Supplementary Information

Seasonal assessment and characterization of microplastics in two urban (Balu) and peri-urban (Shitalakshya) rivers of Bangladesh

Vaskur Kanti Roy[1,¥], Md Numaer Tahnun[1,2,¥], Hridoy Roy[1,¥], Rumana Afrin[3], Md. Shahinoor Islam[1,#] and Md. Mujibur Rahman[3,*]

1. Department of Chemical Engineering, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
2. Department of Chemical and Environmental Engineering, University of California, Riverside, CA 92507, United States
3. Department of Civil Engineering, United International University (UIU), Madani Avenue, Badda, Dhaka, 1212, Bangladesh

¥: Equal Contributions

Corresponding authors:

#Md. Shahinoor Islam (shahinoorislam@che.buet.ac.bd)

*Md. Mujibur Rahman (mujibur@ce.uiu.ac.bd)

Table S1 Site selection module

Site no	River	Sampling sites	Site code	Major pollution sources	Latitude	Longitude
1	**Balu**	Balu Bridge, 300 ft	**BL1**	Local bazars, restaurants, and industries (Ready mix cement factory)	23.834295	90.478048
2		LGED Bridge, Jolshiri	**BL2**	Industrial zone and residential zone	23.816141	90.48583
3		Beraid Boat Ghat	**BL3**	Bazar, boat jetty, residential and industrial zone.	23.803583	90.483178
4		Edarkandi-Fakirkhali Road	**BL4**	Residential area, poultry farms, and dairy farms	23.7782864	90.4760599
5		Eastern Straw Board	**BL5**	Paper mills and residential area	23.754917	90.488611
6		Rajakhali Ghat, Demra	**BL6**	Agro farms, electronic market, and residential area.	23.7358887	90.4916777
1	**Shitalakshya**	Kholapara-Ghorashal Kheyaghat, Ghorashal	**SL1**	Painting and chemical industries and industrial discharge	23.940269	90.6175277
2		Kaliganj Kazir Char	**SL2**	newly developing AK Khan economic zone,	23.9165061	90.5659873

			cotton mill, Hameen industrial park.		
3	Beldi Bazar	**SL3**	brick manufacturing industry, residential area, etc.	23.866084	90.55454
4	Hatabo Bazar, Rupganj	**SL4**	paper mills, dockyard, jetty and residential area.	23.808758	90.54234
5	Habib Ghat, Boralu Bazar	**SL5**	Industrial zone, several paper mills, food industries, chemical warehouse.	23.762157	90.509764
6	South Rupshi Mosjid Ghat	**SL6**	public market with small waste dumps, weaving factory, clothing industry, textile mills, residential area, and jetty etc.	23.732362	90.508041

Table S2 Quantification of Microplastics in the Balu and the Shitalakshya Rivers for water and sediment samples in the dry season.

Sampling Point	The Balu River		The Shitalakshya River	
	Water	Sediment	Water	Sediment
	MP/L	MP/kg	MP/L	MP/kg
1	3.97±0.159	10665±1664	4.13±0.248	4100±451
2	6.29±0.440	4905±481	4.18±0.334	4595±483
3	5.39±0.126	6955±1085	4.04±0.121	4295±387
4	4.06±0.230	4155±327	4.28±0.086	3825±306
5	3.34±0.401	3915±568	4.00±0.420	3485±303
6	4.77±0.471	3445±448	3.5±0.235	3065±399

Table S3 Quantification of Microplastics in the Balu and the Shitalakshya Rivers for water and sediment samples in the wet season.

Sampling Point	The Balu River		The Shitalakshya River	
	Water	Sediment	Water	Sediment
	MP/L	MP/kg	MP/L	MP/kg
1	1.760±0.211	1410±113	6.72±0.739	2850±381
2	3.400±0.238	2850±428	2.77±0.249	2130±185
3	5.110±0.588	515±16	6.09±0.852	2020±197
4	3.770±0.189	2905±204	2.47±0.494	875±52
5	3.120±0.237	3275±148	5.98±0.478	3275±255
6	6.360±0.356	9675±1064	3.87±0.561	4880±654

Table S4 PLI values of sediment samples and water samples in the Shitalakshya River across both seasons.

	Sediment Samples ($C_o = 875$)						**Water Samples ($C_o = 2$)**					
	Wet Season			Dry season			Wet Season			Dry season		
Sampling Point	C_i	C_{fi}	PLI	C_i	C_{fi}	PLI	C_i	C_{fi}	PLI	C_i	C_{fi}	PLI
SL-1	2850	3.3	1.80	4100	4.67	2.17	7	3.5	1.87	4.13	2.07	1.44
SL-2	2130	2	1.6	4595	5.25	2.29	3	1.5	1.25	4.18	2.09	1.45
SL-3	2020	2	1.5	4295	4.91	2.22	6	3	1.73	4.04	2.02	1.42
SL-4	875	1	1	3825	4.37	2.09	2	1	1	4.28	2.14	1.46
SL-5	3275	4	1.9	3485	3.98	1.99	6	3	1.73	4	2	1.41
SL-6	4880	6	2.4	3065	3.50	1.87	4	2	1.41	3.5	1.75	1.32
	PLI_s		1.64	PLI_s		1.89	PLI_w		1.46	PLI_w		1.35

Table S5 PLI values of sediment samples and water samples in the Balu River across both seasons.

	Sediment Samples ($C_o = 515$)						**Water Samples ($C_o = 2$)**					
	Wet Season			Dry season			Wet Season			Dry season		
Sampling Point	C_i	C_{fi}	PLI	C_i	C_{fi}	PLI	C_i	C_{fi}	PLI	C_i	C_{fi}	PLI
BL-1	1410	2.75	1.66	10665	20.71	4.55	2	1	1	3.97	1.98	1.41
BL-2	2850	5.53	2.35	4905	9.52	3.08	3	1.5	1.22	6.29	3.14	1.77
BL-3	515	1	1	6955	13.50	3.67	5	2.5	1.58	5.39	2.69	1.64
BL-4	4865	9.45	3.07	4155	8.07	2.84	4	2	1.41	4.06	2.03	1.42
BL-5	3275	6.36	2.52	3915	7.60	2.76	3	1.5	1.22	3.34	1.67	1.29
BL-6	9675	18.79	4.33	3445	6.69	2.59	6	3	1.73	4.77	2.38	1.54
	PLI_s		2.25	PLI_s		3.19	PLI_w		1.34	PLI_w		1.35

Table S6 Risk level criteria for microplastic pollution.

Value of the pollution load index (PLI)	**<10**	**10-20**	**20-30**	**>30**
Risk category	I	II	III	IV

Table S7 Pearson's correlation analysis between microplastic (MP) abundances in water (MPs/L) and sediments (MPs/kg dry weight) across sampling sites in dry and wet seasons.

