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

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

Approach of MPs sampling and analysis in sediments of river Ganga

Presented by
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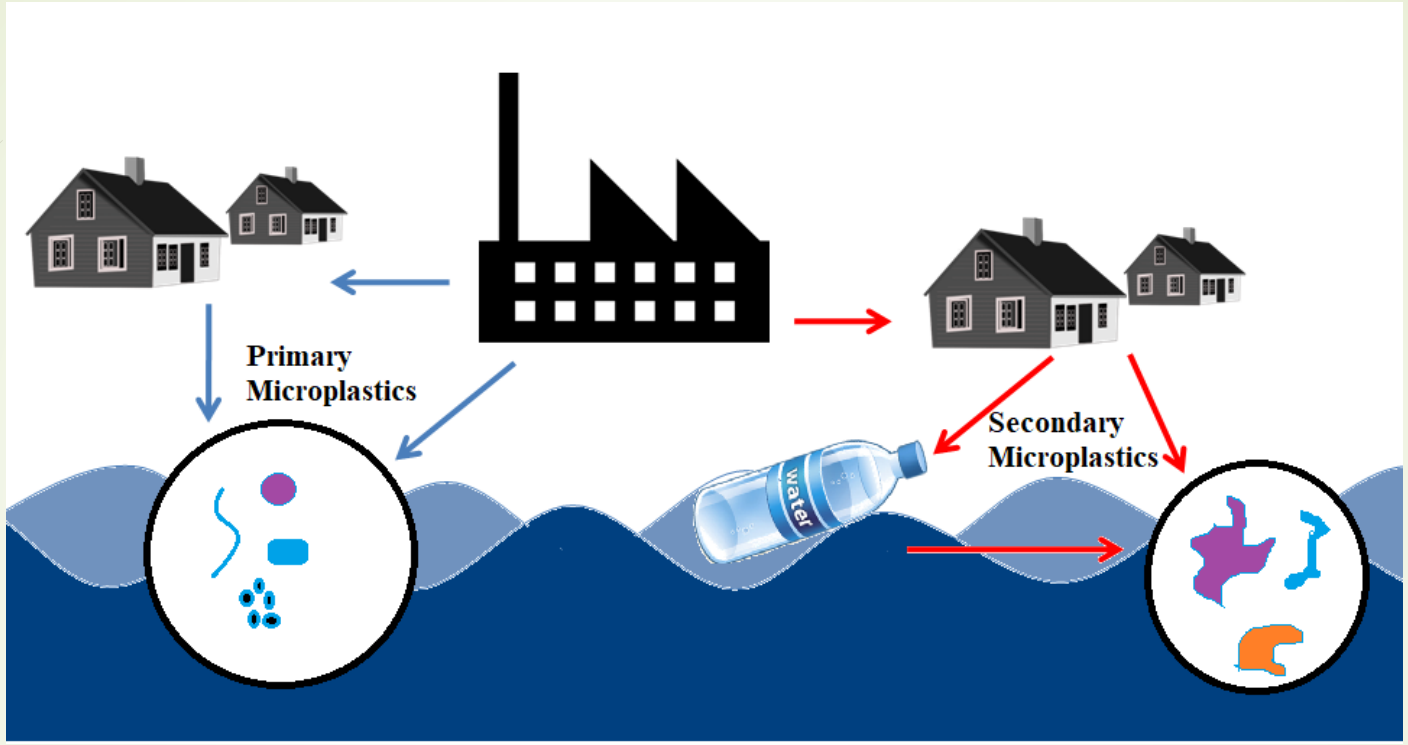
Single use plastics

