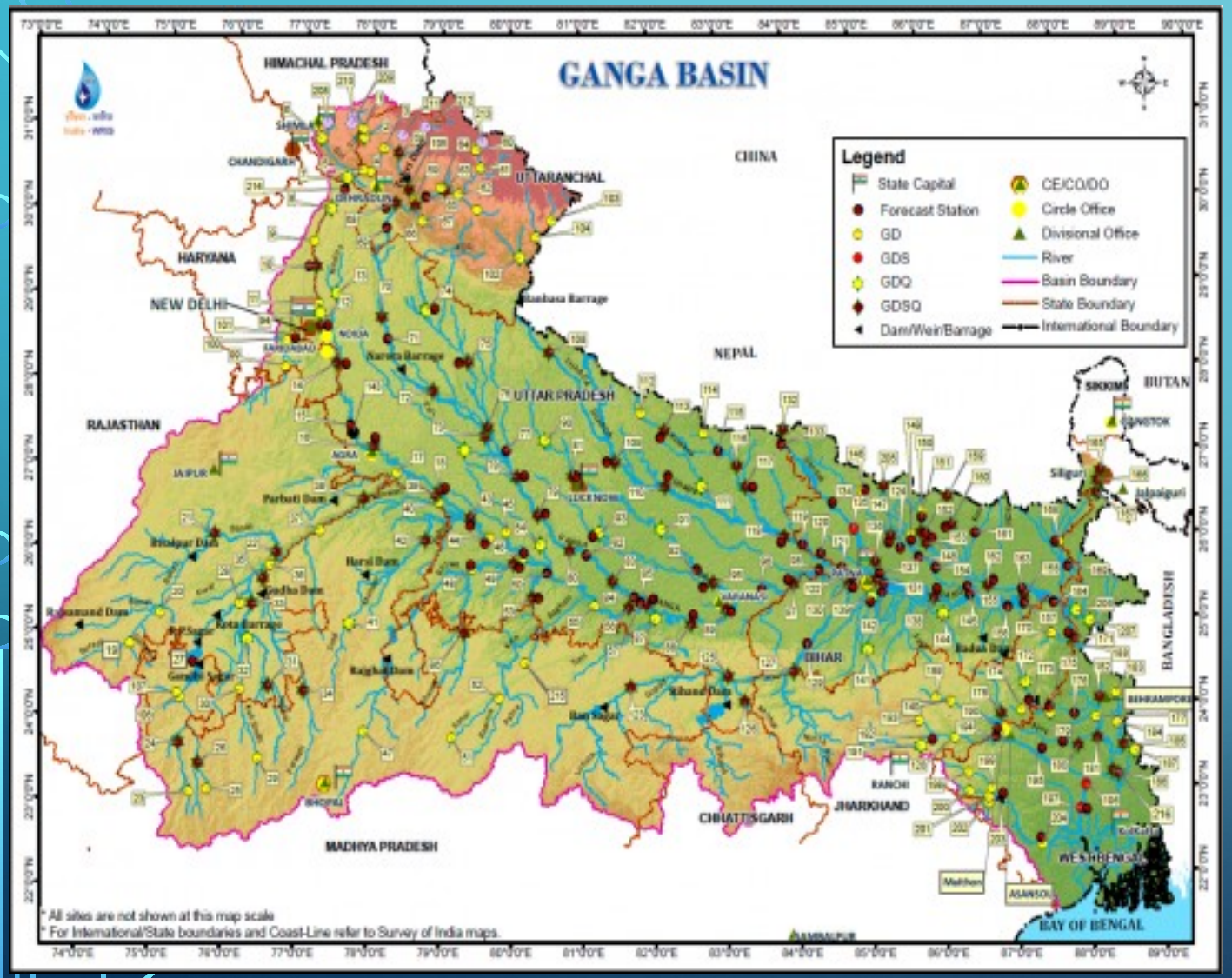
POLLUTION IN THE GANGA BASIN

KEY FINDINGS IN WATER SAMPLES FROM HARIDWAR, RISHIKESH AND NEARBY AREAS

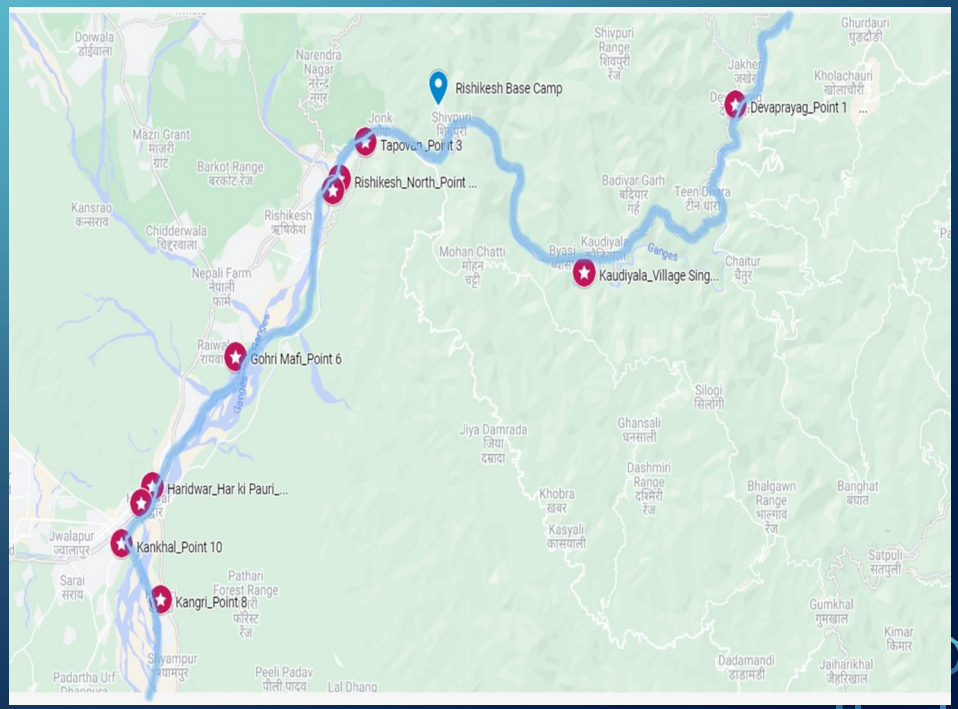
ABOUT THE GANGA PROJECT



- The Ganga project covers three components to address plastic pollution in the Ganga Basin holistically –
  1. Research – To provide quantitative and qualitative data about plastic pollution in the Ganga, including data from the ULBs in the basin.
  2. Solution – To connect CGAPP's rich network of clean tech start-ups incl. waste management, river cleaning, sustainable alternatives and other start-ups with local stakeholders and help them contextualise solutions.
  3. Outreach – To connect with locally active NGOs, youth organisations and civil society institutions and generate awareness about problems and specific solutions.

RESEARCH

- Project Research in Rishikesh used the methodology of National Geographic “Sea to Source” expedition.
- The “Sea to Source: Ganges” river all-women expedition used rapid assessment methods to provide empirical baseline data on the source, quantities, and flow of plastic pollution along the length of the Ganges River system
- The methods applied in the study covered primarily –
    1. Land-Based Systems (Litter Transects, Input and Use of Plastic Packaging; Collection and Management of Solid Waste; Municipal Solid Waste Characterization; and Photo Quadrat Litter Data Collection)
    2. Aquatic Systems and Air (Water Sampling for Microplastics; Sediment Sampling for Microplastics; Air Sampling for Microplastics; Riverbank Surveys for Fishing Debris)
    3. Knowledge, Attitudes, and Perceptions (Key Informant Interviews; Focus Group Discussions; Household Surveys; World Café Workshop; Youth Outreach and Education)



RESEARCH IN RISHIKESH & NEARBY AREAS

- Water & sediment samples were sent to CIPET, Bhubaneshwar, a government of India laboratory.
- Water samples were additionally tested for metal contamination by our researcher Dr. Priyanka Mukherjee at CSIR-Institute of Minerals & Materials Technology, Bhubaneshwar.

SOLUTION COMPONENT

- Anti-Plastic Expo with local govt reps, including Mayors from 2 ULBs, officials, NGOs, domain experts and start-ups was organised in Rishikesh.
- Discussions on the problem statement around plastic pollution and solutions offered by Start-ups were held.

