast, Indore could attain the status of the cleanest city in India by following the practices of six-bin source segregation of wastes, spot fines through door-to-door inspections and monitoring by CCTV cameras, constant awareness building by NGOs, revenue generation by collection of user fees, and processing the wastes. Such revenues are reinvested in the enhancement of the waste management infrastructure of the city. Such a model is replicable in all other parts of the country.

CEPA (Communication, Education & Public awareness) and Outreach include environmental education for awareness and behavior change such as the mandatory introduction of different color dustbins at all educational institutes to inculcate behavioral change in future generations, nurturing young minds through the inclusion of "Litter literacy", "Marine pollution & conservation" in the syllabus of NCERT and other school books. Measures such as raising awareness among the fishers on ALDFG, scaling up public participation in the International Coastal Clean-up Day, and involving academic institutions in coastal clean-up campaigns will drive changes in attitudes and behaviors (Wyles et al., 2016). Promoting the store drop-off program and installation of smart bins in community living will improve collection efficiency.

The development of public reporting platforms for hotspot mapping, such as mobile apps and dashboards is essential. These platforms empower citizens to geotag the litter accumulated in various areas such as beaches, river banks, streets, and other open dumping sites.

Moreover, leveraging mass media to raise public awareness by broadcasting government initiatives towards the management and mitigation of plastic waste will have a significant impact on littering behavior.

Strategy 8 - Sustainable production and consumption

Sustainable production measures such as designing the product with multi-use potential and consideration on end-of-life management are essential. Imposing a ban on the production of non-recyclable and single-use potential materials, other difficult-to-recover materials, and avoidable or auxiliary usage of plastic products such as brand labeling in plastic sheets. The problematic, unnecessary, and avoidable plastic products can be effectively addressed by redesign, or their usage can be reduced, or ultimately removed from the market (Raubenheimer and Urho, 2024). Promoting and mandating the usage of eco-friendly alternatives to SUPs available in the market (Table 1) is recommended.

Other measures include: Preventing the leakage of plastic pellets, powder, and flakes from industrial processes through good house-keeping and containment practices. Innovation in the food sachet packaging with an orientation towards improved management is the need of the hour. Snipping off the tip or small piece apart from the pouch leads to difficulty in collection and recycling. Easy linear tear design for not snipping off the tip in all the food packaging products and its usage shall be promoted by driving consumer awareness and engagement through advertisements in mass media.

The following are the difficulties observed related to milk pouches EPR compliance in India: (a) Soiled or contaminated pouches are difficult to segregate and recycle. (b) The inability of the consumers to follow the best practice of washing, drying, and storing in carton boxes (c) Higher cost associated with the recollecting of the used pouches. PET bottles and pouch packaging (brick carton – higher fiber content with low poly aluminum) with tethered caps for milk supply instead of traditional milk pouches can be an alternate better option. The higher recycling rate in India (~80 %), resalable value, ease of handling, shock resistance, and transparency are the advantages of using PET bottles for milk supply while the disadvantages include uneconomical shipping impact, and the problem associated with cleaning of bottles.

Strategy 9 - Tax differentiation based on environmental factors

In India, eco-friendly alternatives struggle to gain consumer acceptance due to their higher product costs. However, as the quantum of production and utilization of these eco-friendly products increases, the economies of scale may drive down their prices. To incentivize the adoption of sustainable alternatives, it is imperative to include environmental costs and implement the Deposit Refund Scheme (DRS). Unsustainable products should be priced higher than their eco-friendly counterparts.

Care should be taken to avoid imposing environmental levies that are either too low to influence consumer behavior or unlikely to yield

Table 1
List of eco-friendly alternatives to SUPs in India.

