

**BEFORE THE NATIONAL GREEN TRIBUNAL  
EASTERN ZONE KOLKATA BENCH  
Original Application No. 202 of 2024 / EZ.**

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News item "Microplastic in West Bengal's Digha and Odisha's Puri seawater at alarming levels" Appearing in the Times of India Sated 04.08.2024.

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SPCB Odisha,R.No.3

Through



**Smt. Papiya Banerjee Bihani**  
Advocates for the Respondent No.3  
(State Pollution Control Board, Odisha)  
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Kolkata

Date:



**BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL  
 EASTER ZONE BENCH, KOLKATA  
 ORIGINAL APPLICATION NO. 202 OF 2024 / EZ  
 (Earlier OA No.1064/2024/PB)**

**06 DEC 2024**

Suo motu case:

News item titled "Microplastic in West Bengal's Digha and Odisha's Puri seawater at alarming levels" Appearing in the Times of India Dated 04.08.2024

**AFFIDAVIT ON BEHALF OF STATE  
 POLLUTION CONTROL BOARD, ODISHA,  
 RESPONDENT NO.3.**

I, Dr. Kailasam Murugesan, IFS, son of late Paramasivam Kailasam aged around 56 years, at present working as Member Secretary, State Pollution Control Board, having my office at Paribesh Bhawan, A/118, Nilakantha Nagar, Unit-VIII, P.O. Nayapalli, Bhubaneswar, Dist – Khurda, Odisha-751012, do hereby solemnly affirm and state as under:

1. That I am the Member Secretary of the Respondent No.3 Board and, as such, am well-acquainted with the facts





and circumstances with the case and competent to swear this affidavit.

2. That the Hon'ble NGT, PB, New Delhi has registered suo motu a case vide OA No.1064/2024/PB on the basis of the news item titled "Microplastic in West Bengal's Digha and Odisha's Puri seawater at alarming levels" appearing in the Times of India Dated 04.08.2024 and impleaded various authorities including the R-3 Board as party respondent and directed to file their response respectively before the Hon'ble NGT, EZB, Kolkata by 14.10.2024 when the matter will be listed for hearing.
3. That the Hon'ble NGT, EZB, Kolkata has renumbered the OA as OA No.202/2024/EZ and issued notice fixing 14.10.2024 as the date of appearance and this Board has been impleaded as R-3.
4. That at the outset, it is humbly submitted that the R-3 Board operates a Coastal Management Cell under ICZMP (Integrated Coastal Zone Management Programme) headed by Chief Environmental Scientist –





cum – Nodal Officer. The Coastal Management Cell has conducted the inspection on dtd.06.11.2024. During inspection sample of microplastic contamination in sea water and beach sediment of Puri sea beach has been collected and analysed in the Central Laboratory of the R-3 Board.

5. That in response to the notice received from the Hon'ble Tribunal in the above case, the R-3 Board has made a study during inspection on 6.11.2024 which includes sediment and sea water analysis focussing on (1) Quantitative Analysis of microplastics in seawater and sediment samples; (2) Characterization of microplastic types.

6. That after conducting the inspection, the samples have also been analysed and a technical report on investigation into presence of microplastic in Puri sea beach has been prepared. The technical report also deals with summary of findings and provide suggestive source, specific interventions on certain areas like

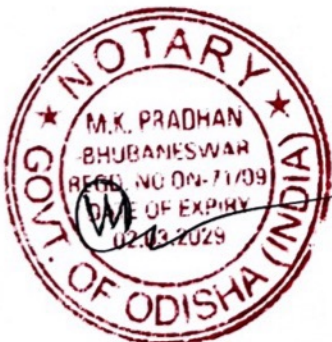




enhanced monitoring and clean up, policy and enforcement and infrastructure development, public awareness and involvement etc. In page No.12 of the technical report under the heading Prioritized Actions for Puri has been suggested which are as follows:

- a. Immediate microplastic cleanup drives at Sea Beach.
- b. Deployment of fiber filters in urban runoff channels.
- c. Regular seawater sampling to monitor and track pollution levels.
- d. Local bans on high-risk plastic items like microbeads, straws, and disposable cutlery.

The above suggestive and prioritize action plan for management and control of microplastic pollution may be carried out by the Puri Municipality in coordination with the District Administration, Puri.





Copy of the technical report on investigation into the presence of microplastic in Puri Sea Beach water referred above is annexed to this affidavit and marked as **ANNEXURE – R3/1**.

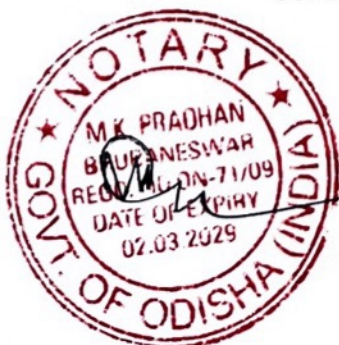
7. That the Respondent No.3 Board craves the leave of this Hon'ble Tribunal to file further affidavit if necessary for proper adjudication of this case.
8. That the annexure annexed to the present affidavit is true and correct copy of its original.
9. That the contents of the above paragraphs are true and correct to the best of my knowledge, as derived from the official records, and that nothing material has been concealed therefrom.



**DEPONENT**  
Member Secretary  
State Pollution Control Board  
Odisha, Bhubaneswar

**VERIFICATION:**

I, the above named deponent, do hereby verify that the contents of the above affidavit are true and correct to the best



MANJULA KUMAR PRADHAN  
NOTARY PUBLIC  
BHUBANESWAR  
REGD NO ON-71/2009  
PH -8437627119 (M)

*[Handwritten signature]*  
06/12/24

of my knowledge, as derived from official records, and that nothing material has been concealed therefrom.