Season	**Pearson's r**	**p-value**
Dry	0.16	0.61
Wet	0.38	0.25

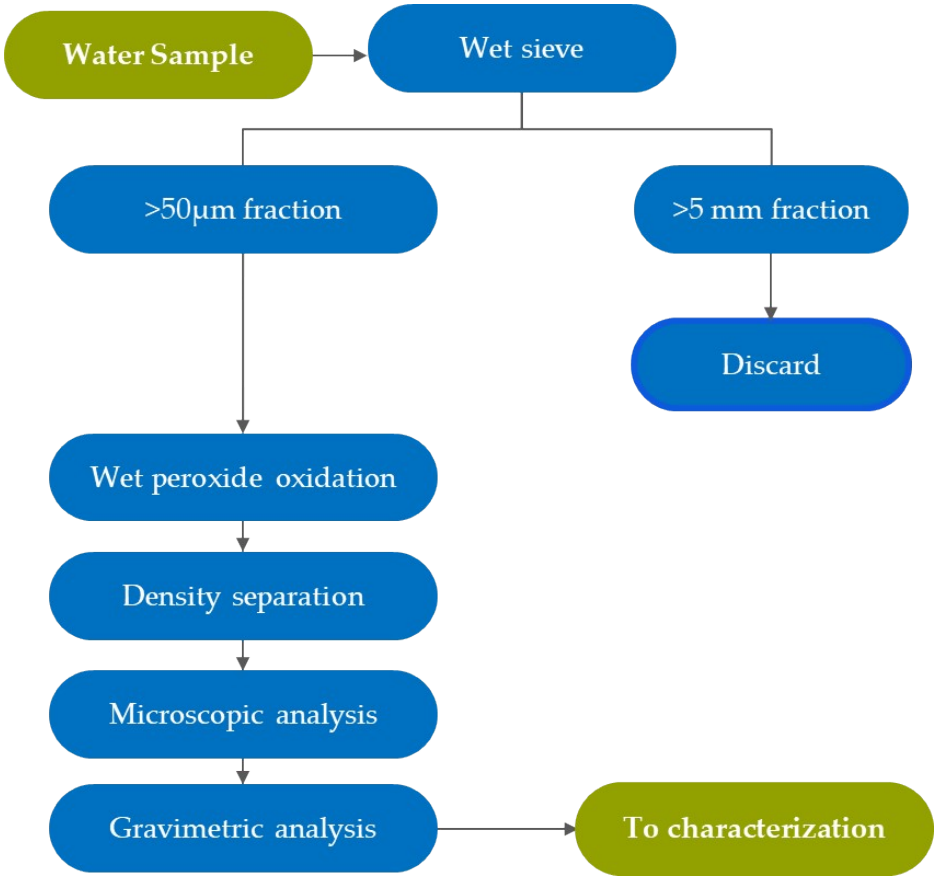

Figure S1 Block Diagram of Methods for Processing Water Samples

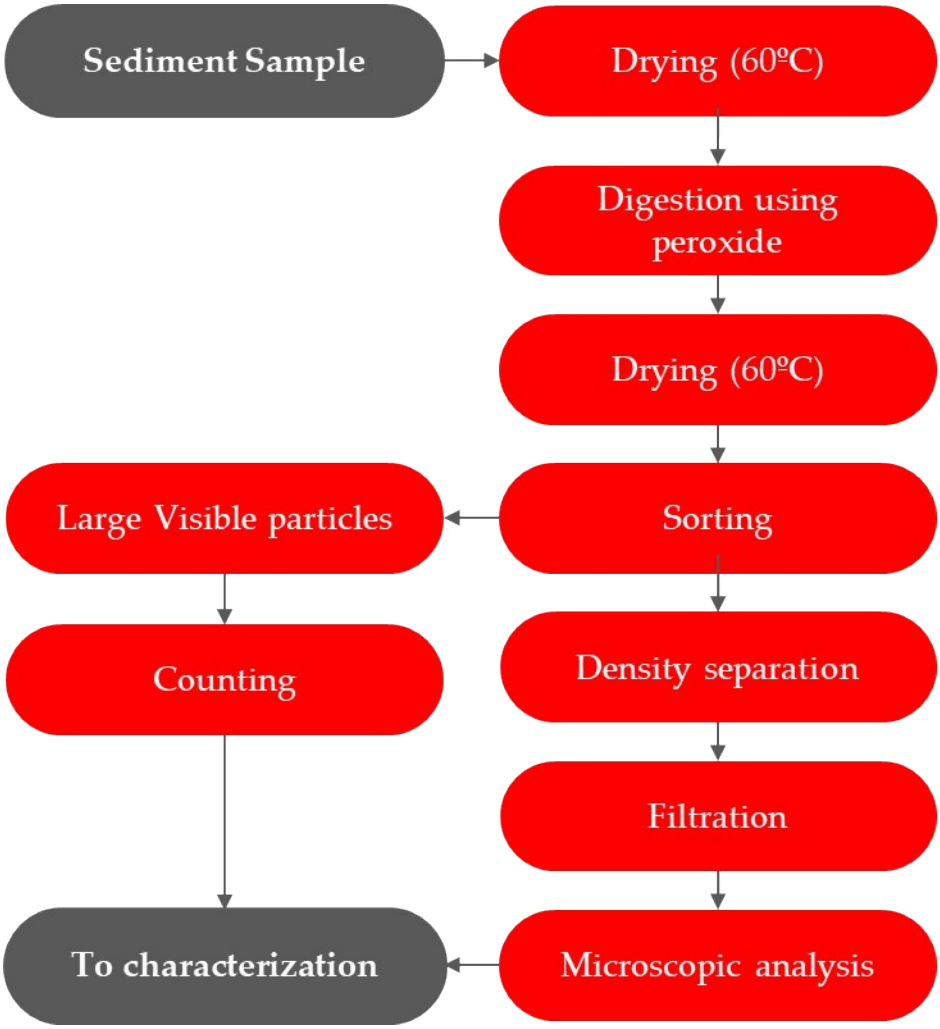

Figure S2 Block Diagram of Methods for Processing Sediment Samples

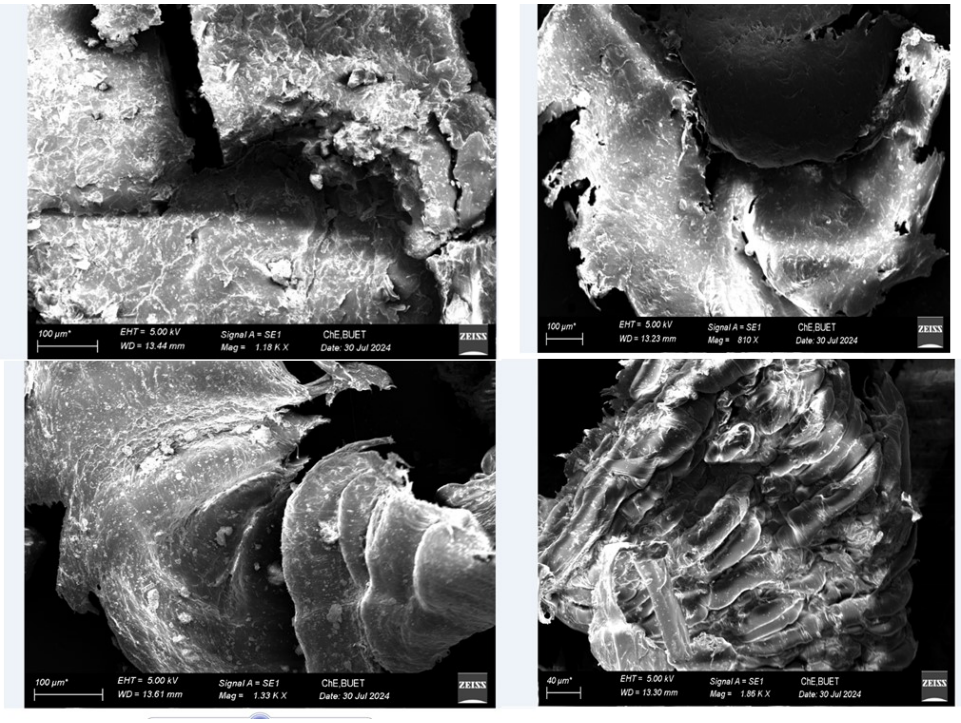

Figure S3 SEM Image of Balu-1 sediment

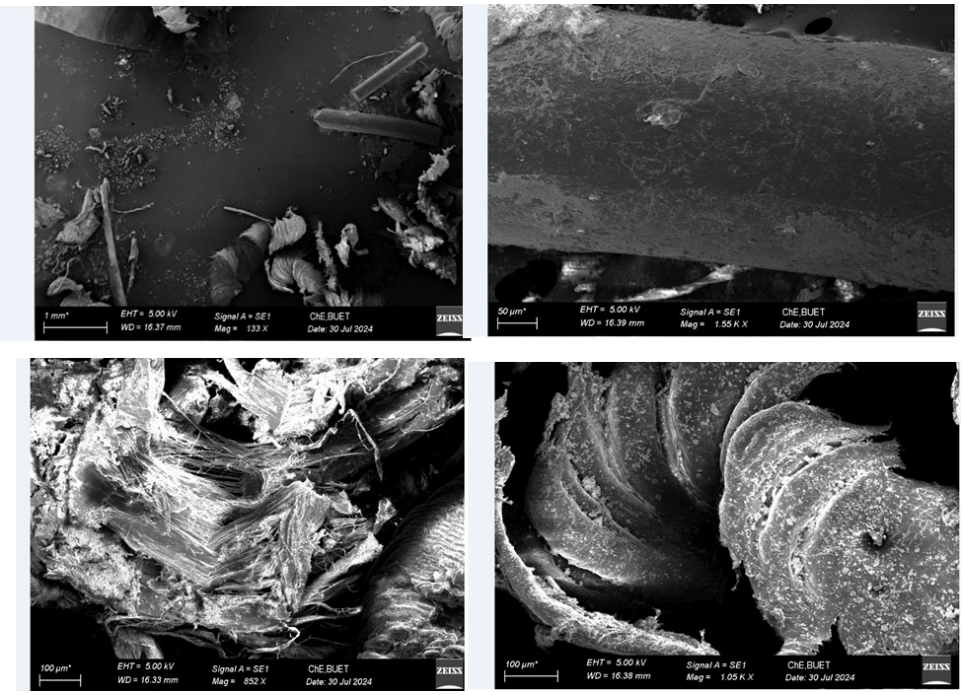

Figure S4 SEM Image of Balu-1 water

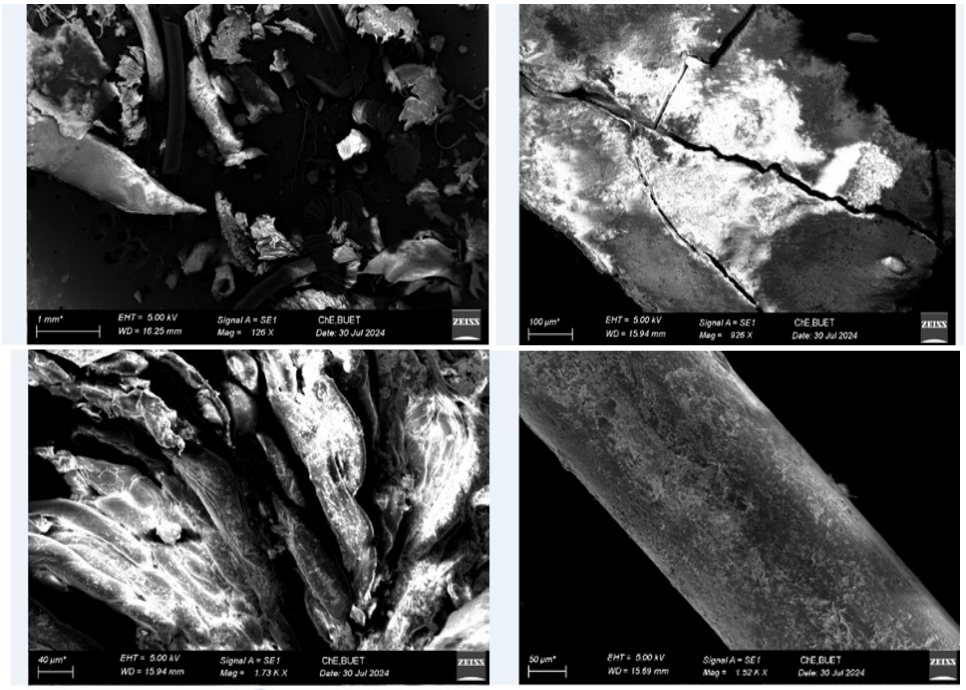

Figure S5 SEM Image of Balu-4 Sediment

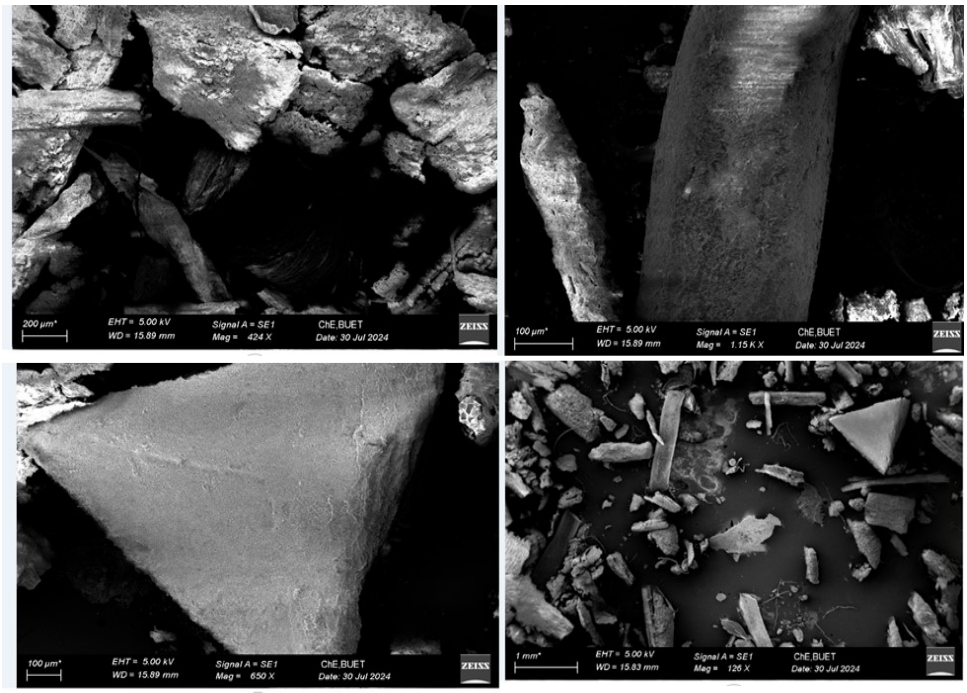

