

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

***Session 4: Assessment of plastic pollution impact on natural capital and riverine and marine ecosystems needing policy intervention***

**SAMPLING AND ANALYSIS CHALLENGES IN FRESHWATER MICROPLASTIC STUDIES**  
**18-May-2020**

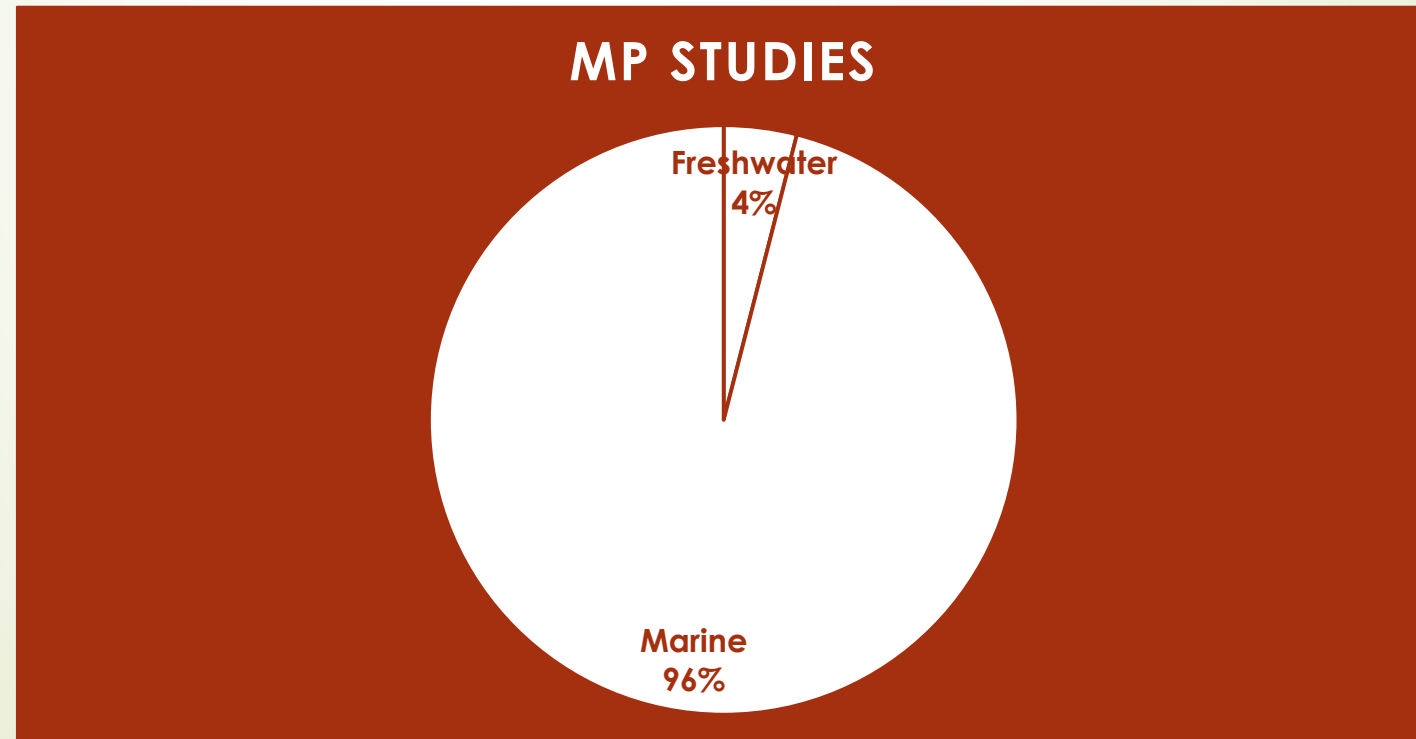
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**Wildlife Institute of India**

# Introduction

- ▶ Microplastic research is accompanied by many methodological challenges that need to be overcome first to assess the impact of microplastics on aquatic systems.