Verified at Bhubaneswar on this the 6<sup>th</sup> day of December, 2024.

*[Handwritten signature]*

**DEPONENT**  
Member Secretary  
State Pollution Control Board  
Odisha, Bhubaneswar

**SWORN BEFORE ME**



MANJULA KUMAR PRADHAN  
NOTARY PUBLIC  
BHUBANESWAR  
REGD NO ON-71/2009  
PH -8437627119 (M)

*[Handwritten signature]*  
06/12/24

## Technical Report on Investigation into the Presence of Microplastics in Puri Sea Water as Directed by the Hon'ble NGT, Kolkata in OA No. 202/2024/EZ (Earlier OA No. 1064/2024/PB)

### Executive Summary

The inspection and analysis of microplastic contamination in seawater and beach sediment collected from the coastal region of Puri, Odisha. The study was conducted in response to directives issued by the Hon'ble National Green Tribunal (NGT, Kolkata). The investigation aimed to quantify the levels of microplastic pollution, identify potential sources, and recommend remedial measures to mitigate environmental and ecological impacts.

### Introduction:

Microplastic pollution in oceans and beach sediments is a growing global ecological concern. These tiny particles (1 nanometer to 5 millimeters) originate from sources like polyethylene bags, bottles, microbeads, synthetic fabrics, and fishing gear. Polyethylene is the most prevalent type, posing significant risks to marine ecosystems due to its abundance and persistence. Microplastics are increasingly found across trophic levels, raising concerns about their impact on marine life and human health.

Key sources include land-based residues, plastic dumping, climatic factors like cyclones, ghost fishing nets, and untreated waste. Tourism, coastal aquaculture, and industrial activities contribute to the problem, making beaches microplastic hotspots. These pollutants infiltrate marine sediments, persist in ecosystems, and threaten the food chain.

A recent study by Patidar et al. (2024), highlighted in *The Times of India* (August 4, 2024), revealed alarming microplastic pollution in Digha (West Bengal) and Puri (Odisha). Funded by the Science & Engineering Research Board, it reported 5.3 and 6.4 microplastic items per liter of seawater and 173.4 and 190.4 items/kg in sediments, respectively.

This poses a severe threat to marine biodiversity and recreational activities. Violations of key laws, including the Plastic Waste Management Rules (2022), have prompted the NGT to take suo-motu action, involving authorities like CPCB, SPCBs of West Bengal and Odisha, MoEF regional centers, and local District Magistrates.

The Odisha State Pollution Control Board (OSPCB), responding to an NGT directive, conducted microplastic sampling at Puri Beach on November 6, 2024. The study included sediment and seawater analysis, focusing on:

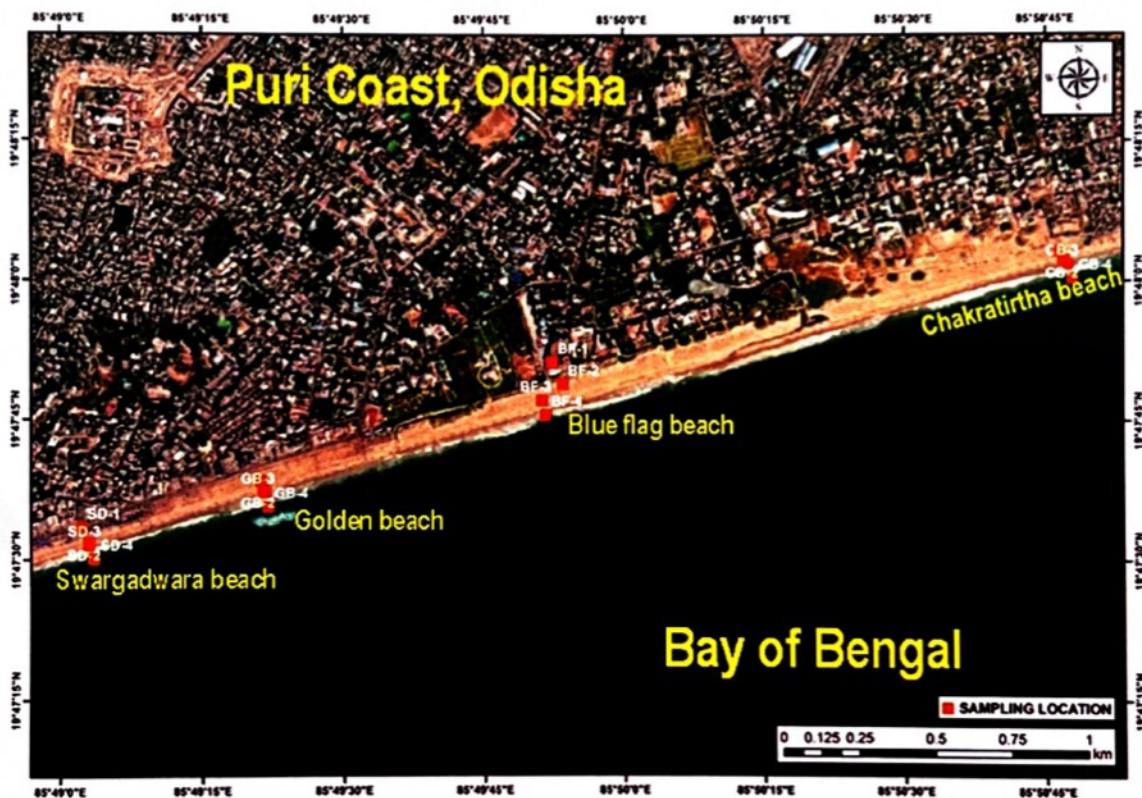
1. **Quantitative analysis** of microplastics in seawater and sediment samples.
2. **Characterization** of microplastic types.