OUTREACH

- During the Research leg, our researchers reached out to local schools and youth organisations to raise awareness about Plastic Pollution.
- A cleanliness drive was also held in Rishikesh with students from a Parmarth Niketan Ashram.
- Local NGOs such as Waste Warriors Society, helped organise the cleanliness drive.

METAL ION CONCENTRATION

Analysis of water samples by CSIR-IMMT for the expedition : "Tackling of Plastic Pollution in the Ganga Basin".

Sl. No	Site	pH	T.S.S	Metal Ions(ppm)						
				Fe	Cu	Pb	Cd	Cr	Zn	As
1.	S2	7.1	0.006	0.033	4.8	--	--	--	--	1.532
2.	S3	7.2	0.008	--	1.8	--	--	--	--	1.152
3.	S4	7.1	0.007	--	0.754	--	--	--	--	0.014
4.	S7	7.3	0.008	--	0.380	--	--	--	--	0.863
5.	S9	7.2	0.006	--	0.479	--	--	--	--	0.014
6.	S10	7.2	0.007	--	0.202	--	--	--	--	1.050
7.	S11	7.3	0.006	--	--	--	--	--	--	0.702

Abbreviations

pH: power of Hydron ion Concentration

T.S.S : Total suspended solids

Ppm: Parts per million (mg/L)