S. No	Plastic products	Eco-friendly products
1.	PVC banner	Cloth & other recyclable banners
2.	Polymer-based wet wipes	Cotton-based wet wipes
3.	Plastic cutleries	Wooden, edible, stainless steel
4.	Plastic cup	Paper cup, edible cup
5.	Plastic straw	Paper straw, edible straw
6.	Plastic foodpacks	Bagasse molded packs
7.	Pens with plastic outer cover	Covers made of dried coconut leaves, recycled paper
8.	Polymer exfoliating microbeads	Exfoliants made of Jojoba, Chito beads, Pumice, oatmeal, walnut, husks, wheat oats, almond shell
9.	Single-use mini toiletries	Refillable containers and wooden comb
10.	Protective packaging – Styrofoam, bubble wrap, or air pillows	paper cushions, paper bubble wraps, and molded pulps
11.	Transparent plastic sticky tape	Paper adhesive tape

significant results. A higher tax rate on unsustainable goods will not only raise their prices for consumers but also reduce the profitability of producers, thereby encouraging both parties to shift towards sustainable alternatives. These levies will serve the dual purpose of deterring the manufacture or use of products that are detrimental to the environment while generating revenue for environmental cleanup efforts. It is recommended to ensure that the environmental levies correspond to the scale of environmental damage caused by the product and remain aligned with inflationary trends. Implementation and monitoring of environmental legislation poses significant challenges in a developing country like India, given its large population and diverse socio-economic landscape.

To promote recycling and reuse, the cost of virgin materials and associated taxes should be set sufficiently higher than the cost associated with the collection and recycling of used materials. This can reduce reliance on virgin resources, incentivize the adoption of eco-friendly practices, and reduce environmental impact. Currently, the recycling industry in India focusing on plastic waste, parings, and scrap falls under the 5 % tax regime and this shall be incentivized to promote recycling. Implementing an environmental tax on tourists can help manage the waste generated by tourism and promote eco-tourism initiatives. This revenue generated can be allocated towards waste management infrastructure and conservation efforts, thereby mitigating the environmental impact of tourism while encouraging sustainable tourism practices.

By integrating economic instruments like DRS, EPR, and taxation measures, along with promoting recycling, reuse, and eco-tourism initiatives, India can effectively address the challenges of marine litter and promote sustainable development. However, it is essential to ensure that these measures are strictly and transparently implemented, and rigorously monitored to achieve the desired environmental outcomes.

Strategy 10 - Green Procurement Policies

The percentage of public procurement is estimated to constitute between 20 and 22 % of India's gross domestic product (GDP) (PIB, 2019). India, as one of the fastest-growing economies in the world (IMF, 2023), lacks guidelines mandating organizations to include environmental criteria in public procurements.

To address this gap, it is essential to adopt green procurement policies for government agencies and institutions. These policies should prioritize the purchase of products and materials with minimal environmental impact. For example, the Environmentally Preferable Purchasing (EPP) program of the USEPA leverages the power of the federal government's over \$690 billion trade book to foster a more sustainable marketplace. (<https://www.epa.gov/greenerproducts/about-environmentally-preferable-purchasing-program>). Moreover, providing market incentives for greener or more sustainable alternatives, along with products certified with ECO Mark by the BIS, can further encourage environmentally conscious procurement practices. Additionally, where possible, incorporating environmental incentives into the structure of existing product taxes can drive consumer and producer behavior towards more sustainable choices.

Strategy 11 - Extended Producer Responsibility (EPR)

EPR schemes have demonstrated effectiveness in transferring some waste management costs from taxpayers to the producers and consumers of waste-generating products (OECD, 2016). Additionally, EPR encourages the development of Design for Environment (DfE) products, which prioritize considerations such as recycling and end-of-life management of products and packaging. Ultimately, this approach could pave the way for a reduction in landfills and open dumping.