## Methodology

### Study area:

Puri, a coastal district in Odisha, India, lies at 19° 47' N, 85° 49' E, bordered by the Bay of Bengal to the east and is a major tourist destination due to its holiness due to presence of Lord Jagannath and picturesque beaches like Golden Beach and Blue Flag Beach. Awarded the prestigious 'Blue Flag' certification in October 2020, the Golden Beach is a key attraction.

Puri's beach hosts a fish landing center, facilitating the trade of diverse marine fishes and shellfish. However, the coastline faces environmental challenges, including sewage, plastic pollution, and significant microplastic contamination, raising eco-legal concerns addressed by the National Green Tribunal (NGT). The area also experienced severe impact from Cyclone Fani, which made landfall on May 3, 2019.



**Figure-1** Micropalstic sampling station map of Puri Coast, Odisha

Puri Beach is systematically categorized into four distinct segments for the study (Figure-1). A single-point sampling approach was employed to collect microplastic samples from both sediment and water across the following locations: (i) Swargadwar Beach (SD), (ii) Golden Beach (GB), (iii) Blue Flag Beach (BFB), and (iv) Chakratirtha Beach (CKT). Each sampling station was accurately georeferenced using GPS coordinates, ensuring precise spatial documentation. The GPS coordinates for all sampling locations are detailed in Table-1.

- (i) **Swargadwar Beach**- This region of Puri Beach experiences the highest density of visitors, as it serves as the epicenter for the final rites of the Hindu religious tradition, known as the 'Daaha Sanskar.' This ritual is conducted continuously for 24 hours, resulting in a persistent congregation of individuals at this location throughout the day and night.
- (ii) **Golden beach**- The location lies approximately 1 kilometer to the west of Swargadwara Beach. Under bright sunlight, its appearance takes on a golden hue, attributed to the reflective properties of its surface. Renowned as a prominent tourist attraction, it holds significant appeal for visitors to Puri Beach.
- (iii) **Blue Flag Beach**- The location lies 1 km to the west of Golden Beach. This region is characterized by significantly lower pollution levels, meticulous maintenance, and a pristine atmosphere conducive to environmental and aesthetic enjoyment.
- (iv) **Chakratirtha Beach**- This beach, located approximately 1 km to the left of the Blue Flag Beach in Puri, exhibits notable human activity. It experiences significant tourist influx, contributing to increased anthropogenic stress. Proximity to the nearby fishing village further amplifies this stress, as activities such as fishing operations, waste disposal, and local interactions intensify environmental pressures in this area.

<b>Table-1 details of the GPS coordinates of the Microplastic Sampling Station of Puri beach</b>			
Name	Code	LATITUDE	LONGITUDE
Swargadwara-1	SD-1 (Sediment)	19°47'33.42" N	85°49'0.21" E
Swargadwara-2	SD-2(Sediment)	19°47'31.87" N	85°49'0.29" E
Swargadwara-3	SD-3(Sediment)	19°47'31.56" N	85°49'0.28" E
Swargadwara-4	SD-4(Water)	19°47'30.05" N	85°49'0.35" E
Golden Beach-1	GB-1(Sediment)	19°47'38.39" N	85°49'2.09" E
Golden Beach-2	GB-2(Sediment)	19°47'37.44" N	85°49'2.12" E
Golden Beach-3	GB-3(Sediment)	19°47'37.16" N	85°49'2.14" E
Golden Beach-4	GB-4(Water)	19°47'35.58" N	85°49'2.18" E
Blue Flag Beach-1	BFB-1 (Sediment)	19°47'51.18" N	85°49'5.23" E
Blue Flag Beach-2	BFB-2 (Sediment)	19°47'48.85" N	85°49'5.33" E
Blue Flag Beach -3	BFB-3 (Sediment)	19°47'47.08" N	85°49'5.11" E
Blue Flag Beach-4	BFB-4(Water)	19°47'45.51" N	85°49'5.15" E
Chakratirtha Beach-1	CKT-1 (Sediment)	19°48'3.24" N	85°50'4.64" E
Chakratirtha Beach-2	CKT-2 (Sediment)	19°48'2.24" N	85°50'4.69" E
Chakratirtha Beach-3	CKT-3 (Sediment)	19°48'1.78" N	85°50'4.73" E
Chakratirtha Beach-4	CKT-4 (Water)	19°48'0.27" N	85°50'4.8" E

#### Sample collection:

For the microplastic survey sample collection was carried in four different stations of each region i.e. from the Supra littoral zone, from the high tide mark, from the low tide mark

and from the coastal water (Figure-6). Different sampling strategies were adopted for the microplastic sampling for the sediment and from the water (Figure-7).

### **Collection of microplastic from sediment and water**

Coastal and marine sediment becomes the sink for the deposition of micro plastics. Therefore, considering this several mechanisms are available to separate the microplastic from the marine sediment.

- (i) ***Microplastic extraction from Sediment.*** All sediment samples were collected by scrubbing the surface sediment with 30 cm x 30 cm area by using stainless steel spatula then the collected sediment was kept in labelled glass bottles. Samples were further carried out to the laboratory for the subsequent analysis.

In the laboratory the sample were taken for their wet weight and then subjected to oven dry at 60 °C for 72 hours. After drying, the dry weight of the sediment was taken in order to get the mass of the sample matrix (i.e. wet weight – dry weight of the sediment). Then the sediment sample was subjected to sieving under the sieves of three different size fraction such as Sieve size of 5 mm, 0.5 mm, 0.063mm in order to remove the macro and meso plastic debris. Then the sediment sample was allowed for the density Separation process.