Plastics: Agriculture and Fisheries

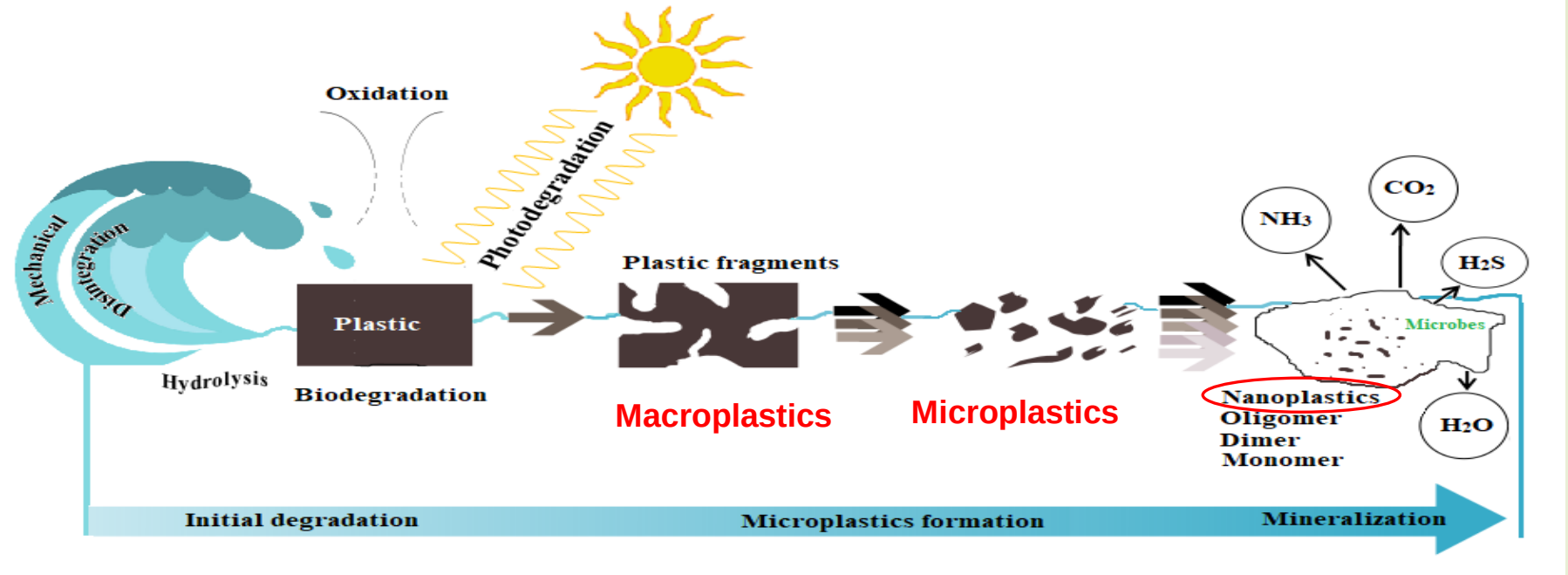
Plastics transport to river



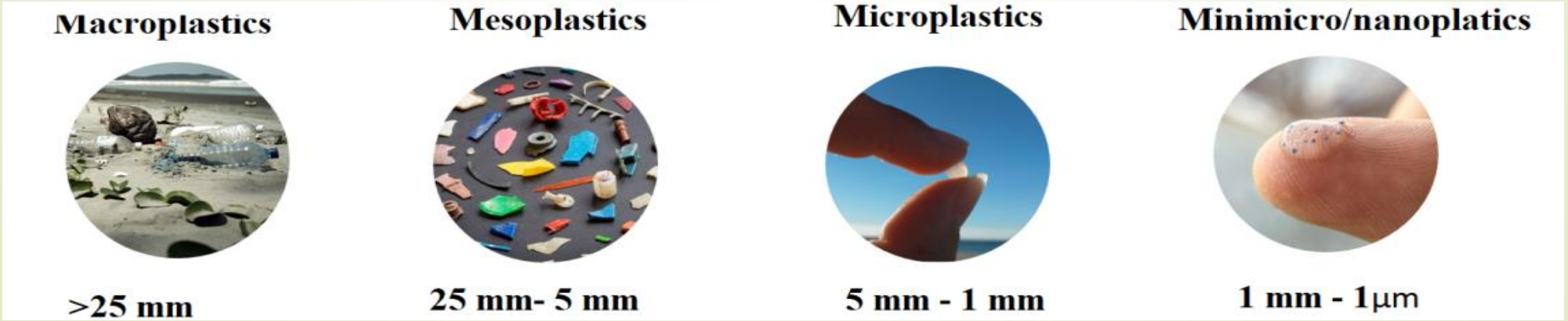
- River is the one of main source of marine plastic pollution carrying more than 2 million tonnes of MP per year
- Asian river contributes 86% of the total global plastic input
- According to a predictive model it has been highlighted that Yangtze river catchment of China holds highest annual (0.33 million tonnes) plastic debris followed by Ganges of Indian Subcontinent (0.12 million tonnes per year)

(Leberton et al., 2017, Nature Communication)

Plastic transformation in aquatic bodies



Micro-plastics are synthetic polymers that range in size from 100 microns to 5 millimeters



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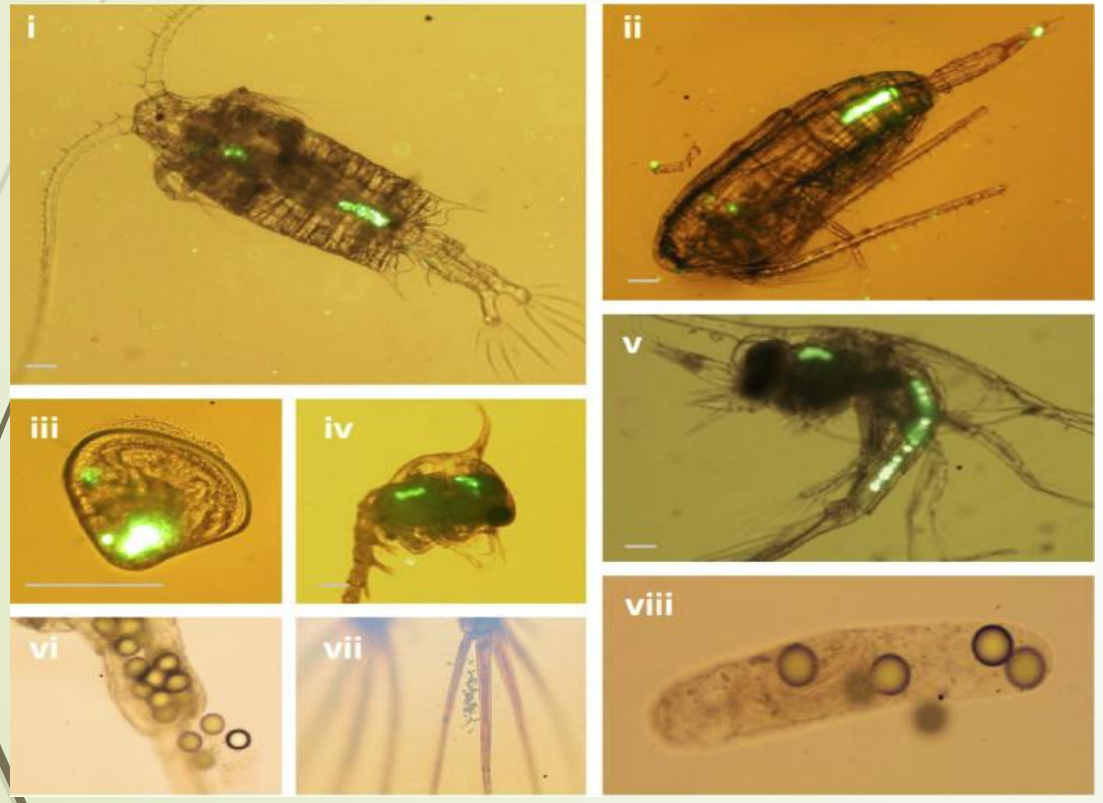
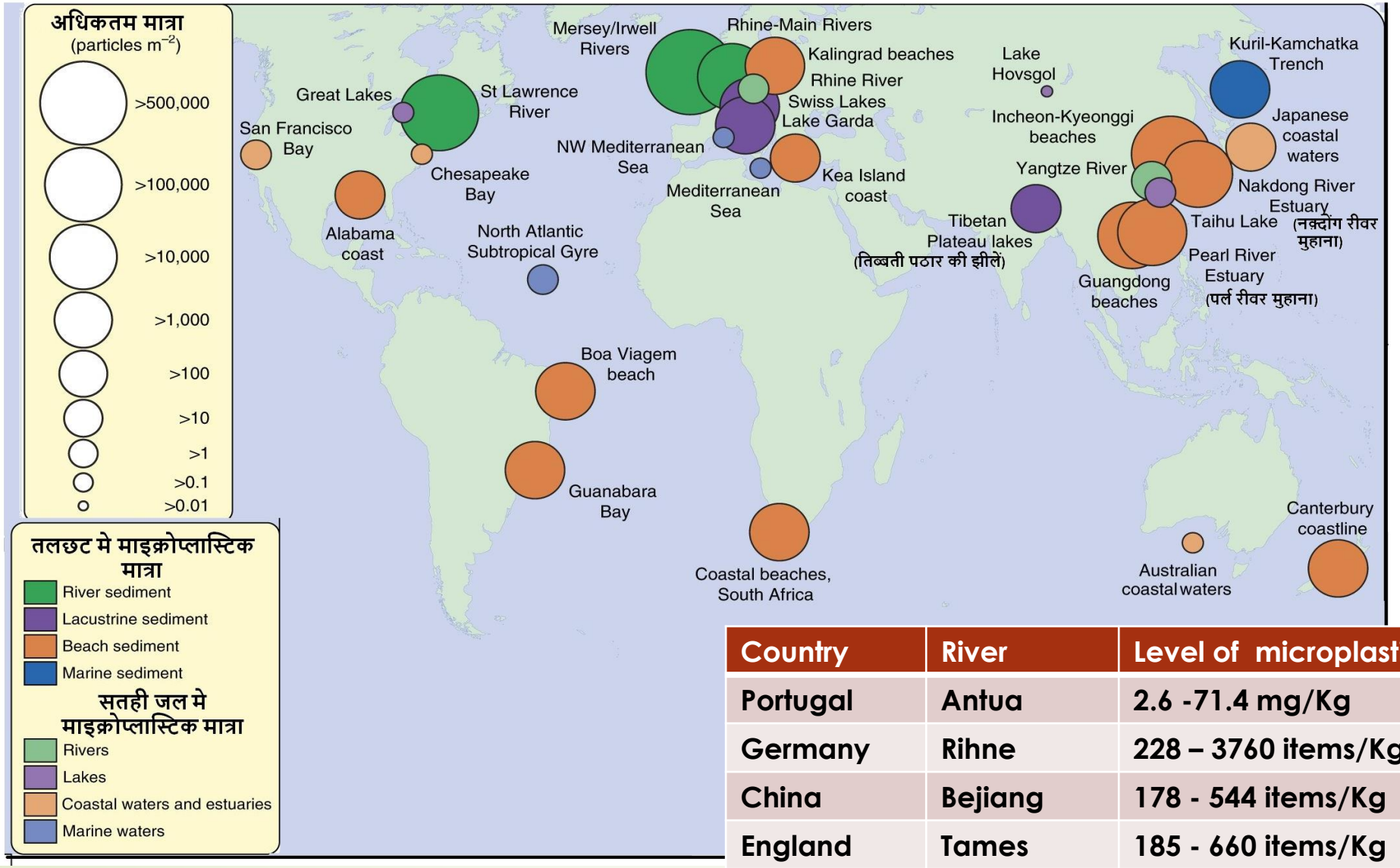
Effect on aquatic biota