The existing EPR framework in India is an exemplary strategy for addressing the burgeoning waste management challenges. EPR obligations are proposed based on the amount and type of plastics generated, with a particular focus on packaging wastes, a significant sector associated with consumption and mismanagement. It is estimated that approximately 70 % of plastic packaging products end up as plastic waste within a short span (SBM, 2019). Hence, the EPR framework

creates a robust reverse demand for used material in the market, thereby enhancing collection and recycling efforts. Successive amendments to the EPR framework have the potential to further harness its effectiveness for managing other types of wastes (e.g., plastic water and beverage bottles, Styrofoam, tyres, plastic composites, rice, and cement bags made of polypropylene and polyethylene). Incorporating of modulated fee structure as per the environmental performance of the product can incentivize producers to improve the sustainability of their products.

Strategy 12 - Deposit refund and waste depository scheme

Although the deposit refund scheme already exists in India for several products, its effective implementation has proven challenging for SUPs such as plastic water or beverage bottles, and milk pouches, which have low utility and high littering potential. Implementation of DRS is comparatively easier for the products with less production volume, higher costs, and longer life cycles (ex: batteries, and electronic goods) as compared to the products with high production rates, low costs, and shorter life cycles.

The refund cost will be the key driver in the effectiveness of the DRS which should be sufficiently high (X % of product cost) to influence a notable shift in public behavior. It affects purchasing behavior, compelling producers and manufacturers to shift to sustainable alternatives and facilitating cost-effective reuse, recycling, or material recovery processes. The initial deposit serves as an environmental cost borne by the consumers who do not intend to return the product for deposit redemption. Additionally, the discarded bottles may be collected and returned by rag pickers or individuals motivated by refund incentives.

For the effective implementation of DRS, several key aspects need to be addressed.

Scope Definition: Well-defined scope of DRS, including a channelization chart that outlines the flow of products from consumers to recycling facilities.

Product and Brand Inclusion: List the specific products or brands covered by the DRS. Consider including provisions for cross-brand collection to ensure comprehensive coverage.

Deposit Refund Locations: Specify the designated places where the consumers can deposit products for refund redemption. This could include mandatory recollection from the retailers selling the applicable products. Ensure clarity on the conditions for recollection and deposit refund, such as any physical condition requirements for the returnable items.

Collection Options: The possible options for collection include (i) the automatic refund machines established by the government or authorized entities, (ii) digital DRS, and (iii) collaboration with Producer Responsibility Organization (PRO) for collection and recycling.

The implementation of a DRS involves significant complexities including, operational challenges and associated costs. Placing the operational burden on producers, distributors or retailers may eventually result in higher product prices for consumers. The DRS could fail to achieve the intended outcome and can have regressive impacts, if its scope is poorly defined and due to a lack of coordinated efforts. E.g., prices of plastic water bottles may skyrocket due to the inclusion of DRS, while recollection efforts suffer due to inadequate channelization, ultimately affecting the lower-income group.

In contrast, waste depository schemes such as the plastic-for-schooling program demonstrate promising alternatives to improve the collection rate and raise awareness in rural regions or towns. Funded by Oil India Limited, the Akshar Green School in Assam encourages its students to bring plastic waste weekly, offering an exemption from school fees in return. Such incentives not only incentivize recycling but also help generate environmental consciousness among the younger generation.

Strategy 13 - Incentivization

Setting up reverse vending machines at mass gathering places could amplify the collection efficiency. The other measures include: engaging fishers in clean-up programs and fishing for litter during the times of ban

on fishing, rewarding fishermen for collecting ALDFG, marine litter during fishing activities and handing over at the harbor, award-based incentives for coastal stakeholders, damaged gear buyback incentivization, providing incentives for local artisans who create products from marine litter for their recycling and repurposing efforts, incentivize consumers to purchase sustainable products.