#### ***Density Separation***

Dry sediment samples were taken to a clean glass beaker in which saturated salt solution (NaCl with  $\rho = 1.20$  g/mL) was added. Then the sediment was stirred with the solution for 5 minutes by using a glass stirrer. Then the mixture was allowed to settle for 3-6 hours. Soon after settlement, the supernatant water was transferred to another beaker. Then the supernatant was subjected to the organic matter digestion.

#### ***Digestion of Organic Matter***

To carryout this process exactly 30% H<sub>2</sub>O<sub>2</sub> was added to the supernatant mix and allowed digestion process for 24 hrs. The H<sub>2</sub>O<sub>2</sub> subsequently digested all the organic material present in the solution. Then the same was taken for vacuum filtration.

#### ***Vacuum Filtration***

After digestion, the samples treated with H<sub>2</sub>O<sub>2</sub> solution was further vacuum filtered with Whatman G/F Filter paper of 0.7  $\mu$ m pore size. Later on the Filter paper was oven dried at 60°C for 24 hours. Then the filtered paper was removed out from the hot air oven and taken for microscopic analysis.

- (ii) ***Microplastic extraction from water.*** For the collection of the microplastic from the sea water one phytoplankton net was used with 63 micron in order to get maximum size

fraction of microplastic in the near shore water of Puri. After collection the sample was transferred to pre-labeled glass bottle. Bucket sampling was adopted for the collection of sea water samples at different locations. Four water samples were collected from the four different beach regions as described earlier (Figure-3)

#### ***Wet sieving***

Water samples were sieved through sieves of 5.0 mm and 0.3 mm. Subsequently, the sampling bottles should be rinsed with Milli-Q water and filtered through the sieves. Repeatedly this procedure was made to ensure complete removal of all the samples from the bottle. The material retained over the 5 mm sieve is checked for the presence of mesoplastics. These were removed out and stored in the different location for the further study. The material retained on the 0.3 mm sieve was rinsed thoroughly with Milli-Q water and transferred to clean and dry beaker to carry out wet peroxide oxidation process.

#### ***Peroxide Digestion (Wet Peroxide Oxidation)***

30% Hydrogen Peroxide ( $H_2O_2$ ) was added in the material retained on the 0.3 mm sieve which was rinsed for digesting the organic material present in the sample. Then the solution was heated at 50°C and kept overnight. Repeated addition of  $H_2O_2$  was made for the dissolution of organic matter. After complete oxidation of organic matter, the sample was subjected for density separation.

#### ***Density separation and Filtration***

Sodium Chloride floatation media were used for density separation. Then the solution was well mixed with glass stirrer then the sample was allowed. To allow density separation of microplastic the sample was kept overnight. The supernatant was filtered through a glass fiber filter (GF/F Whatman, 47 mm diameter and 0.7 $\mu$ m pore size) through a vacuum filter. Then the filter paper was removed carefully and rested over petridish for oven dried up. After couple of hours the petridish were removed out for the visual inspection (Figure-4) and microscopic analysis. Visual observations were made in naked eye and if any large microplastic is seen then removed by forcep and kept for further analysis. Figure 4 (j & k) exhibits image showing stereo zoom microscopic analysis for microplastic obtained from water and beach sediment respectively.

#### **Microscopic Analysis:**

The analysis identified five major categories of microplastics in the study area: **fibers, fragments, films, pellets, and foams**, with a variety of colors including **white, blue, red, and green**. White-colored microplastics were the most prevalent, followed by blue, red, and green.

In the beach sediments at Swargadwar sampling stations, all five categories of microplastics were detected, highlighting the diversity of plastic pollution in this area. Seawater samples, however, showed a predominance of fiber-like materials, consistent with observations from sediment analysis.

Among all the four beaches in Puri, **fiber-type microplastics emerged as the most dominant category** in sediment samples, followed by fragments, pellets, films, and foams. This trend underscores the widespread prevalence of fiber-based pollutants, likely originating from synthetic textiles and fishing-related activities.

The total microplastic abundance in sediment samples across the beaches exhibited a relatively consistent pattern, with **Swargadwar Beach recording the highest quantities** across all categories. This observation aligns with its heavy tourist activity and proximity to urban sources of plastic pollution.

The results are detailed in the following table and figures, which illustrate the distribution and composition of microplastics across sampling locations, emphasizing the urgent need for targeted mitigation measures in high-pollution zones like Swargadwar.

Microplastic Abundance in Puri Beaches and Seawater (Site-Wise Overview)

Table 2 Analysis data of Microplastic in Sediment and sea water

Beach /Location	Sediment (Density : no./Kg)	Dominant Types in Sediments	Seawater (Density: no./L)	Dominant Types in Seawater	Key Observations/ Justifications
<b>Swargadwar Beach</b>	SD1: 277, SD2: 198, SD3: 107 <b>Avg.194</b>	Fibers > Fragments (SD2), Fibers (SD1 & SD3)	1.78	Fibers	High activity due to tourism and rituals increases deposition. Fibers from textiles predominate.
<b>Golden Beach</b>	GB1: 343, GB2: 163, GB3: 54 <b>Avg.186.7</b>	Fibers > Fragments (GB1), Fibers & Pellets	1.34	Fibers & Pellets	Tourist hotspot leads to higher plastic waste. GB1 shows maximum sediment microplastic density.
<b>Blue Flag Beach</b>	BFB1: 340, BFB2: 154, BFB3: 62 <b>Avg.185.3</b>	Fibers > Films, Pellets	0.38	Fibers, Some Fragments	Lower seawater density due to stricter cleanliness standards for Blue Flag certification.
<b>Chakratirtha Beach</b>	CKT1: 196, CKT2: 136, CKT3: 153 <b>Avg.161.7</b>	Fibers > Pellets, Fragments	0.64	Fibers, Pellets, Some Fragments	Urban and wave-mediated plastic input. Sediments act as significant microplastic sinks here.