Figure S6 SEM Image of Balu-4 Water

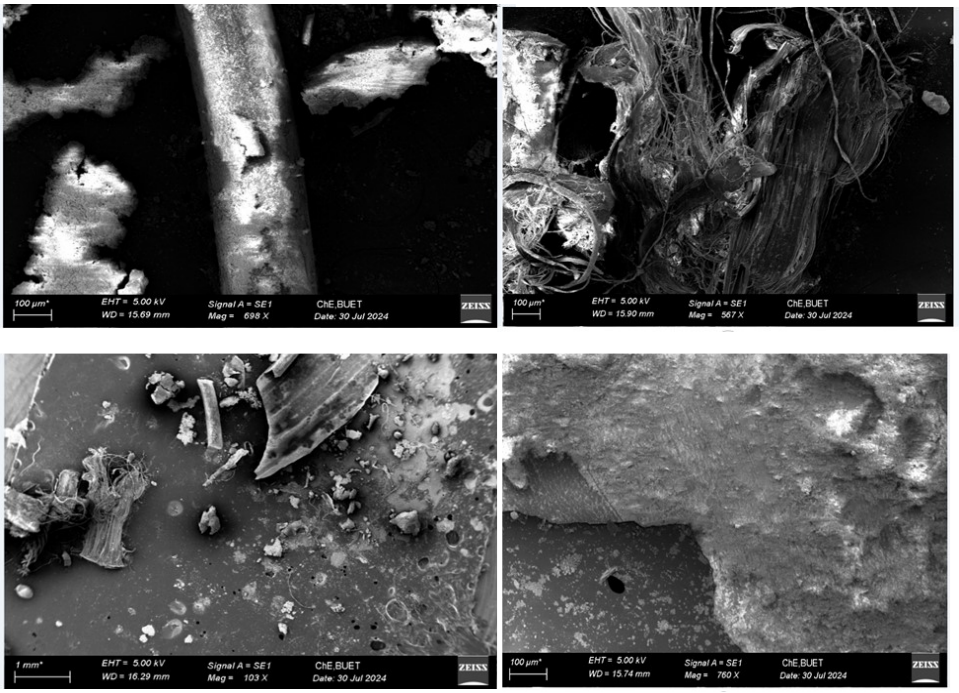

Figure S7 SEM Image of Shitalakshya-2 Water

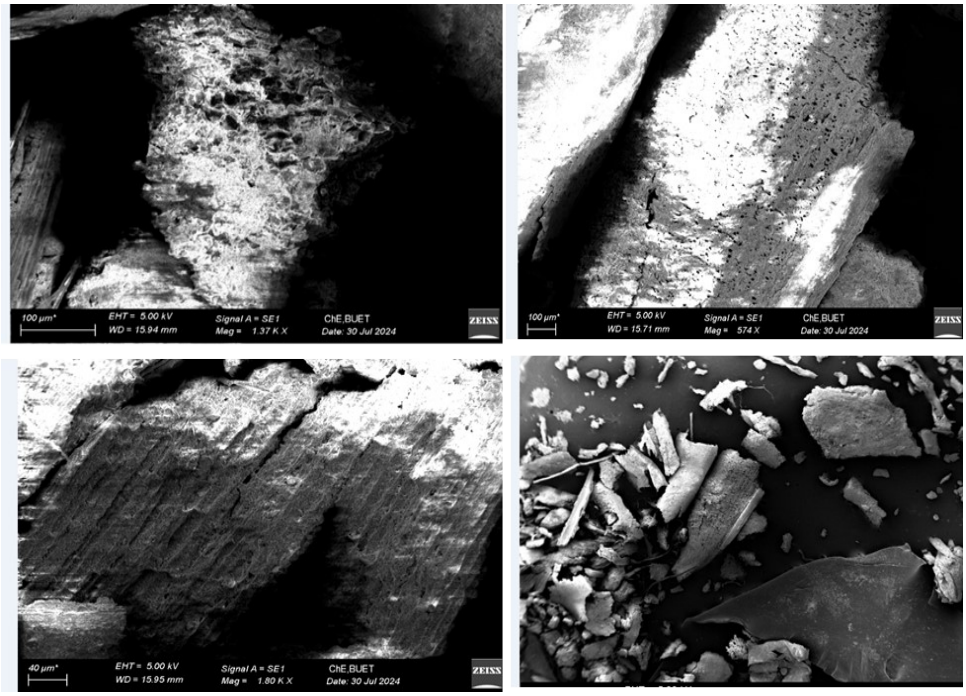

Figure S8 SEM Image of Shitalakshya-4 Sediment.

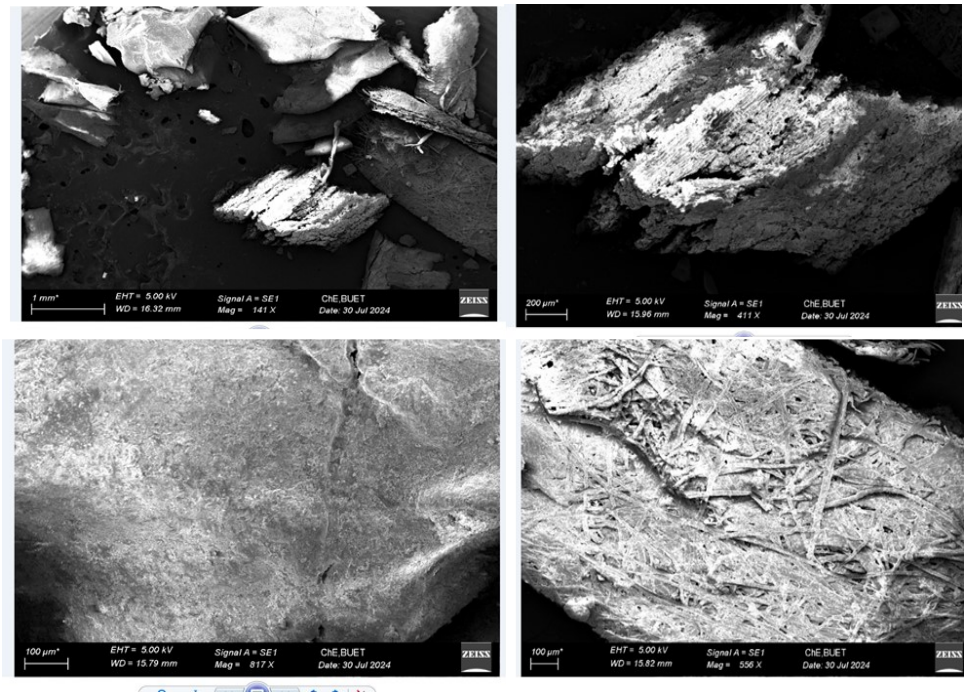

Figure S9 SEM Image of Shitalakshya-5 Sediment.

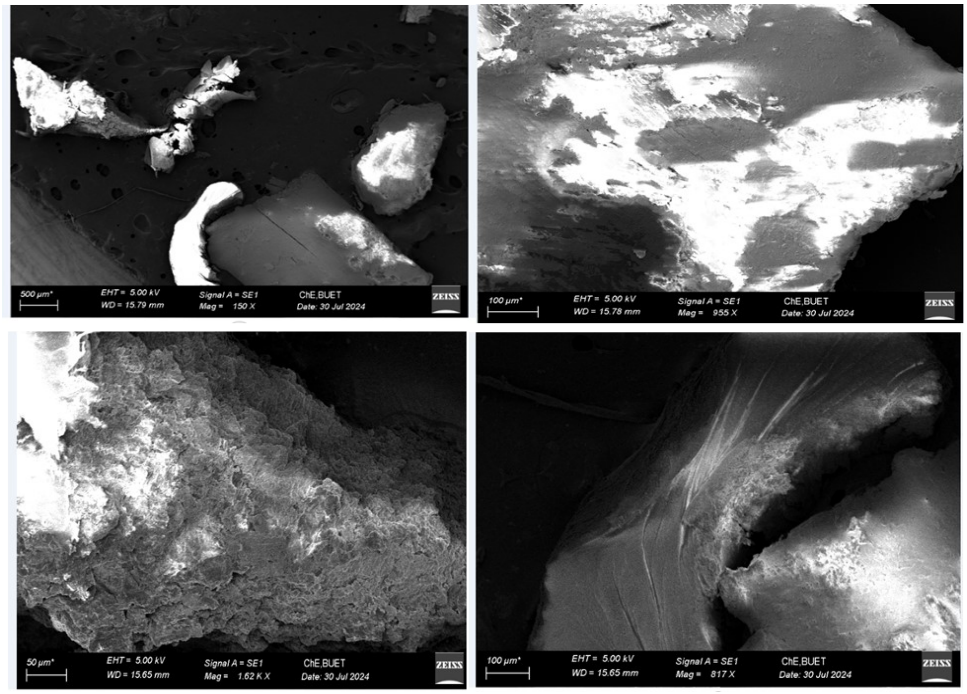

Figure S10 SEM Image of Shitalakshya-5 Water.

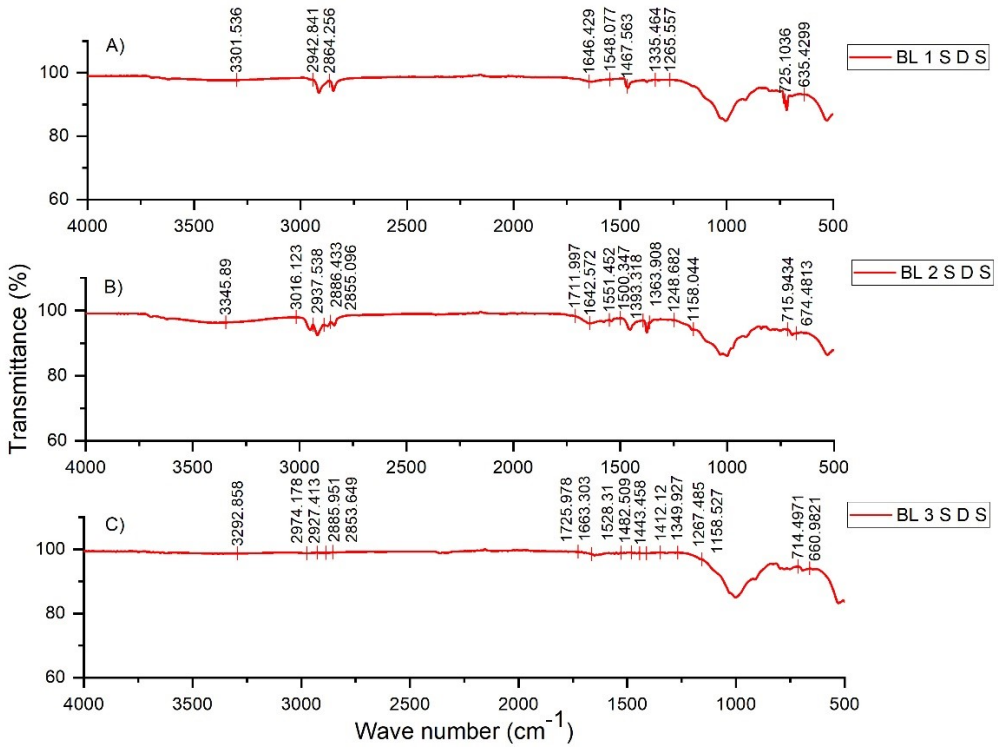

Figure S11 FTIR spectra of A) Balu-1, B) Balu-2, and C) Balu-3 sediment in the dry season.