Strategy 14 - Control of packaging waste

In India, the packaging sector contributes to the highest share (24 %) of consumption (NITI Aayog, 2022). Unsurprisingly, the packaging sector contributes to the highest share of consumption in other major countries viz., United States of America (31 %), European Union member states and the United Kingdom (44 %), global average (35–40 %) (<https://www.plasticsoupfoundation.org/en/plastic-facts-and-figures/>). The current trend in this industry focussing on intra-sector breakup, dominant usage segment, and material trend is shown in Fig. 3. Measures to control packaging waste include a ban on the packaging of fruits and vegetables, increasing the thickness of shrink wraps as suitable for recycling, and limiting the unnecessary usage of shrink wraps in secondary or tertiary packaging. Biodegradable protective packaging such as paper cushions, paper bubble wraps, and molded pulps can be used as an alternative to dunnages such as bubble wrap, or air pillows.

In India, the market value of packaged drinking water amounted to over 221 billion INR. In the current decade, its growth rate is expected to compound at double digits (<https://www.statista.com>). The market share of the low-volume variants (1 L > 0.5 L > 0.25 L) is higher compared to the high-volume variants (2 L & >10 L). It is observed that low-volume variants (<1 L) are of high pollution potent and widely used in public functions and business gatherings (MSME report, 2021). Phasing out of low-volume variants with immediate effect at eco-sensitive sites and coastal states, providing potable and palatable free-of-cost drinking water facilities at mass gatherings, and its' proper management is recommended to curb ~2.8 lakh tonnes/annum of mismanaged plastic bottles in India.

Strategy 14.1 - Grocery sector

Setting up year-wise targets for reducing grocery packaging waste by X%, maximizing the usage of recycled content, and improving the recyclability of packaging products are crucial areas for mitigation. Undoubtedly, a reduction in consumption can be achieved by implementing refill models such as brand-owned packaging and consumer-owned packaging.

In the brand-owned packaging, the brand reserves the ownership of the product packaging, designed sustainably for cleaning and refilling. The consumers pay a refundable deposit, and rules for packaging return will be framed by the brand owners. Stainless steel and other metallic materials can be used as an alternative to plastics. E.g., sprinkler boxes for powder forms, and sturdy boxes for flour, dal, rice, etc. can be used. Conversely, the responsibility of purchasing and managing is shifted to the users in the case of consumer-owned packaging. Resistance from the brand owners could arise due to concerns about adulteration and retail market supply burdens. Concentrated refills for body, hand, and dish

wash can minimize package footprint (<https://www.plasticstoday.com/packaging/refillable-plastic-packaging-trend-androll/>). Establishing refill stations at offices, supermarkets, shopping malls, and a dedicated place will boost its usage.

Strategy 14.2 - E-commerce sector

Implementing the mandatory use of recyclable materials (paper, cardboard, tape) in e-commerce packaging is vital. Improving the collection efficiency through incentives or loyalty schemes such as "Return from home" for returning old packages while receiving consecutive orders. To facilitate the proper inventory of plastic waste (e.g., port waste reception and handling plans, e-commerce), packaging should bear the visible and durable barcode or markings (such as tare weight, and polymer type) either on the packaging material or the label.

Guidelines or limitations on design criteria such as product-to-package ratio should be provided to minimize excessive packaging. High taxes on packaging materials can encourage reduction and selective taxation targeting the most damaging forms of packaging (e.g., composite materials that cannot be recycled), which would encourage a switch to recyclable and eco-friendly packaging.

Strategy 15 - Plastics- value chain management and Circular economy

India has prioritized resource efficiency and the circular economy as one of its core themes during its G20 presidency. This strategic focus aligns with UN SDG targets 12.4 and 12.5 dealing with environmentally sound management of waste throughout the life cycle and reduction of waste generation, respectively. Shifting from linear economy (Take-make-use-dispose) to circular economy (Take-make-use-remake) emphasizes redesigning products during production to extend their lifespan.

Value retention processes such as refurbishment, repair, and reuse help to increase both economic and environmental sustainability. However, the availability of affordable spares is a major concern for consumers, hindering the repair and reuse efforts. To address this, the Ministry of Consumer Affairs is developing a comprehensive framework for the 'Right to Repair' aimed at streamlining the repair and spare parts market, which will make repairs more accessible to consumers.