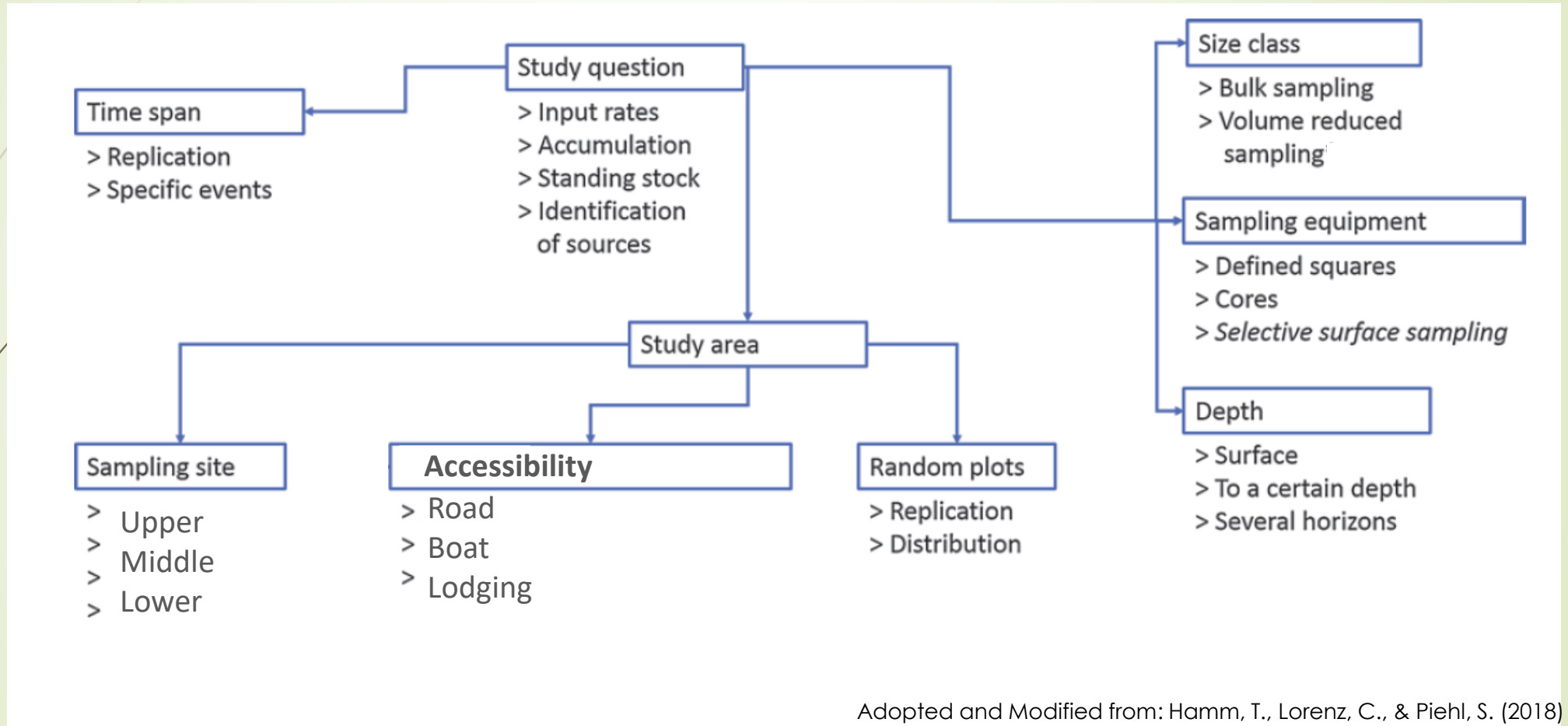


# Schematic of Challenges in Freshwater MP studies

- Sampling Design
- Equipment
- Contamination Issues
- Sample Processing
- Well equipped Lab
- Instrumentation Facility
- Trained Manpower
- Time & Funds



# Sampling Design



# Field Sampling



## 1. Site Selection

- ▶ Representative considering natural and anthropogenic factor variance
- ▶ Spatial Coverage
- ▶ Temporal Coverage
- ▶ Replicates

## 2. Natural Factors

- ▶ Contamination
- ▶ Weather Conditions
- ▶ Flow and Current

## 3. Other Factors





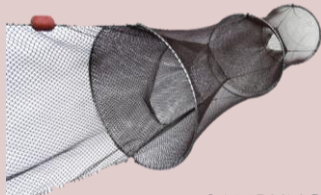
- ▶ Accessibility
- ▶ Logistics Support
- ▶ Local Community Support
- ▶ Boarding and Lodging for team
- ▶ Safety of team members
- ▶ Safety of equipment

