Electronic Supplementary Material (ESI) for Environmental Science: Processes & Impacts.

Supplementary materials for

Spatiotemporal trends and characteristics of microplastic contamination in a large river-dominated estuary

Md. Refat Jahan Rakib [a,*], Sultan Al Nahian [b], Reyhane Madadi [c], Sayeed Mahmood Belal Haider [b], Gabriel Enrique De-la-Torre [d], Tony R. Walker [e], M. P. Jonathan [f], Win Cowger [g, h], Mayeen Uddin Khandaker [i, j], Abubakr M. Idris [k,l]

[a] Department of Fisheries and Marine Science, Faculty of Science, Noakhali Science and Technology University, Noakhali, Bangladesh

[b] Bangladesh Oceanographic Research Institute, Ramu, Cox's Bazar, Bangladesh

[c] Environmental research laboratory, School of Civil Engineering, Iran University of Science and Technology, Tehran, Iran

[d] Grupo de Investigación de Biodiversidad, Medio Ambiente y Sociedad, Universidad San Ignacio de Loyola, Lima, Peru

[e] School for Resource and Environmental Studies, Dalhousie University, Halifax, Nova Scotia, Canada

[f] Centro Interdisciplinario de Investigaciones y Estudios sobre Medio Ambiente y Desarrollo (CIIEMAD), Instituto Politécnico Nacional (IPN), Calle 30 de junio de 1520, Barrio la Laguna Ticomán, Del. Gustavo A. Madero, C.P. 07340, Ciudad de México, México

[g] Moore Institute for Plastic Pollution Research, Long Beach, California, USA

[h] University of California, Riverside, Riverside, California, USA

[i] Centre for Applied Physics and Radiation Technologies, School of Engineering and Technology, Sunway University, 47500 Bandar Sunway, Selangor, Malaysia

[j] Department of General Educational Development, Faculty of Science and Information Technology, Daffodil International University, DIU Rd, Dhaka 1341, Bangladesh

[k] Department of Chemistry, College of Science, King Khalid University, 61431 Abha, Saudi Arabia

[l] Research Center for Advanced Materials Science (RCAMS), King Khalid University, Abha 61421, Saudi Arabia

*Corresponding author: **rifatjahanrakib@gmail.com (Md.R.J. Rakib)**

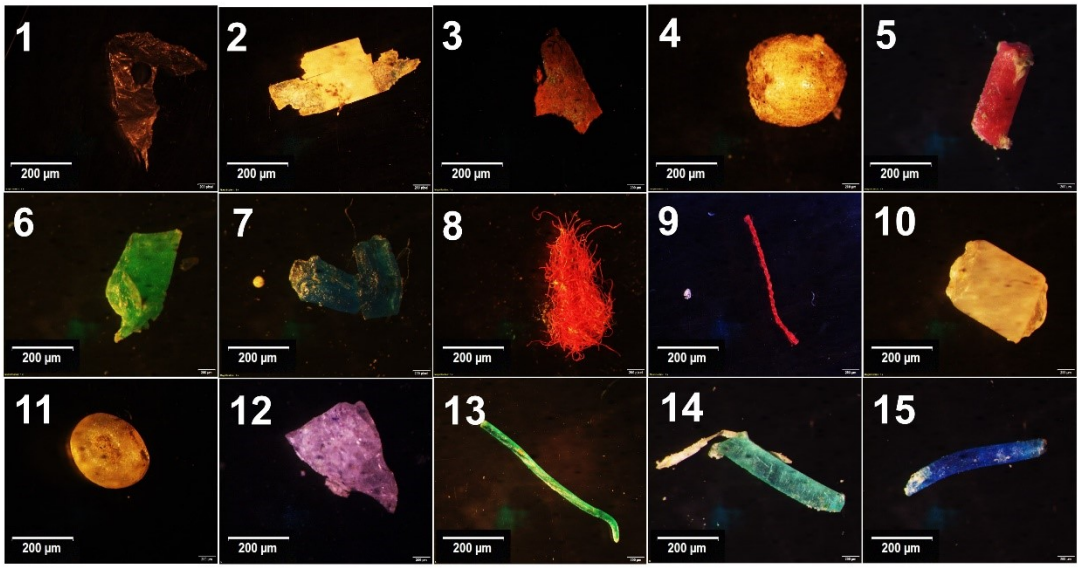

Fig. S1. Photographs of multiple MPs morphotypes extracted from water samples: film: (1, 2); foam: (3, 4); fragment: (5, 6, 7); fiber: (8, 9); Pellet: (10, 11); sheet: (12); fishing line: (13, 14, 15).