Certain low-density plastics like styrofoam pose challenges for informal waste collectors in India due to their lower weight affecting the cost-benefit ratio of collection and their bulky volume requires significant storage and transportation space. Increasing the recollection cost along with the usage of combined economic instruments keeps this material circulating in the economy.

Strategy 16 - Discrete directives on marine litter and microplastic management

The differences in sampling techniques, reported units, mesh size of nets, variety of samplers, and extraction techniques pose significant challenges to the direct comparison of microplastic abundance across studies (Sambandam et al., 2022). The establishment of standardized protocols and quality assurance measures can help improve the comparability and reliability of MP abundance data across different



Fig. 3. Overview of the packaging industry in India (Data compiled from various sources).

studies. To ensure consistency in beach litter data, a guideline on survey and monitoring of beach litter was developed and disseminated to stakeholders (Supplementary Information). Such measures will help to track the types, and quantities of litter, and facilitate more effective policy-making and cleanup operations. The evolution of drinking water standards concerning microplastic concentration based on human health risk assessments and the development of effluent discharge standards for the safe disposal of microplastics in various environments are crucial. Incorporating the Extended Producer Responsibility for products (such as fishing nets, and ropes) prone to degrade into microplastics, is essential. On a global scale, there is a rising trend among regulators to implement strategies addressing microfiber pollution (EU, USA, UK, Canada, Australia), while policymakers recognize filtration as a viable and efficient method for the containment of microfiber particles (Schmaltz et al., 2020). Implementing the mandate on the installation of fiber holder bags or laundry nets in all washing machines used in India and microplastic filters to arrest leakage from artificial turfs are highly recommended as a source containment measure.

Strategy 17 - Fostering Research & Innovation

Strategy 17.1 - Scientific research and monitoring of marine litter and microplastics

Integration of the monitoring of marine litter and microplastic pollution with the National Water Quality Monitoring Program is crucial for understanding the present status of marine litter and also to check the effectiveness of mitigation measures. Hotspot mapping using technology-driven techniques such as Artificial Intelligence/Machine Learning/Remote Sensing and Geographic Information System (GIS) can significantly enhance litter monitoring and identification. Integrating technology and artificial intelligence into the monitoring and management of marine litter involves existing and new solutions, such as the installation of solar-powered 24×7 monitoring cameras near the river mouth to estimate the plastic waste input into the ocean, providing valuable data for targeted intervention strategies. Promoting the research to examine the effects of marine litter on marine life, ecosystems, and biodiversity is essential for raising awareness and informing effective mitigation efforts.

Strategy 17.2 - Research on Eco-Friendly and alternative materials

Allocate funding for research into eco-friendly materials such as biodegradable materials and innovative packaging solutions. Investing in research to identify and develop alternative materials to plastics, especially for industries and sectors viz., packaging, agriculture, healthcare, textiles, and horticulture, where plastic usage is prevalent and in turn, significantly contributes to marine litter. Many of the additives used in plastics have proven to be a carcinogen, endocrine disruptor compounds, neurotoxins, growth inhibitors, and thyroid, immune, and hormone disruptors (Plastic and Health, 2019). Therefore, research is essential on chemical hazard reduction measures such as the production of bisphenol A (BPA) and phthalate-free materials, the use of alternative compounds that are less likely to leach, non-carcinogenic, and non-toxic.

Strategy 18 - Certifications

At present, India has 12 Blue Flag certified Beaches viz., Shivrajpur Beach (Gujarat), Ghoghla Beach (Diu), Kasadgod and Padubidri beaches (Karnataka), Kappad Beach (Kerala), Golden Beach (Odisha), Rushikonda Beach (Andhra Pradesh), Kovalam Beach (Tamil Nadu), Eden Beach (Puducherry), Radhanagar Beach (Andaman & Nicobar), Minicoy Thundi and Kadmat beaches (Lakshadweep) (PIB, 2022). Blue flag beaches create an opportunity for an improved environment and employment by boosting the local economy. Therefore, we recommend focusing on increasing the number of blue flag beaches in India. Establishing a certification system for businesses, and introducing the Ocean-friendly certification for resorts, hotels, and restaurants on or near beaches that are committed to reducing plastic waste in their operations (ex: replacing the complementary SUPs self-care kits with eco-products), can encourage corporate responsibility.