The study reveals that sediments at Golden Beach, Blue Flag Beach, and Chakratirtha Beach predominantly contain microplastic fibers and fragments, with minimal pellet presence. Swargadwar Beach, however, exhibits the highest microplastic abundance, attributed to its proximity to dense populations and tourism activities. Fiber-type microplastics dominate across all sites, likely originating from synthetic textiles, fishing nets, and other anthropogenic sources.

In seawater, microplastic concentrations follow the order: **Swargadwar Beach > Golden Beach > Chakratirtha Beach > Blue Flag Beach**, with fibers being the most prevalent type. The lowest concentrations at Blue Flag Beach highlight effective waste management practices.

Sediment microplastic trends mirror those of seawater, emphasizing Swargadwar Beach as a microplastic hotspot needing urgent mitigation. Figures 2, 3, 4 & 5 illustrate the observed microplastic types and their distribution across the study area.

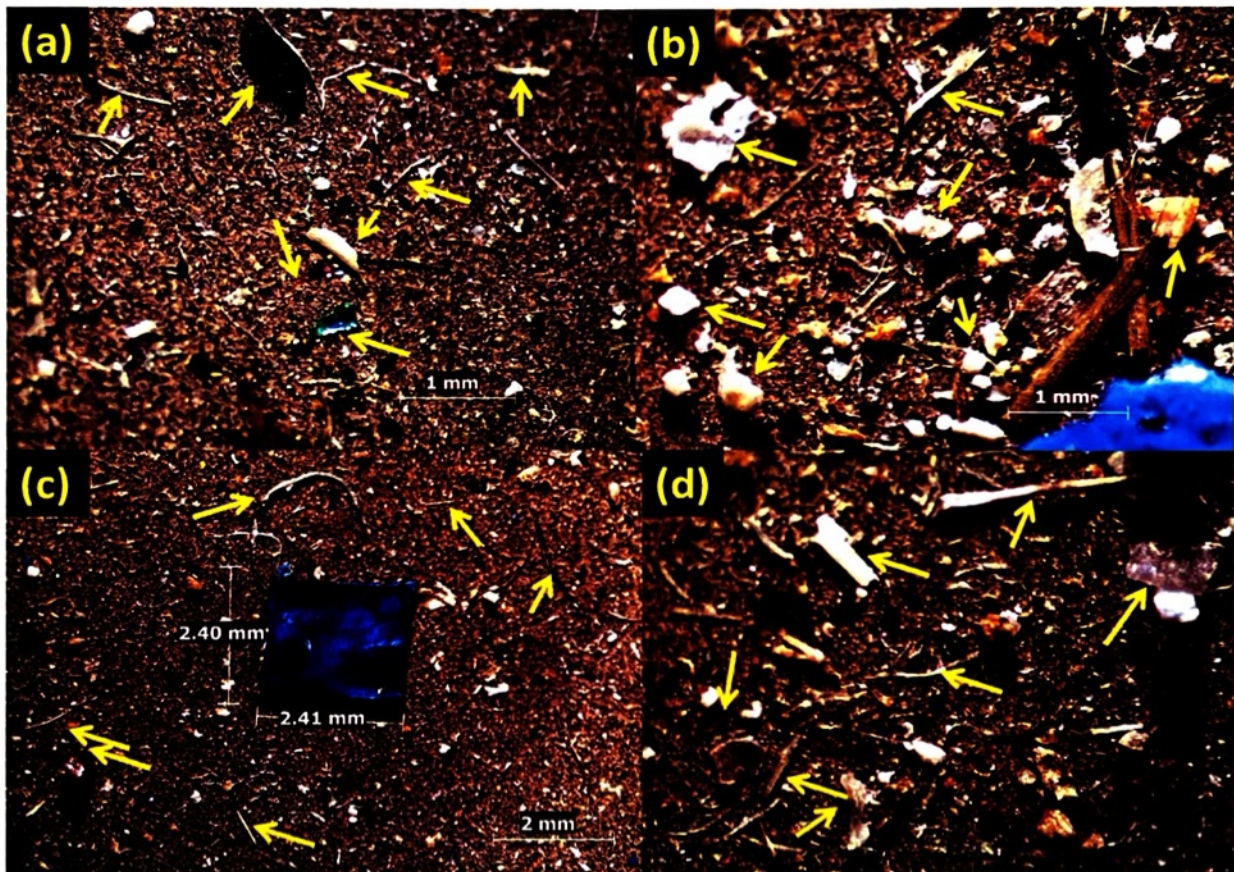


Figure 2-a,b,c,d Presence of microplastic like substances of Swargadwar beach observed under stereozoom microscope