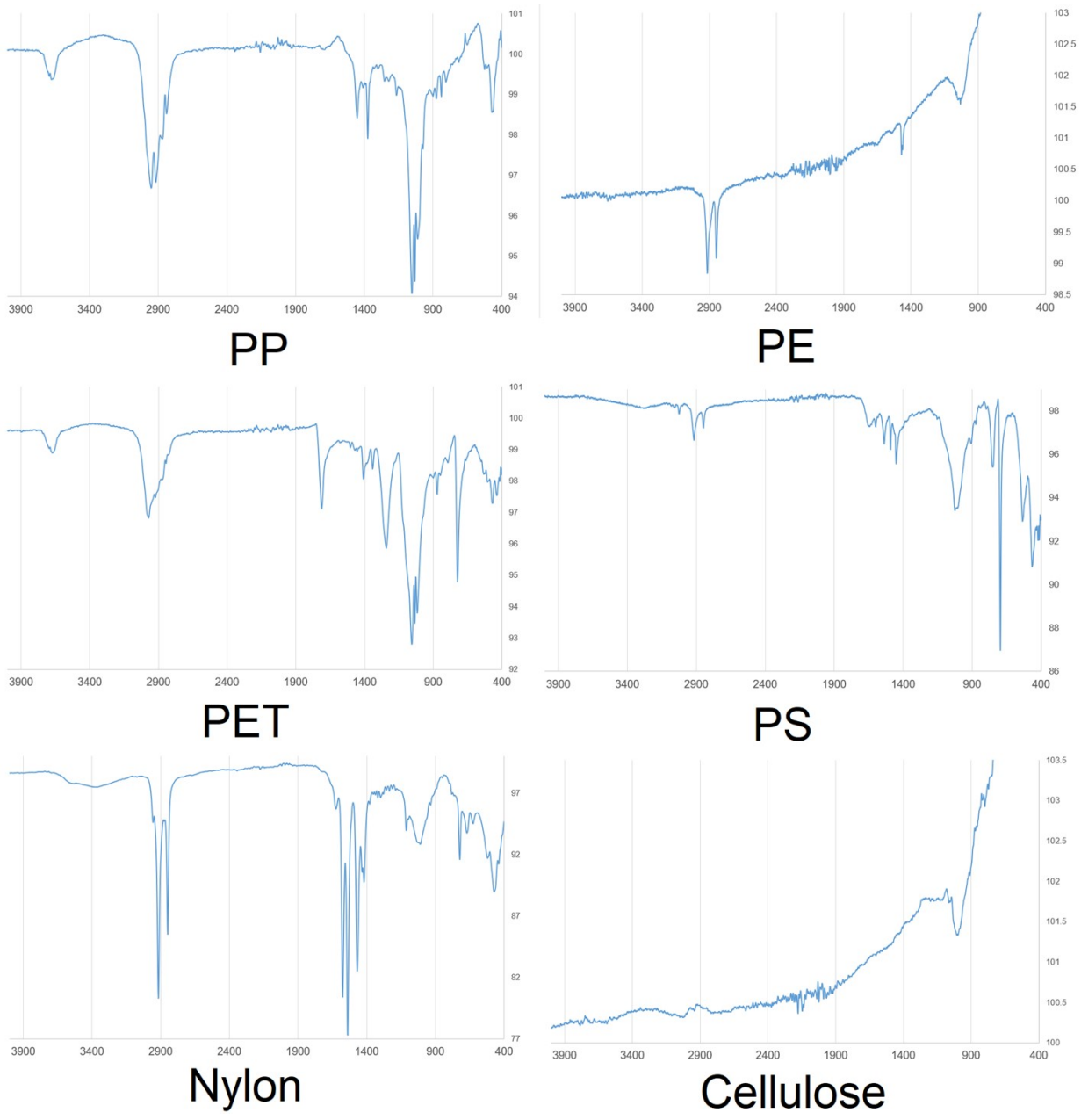

Fig. S2. Fourier transform infrared (FTIR) spectra of MPs observed in river estuary.