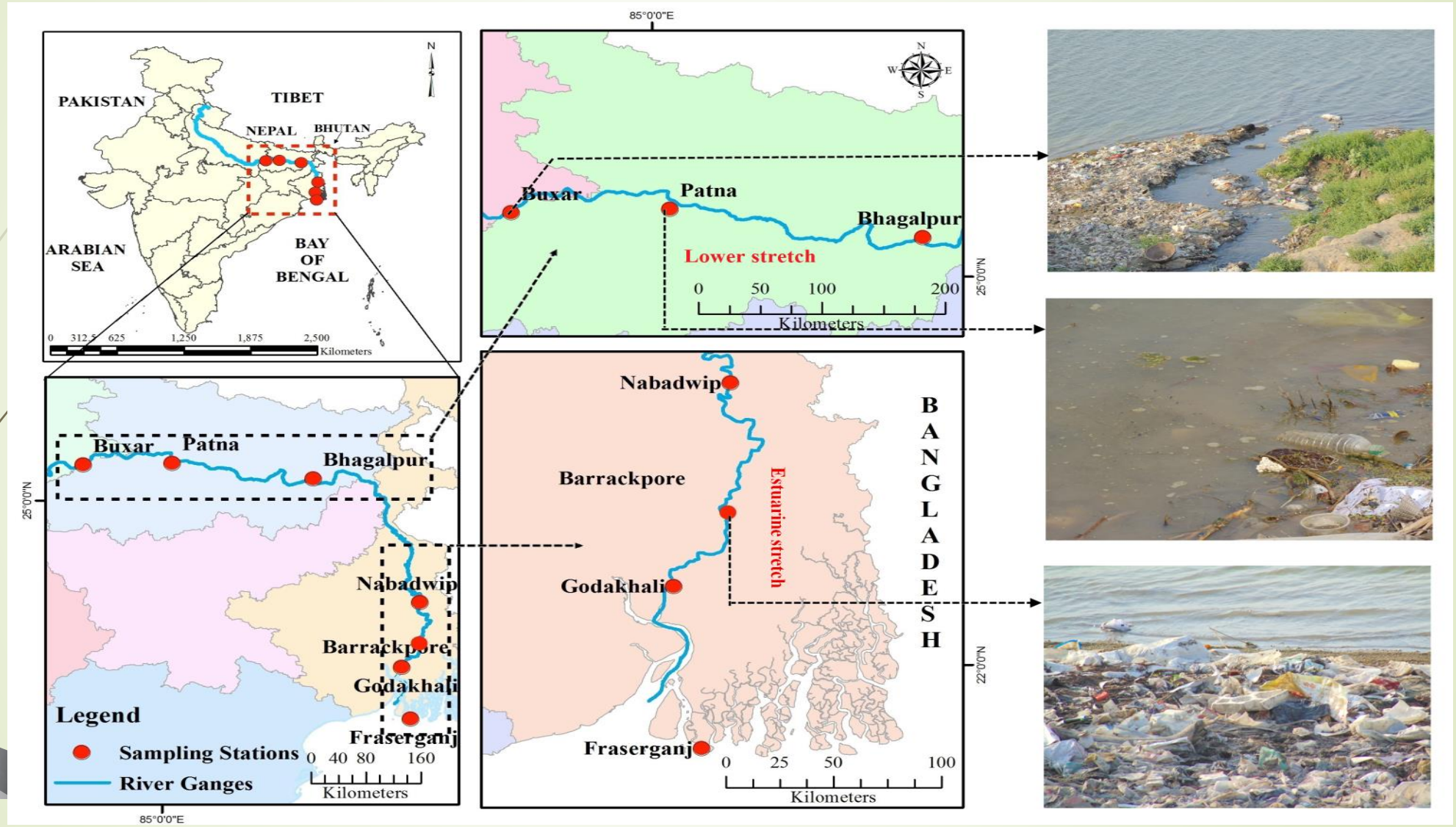
Organisms	Damage type
Polychaetes, Echinoderms, Bivalves, Fish	Impaired metabolism and cellular stress response
Fish	Tissue damage
Crustaceans, Mussels, Fish	Tissue transfer
Polychaetes, Crustaceans, Bivalves	Obstructed respiration
Polychaetes, Crustaceans, Bivalves, Fish	Hindered feeding potentiality
Crustaceans, Echinoderms, Bivalves, Fish	Retarded physiological development and reproductive competency
Crustaceans, Bivalves	Decreased growth rates
Fish	Behavioural abnormalitis
Crustaceans, Bivalves, Fish	Increased mortality

Estimates of Microplastics in World



Country	River	Level of microplastics
Portugal	Antua	2.6 -71.4 mg/Kg
Germany	Rihne	228 – 3760 items/Kg
China	Bejiang	178 - 544 items/Kg
England	Tames	185 - 660 items/Kg
South Africa	Bloukrans	0.60 -160 items/Kg