Fe: Iron

Cu: Copper

Pb: Lead

Cd: Cadmium

Cr: Chromium

Zn: Zinc

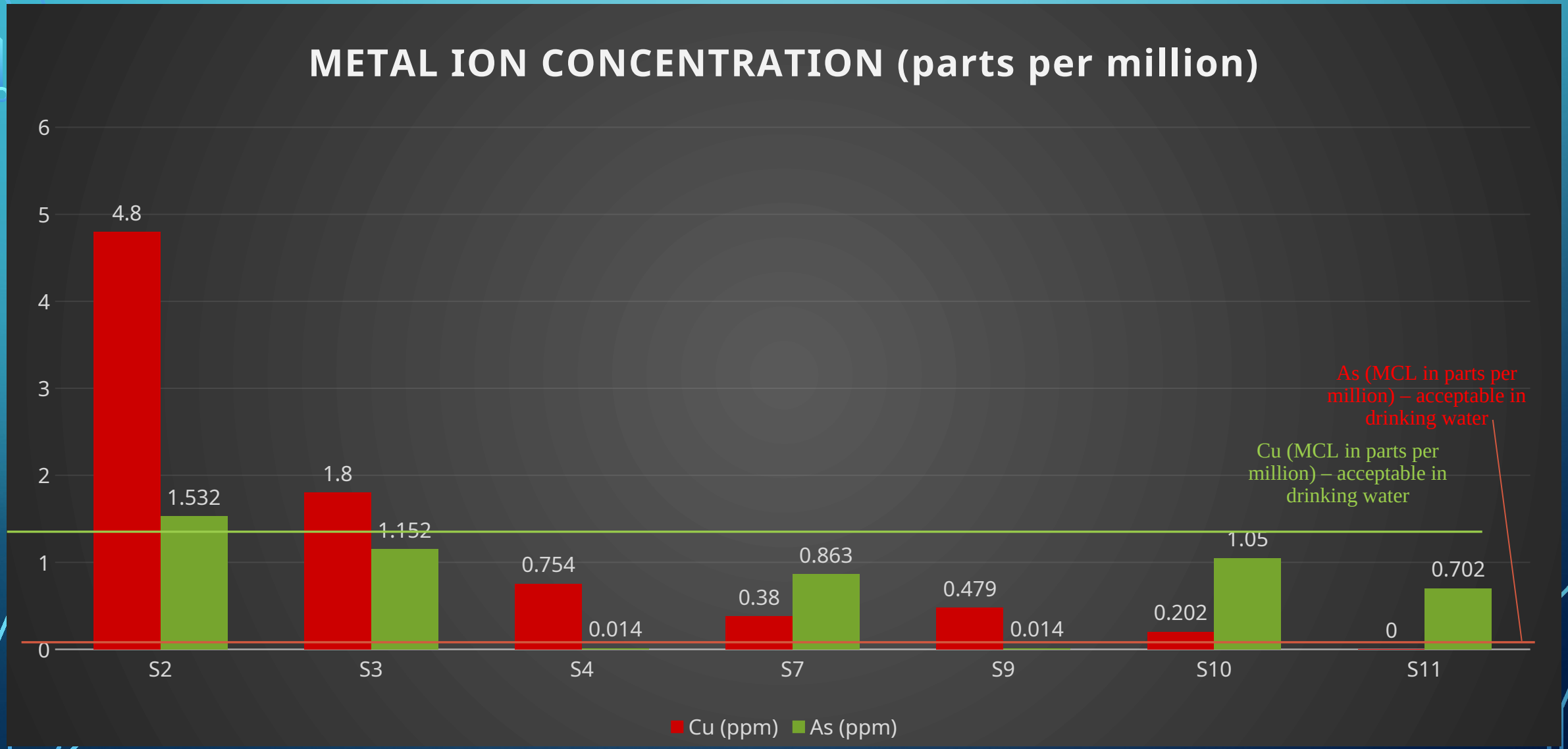
As: Arsenic

Dr. (Mrs.) Mamata Mohapatra, Sr. Pr. Scientist, Hydro& Electrometallurgy Department, Assistant Prof. (AcSIR Academy), CSIR-Institute of Minerals & Materials Technology, assisted by our researcher Dr. Priyanka Mukherjee tested water samples collected during the expedition for metal contamination.

The results indicate that water in the Ganga shows copper and arsenic contamination. The Arsenic contamination is higher than the acceptable Maximum Contaminant Levels (MCL) for drinking water in all sites. The Copper contamination is higher than prescribed MCL in one site.

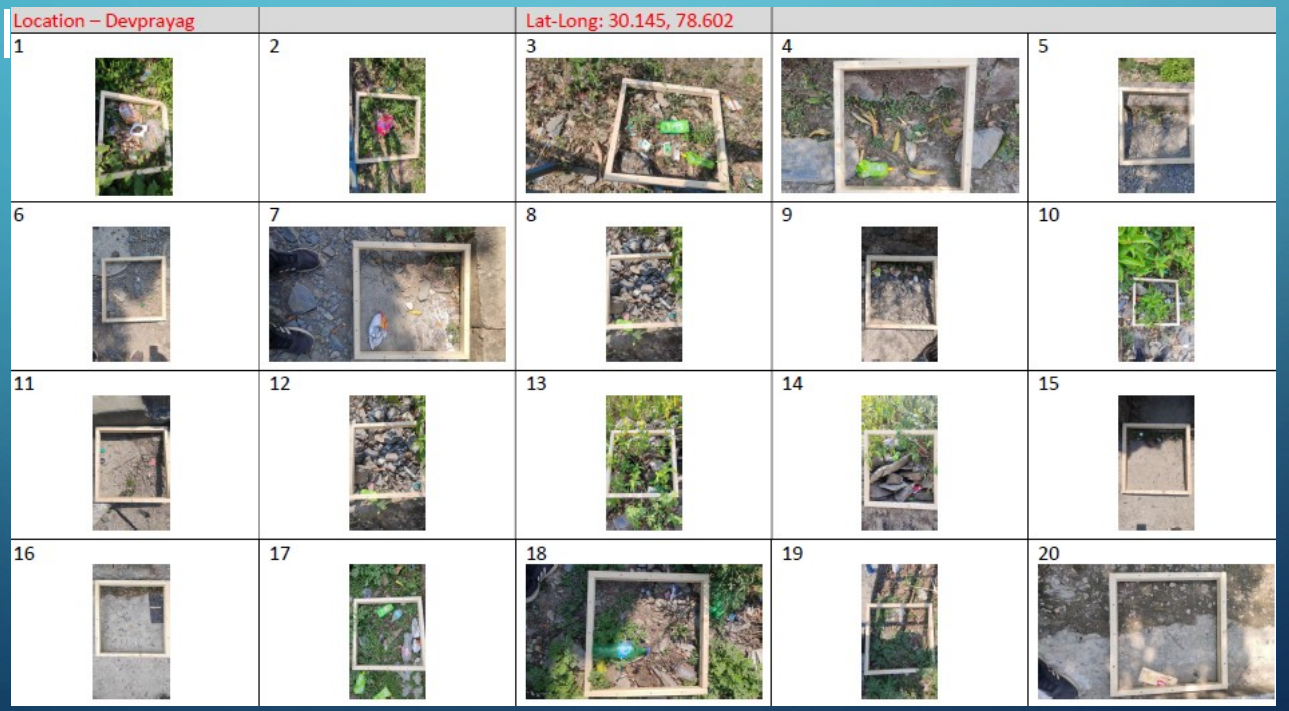
The results are showcased below.