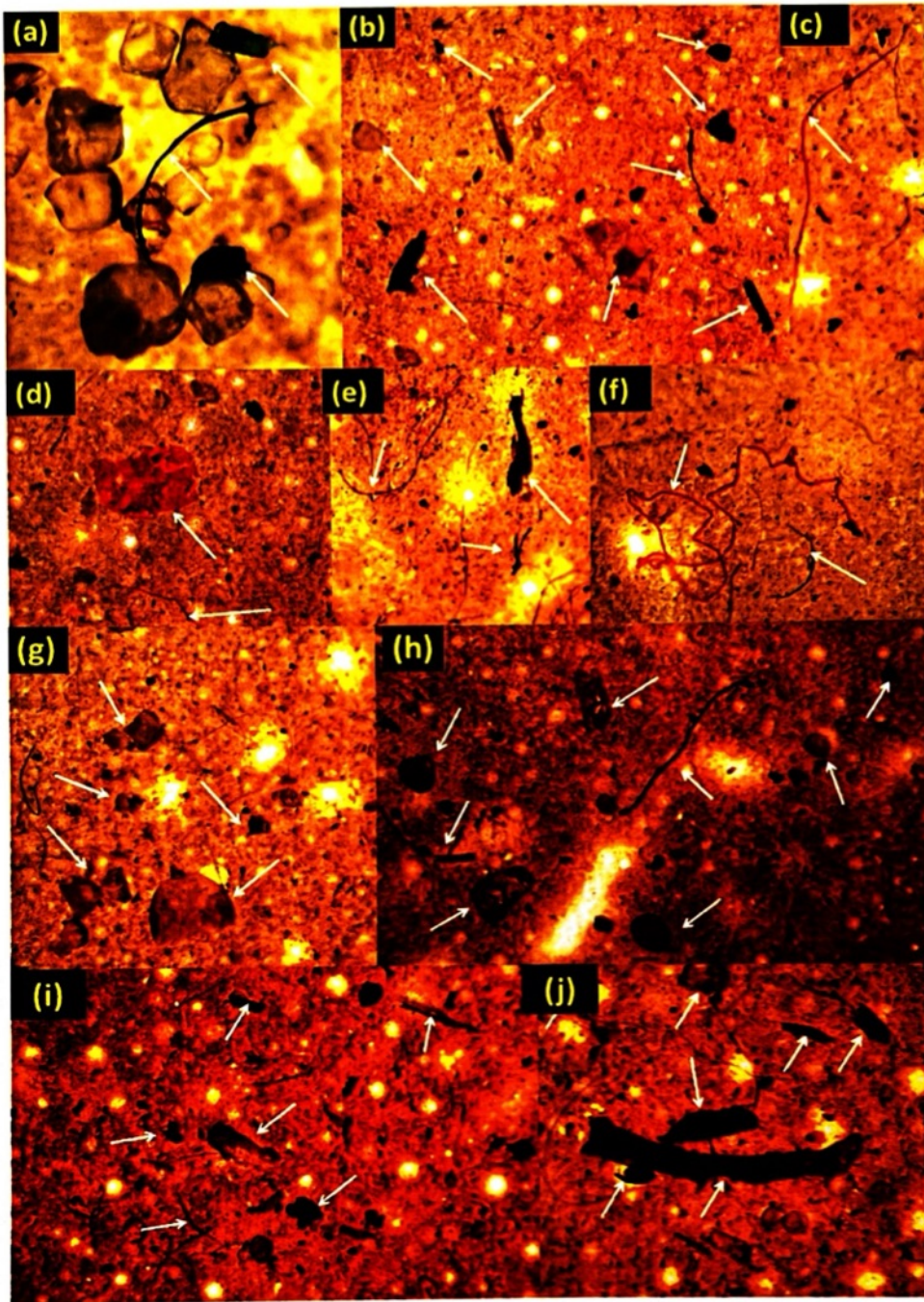
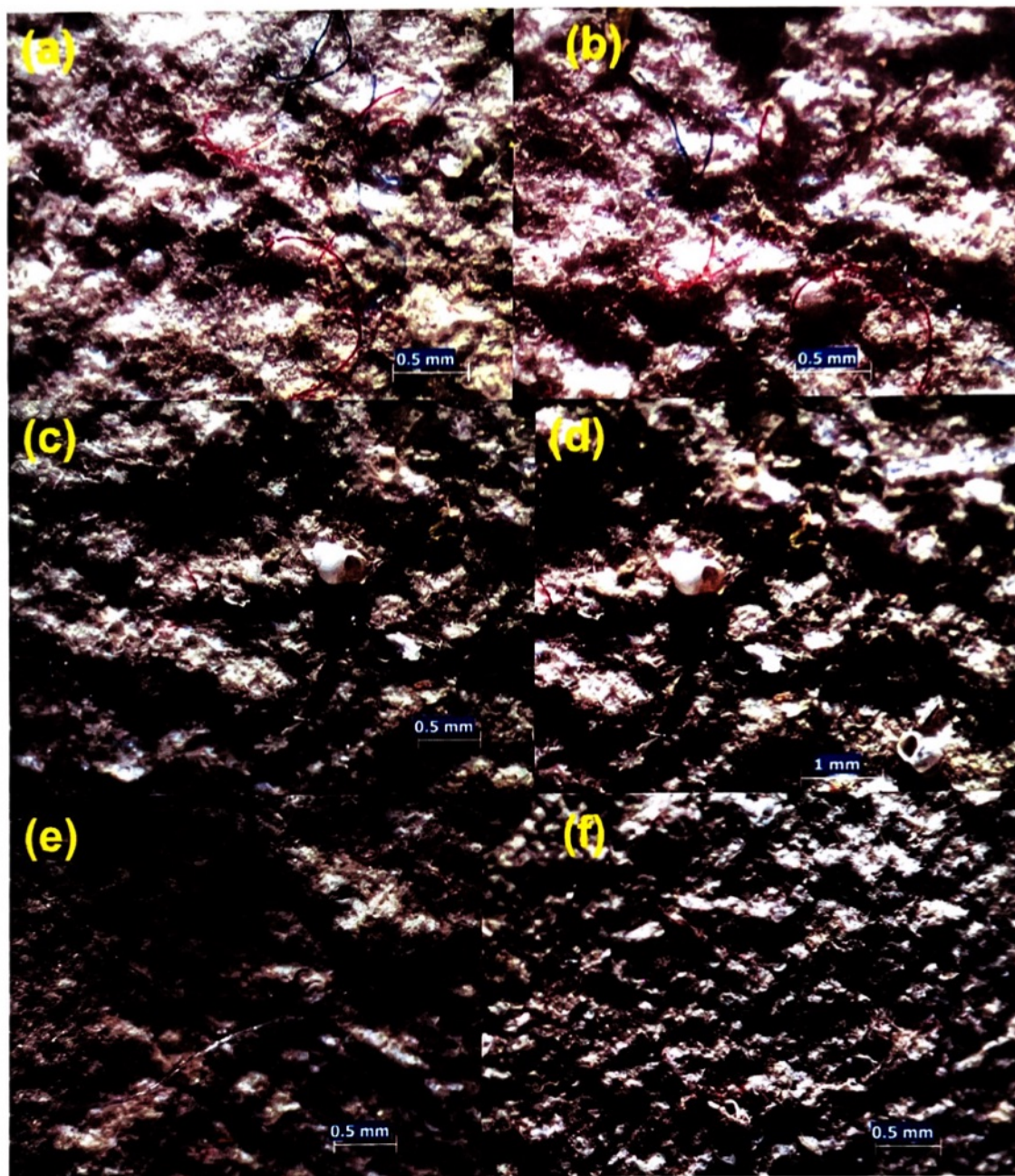