Case study: sediment sampling at Ganga



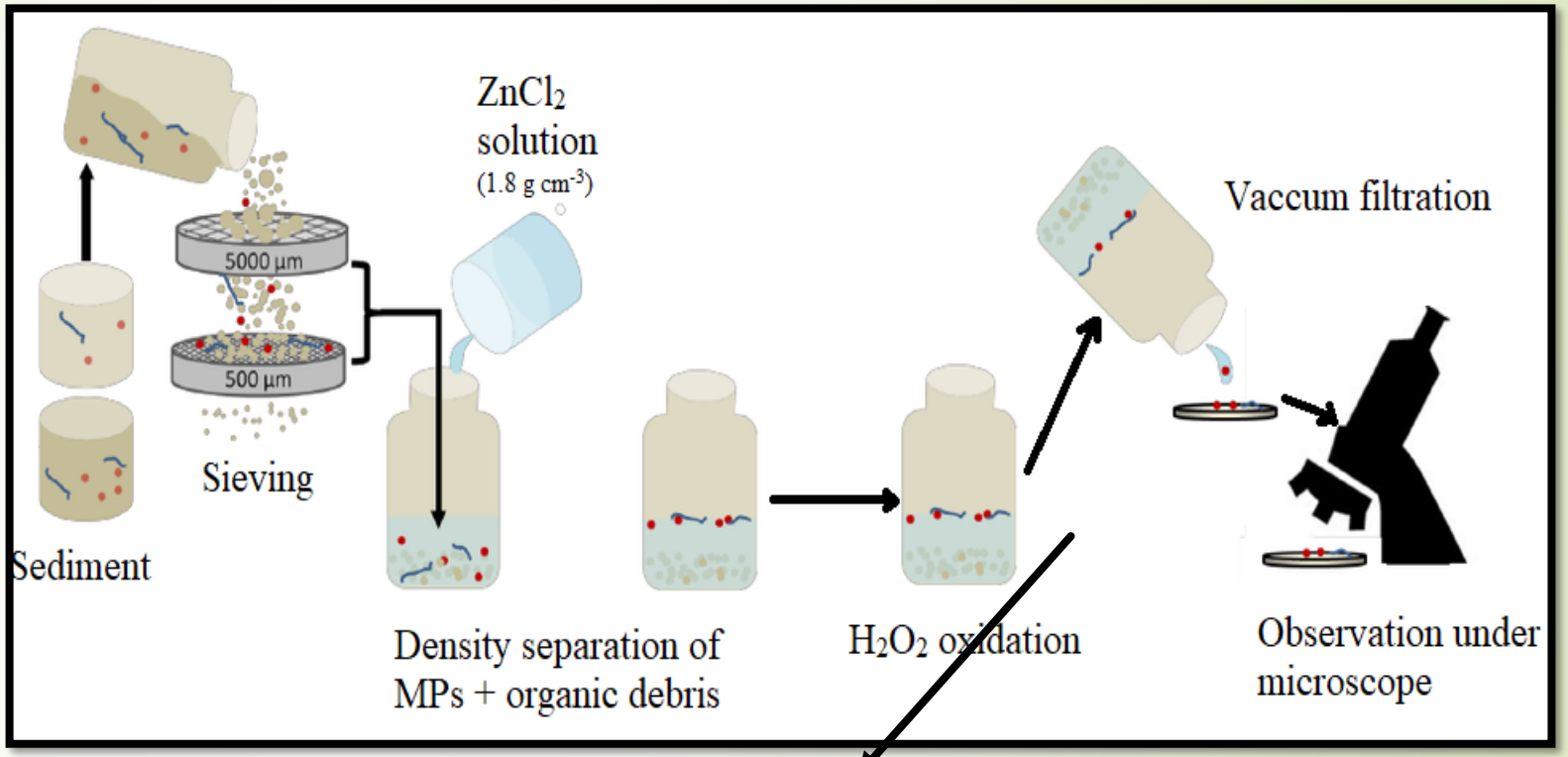
Methodology: Sediment sampling from Ganga

- The sediments were collected from the river shoreline
- At each sampling site, three locations (100 to 150 m apart) were chosen and from each location, sediment samples were pulled from 5 randomly chosen spots (10 to 20 m apart) to get final quantity.
- Steel spoon was used to collect wet sediment (2–3 kg) from the shore line

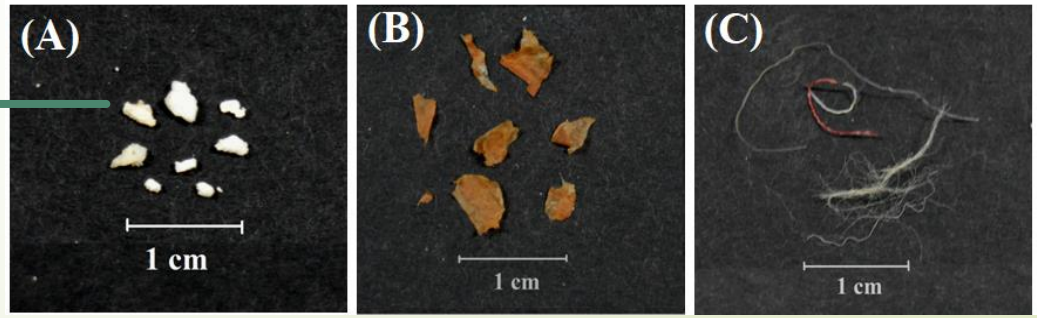
Methodology: Extraction of Microplastics