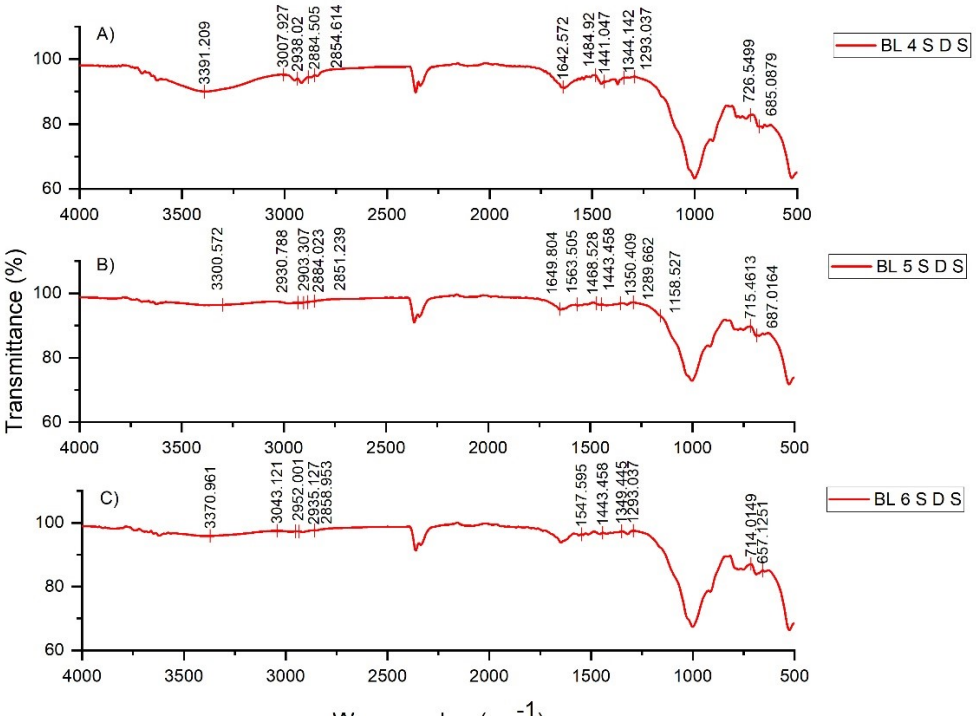

Figure S12 FTIR Spectra of A) Balu-4, B) Balu-5, and C) Balu-6 sediment in the dry season.

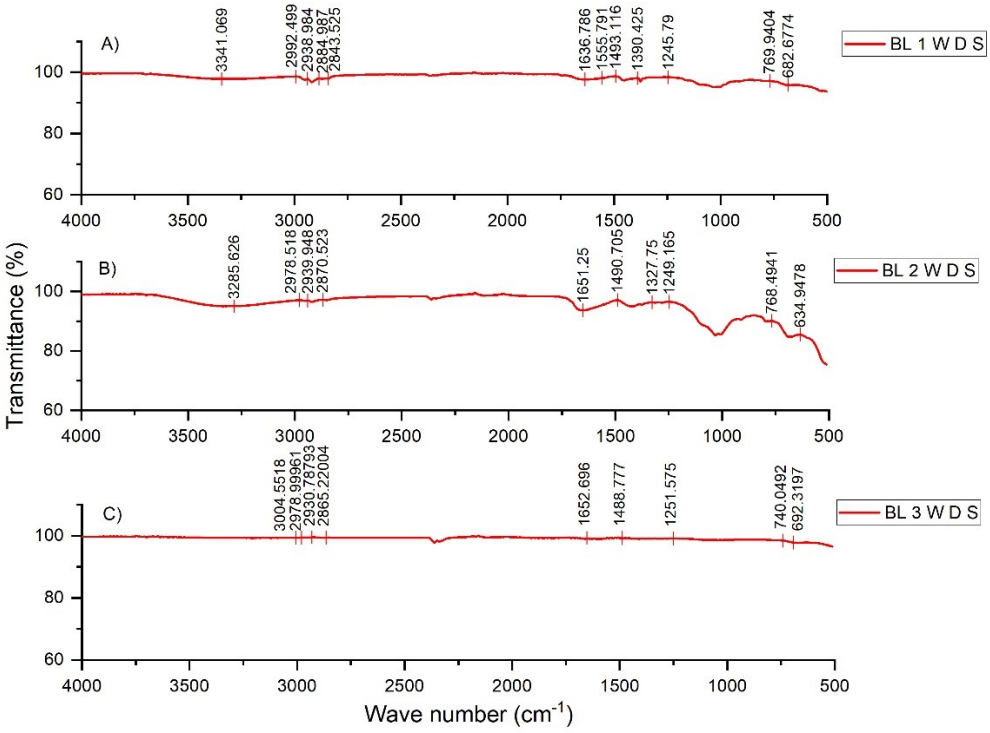

Figure S13 FTIR spectra of A) Balu-1, B) Balu-2, and C) Balu-3 water in the dry season.

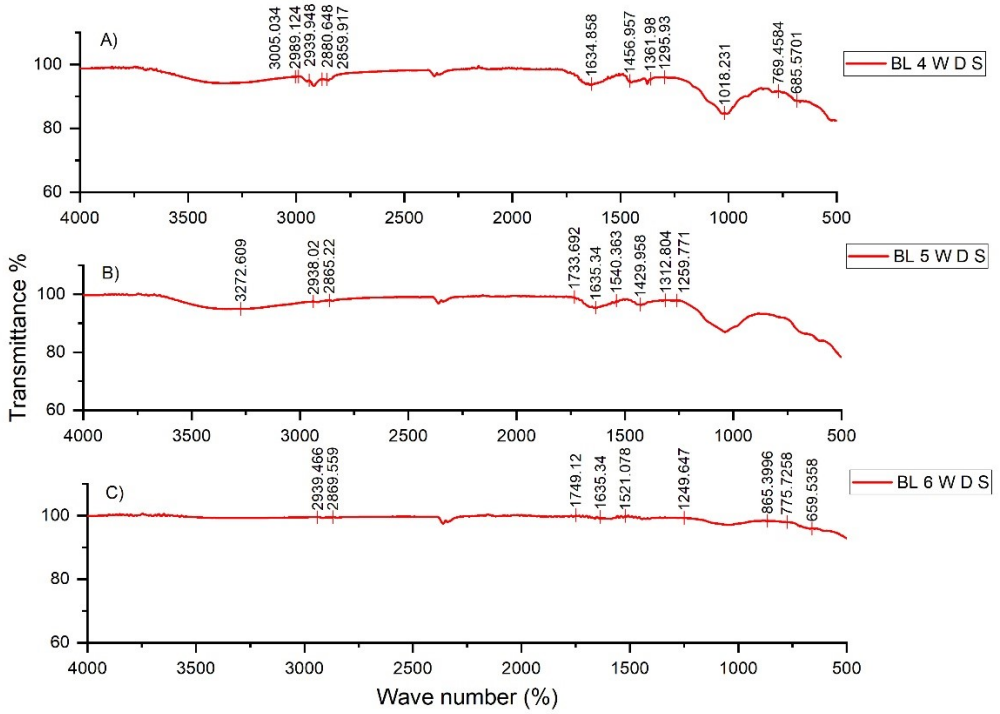

Figure S14 FTIR spectra of A) Balu-4, B) Balu-5 and C) Balu-6 water in the dry season.

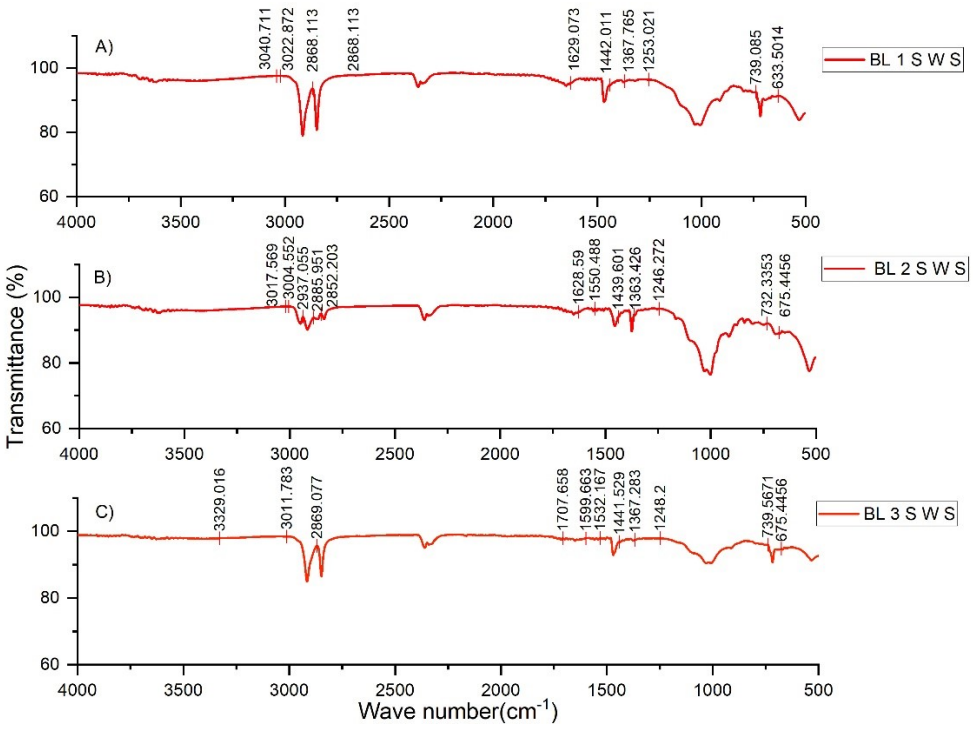

Figure S15 FTIR spectra of A) Balu-1, B) Balu-2, and C) Balu-3 sediment in the wet season.