# Equipment

## 1. Water

- ▶ For freshwater sampling large Manta trawls and Neuston nets cannot be used
- ▶ Depth and flow profile variability of river makes it difficult to use trawls
- ▶ Depending on physical characteristics of the river, the sampling equipment should be decided
- ▶ Initial hit & trial with recommended and local solutions need to be worked out

Adopted and Modified from :  
Listener, 2018

Sampled compartment	Most common used equipment	General description	Pro	Contra
Manta or plankton/neuston nets with flowmeter		Net is towed over the water surface to a certain depth (depending on mouth opening) and volume recorded with a flowmeter	large sample sizes exact for the water surface layer integrates a high area of water surface	Handling of bulk equipment impossible on small boats used for sampling in Rivers
Bulk sampling with bottles		Water samples are taken directly from water surface and bottles closed below surface to reduce contamination	whole size range of MPs can be sampled reduced contamination issues	small sample sizes may result in a high variability varying sampling depth
Bulk sampling with hand-net		Water sample is taken with a container/bucket and poured over meshes on board	whole size range of MPs can be sampled pre-separation of size classes possible large sample sizes can be obtained	varying sampling depth contamination through higher air exposure times device materials need to be considered
Pumping systems		Water is either collected by a hose or a submersible pump	whole size range of MPs can be sampled pre-separation of size classes possible large sample sizes can be obtained reduced contamination issues	Works only with motorboats/power source.
Eel Fyke Net		Cylindrical netting bag usually with several netting cones fitted inside the netting cylinder	low operation effort archived data records available	smaller MP particles, which cannot be hand-picked can probably not be recovered from the silk material

# What may work for rivers?



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- Selection of right mesh size is crucial
- Mesh size of 300  $\mu\text{m}$  is commonly used
- Different mesh sizes are often used depending on the required volumes and the targeted size of plastic
- E.g. 80  $\mu\text{m}$ -mesh-size net collects thin fibers more efficiently whereas in 500  $\mu\text{m}$  net, bigger and scarcer debris are sampled more representatively.
- Availability of correct mesh in India is a challenge.
- Not in stock. Generally requires a lead time of 2 months to order.
- Option of Import and high cost plays a role



# Equipment

## 2. SEDIMENT

### a) Surface Sediment

- ▶ In marine sediment sampling, transects are a common approach when conducting a beach survey with quadrats of various sizes utilized
- ▶ In freshwater sediments, sediments are often collected from the river shoreline based on the sampling design
- ▶ Nonplastic sampling tool (tablespoon, trowel, or small shovel) and a nonplastic sampling vessel are sufficient for surface sediments
- ▶ Depth – 5 cm – 0.5m



# Equipment

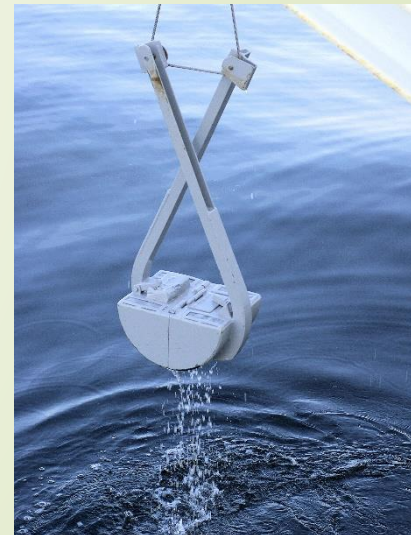
## 2. SEDIMENT

### a) Bottom Sediment

- ▶ Instrument size strongly depends on the water depth of the sampling location
- ▶ Depth 5cm – 25 cm
- ▶ Tools – Different grabs and Corers - Van Veen grab, Petite Ponar Grab, Petersen grab
- ▶ Grabs are difficult to handle in rocky bottom
- ▶ Often may break and very heavy to carry on a boat.