METAL ION CONCENTRATION



PLASTIC WASTE PROFILE FINDINGS

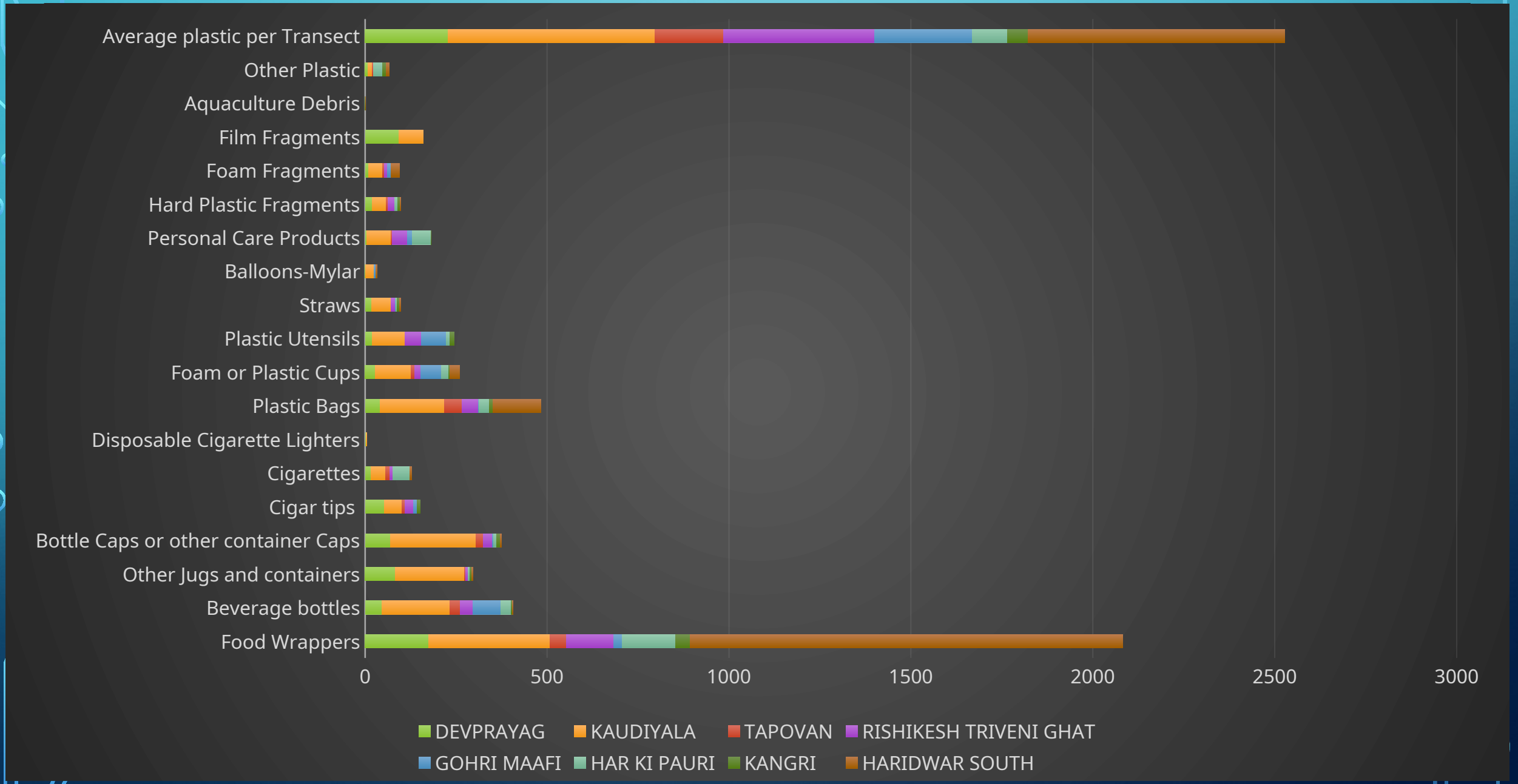
- In addition to sediment and water sampling, our researchers conducted transect analysis to establish the plastic waste profile of the area. The findings are shared here for the 9 sites with residents on the banks of the Ganga
- An exampl