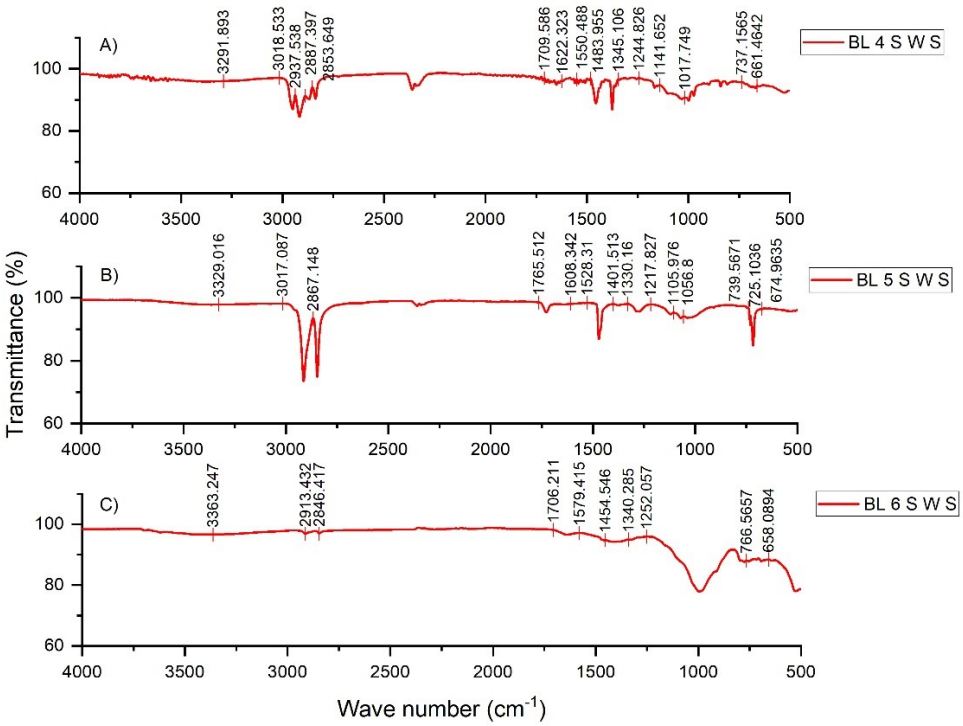

Figure S16 FTIR spectra of A) Balu-4, B) Balu-5, and C) Balu-6 sediment in the wet season

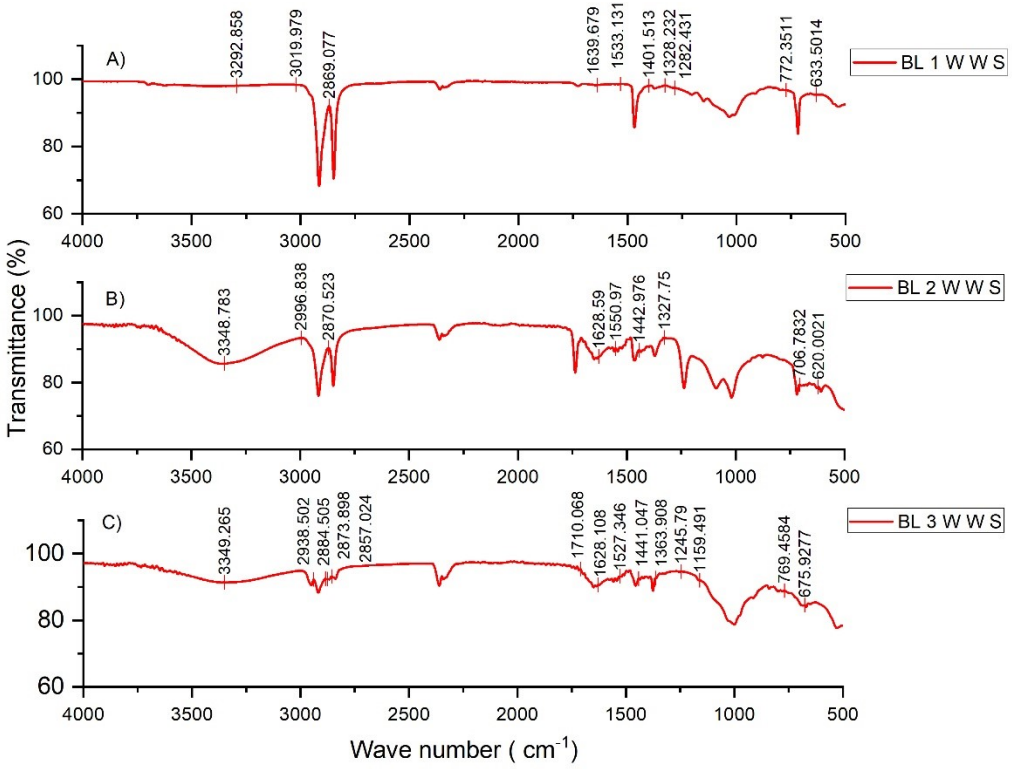

Figure S17 FTIR spectra of A) Balu-1, B) Balu-2, and C) Balu-3 water in the wet season.

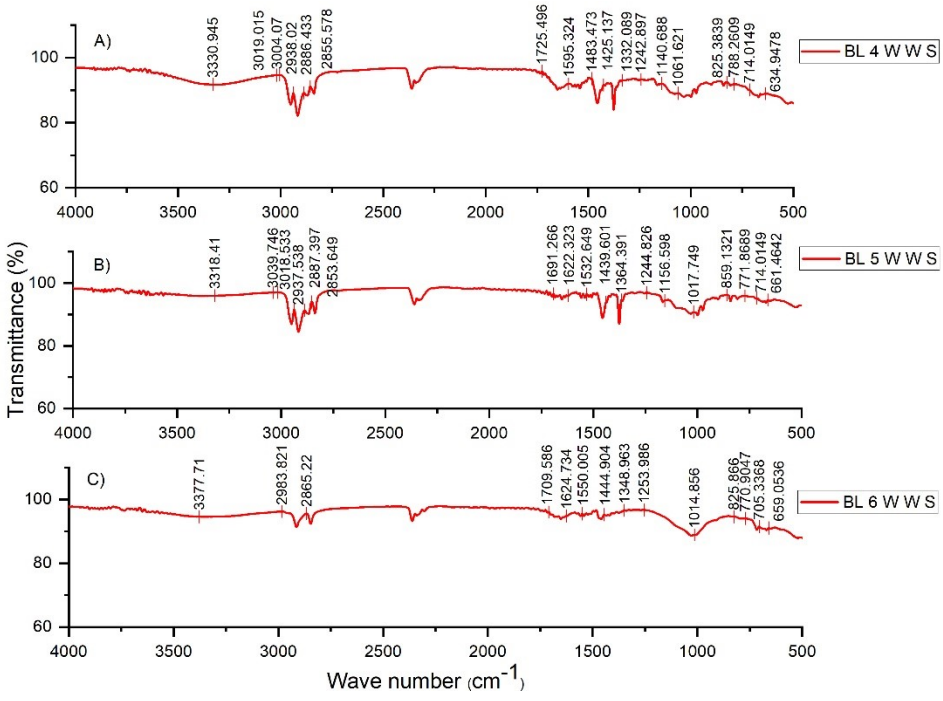

Figure S18 FTIR spectra of A) Balu-4, B) Balu-5, and C) Balu-6 water in the wet season

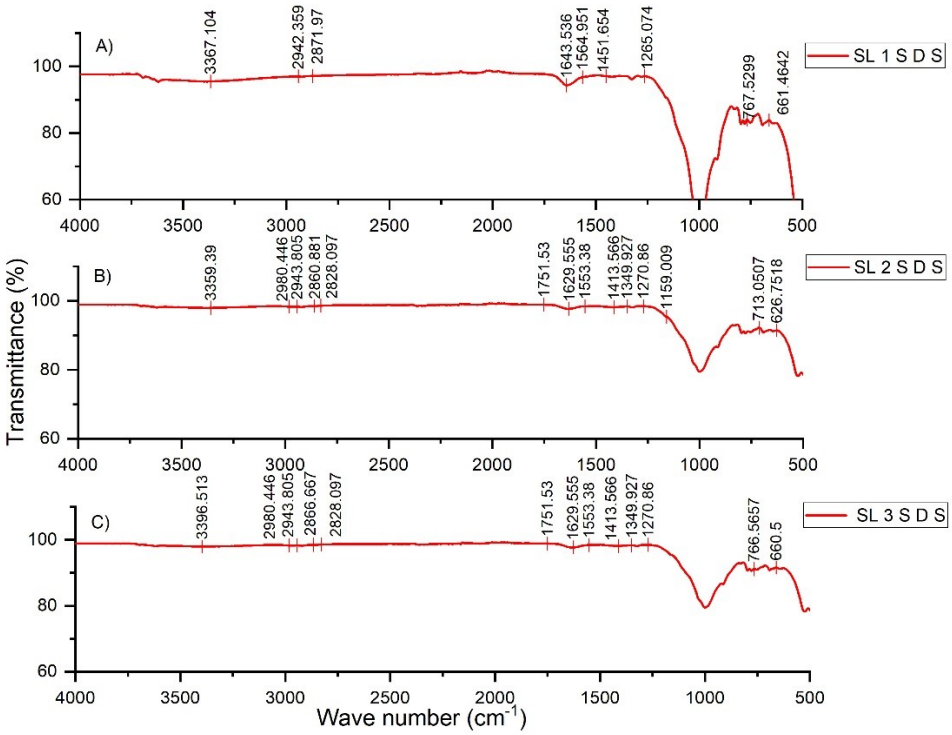

Figure S19 FTIR spectra of A) Shitalakshya-1, B) Shitalakshya -2, and C) Shitalakshya -3 sediment in the dry season.

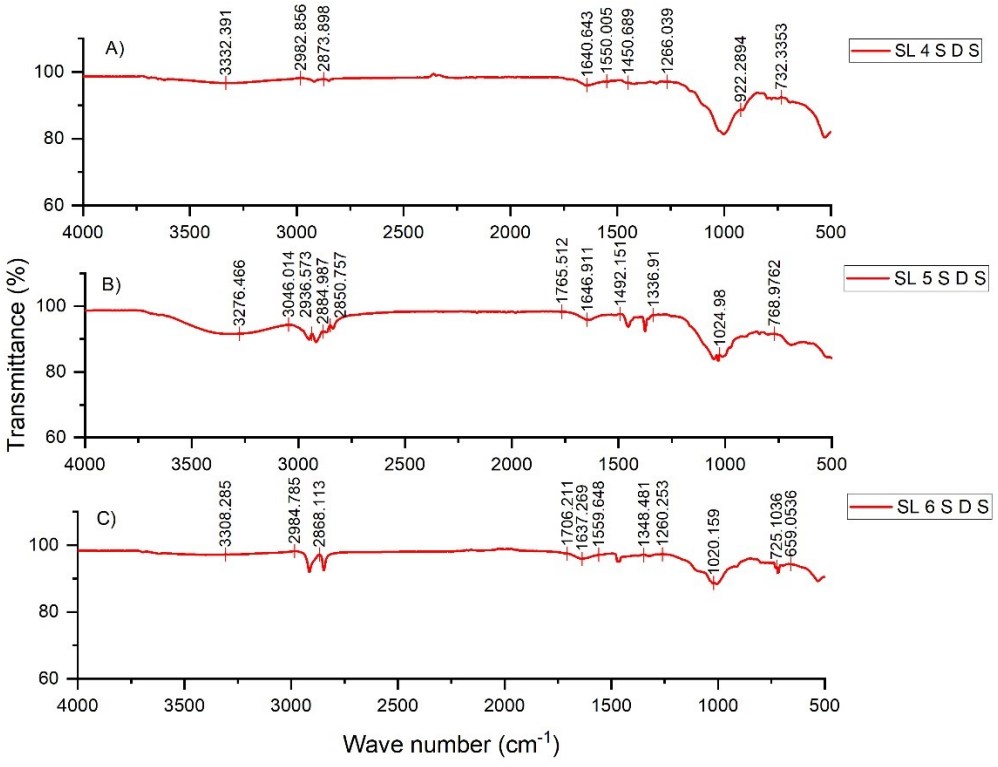

Figure S20 FTIR spectra of A) Shitalakshya-4, B) Shitalakshya-5, and C) Shitalakshya -6sediment in the dry season.