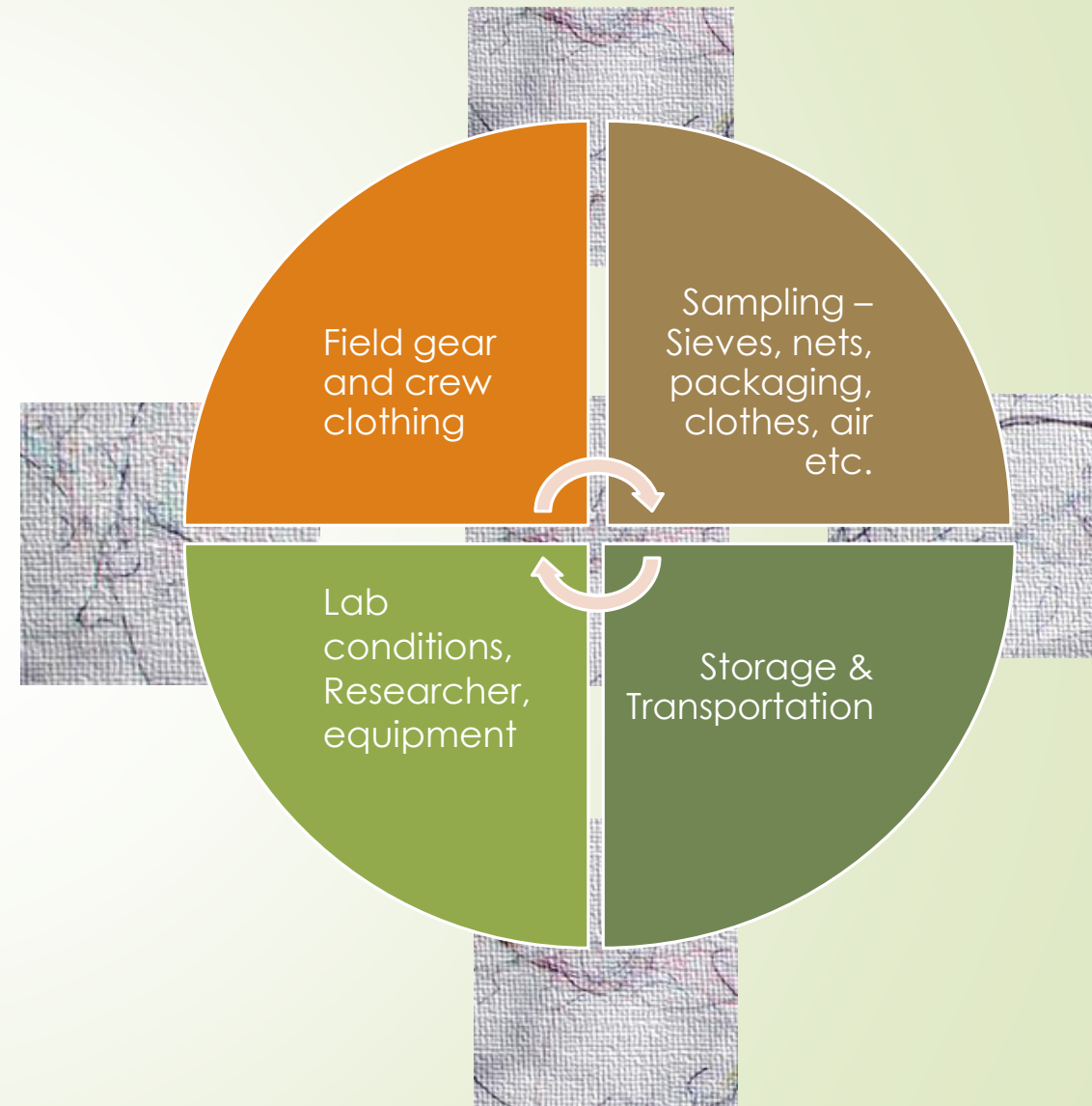
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NO SINGLE TESTED FORMULA WORKS – NEED TO EXPERIMENT AND INNOVATE AS PER THE LOCATION

# Contamination

- ▶ MP in its finest form is virtually everywhere
- ▶ Avoiding contamination to be an integral part of sampling campaign, but extremely challenging and often unavoidable in the field
- ▶ Field blanks are a must and so is statistical design to estimate variation in procedural contamination control measures vs contamination from field



# Sample Preparation

- ✓ High amount of biogenic material (biota and detritus) and inorganic material (clay, silicates) is part of the sample
- ✓ Standardization of method for extraction from selected samples
- ✓ Several methods available for each matrix
- ✓ Lab shall be equipped to contain contamination through labcoats, consumables, lab items, open chamber etc.
- ✓ Procedural blanks cannot be ignored