PLASTIC WASTE PROFILE FINDINGS

	SITE	Site 1: Devprayag			Site 1 Overall	Site 2: Kaudiyala			Site 2 Overall	Site 3: Tapovan		Site 5: Rishikesh Triveni Ghat				Site 6: Gohri Mafi		Site 7: Har Ki Pauri					Site 8: Kangri			Site 9: Haridwar South			
	TRANSECT	Transect 1	Transect 2	Transect 3		Transect 1	Transect 2	Transect 3		Transect 1		Transect 1	Transect 2	Transect 3		Transect 1		Transect 1	Transect 2	Transect 3	Transect 4		Transect 1	Transect 2		Transect 1	Transect 2		
`	CO-ORDINATES	30.145, 78.602	30.145, 78.605	30.149, 78.597		30.075, 78.501	30.071, 78.502	30.073, 78.502		30.12952 50, 78.33129 70													29°53'45. 2"N 78°10'18. 8"E	29°53'48. 5"N 78°10'23. 9"E		29.93657 2,78.121 552	29.93650 3,78.133 853		
	Litter transect Material type - Plastic	Qty.	Qty.	Qty.	T1	Qty.	Qty.	Qty.	T2	Qty.	T3	Qty.	Qty.	Qty.	T5	Qty.	T6	Qty.	Qty.	Qty.	Qty.	T7	Qty.	Qty.	T8	Qty.	Qty.	T9	Material (T1-T9)
LT1	Food Wrappers	89	56	29	174	87	57	189	333	45	45	32	85	14	131	22	22	27	34	31	56	148	21	18	39	901	289	1190	2082
LT2	Beverage bottle	16	17	12	45	68	31	89	188	28	28	23	4	7	34	78	78	4	7	4	13	28	2	1	3	2	1	3	407
LT3	Other jugs or containers	43	23	16	82	81	19	91	191	3	3	4	0	3	7	0	0	0	1	0	3	4	0	5	5	2	2	4	296
LT4	Bottle or container caps	41	19	10	70	93	29	112	234	20	20	6	2	17	25	3	3	2	1	3	3	9	4	6	10	2	2	4	375
LT5	Cigar tips	29	17	7	53	23	11	13	47	8	8	12	10	3	25	9	9	0	0	0	0	0	0	10	10	0	0	0	152
LT6	Cigarettes	4	7	4	15	17	3	21	41	12	12	8	0	0	8	0	0	12	4	19	11	46	0	0	0	0	6	6	128
LT7	Disposable Cigarette lighters	3	0	0	3	1	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
LT8	Six-pack rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LT9	Plastic Bags	23	11	7	41	56	27	93	176	48	48	32	12	2	46	1	1	5	2	15	7	29	7	3	10	103	30	133	484
LT10	Foam or Plastic cups	17	7	3	27	37	21	41	99	10	10	8	8	1	17	57	57	8	1	6	4	19	0	3	3	16	11	27	259
LT11	Plastic utensils	11	3	5	19	43	13	34	90	0	0	3	5	37	45	68	68	5	4	0	2	11	0	12	12	0	0	0	245
LT12	Straws	8	3	7	18	25	9	19	53	0	0	7	4	0	11	2	2	0	0	1	3	4	0	6	6	4	0	4	98
LT13	Balloons-Mylar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	4	4	9
LT14	Personal care products	3	1	0	4	6	7	11	24	3	3	6	3	32	41	14	14	3	6	11	32	52	1	0	1	0	0	0	139
LT15	Hard Plastic Fragments	9	7	3	19	31	13	23	67	5	5	10	7	0	17	0	0	0	7	3	0	10	3	2	5	0	3	3	126
LT16	Foam fragments	2	4	3	9	11	9	19	39	5	5	5	3	0	8	9	9	0	0	0	0	0	0	0	0	25	0	25	95
LT17	Film fragments	57	23	13	93	24	13	31	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	161
LT18	Shotgun shells/wads	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LT19	Aquaculture Debris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
LT20	Other Plastic	0	2	5	7	2	3	8	13	2	2	2	0	8	10	0	0	8	3	6	9	26	2	7	9	9	0	9	76
	Total Plastic	355	200	124		605	265	796		189		158	143	124		268		74	70	99	143		40	73		1065	348		