Key steps

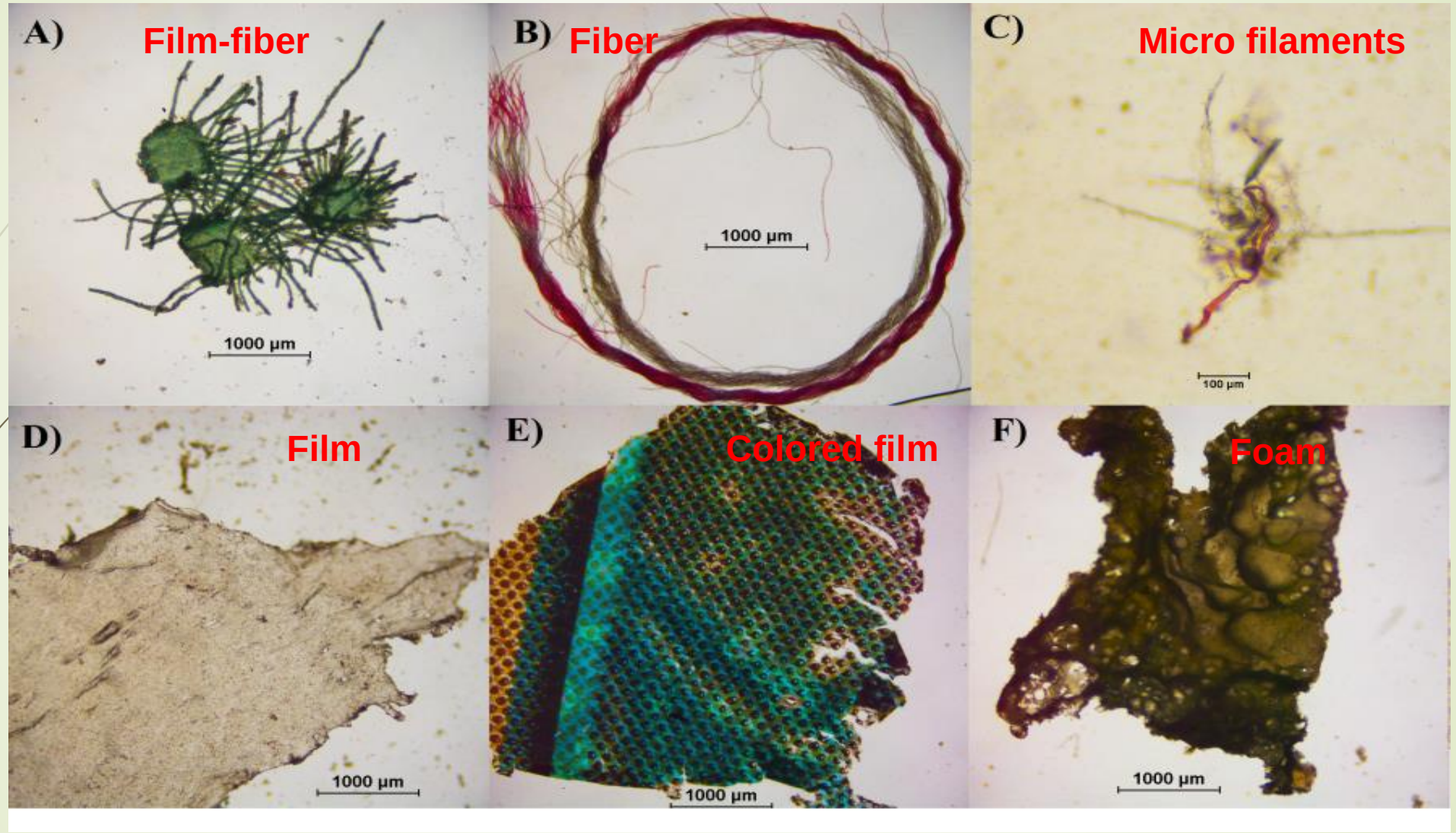
- Sieving
- Density separation
- Peroxide digestion
- Observation



ATR FT-IR

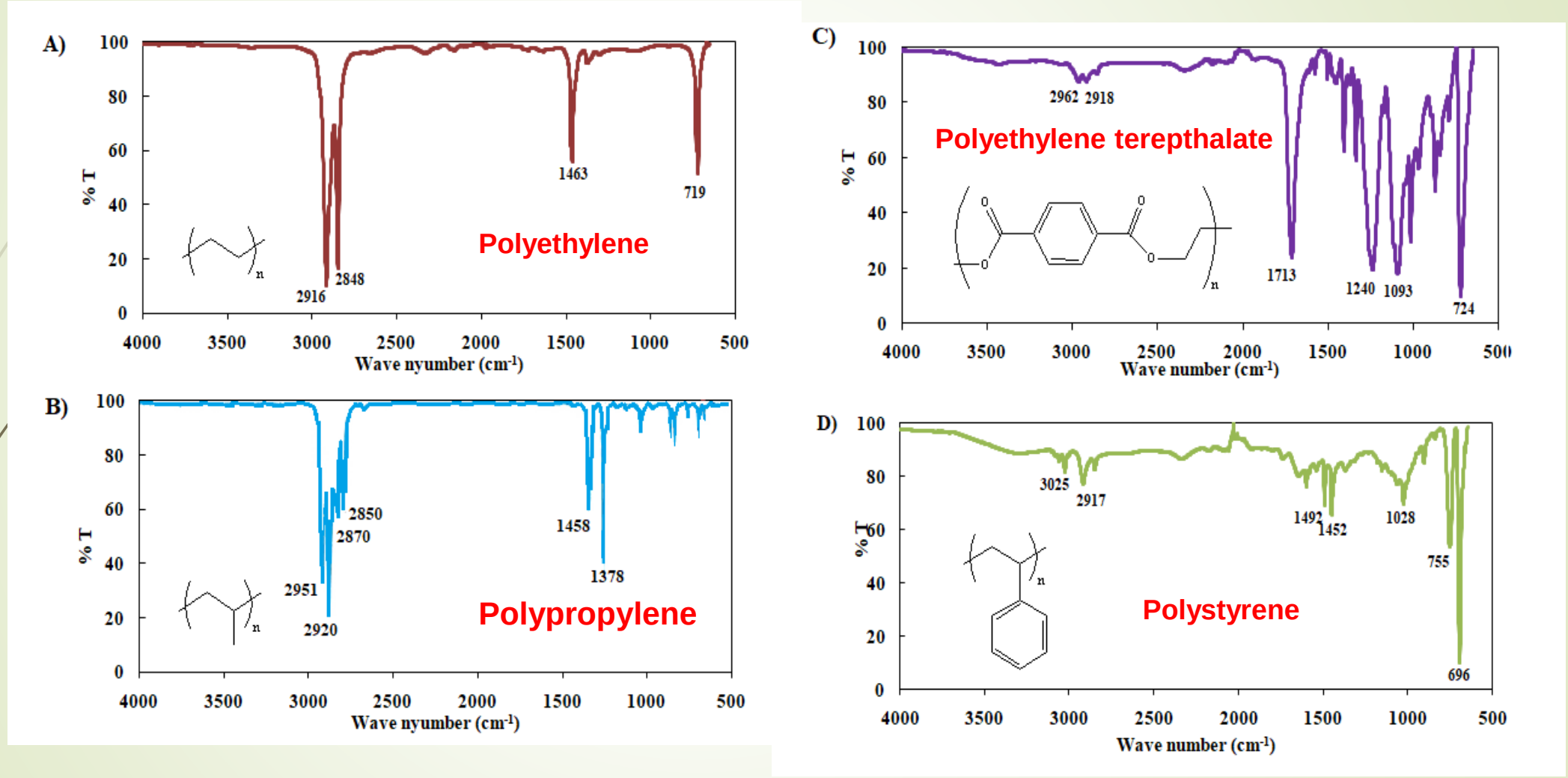


Finding: Microplastics found in Ganga



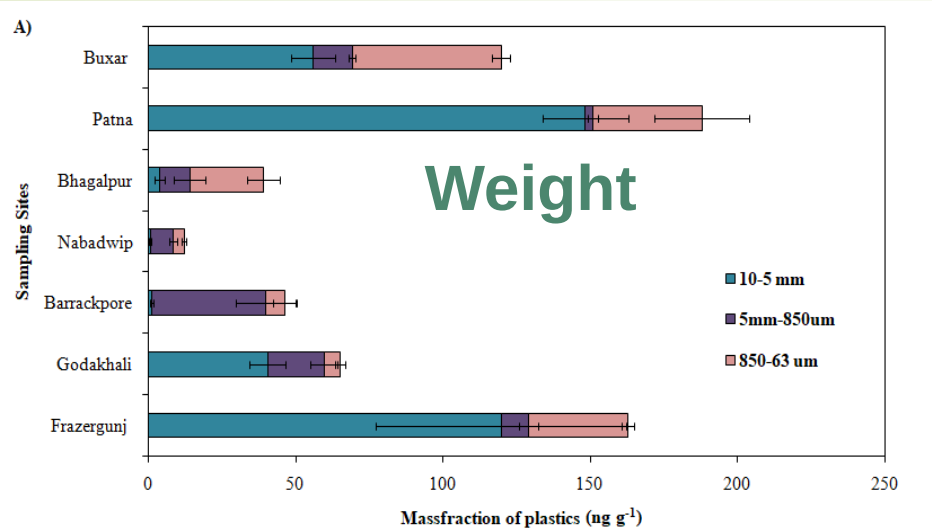
Optical microscope picture of MPs found from Ganga