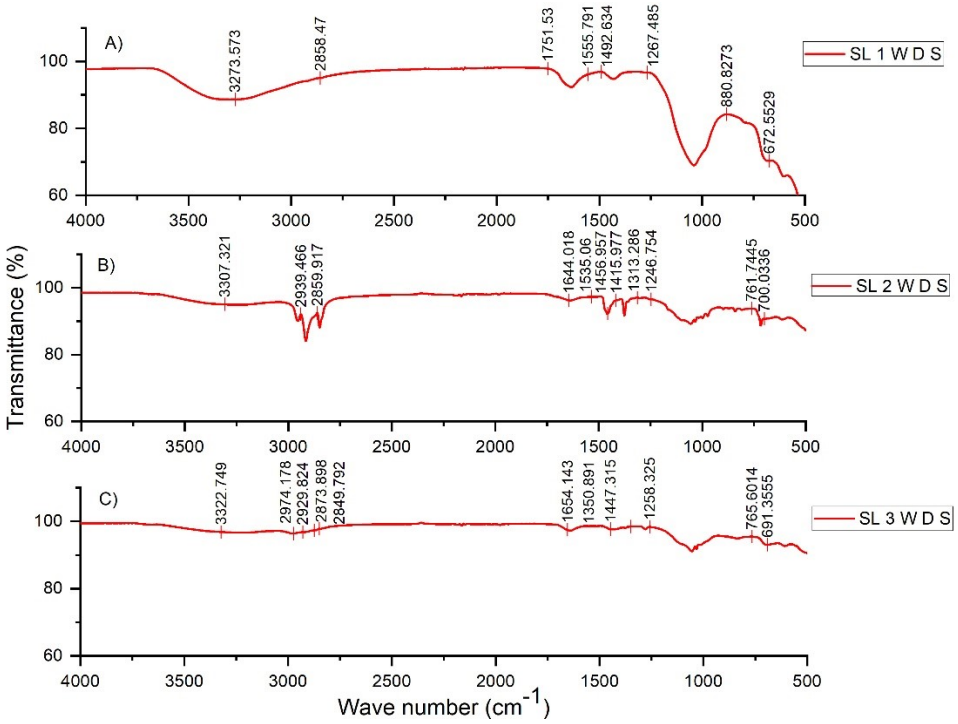

Figure S21 FTIR spectra of A) Shitalakshya-1, B) Shitalakshya -2, and C) Shitalakshya -3 water in the dry season.

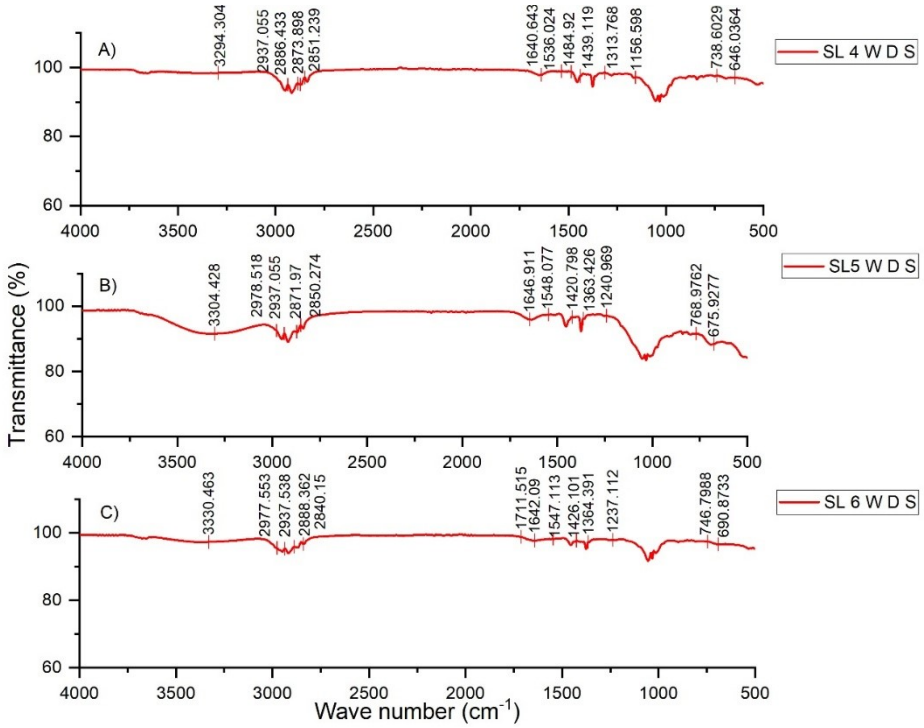

Figure S22 FTIR spectra of A) Shitalakshya-4, B) Shitalakshya -5, and C) Shitalakshya -6 water in the dry season.

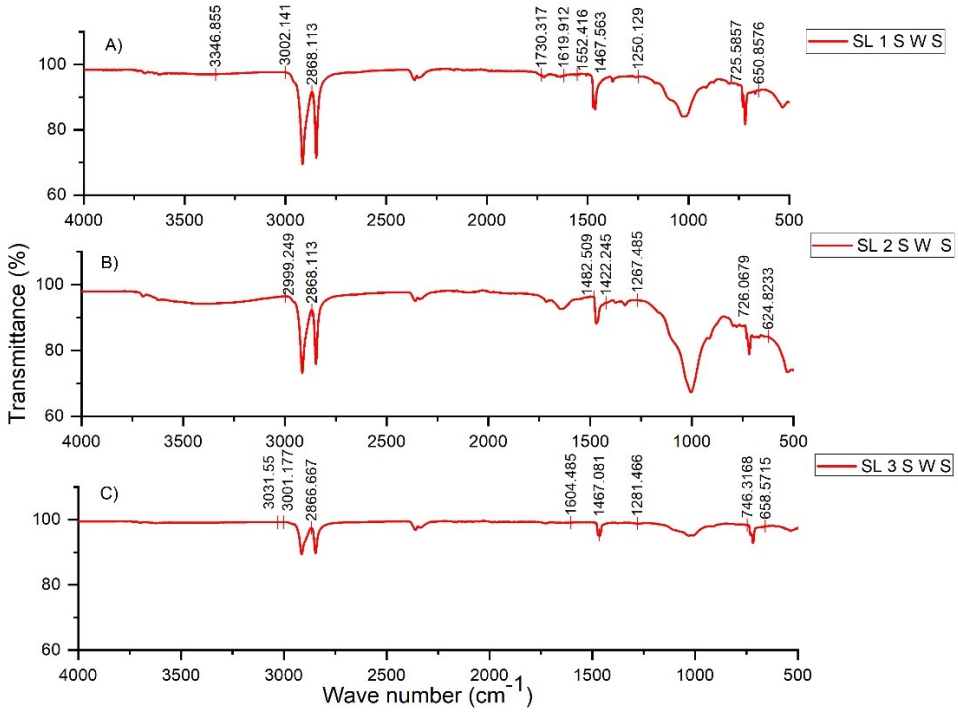

Figure S23 FTIR spectra of A) Shitalakshya-1, B) Shitalakshya -2, and C) Shitalakshya -3 sediment in the wet season.

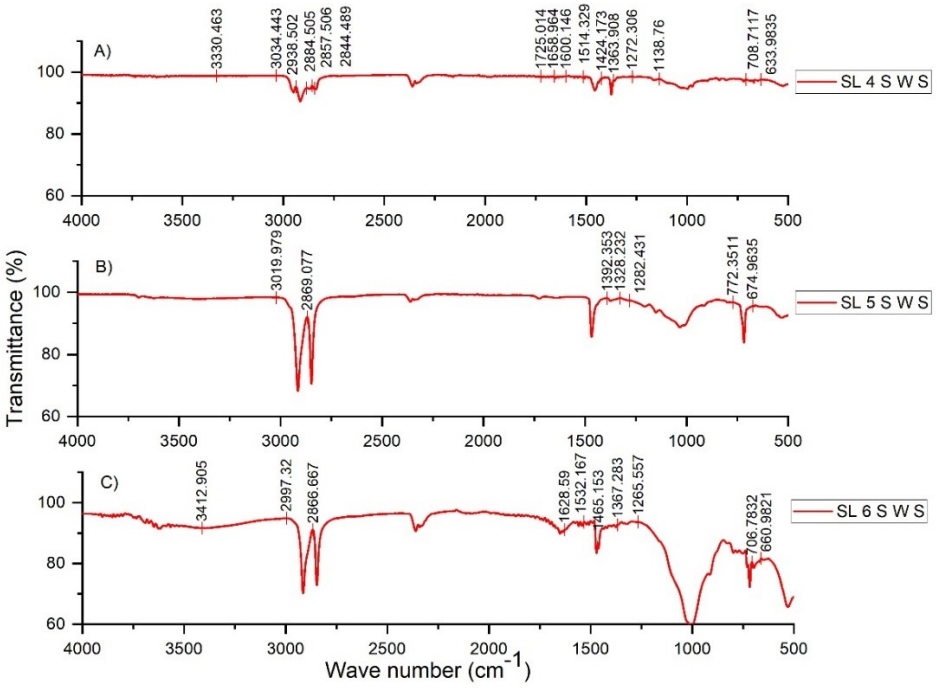

Figure S24 FTIR spectra of A) Shitalakshya-4, B) Shitalakshya -5, and C) Shitalakshya -6 sediment in the wet season.