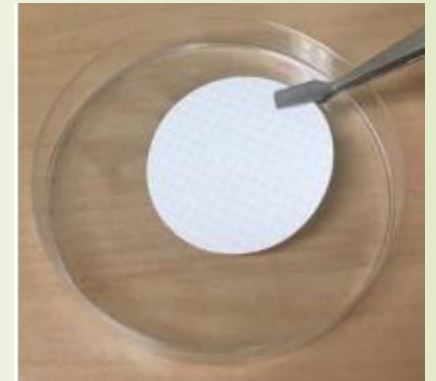
# 1. WATER Processing

## 1. Sample purification

- ▶ Several digesting agents used – Acids, bases, oxidative agents, enzymes etc.
- ▶ Purification can take long time!
- ▶ Time, cost, destructiveness and effectiveness to be considered.

## 2. Sample Extraction

- ▶ Multiple Vacuum Filtration Units are required to simultaneously filter the sample
- ▶ Selection of Filter paper – Several types are recommended, of different material and pore size
- ▶ Availability of required filter paper and in sufficient stock is a issue and costly affair
- ▶ Clogging of filter disk is a regular issue. Acid wash also doesn't work many a times. Replacement and cost are the next issues to fix it.



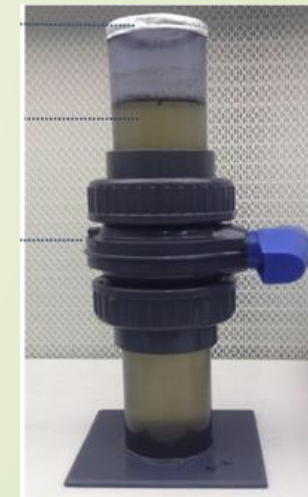
Standardization through continuous trials

## 2. SEDIMENT Processing

- Standardization of extraction process – No. of extraction processes recommended (Decantation, elutriation, fluidization etc.)
- Density separation is preferred – No. of salts are recommended (NaCl, ZnCl<sub>2</sub>, NaI, CaCl<sub>2</sub>, SPT etc.)
- Stirring and shaking through mechanical vs magnetic stirrer suggested. Varying time reported
- Separation units and isolation units are recommended. Availability and maintenance is an issue
- Settling time for sediment reported to vary between 5-8 hrs to overnight
- Recovery rates vary between 68-100%.
- So, selection of right extraction process considering important



Ref. Imhof, 2012



Ref. Coppock et al., 2017

Cost, equipment availability, time and QC are the key !!!

# Microplastic Identification

## 1. Visual Screening

- ▶ 70% of particles that potentially resemble MPs based on merely visual inspection can not be confirmed to be of synthetic origin
- ▶ Chemical characterization (CC) required to avoid overestimation
- ▶ Visual sorting followed by CC can underestimate analyte esp. very small particles
- ▶ Some recommend staining to facilitate visual analysis
- ▶ Either visual or CC the cost of identification remains challenge
- ▶ Stereo microscopes if not available may jeopardize initial screening
- ▶ Good quality high resolutions costs 5-6 Lakh INR