Strategy 19 - Enhancing existing legislative measures

Despite the ban on the sale and usage of single-use plastics such as thin carry bags ($<120 \mu\text{m}$), plastic cups, and plastic cutleries, their widespread use persists due to a lack of economical alternatives (Biswas et al., 2023). It is imperative to ensure stringent implementation, field enforcement, and compliance monitoring of existing legislation related to waste management. Currently, banned SUPs ($n = 19$) constitute about 2–3 % of manufactured plastics and 11 % of generated SUP waste. These items were proposed for the ban based on outcome scores of comparative assessment of parameters such as the Utility Index (Hygiene, product safety, essentiality, social impact, economic impact) and its Environmental Impact (Collectability, recyclability, possibility of end-of-life solutions, environmental impact of alternative products, littering propensity) (Report on Single-Use Plastics, 2019). The evaluation method could benefit from some enhancements such as differential weightage on parameters (e.g., collectability affects recyclability), and inclusion of factors such as disintegration tendency, production scale, and availability of economic alternatives. Moreover, some of the high-scored pollution potential products (e.g., plastic bottles $<200 \text{ mL}$) were deferred from the immediate ban.

Dilation of the ban to other pollution potential SUPs and phasing out difficult-to-recover plastic items is essential to eliminate the problem of marine litter at the grassroots level. The labels of SUPs should contain information on reuse hazards on human health to promote awareness. Enforcing the ban on low-usage, high-littering potential single-use items, for which alternatives already exist in the market (e.g., polymer wet wipes, cellulose acetate adhesive tape) is essential. Additionally, adherence to landfill site selection criteria and implementing measures such as chain-link fencing, or litter netting at the perimeter of landfills can help contain plastic waste and prevent environmental contamination. Framing guidelines for the establishment of plastic waste storage facilities in flood-prone zones, ensuring consideration of fire safety, litter netting, and other relevant factors are advocated.

Strategy 20 - Environmental principles

Imposing severe penalties and legal action against individuals or companies relative to the level of damage caused through the Polluter Pays Principle. The severity of penalties should correlate with the extent of damage caused by the unsustainable products, prioritizing accountability starting from the producer or manufacturer, distributor, retailer, and finally consumers. The manufacturers or producers of banned plastic products should face legal action and significant fines. Preventive principle shall be applied for the elimination of pollution at the source. The free rider problem hinders the circular economy by restraining the reuse of many products (e.g. carry bags). As part of this action, complimentary carry bags (excluding eco-friendly products such as cloth, and paper bags), free supplementary use and throw items (e.g., plastic spoons for powder-form products) should be banned.

6. Key performance indicators (KPI) and review of policy

It is highly recommended to devise a framework to gauge the effectiveness of enforcement. The availability of resources (KPI 1) viz., infrastructure, human and financial resources is crucial for the successful implementation and enforcement of legislation. Ideally, KPI 2 (Enforcement) and KPI 3 (Management) should have an inverse relationship. In case, the targets of KPI 3 for the specific period could not be achieved due to any reason, KPI 2 should reflect a positive outcome in terms of the parameters listed (Fig. 4). The levies collected through effective enforcement (KPI 2) could be used to finance the waste management system.