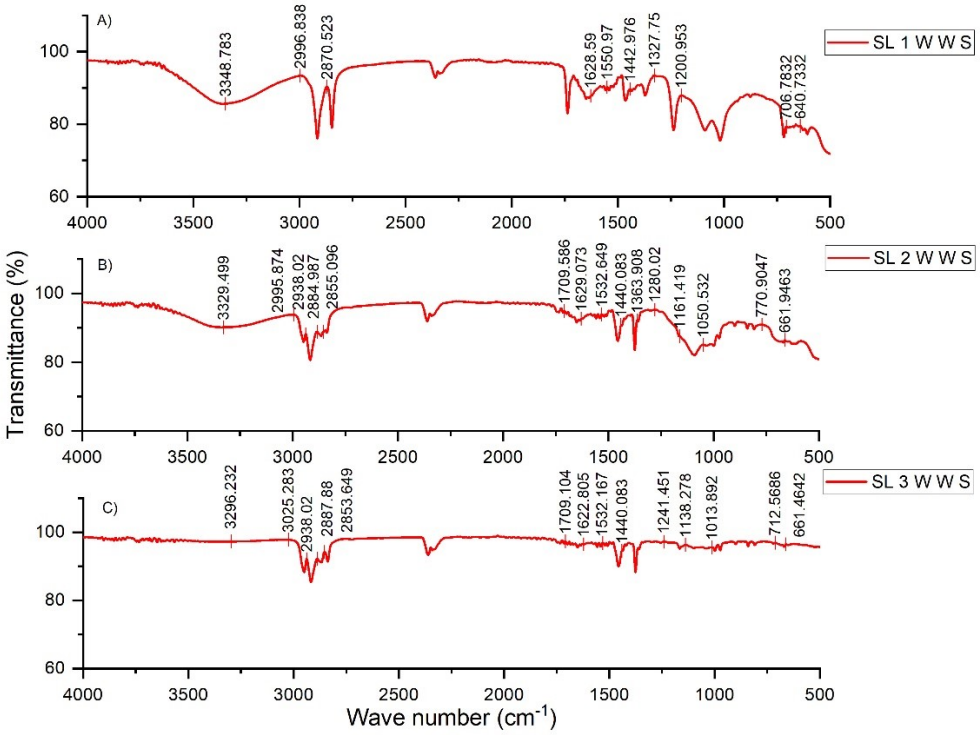

Figure S25 FTIR spectra of A) Shitalakshya-1, B) Shitalakshya -2, and C) Shitalakshya -3 water in the wet season.

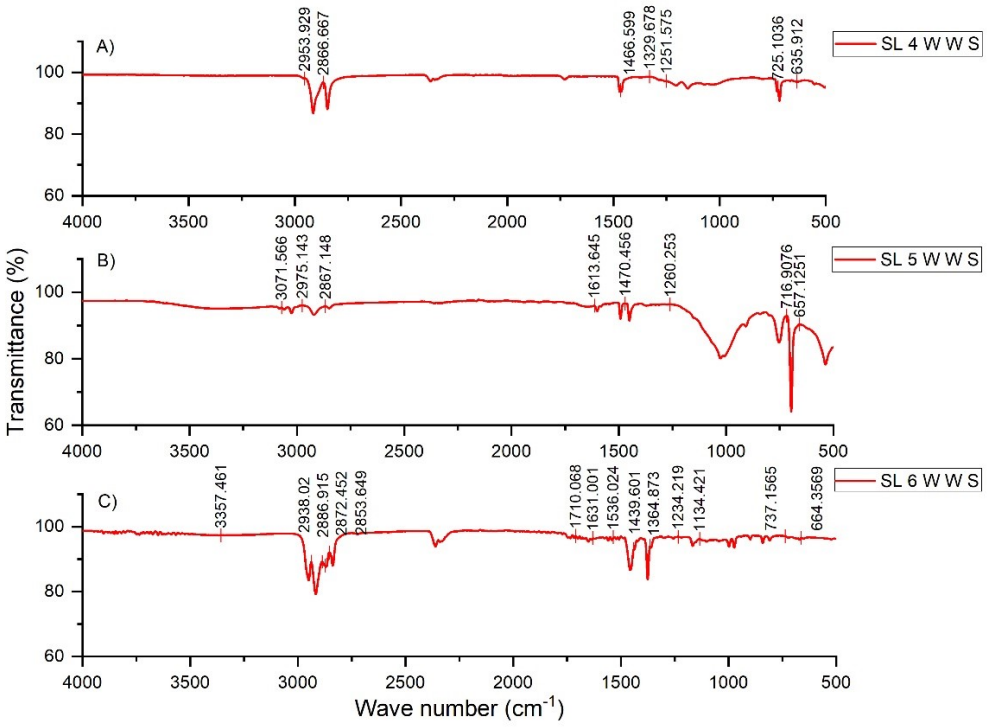

Figure S26 FTIR spectra of A) Shitalakshya-4, B) Shitalakshya -5, and C) Shitalakshya -6 water in the wet season.

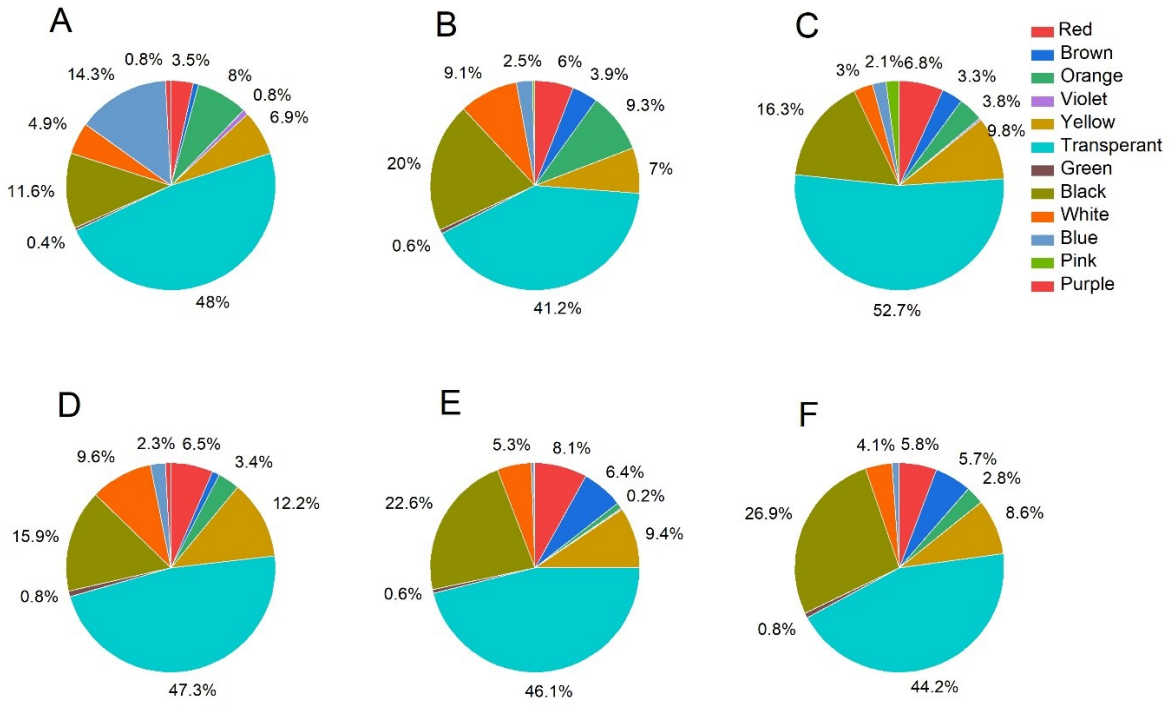

Figure S27 Color composition of MPs in The Shitalakshya river sediment samples in the dry season (A) SL-1; (B) SL-2; (C) SL-3; (D) SL-4 (E) SL-5 and (F) SL-6

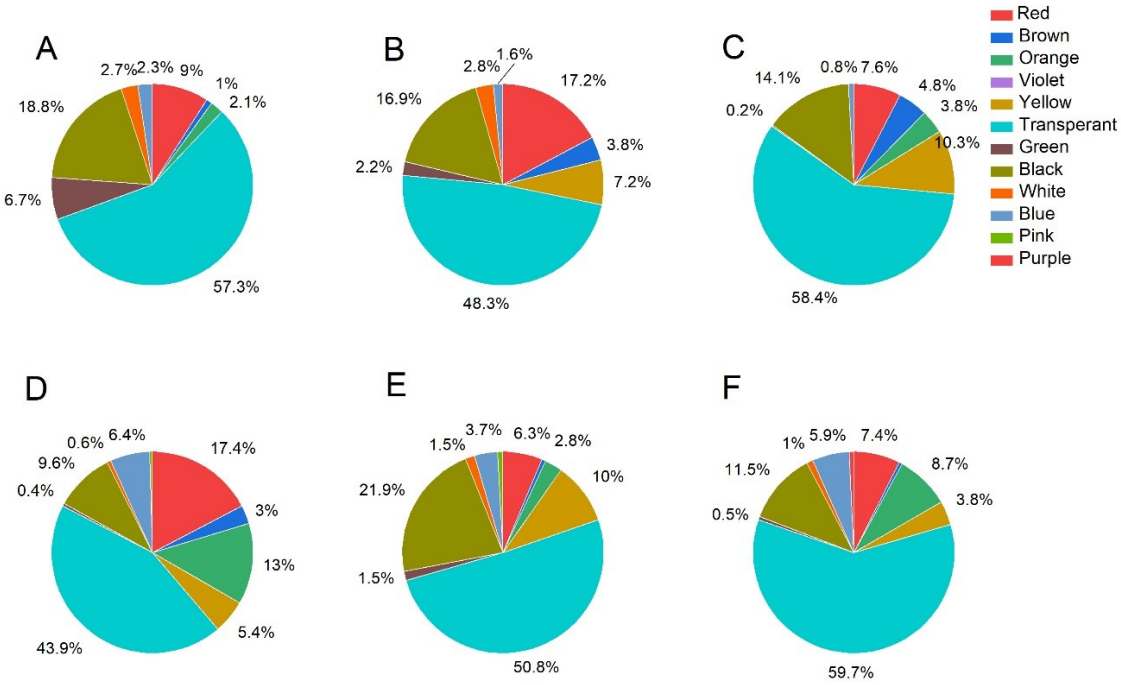

Figure S28 Color composition of MPs in The Shitalakshya river water samples in the dry season (A) SL-1; (B) SL-2; (C) SL-3; (D) SL-4 (E) SL-5 and (F) SL-6