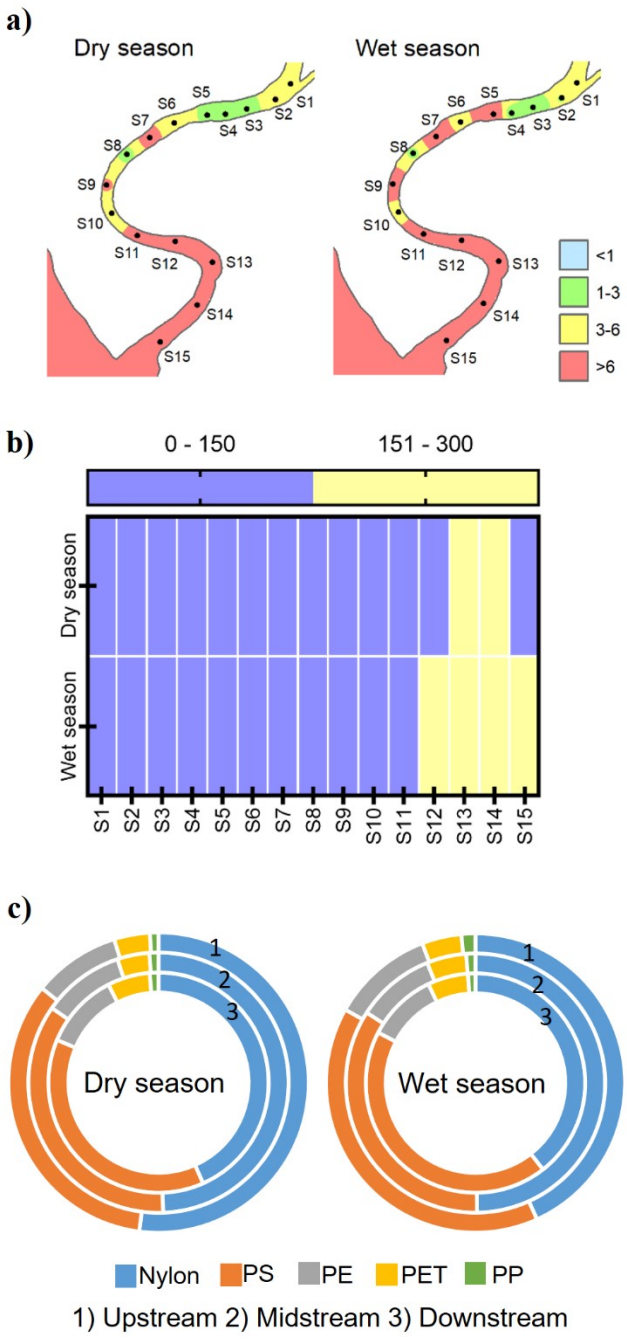

Fig. S3. a) CF_i index; b) PRI_i index; c) contribution of polymers in PHI index.

Table S1. Indexes of water microplastic assessment used in this study.

Formula	Explanations	Limit values	Reference
Contaminant factor (CF_i)			
$CF_i = C_i / C_{0i}$	C_i - MP concentration C_{0i} - minimal MP concentration	<1 low contamination 1-3 moderately contaminated 3-6 considerably contaminated > 6 very highly contaminated	(Ibeto et al., 2021)
Polymer hazard index (PHI)			
$PHI_i = \sum_{i=1}^{n} P_i \times S_i$	P_i - percent of specific MP polymer types S_i - hazard score for polymer i based on Lithner et al. (2011).	<10 partially hazardous 10-100 moderately hazardous 100-1000 strongly hazardous 1000-10,000 strongly to extremely hazardous >10,000 extremely hazardous	(Kabir et al., 2021)
Pollution load index (PLI)			
$PLI_i = C_i / C_{0i}$ $PLI_{river} = \sqrt[n]{PLI_1 \times PLI_2 \times \ldots \times PLI_n}$	PLI_i - pollution load index at station i PLI_{river} - riverine MPs pollution load index	<1 no pollution >1 polluted condition	(Tomlinson et al., 1980)
Pollution risk index (PRI)			
$PRI_i = PHI_i \times PLI_i$ $PRI_{river} = \sqrt[n]{PRI_1 \times PRI_2 \times \ldots \times PRI_n}$	PRI_i - MPs pollution risk index at the station i PRI_{river} - MPs pollution risk for the river	<150 low risk 150-300 medium risk 300-600 considerable risk 600-1200 high risk >1200 very high risk	(Kabir et al., 2021)

Table S2. Water physicochemical parameters of Karnaphuli River Estuary.