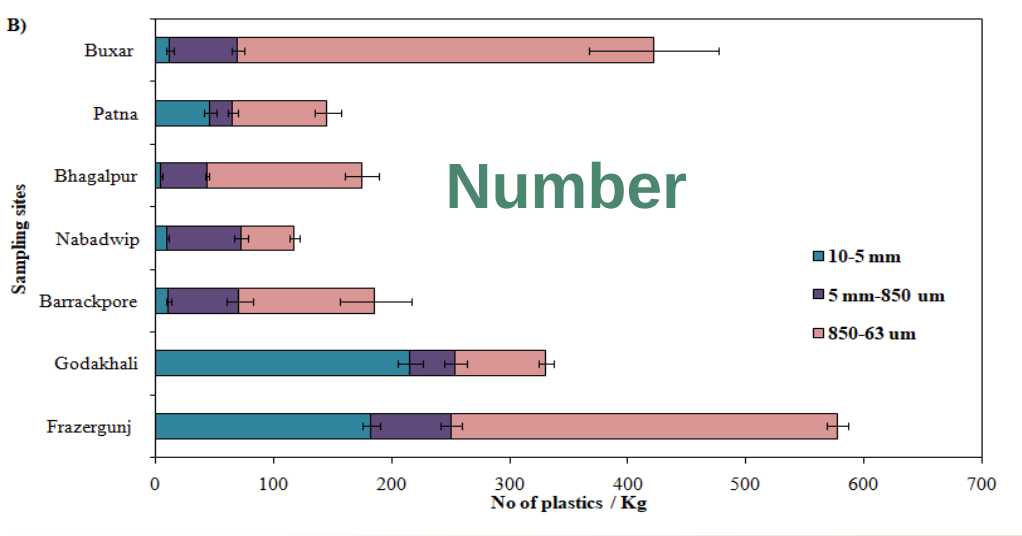
Finding: Identification of microplastics (ATR-FT-IR spectroscopy)

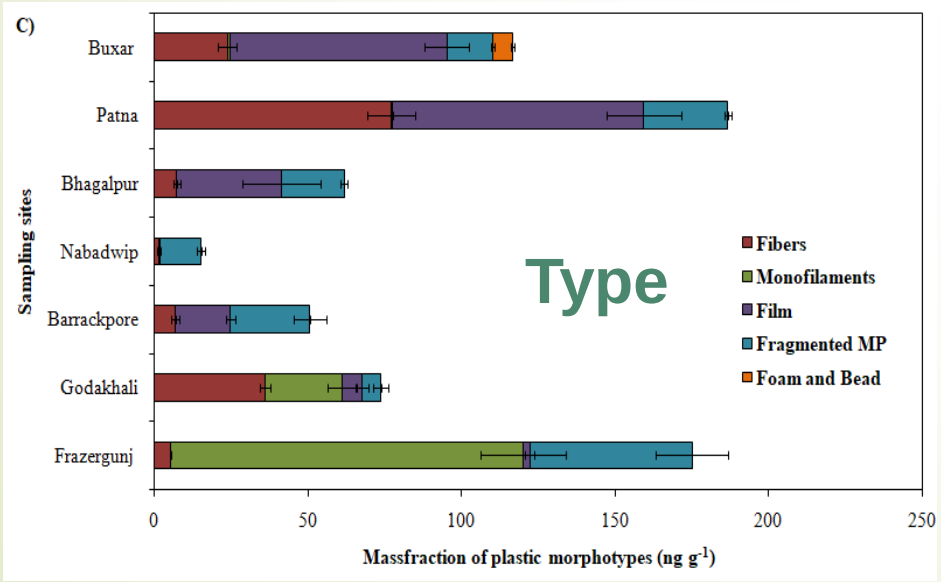


FT-IR spectrum of MPs found from Ganga

Finding: Quantification of Microplastics in Ganga







- Plastic concentration was found higher at sites viz. Buxar, Patna, Godakhali and Frazerganj
- High concentration of plastic at the estuarine sites might be due to deposition of heavy plastic influx