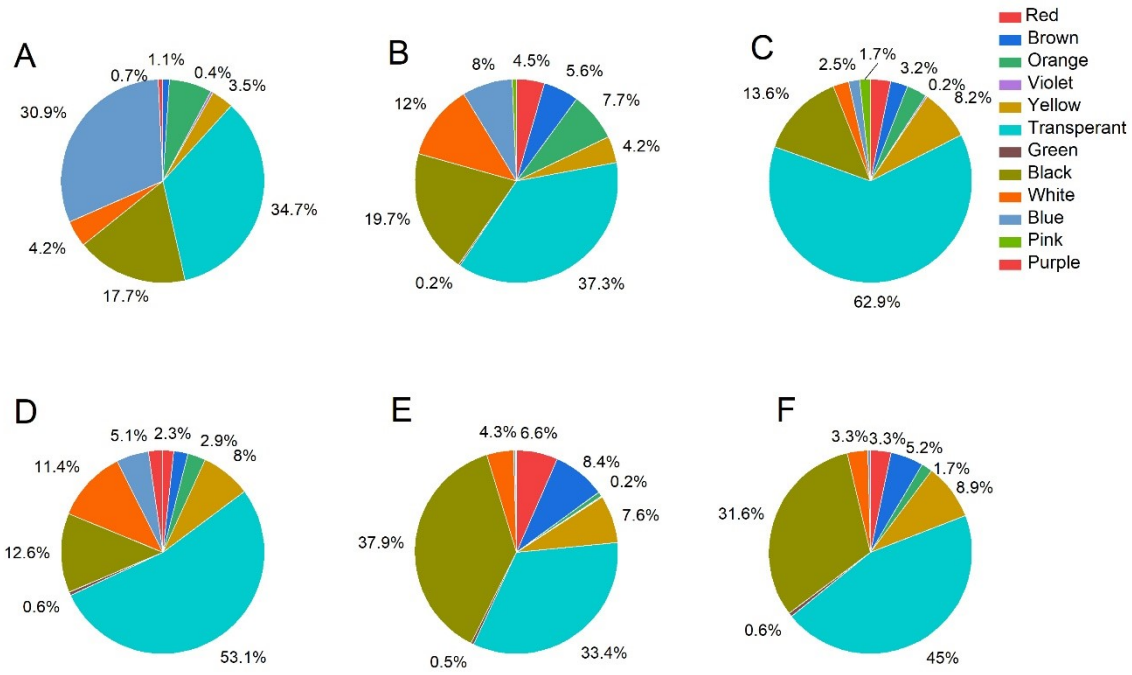

Figure S29 Color composition of MPs in The Shitalakshya river sediment samples in the wet season (A) SL-1; (B) SL-2; (C) SL-3; (D) SL-4 (E) SL-5 and (F) SL-6

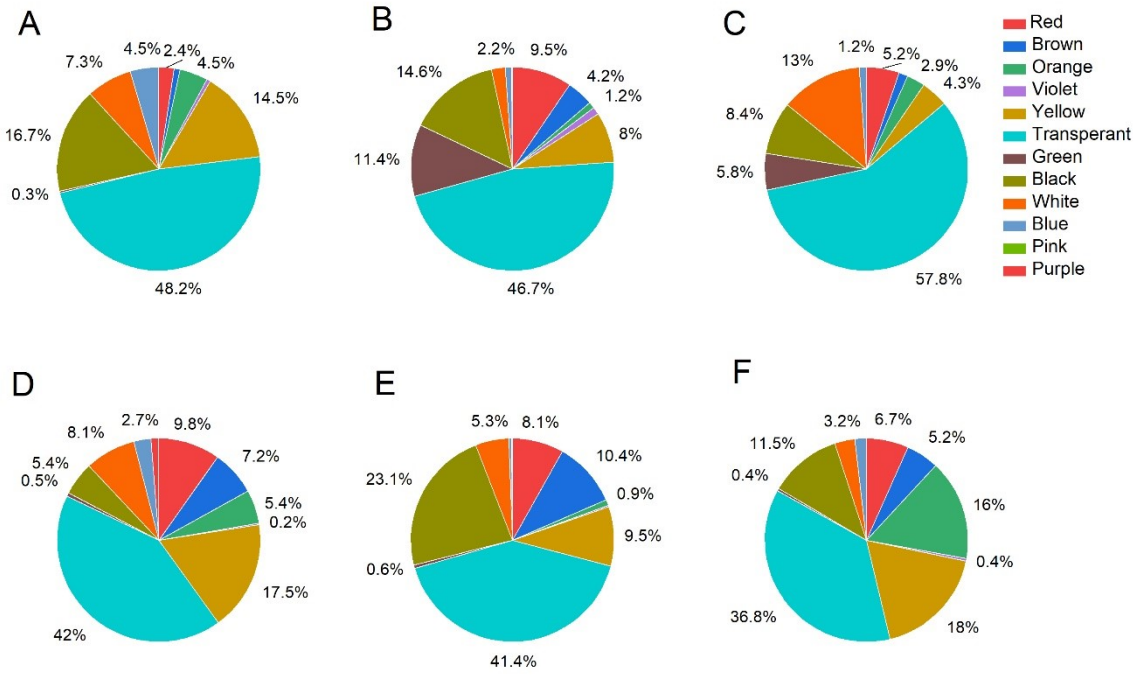

Figure S30 Color composition of MPs in the Balu River sediment samples in the dry season (A) BL-1; (B) BL-2; (C) BL-3; (D) BL-4, (E) BL-5 and (F) BL-6.

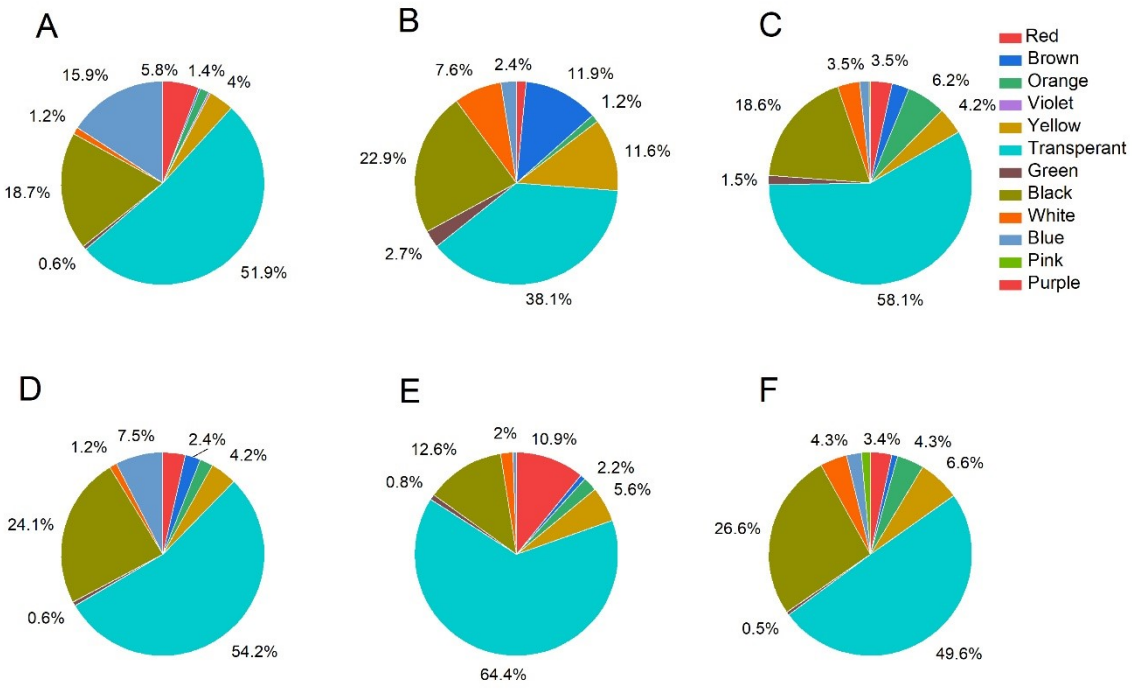

Figure S31 Color composition of MPs in the Balu River water samples in the dry season (A) BL-1; (B) BL-2; (C) BL-3; (D) BL-4, (E) BL-5 and (F) BL-6.

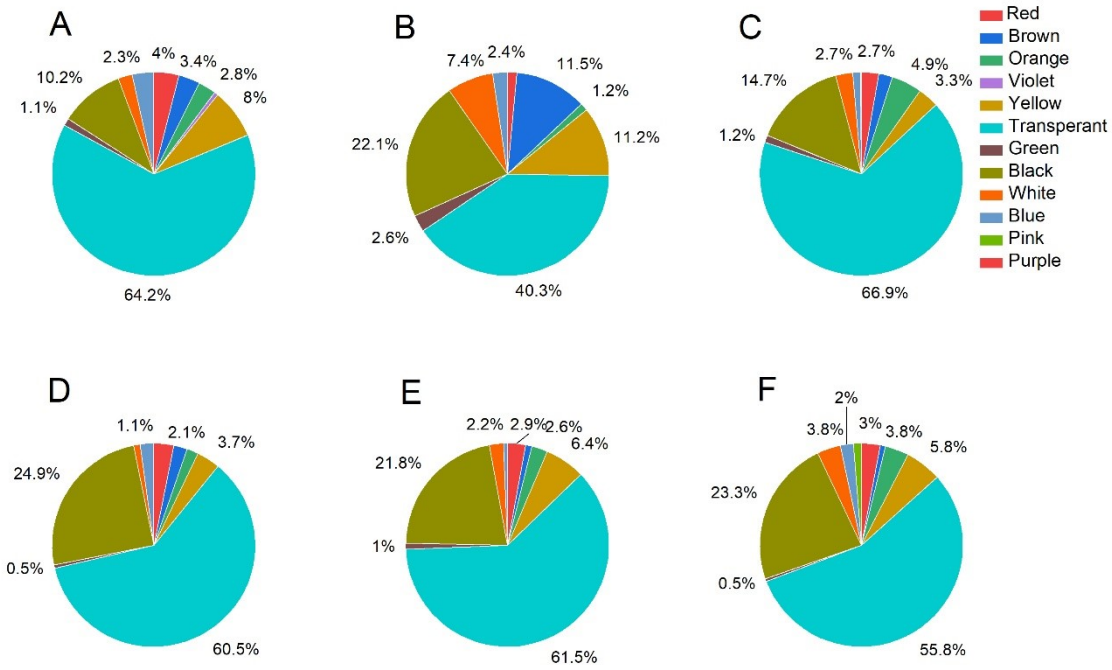

Figure S32 Color composition of MPs in the Balu River water samples in the wet season (A) BL-1; (B) BL-2; (C) BL-3; (D) BL-4, (E) BL-5 and (F) BL-6.

Figure S33 Land-use map of sampling site BL-6 prepared from Google Earth imagery, showing surrounding industrial clusters and local markets.

Figure S34 Land-use map of sampling site SL-6 prepared from Google Earth imagery, showing surrounding industrial clusters and local markets.

Data Availability

The raw FTIR spectral data (.csv files) supporting this study have been deposited in the open-access repository **Zenodo** and are publicly available at:

https://doi.org/10.5281/zenodo.17237954