Rule 17(3) of PWM Rules, 2016 mandates the State Pollution Control Board and Pollution Control Committee to submit an annual report as per Form-VI to CPCB. Non-compliance with this rule has been observed since its inception (<https://cpcb.nic.in/annual-report.php>). Strict compliance with proper inventories of plastic waste is crucial for mass budgeting, facilitating accountability in recycling and disposal rates,

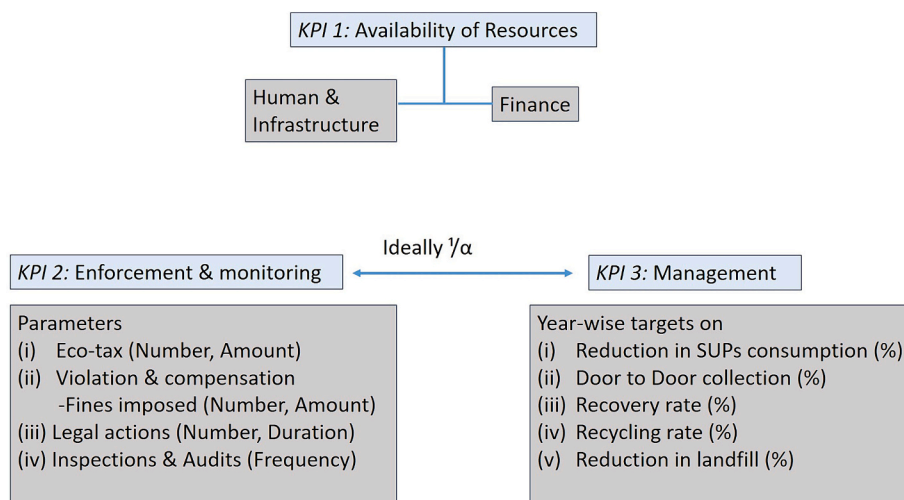


Fig. 4. Key Performance Indicators to gauge the effectiveness of policy.

and mapping the sources of waste generation. A waste bin or landfill monitoring program can help identify the violated usage of banned products, while a waste auditing program helps to assess the major composition of unsustainable products.

It is recommended to monitor the effect of the SUPs ban on the beaches. Such monitoring systems are necessary to gauge the effectiveness of the policy. Setting up specific goals for targeted reduction of plastic waste, increasing recycling rates, and remediation frequencies will help measure the progress. As scientific understanding and circumstances evolve, policies must also adapt and remain effective by implementing a framework for regular policy review and adaptation. Continuous monitoring of international best practices in marine litter management is vital. It is recommended to adapt national policies to align with evolving global standards, thereby ensuring that local efforts are aligned with broader international efforts to address marine litter pollution.

7. Conclusion

The rapid growth rate of plastic waste generation in India, estimated at 8.5 % per annum, poses a significant threat to the country's marine ecosystems, economy, and cultural heritage. The vision of achieving a cleaner, healthier, and more resilient marine environment is achievable through unified action and effective policies. While progress has been made, persistent challenges and the scale of the issue underscore the need for continued and intensified efforts. By adopting a comprehensive policy framework, India can mitigate the adverse impacts of marine litter, promote sustainable practices, and secure its coastal resources for future generations. As we navigate the challenges of the 21st century, a national policy focused on the seas is not merely an option but an indispensable necessity.

CRediT authorship contribution statement

Murugan Sambandam: Writing – original draft, Visualization, Conceptualization. **Pravakar Mishra:** Writing – review & editing, Supervision, Conceptualization. **Kuppuswamy Dhineka:** Writing – review & editing, Data curation. **Thanamegam Kaviarasan:** Writing – review & editing, Data curation. **M.V. Ramana Murthy:** Supervision. **Muthalagu Ravichandran:** Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

Data availability

No data was used for the research described in the article.