## 2. Chemical Characterization

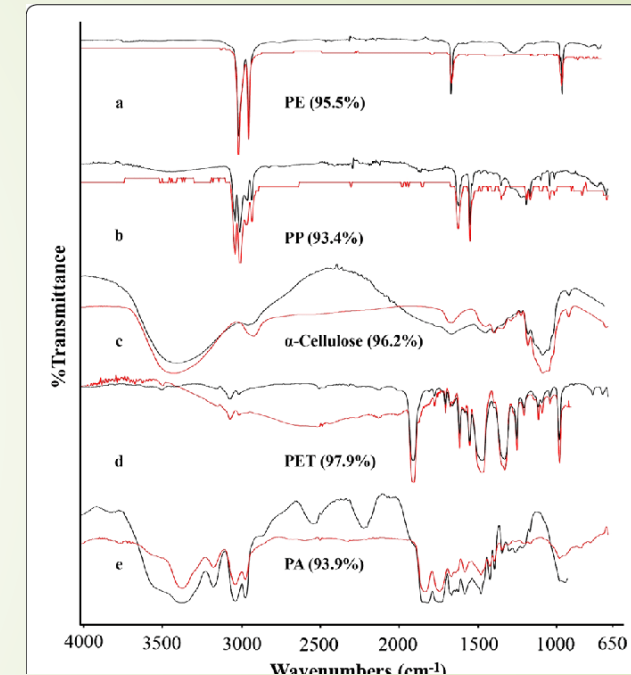
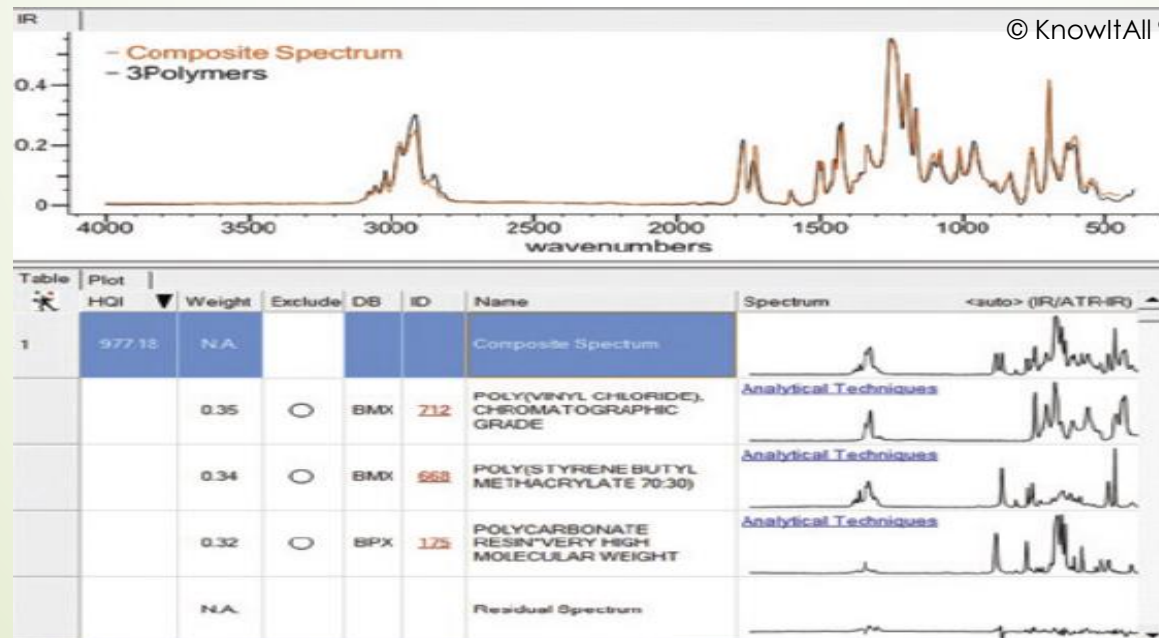
- FTIR, Raman, EDX or thermal analysis all are exceptionally costly (upto INR 1.25 Cr)
- If instrument is unavailable, dependence on external lab could be time consuming and personal learning is compromised, since external labs have a dedicated technician to handle their instruments
- Private Labs charge for per MP identification, leading to optimization of CC and potential underestimation of MPs in the sample



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### 3. Polymer Library

- Standard polymer libraries may not have peaks for all polymers. May lead to underestimating and missing a possible polymer type
- Additional libraries comes at an extra cost (INR 3-4 Lakhs)
- Experienced and skilled person is required for peak integration and matching. Lack of knowledge about polymer classes may lead to missing some



# Key Gaps and Needs Identified

Gap	Rationale
Standard protocol for microplastic sampling in freshwater bodies	Several standard protocols exists for marine MP sampling and analysis, making studies easy
	Most plastic litter being produced onshore and introduced into marine environments by rivers, thereby requiring larger standardized studies on Rivers
India Specific monitoring and analysis Strategy	Cultural, religious status of rivers in India. Require tremendous local support for sampling and safety.
Training and capacity building of Research and Scientific Community in India for MP studies	Self learning, working in silos or through international collaborations, few studies from India as compared to other countries
Funding Support for MP studies	Very high cost of equipment and analysis

# Suggestions , Recommendations and Discussion

- Scientific consultation to prepare standard protocol for freshwater MP sampling and analysis
- India specific guideline considering local issues. Community trainings and involvement will facilitate larger spatial coverage at the same time empower communities.
- Collaborations and exchange of knowledge for mutual benefits
- Till the standardization of methodology, consideration for strong sampling design for spatial, temporal coverage, replicates and avoidance of contamination
- Need to team up!

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Namaste.



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