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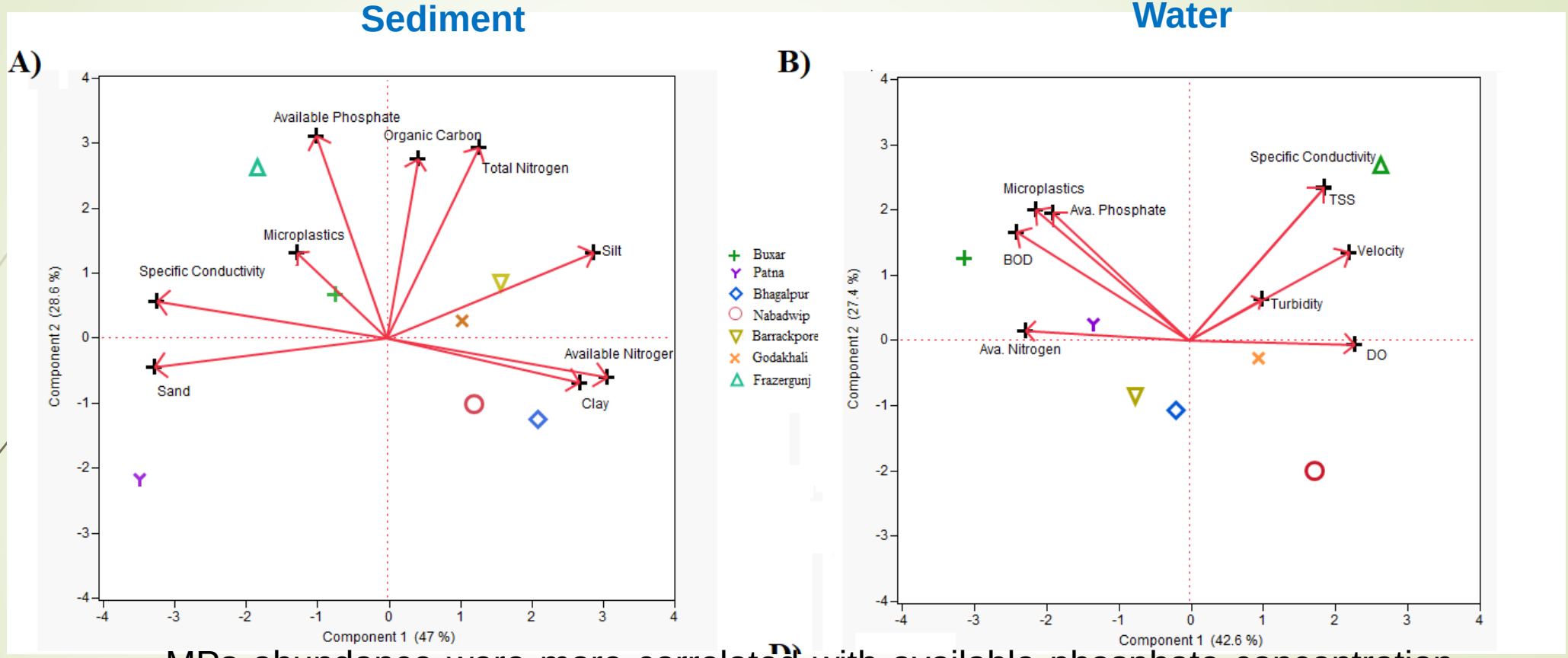
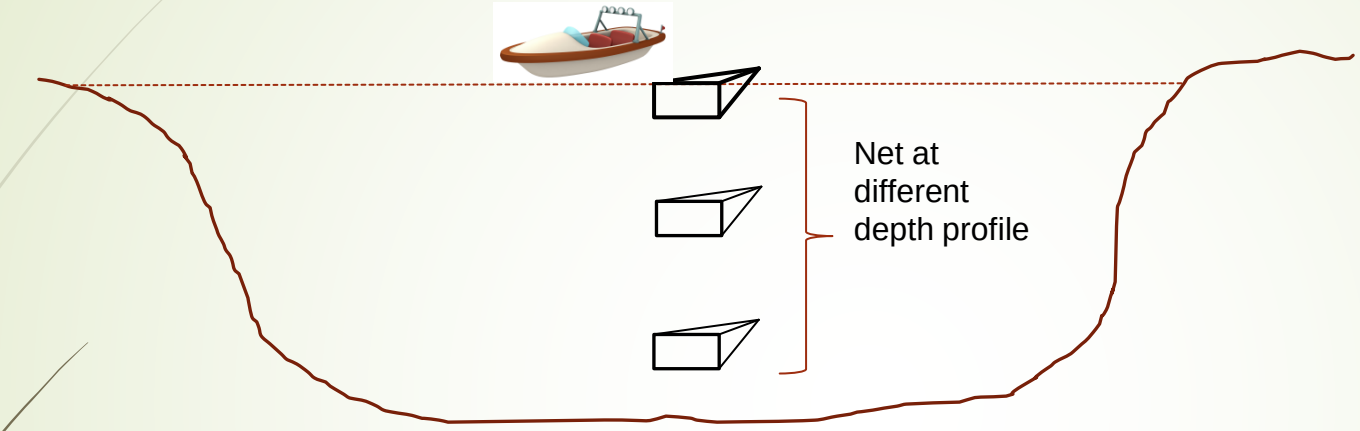
Results: Correlation (PCA) with water pollution parameters

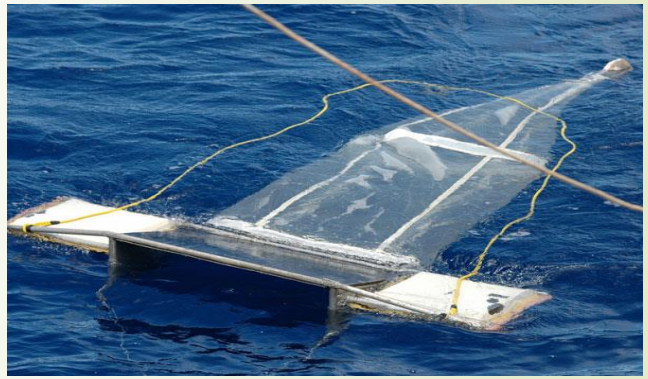


- MPs abundance were more correlated with available phosphate concentration of sediment and water, and with BOD of water
- It refers that MPs abundance in Ganga is more localized at other aquatic pollution points

Key Gaps and Needs Identified

Analysis of plastic flow rate in Ganga at different river points





Key Constraints

1. High rate of water flow, turbulence, etc.
2. Inaccessibility in installing the setup across the river
3. Fund

Device and analytical instruments needs:

1. Hardware requirement (net, mesh, etc.)
2. Micro-FT-IR (μ-FT-IR)

Key Gaps and Needs Identified

Microplastic identification

It is required to identify plastic to understand their origin, fate and toxicological dynamics on the aquatic biota

FT-IR

- FT-IR can identify the plastic particles through spectrum match
- However, it very difficult to handle very fine microplastic particles (<5mm) in the FT-IR instrument and analyze them.
- Further, it is very difficult to identify thousands of fine plastic particles present in a extracted sample

µ-FT-IR

- µ-FT-IR is a combination of microscope and FT-IR instrument
- Very fine plastic sample (> 10µm) can be identified here
- A bulk amount of fine plastic samples can be identified with shortest possible time
- Gap: the device is costly (>60 lakhs)

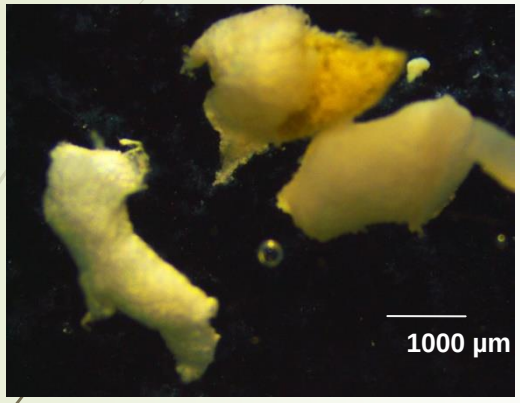
Stakeholder at risk: capture fisheries at river Ganga

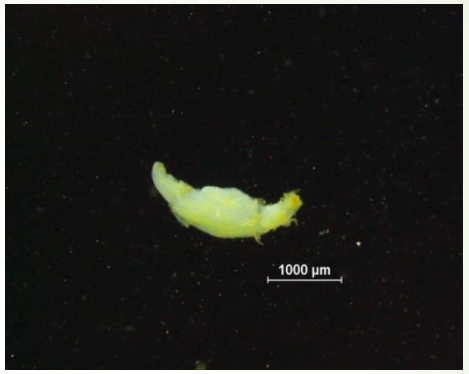
Shorting of plastics from captured fish from net