Figure 3 a-j microplastic at different locations of the Sampling stations of Puri.



**Figure- 4 (1-12)** Image showing Oven dried Filter paper containing microplastic of four sampling location such as Swargadwar beach, Golden beach, Blue Flag beach and Chakratirtha beach kept in petridish glass. (a,b,c,d), image showing microplastic from sea water of respective beaches on November 2024.



**Figure-5** Seawater Microplastic content shown in the filter paper observed under the stereozoom microscope from the four sampling locations of Puri sampled on on November 2024.

### Summary of findings

1. **Highest Microplastic Density in Sediments:**
  - Golden Beach (GB1) at 343 no./Kg
  - Justification: Heavy tourist activity and localized plastic degradation.
2. **Highest Microplastic Density in Seawater:**
  - Swargadwar Beach (SD-w) at 1.78 no./L.
  - Justification: Input from land-based sources, rituals and continuous tourist activities.
3. **Dominant Microplastic Type Across Locations:** Fibers.
  - Justification: Derived from synthetic textiles, fishing nets, and other local anthropogenic sources.
4. **Lowest Seawater Density:**
  - Blue Flag Beach (BFB-w) at 0.38 no./L.
  - Justification: Regular clean up under certification guidelines.

### Suggestive Source-Specific Interventions

- **Tourist Activities:**
  - Install **microplastic waste bins** and ensure proper segregation at high-footfall areas like Swargadwar, Golden Beach, and Blue Flag Beach.
  - Conduct awareness campaigns targeting tourists to reduce littering, emphasizing alternatives to single-use plastics.
- **Fishing Activities:**
  - Promote **responsible disposal of fishing nets** and gear to prevent fiber and fragment pollution.
  - Encourage the use of biodegradable or recyclable fishing materials.
- **Urban Runoff:**
  - Implement **stormwater management systems** with microplastic filtration mechanisms to prevent runoff into the sea.

### Enhanced Monitoring and Cleanup:

- **Beach-Specific Cleanup Drives:**
  - Conduct weekly microplastic-specific beach clean ups, particularly at **Swargadwar Beach**, the identified hotspot.
  - Utilize **microplastic sieving techniques** during clean ups to capture fine debris.
- **Seawater Monitoring:**
  - Deploy **marine microplastic sampling programs** to regularly monitor fiber and fragment concentrations in seawater.
  - Collaborate with research institutions to identify trends and sources.

### Policy and Enforcement:

- **Local Bans on High-Risk Plastics:**
  - Prohibit the use of single-use plastics within a defined radius around the beaches.

- **Stricter Waste Regulations:**

- Mandate **zero-plastic discharge policies** for industries and businesses operating near Puri's coastline.
- Enforce penalties for improper disposal or illegal dumping of plastic waste.

**Infrastructure Development:**

- **Wastewater Treatment:**

- Upgrade Puri's wastewater treatment facilities to include **microplastic filtration systems** to capture fibers and pellets before discharge.

- **Beach Management Facilities:**

- Establish **dedicated waste collection and processing units** at major beaches.

**Public Awareness and Engagement:**

- **Local Community Involvement:**

- Train and engage local communities, vendors, and fishermen in microplastic monitoring and waste reduction activities.

- **Educational Programs:**

- Conduct **targeted awareness campaigns** for tourists, highlighting the ecological impact of microplastics and promoting responsible behavior.

**Research and Data Collection:**

- **Hotspot Identification:**

- Map microplastic density hotspots within Puri's beaches and nearshore waters for targeted interventions.

- **Impact Studies:**

- Collaborate with local universities to study the ecological and health impacts of microplastic pollution in Puri's marine ecosystem.

**Certification and Recognition:**

- **Blue Flag Expansion:**

- Extend **Blue Flag certification standards** to other beaches, incorporating microplastic reduction goals.

- **Eco-Tourism Incentives:**

- Recognize hotels and businesses adhering to plastic-free practices.