PLASTIC WASTE PROFILE FINDINGS

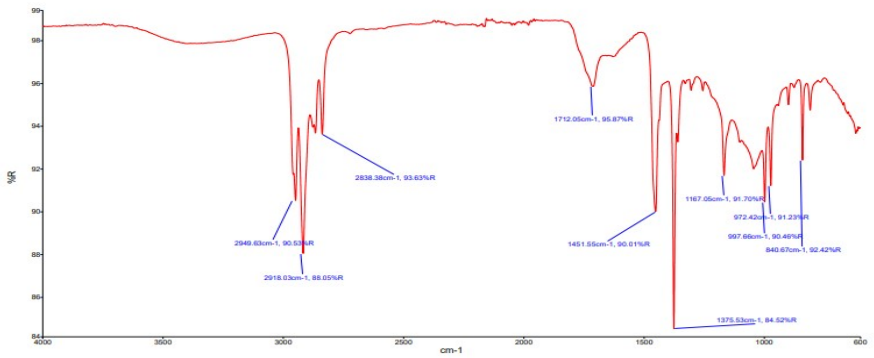


MICROPLASTICS IN THE GANGA

1. Methodology - Water samples were subjected to sieving using a 500µm mesh size sieve to separate out the microplastics which would be analysed for quantification (shape, size, colour and type) as particles smaller than 500µm would be difficult to analysis using ATR-FTIR mode.
2. Since, no samples were retained on the 500µm sieve the samples were analysed using micro-FTIR.
3. First, to dissolve the natural organic material in the water samples, 500 mL water samples were treated with 10 mL 30% H_2O_2 for 24 h at room temperature. Later, water samples were diluted with 500 mL Milli-Q water before being passed through 0.45 µm silicon membrane filter of pore size 10µm using a filtering system that was facilitated with a vacuum pump. The membrane filter was placed in a clean glass petri dish and dried at 50 °C for 24 h. The materials trapped by the membrane filter was then observed under a micro-FTIR for the type of microplastics found
4. Type of Microplastics Microplastics were analyzed though µ-FTIR and 3 major polymers were found. Polypropylene (PP) was majorly found from all sites including Polyethylene (PE), Polyethylene terephthalate (PET).
5. From the experiment, it was concluded that Polypropylene was found in almost all except two sites.