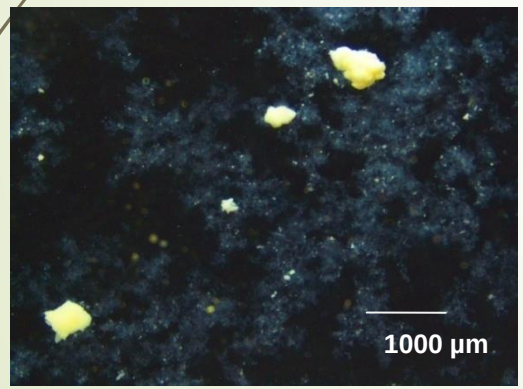
- Around 20-30% of captured mass of net is plastic debris
- Cost associated with ware and tear of fishing nets
- Loss of fishers income

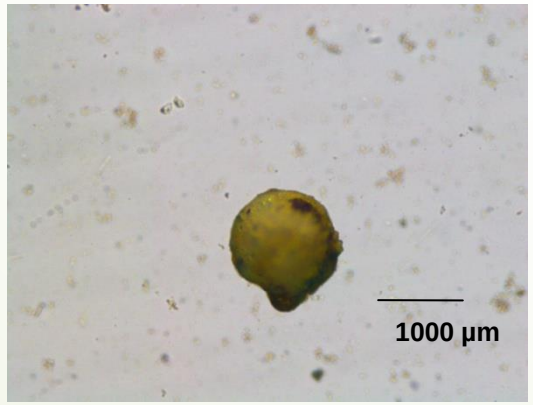
Stakeholder at risk: Microplastics water treatment plant Case study at IGWTP, Kolkata

Choking of filter bed










THE TIMES OF INDIA
CITY

Experts warn of micro-plastics in KMC water

ALL ABOUT PALTA PLANT

Location | Barrackpore (on the bank of the Hooghly)

Capacity | 230 million gallons every day

Serves | 60% of Kolkata's population

The problem | Planktons & micro plastics choking filtration beds

When was it noticed | KMC engineers at Palta plant noticed the problem. Then a team of scientists from Central Inland Fisheries Research Institute (CIFRI) conducted a survey and found that not only planktons, but micro plastic was also responsible for choking the filtration beds

(Top) A worker removes plastic that has been clogging the filtration beds; (above) the Palta water plant

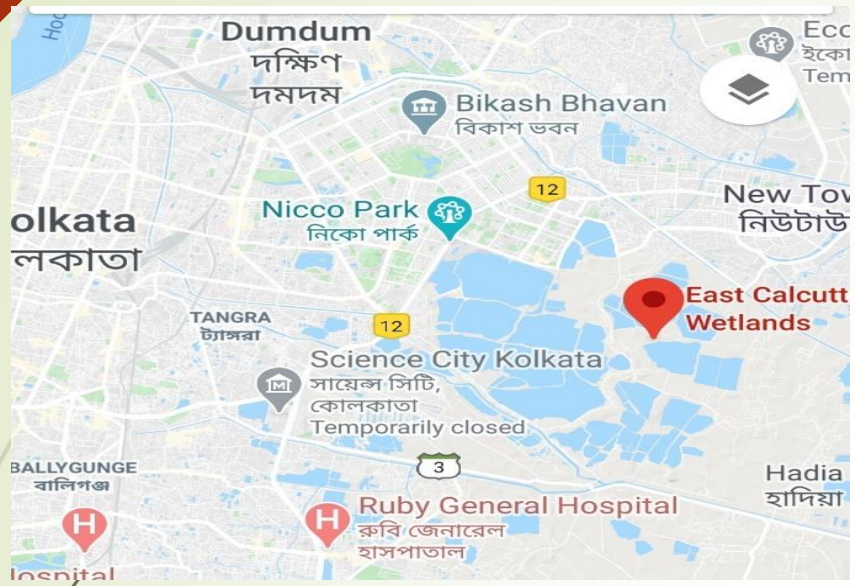
WHAT ARE PLANKTON?

Diverse collection of organisms like bacteria, archaea, algae and protozoa that live in large bodies of water and are unable to swim against a current. They provide a crucial source of food to fish. Though many planktonic species are microscopic in size, plankton includes organisms over a wide range of sizes, including large organisms, like jellyfish

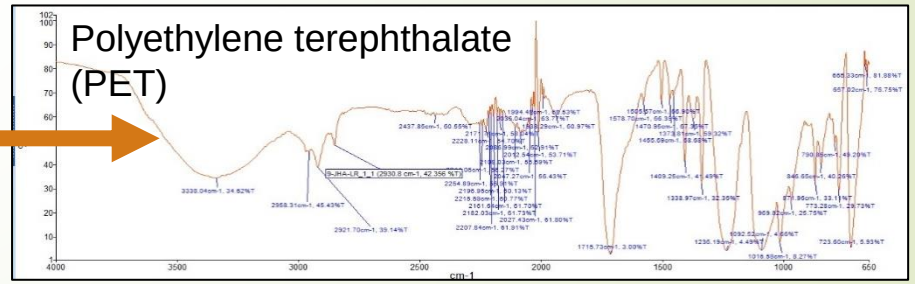
Plastic particles (foam and film) were found on the filter beds of IGWTP, however, till now no MPs were found in the drinking water. Further study is going on.

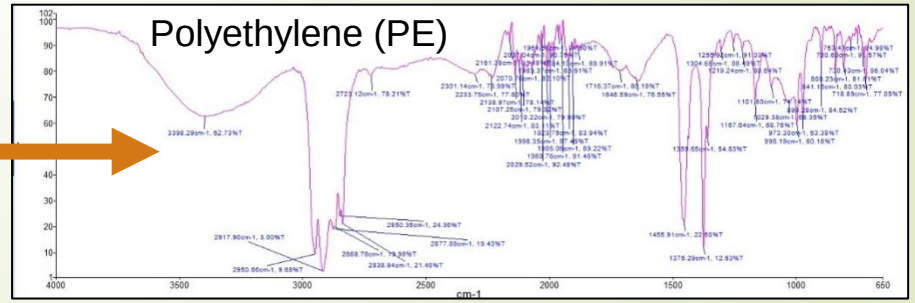
Stakeholder at risk: Fish consumers

Case study at: East Kolkata Wetland, a Ramsar site



- Sediment and water samples were collected from eight sites of East Kolkata wetland and associated feeding canals
- Huge plastic load was found in the sediment and water of feeding canals which delivers water and nutrient to the wetlands
- Fish collected from wetland were dissected and plastic particles were found in the their gut





Recommendations

- Microplastics are emerging pollutants in Indian inland open waters and it posses tremendous threat to aquatic health and potential human health hazard
- Immediate measures should be taken to reduce plastic load in the Indian rivers
- Ganga being the most important river of India, more comprehensive study is required on the plastic transport, fate and toxicity toward life
- Extensive studies is required to asses microplastics contamination and their distribution in Indian rivers, associated wetlands, lakes and others
- Government support and more funding is required to execute the research activities in this direction

Thank You

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