





<u>National Policy Workshop Webinar Series</u> <u>On</u> <u>Countermeasures for Riverine and Marine Plastic Litter in India</u> <u>12 -22 May 2020</u>

Session 1: The Science and technology of Plastics & techniques/best practices of plastics pollution assessment and investigation

> Methodology for Microplastics Assessments in Rivers & Oceans and constraints

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CSIR – National Institute of Oceanography (NIO), Goa, India Methodology for Microplastics Assessments in Rivers & oceans 12.05.2020





Microplastics: why study them in River water?



- Microplastics are everywhere!
- Rivers and land recognised as sources but little studied compared to oceans
- Can be ingested by organisms
- May act as vectors for transport of persistent organic pollutants (POPs)



What we know and what we need to know

What we know:

- · Accumulation of plastics in the aquatic environment
- Microplastics (< 5 mm)
- Microplastics in the food web
- Many studies on marine plastics

What we need to know:

- Very few studies of plastics in freshwater environment
- Very few studies on biological effect
- · How to measure concentrations in the environment/animals
- Should we be concerned and regulate ?





Microplastics (MPs) are one of the most significant emerging pollutants due to extreme durability and synthetic nature posses tremendous threat to aquatic environment . 13-05-2020

Sarkar et al, (2019), Science of total environment





Transport of plastics through river to coastal ecosystem



Out of 200 MPs research study

Marine : 54% Estuary: 18% River : 11% Kdogan and GuvenI (2019), Environmental pollution



Microplastics & Classification





Primary microplastics

- Manufactured in size range of 5-1mm, e.g. Microbeads, scrubbers and pellets.
- Cleaning and cosmetic products are the main sources.



Assessments in Rivers & oceans

Secondary microplastics

- After fragmentation becomes less than 5mm in size, e.g. fibers, fragments, films.
- Fishing nets, line fibers and films are the main sources.



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Sources and fate of Microplastics





Transfer of Plastic Associated Toxins to Humans via the Food Chain

Microplastics contain toxic plastic additives (phthalates, flame retardants- PBDE)

It adsorb persistent organic pollutants (POPs), such as (DDTs) and (PCBs from the environment

Filter-feeding marine megafauna are particularly prone to microplastic ingestion and contamination by plastic-associated toxins because of the large volumes of water they ingest during feeding (Germanov et al., 2018)

Common plastic-associated toxins: CI_ CI_CI 5 Phthalates Organobromines Trends in Ecology & Evolution

>MPs 0.1 µm-5mm (Thompson et al., 2004)

- Land & sea based (UNEP 2005)
- Low and high density (pelagic & bottom)
- Plastic particles break down by physical, chemical and biological processes

(Wright et al., 2013)



Importance of the MPs study in River Ganga



- River Ganga travels almost 2,525 kilometers from its origin and almost 625 million people live in the Ganges River basin. An estimated 11,625 tons of solid waste is generated in cities lying along the Ganges River and its tributary the Yamuna River.
- Lebreton et al. (2017) highlighted the River Ganga was in second most polluted, among the top 20 polluted rivers in the world based on global model with geospatial data of population density. However there was no real time data available to validate their study and confirm the position of Ganga River. Hence the proposed study is extremely important to get real time data on the River Ganga, not only as regional study but also as a national study.
 - Method standardization is needed in order to obtain comparable data from different environmental compartments and sites. This includes sampling strategies (at spatial and temporal scales), sample treatment (taking into consideration high levels of organic matter and suspended solids) and reliable analytical methods.
- Implementing mitigation strategies requires an understanding and quantification of marine plastic sources, taking spatial and temporal variability into account.



Microplastics study in CSIR-NIO, Goa, India



Since 2015 till date, NIO has started to generate the baseline data on distribution, sources and composition of micro-plastics in the coastal and marine environments along the west coast of India.

Abundance, identification, quantification and characterization of microplastics and its associated hazardous chemicals.

Impact of microplastics on biota.







Sorting of microplastics by FTIR-ATR



Microplastic pellets (MPP) along the Goa coast, India

Chemosphere 159 (2016) 496-505



CrossMark



- Input of fresh pellets in SW monsoon and Less fresh MPP and more weathered and colored MPPs were found in NW monsoon.
- PE and PP are the dominant polymer types of MPPs deposited on the Goa beaches.
- Source of MPs are mainly ocean based.



Assessment of micro and macro plastics along the west coast of India: Abundance, distribution, polymer type and toxicity





- A relatively high abundance of plastics recorded on most popular beaches along the west coast of India.
- Toxicological changes in <u>Litopenaeus vannamei</u> were recorded at the highest exposure dose of PE microbeads.





Study area



Microplastics sample

















Constraints during water sampling and Instrument setup

- While collecting surface water, due to high water flow and turbulence it is difficult to tow the net which provide a demanding environment, especially when handling large-sized net.
- High organic matter (plant leaves, flower and other natural waste) can stuck in to the net, which can hamper the movement of flowmeter.
- For collecting measurements in medium- and large-sized natural streams is keeping the device stable at the required points in the water column is very difficult some times.
- Towing time of net should be selected based on the water system (River, estuary, ocean), because there will be high chance of eructation of net due to phytoplankton blooms and other natural phenomenon.
- In the shallow water specially when the water depth is very low less than 3m, towing the net is not possible as sediment load can prevent the flow of net horizontally.







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Water sample



Filtration by 5 µm filter paper Sieves(5mm, 1mm, 300µm)







Stereomicroscope₁₂



FTIR microscopic polymer detection





dominated by fibres, fragments, and films.





TOTAL 30 TYPES OF POLYMERS WERE DETECTED



Deliverables from this study



- This study will be critical for establishing the baselines data on abundance, seasonal variation and source of macro to microplastics for future aquatic pollution and water quality monitoring.
- Standardization of new methodology on microplastics research.
- Identifying the hotspot and vulnerable areas for effective prevention and management options.
- Output of this work will be useful to the coastal and offshore stakeholders, managers and policy makers, State and Central Pollution control boards.
- Establishing advanced microplastics study in India.