**Prioritized Actions for Puri:**

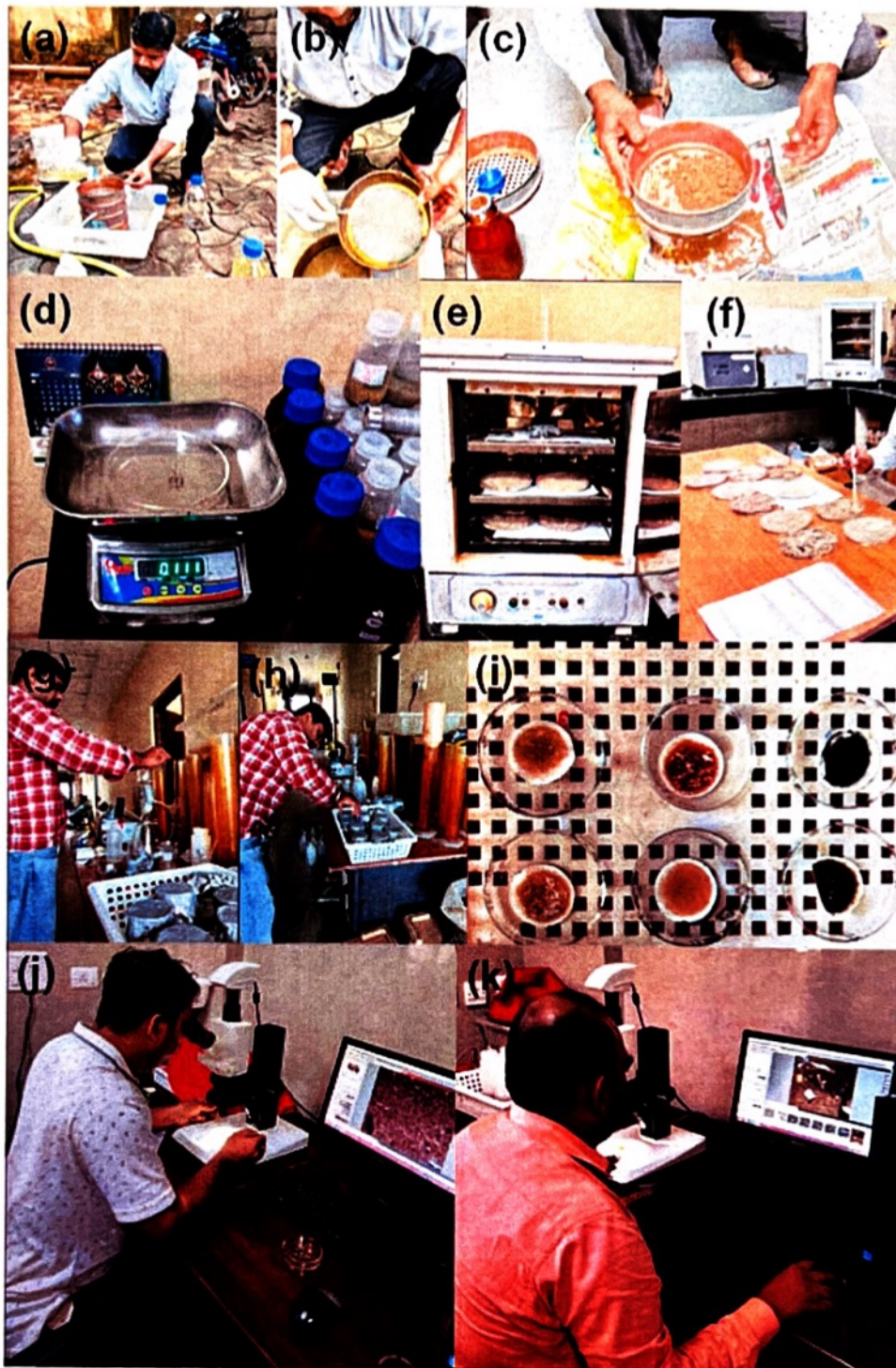
1. Immediate **microplastic cleanup drives** at Sea Beach.
2. Deployment of **fiber filters** in urban runoff channels.
3. Regular seawater sampling to monitor and track pollution levels.
4. **Local bans** on high-risk plastic items like microbeads, straws, and disposable cutlery.

The above suggestive and prioritize action plan for management and control of microplastic Pollution may be carried out by the Puri Municipality in coordination with the District administration, Puri

**SAMPLING AND ANALYSIS PHOTOGRAPH**



**Figure 6 :** (a) Beach sediment collection for microplastic analysis at Supra littoral zone, (b) Sediment collection at High tide zone, (c) Sediment collection at Low tide zone, (d,e,f) Sampling of sea water microplastic through phytoplankton net from the coastal region of Puri during tidal impact, (g) Collection of sea water at glass jar, (h) figure showing phytoplankton net, glass jar containing microplastic containing sea water on November 2024.




**Figure- 7 (a to i)** Image showing different laboratory processes and analysis procedure carried out for the beach sediment and sea water for the microplastic evaluation. Figure 4 (j & k) image showing stereo zoom microscopic analysis for microplastic obtained from water and beach sediment respectively sampled during November 2024.

## **References:**

Patidar, K, Ambade, B and Alshehri, M. (2024). Microplastics and associated polycyclic aromatic hydrocarbons in surface water and sediment of the Bay of Bengal coastal area, India: sources, pathway and ecological risk. Environmental Geochemistry and Health. 46. 10.1007/s10653-024-01926-3.

Mishra, P., Ramu, K., Sivadas, S.K., Sambandam, M., Kaviarasan, T. and Dhineka K. (2020) Protocol for field sampling and Laboratory analysis of marine litter , Meso and Microplastic. National Centre for Coastal Research, NCCR,MoES/SOP v1

  
**Chief Environmental Scientist**  
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CES-cum-Nodal Officer  
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