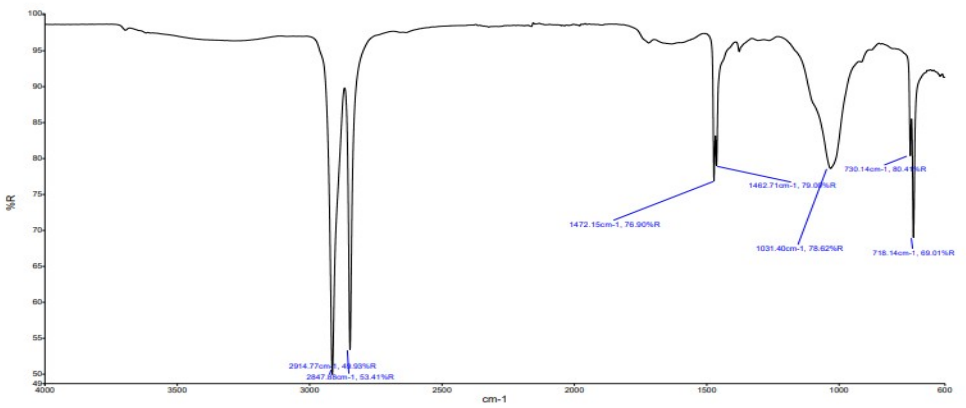
SPECTRAL ANALYSIS OF DATA

1) PP



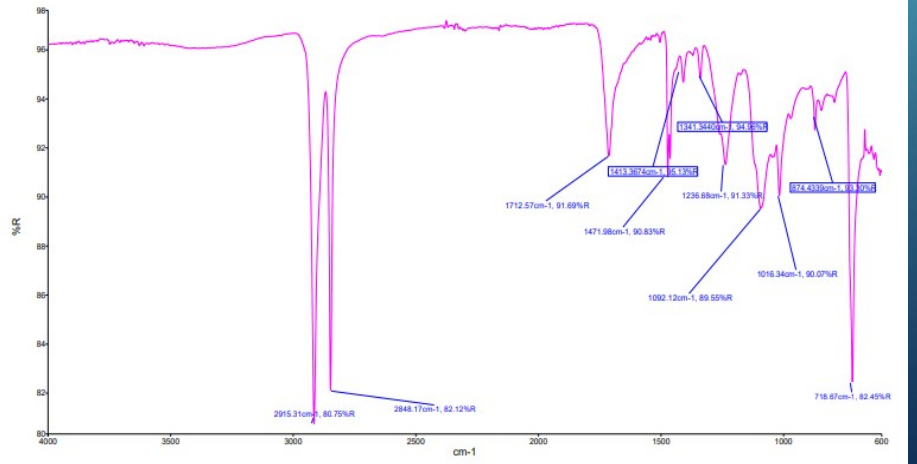
The absorption bands at 2949-2838cm^{-1} shows C-H stretching peaks while the band corresponding 1451cm^{-1} represents the CH_2 deformation. The peak at 1375cm^{-1} shows symmetric CH_3 deformation which is a characteristic peak of PP and the peak at 1167cm^{-1} represented isotactic polypropylene band.

2) PE



The absorption bands of C-H group at the main chain at 2914-2847cm^{-1} can be observed in the spectra. Also, the wagging and rocking vibration of methylene (CH_2) group was observed at 1472-1462cm^{-1} and 718cm^{-1} respectively.

3) PET



SURVEYS & INTERVIEWS

- Our researchers conducted focus group discussions, key informant interviews, youth outreach and surveys to gain insights into the issue of plastic pollution and its perception in communities living close to the Ganga basin.
- In smaller localities outside Municipal bounds, there was a lack of waste management facilities including collection.
- In Municipal areas, waste disposal in smaller Municipalities was a problem with most waste directed to landfills or burnt/dumped at local sites.
- Most communities were aware of the Single Use Plastic Ban, but unaware of easily available alternatives.
- Influx of tourists and associated waste overwhelms the capacity of local bodies to collect, segregate and dispose of waste.
- Several community and civil society organisations are working on awareness and outreach, but agree that government intervention is needed to offer/facilitate solutions and alternatives to plastic.

NEXT STEPS

- Expanding Locations –
  A. Plan to expand to other locations with river bodies ,government connect and vibrant start-up ecosystem (Telangana, Kerala)
  B. Continue Project in other Ganga River Basin states (UP, Bihar & West Bengal)

- Trashboat –
  A. To encourage Start-up plugins, a trashboat designed by a start-up in our network will be used for cleanliness drives.
  B. One of our start-up partners will also offer testing equipment designed to detect customisable parameters (PH, BOD, Metal contamination etc.). This will be used in future locations for testing

- Outreach/Startup connects at major points –
  A. CGAPP has connected with over 200 clean tech start-ups and conducted TWO cohorts of our Clean Tech Start-up accelerator 'Helix' with 15 start-ups. These solutions will be plugged into various locations.
  B. CGAPP will also connect with the start-up ecosystem in new locations (T-Hub in Telangana and University based accelerators in other states)

- Anti plastic alliance with regular outreach –
  A. CGAPP will connect with NGOs and other stakeholders to take engagement on plastic pollution beyond events to regular activities.
  B. The goal is to have one event per month in each location after the initial program, in coordination with partners for follow up on potential projects and actions.