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Appendix A. Supplementary data

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‘Puneet Sagar Abhiyan’ gets global partner: NCC & UNEP sign MoU in the presence of Raksha Mantri Shri Rajnath Singh to synergise efforts to achieve the universal goal of clean water bodies

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National Cadet Corps (NCC) and United Nations Environment Programme (UNEP) signed a Memorandum of Understanding (MoU) in the presence of Raksha Mantri Shri Rajnath Singh in New Delhi on September 22, 2022 to tackle the issue of plastic pollution and achieve the universal goal of clean water bodies through ‘Puneet Sagar Abhiyan’ and ‘Tide Turners Plastic Challenge programme’. The MoU was signed between DG NCC Lt Gen Gurbirpal Singh and Resident Representative, UN World Food Programme Mr Bishow Parajuli. Raksha Rajya Mantri Shri Ajay Bhatt, Defence Secretary Dr Ajay Kumar; other senior officials of Ministry of Defence and representatives of UNEP were present on the occasion.

Describing ‘Puneet Sagar Abhiyan’ as one of the noblest initiatives, the Defence Secretary, in his address, lauded the efforts of NCC in making the campaign a grand success. He asserted that 1.5 million NCC cadets have the ability to influence the thinking of youth across the world, exuding confidence that they will be instrumental in making the campaign a mass movement. Dr Ajay Kumar thanked the UNEP for extending its support to NCC for the campaign, stating that “it is our collective responsibility to protect the environment for future generations to live a long and healthy life”.

Pillar of India’s climate change resolve

The ‘Puneet Sagar Abhiyan’ is among the slew of initiatives taken by the Government to realise the vision of Prime Minister Shri Narendra Modi, which he referred to as ‘Panchamrit’ during the 26th United Nations Climate Change conference, COP26, held in Glasgow, Scotland between October 31 to November 13, 2021. The Prime Minister had presented five nectar elements as India’s unprecedented contribution to deal with climate change. These are:

1. India will take its non-fossil energy capacity to 500 GW by 2030.
2. India will meet 50 per cent of its energy requirements from renewable energy by 2030.
3. India will reduce the total projected carbon emissions by one billion tonnes from now till 2030.
4. By 2030, India will reduce the carbon intensity of its economy by more than 45 per cent.
5. By 2070, India will achieve the target of Net Zero.

Spiralling Drive

The NCC had, on December 01, 2021, launched ‘Puneet Sagar Abhiyan’, a nationwide flagship campaign, initially for one month, to clean sea shores of plastic & other waste material, while raising awareness about the importance of cleanliness. It was subsequently extended as a Pan-India round-the-year campaign to cover rivers and other water bodies as well.

The NCC, the largest uniformed youth organisation in the world, mobilised its cadets to collect plastic and other waste material. The campaign gained tremendous momentum, acceptance and participation following its launch. Different Ministries and organisations, including Ministry of Environment, Forest and Climate Change, Department of Science & Technology, Indian Navy, Indian Coast Guard, Sainik School Society, Army Welfare Education Society, Border Roads Organisation and National Highways Authority of India have extended their support to the NCC in this noble cause.

Since the launch of ‘Puneet Sagar Abhiyan’, over 100 tonnes of plastic waste have been collected from nearly 1,900 locations by more than 12 lakh NCC cadets, alumni and volunteers, impacting 1.5 crore people. Of the approximately 100 tonnes of collected plastic waste, more than 60 tonnes have been handed over for recycling.

‘Puneet Sagar Abhiyan’ – a Tide Turner

Following the growing support and success of the campaign, the UNEP, engaged in this initiative through their ‘Tide Turner Challenge Programme’, decided to join hands with the NCC, with the aim to leverage the youth organisation’s strengths. The UN body has the mandate and knowledge base for addressing various issues relating to environment, including plastic pollution and has a programme for engaging youth.

The aim of the MoU between NCC and UNEP is to synergise and collate efforts towards engaging youth for promoting clean water bodies. The objective is to engage in capacity building and awareness on environmental sustainability through information sharing and training initiatives; promote opportunities for NCC cadets to participate in appropriate national & international platforms related to environment and climate change and engage in and develop joint initiatives of mutual intent pertaining to environment and climate change. The MoU, to remain in force for a period of three years, aims at consolidating, developing and detailing their cooperation and effectiveness to achieve the common objectives in the field of environment.

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