	T (◦C)	pH	ALK (mg/l)	DO (mg/l)	TDS (ppm)	EC (µS/cm)	TH (mg/l)	SAL (ppt)
Dry season (September)								
S1	27.5	6.76	130	5.5	312	4987	340	2.5
S2	27.48	6.5	115	5.4	315	5672	450	2.9
S3	27.66	6.33	112	5.8	678	4950	375	2.5
S4	27.8	6.78	120	5.56	785	6060	360	3.1
S5	27.87	6.47	98	5.6	1249	11210	320	6
S6	27.48	6.38	100	6.1	1362	10870	350	5.8
S7	27.66	6.56	120	5.8	1239	26110	323.7	15.1
S8	27.8	6.38	125	6	1289	27650	450	16
S9	28	6.71	118	5.85	1386	29590	400	17.2
S10	28.1	6.62	130	5.9	1343	29190	430	16.9
S11	28.22	6.54	95	5.5	1248	28160	410	16.2
S12	28.34	6.35	135	5.3	1362	27650	335	15.8
S13	28.5	6.34	123	5.6	1340	28750	365	16.4
S14	28.75	6.35	110	5.9	1401	29140	430	16.6

S15	28.8	6.46	140	5.8	1420	29225	420	16.6
Min	27.48	6.33	95	5.3	312	4950	320	2.5
Max	28.8	6.78	140	6.1	1420	29590	450	17.2
Ave	28.0	6.5	118.1	5.7	1115.3	19947.6	383.9	11.3
Wet season (April)								
S1	30.1	5.8	175	5.6	69.2	5340	560	2.6
S2	29.1	5.6	150	5.8	92.4	6820	785	3.4
S3	29.9	5.7	140	5.5	149.6	5890	675	2.9
S4	29.9	5.8	160	5.85	153.45	6490	730	3.2
S5	30	5.7	128	5.9	99.42	12880	665	6.7
S6	28.5	5.7	130	6.1	110.5	11570	600	6.1
S7	30.3	5.7	165	6.45	125.34	26950	530	14.8
S8	30	5.6	170	6.6	132.8	28956	715	16.1
S9	30.4	5.7	140	6.9	125	30210	680	16.7
S10	30.6	6	175	6.13	68.25	31760	760	17.6
S11	28.9	5.2	125	5.91	58.4	31850	750	18.3
S12	29.04	5	175	6.02	72.5	31755	575	18.1
S13	30.02	5.06	160	6.4	82.12	31850	745	17.8
S14	30.04	5.08	155	6.2	120.5	31955	720	17.9
S15	30.05	5.02	185	6.5	112.2	31250	755	17.5
Min	28.5	5	125	5.5	58.4	5340	530	2.6
Max	30.6	6	185	6.9	153.45	31955	785	18.3
Ave	29.8	5.5	155.5	6.1	104.8	21701.7	683	12

References

Ibeto, C.N., Enyoh, C.E., Ofomatah, A.C., Oguejiofor, L.A., Okafocha, T., Okanya, V., 2021. Microplastics pollution indices of bottled water from South Eastern Nigeria. Int. J. Environ. Anal. Chem. 00, 1–20. https://doi.org/10.1080/03067319.2021.1982926

Kabir, A.H.M.E., Sekine, M., Imai, T., Yamamoto, K., Kanno, A., Higuchi, T., 2021. Assessing small-scale freshwater microplastics pollution, land-use, source-to-sink conduits, and pollution risks: Perspectives from Japanese rivers polluted with microplastics. Sci. Total Environ. 768. https://doi.org/10.1016/j.scitotenv.2020.144655

Lithner, D., Larsson, A., Dave, G., 2011. Environmental and health hazard ranking and assessment of plastic polymers based on chemical composition. Sci. Total Environ. 409, 3309–3324. https://doi.org/10.1016/j.scitotenv.2011.04.038

Tomlinson, D.L., Wilson, J.G., Harris, C.R., Jeffrey, D.W., 1980. Problems in the assessment of heavy-metal levels in estuaries and the formation of a pollution index. Helgoländer Meeresuntersuchungen 33, 566–575. https://doi.org/10.1007/BF02414780