Table 1 Sediment contaminations indices with classification

Index	Equation	Classification	Reference
Enrichment Factor (EF)	$EF = \frac{\left(\frac{Me}{Mn}\right)_{sample}}{\left(\frac{Me}{Mn}\right)_{background}}$ $(Me/Mn)_{sample}$ =s the ratio of concentration between the studied metal and Mn in the sample of interest; $(Me/Mn)_{background}$ = the natural background value of measured metal to Mn ratio. manganese (Mn) was chosen as the reference material of normalization as it has a great abundance in the Shitalakshya river sediment	EF=1, crustal materials or natural weathering processes EF<2 (Deficiency to minimal enrichment), 2≤E<5 (Moderate enrichment), 5≤EF<20 (Significant enrichment), 20≤EF<40 (Very high enrichment) and EF≥ 40 (Extremely high enrichment).	Birch and Olmos (2008)
Geo-accumulation index (I_{-geo})	$I_{-geo} = Log_2 \frac{Cn}{1.5Bn}$ C_n is the individual heavy metal concentration. B_n = geochemical background value (world surface rock average) and the factor 1.5 is introduced to include possible variations of the background values due to the lithogenic effect.	I_{geo}≤0 (unpolluted), I_{-geo}= 0-1 (unpolluted to moderately polluted), I_{-geo}= 1-2 (moderately polluted), I_{-geo}= 2-3 (moderately to strongly polluted), I_{-geo} = 3-4 (strongly polluted), I_{-geo} = 4-5 (strongly to extremely polluted) and I_{-geo} = 5-6 (extremely polluted).	Muller (1969), Martin and Meybeck (1979),
Contamination Factor (CF)	$CF = \frac{C_{m\ sample}}{C_{m_{background}}}$ $C_{m\ sample}$ = concentration of a given metal $C_{m\ background}$ = background value of the metal equals to the world surface rock average.	CF<1 (low contamination), 1 ≤CF<3 indicates moderate contamination, 3≤CF<6 (considerable contamination) and CF≥6 (very high contamination	Hakanson (1980), Martin and Meybeck (1979)
Pollution Load Index (PLI)	$PLI = (CF_1 \times CF_2 \times CF_3 \times \cdots\cdots CF_n)^{1/n}$ n = the number of metals to be analyzed	PLI < 1 denotes perfection; PLI=1 denotes baseline levels of pollutants PLI>1 indicate deterioration of site quality.	Tomilson et al., (1980), Tamim et al. (2016)
Potential Ecological Risk Index (PERI)	$RI = \sum_{i=1}^{n} \left(E_r^i\right)$ $E_r^i = T_r^i X \frac{C_i}{C_o}$ $C_{i=}$ concentration of metal i,, $C_{o=}$ concentration of the same element in background sediment, T_r^i= biological toxicity factor of an individual element,Which is in this study, Cu = Pb = Ni= 5, Zn = 1, As = 10, Cr = 2 and Cd = 30	Single-factor pollution ER ≤ 40 (low risk); 40 < ER ≤ 80 (moderate risk); 80 < ER ≤ 160 (considerable risk); 160 < ER ≤ 320 (high risk); ER > 320 (very high risk). PERI < 110 (low risk), 110 ≤PERI< 200 (moderate risk), 200 ≤PERI< 400 (considerable risk), PERI ≥ 400 (severe risk).	Zheng-Qi et al., (2008); Huo et al., (2013); Chen et al., (2020). Hakanson,(1980)

Table 2 Heavy metal concentration (mg/kg) in the Shitalakshya river sediments (n=10) during the dry and rainy season

Sample & Area	Elements, mg/kg							
	Cr	Mn	Ni	Cu	Zn	Cd	Pb	As
Mean (dry season)	69.42±0.56	611.90±4.90	39.45±0.32	147.03±1.18	162.70±1.30	5.03±0.04	20.01±0.16	13.94±0.11
Range (dry season)	61.00-73.71	563.00-658.00	33.30-46.28	130.00-158.00	132.00-195.00	4.55-6.32	18.31-22.65	12.50-15.22
Mean (rainy season)	66.85±0.53	555.90±4.45	35.09±0.28	140.71±1.13	153.00±1.22	4.74±0.04	19.60±0.16	13.37±0.11
Range (rainy season)	61.00-72.36	502.00-613.00	29.99-42.99	122.00-157.60	131.00-192.00	4.18-6.00	18.25-21.91	12.04-14.70
Aver.Conc (Shitalakshya)	68.14±0.55	583.90±4.67	37.27±0.30	143.87±1.15	157.85±1.26	4.88±0.04	19.80±0.16	13.65±0.11
ERL	81	-	21	34	150	1.2	47	4.2
ERM	370	-	52	270	410	9.6	220	70
TEL	52.3	-	15.9	18.7	124	0.68	30.2	-
PEL	160	-	42.8	108	271	4.21	112	-
USEPA (1997)	77.2	-	16	16	110	0.6	0.6	7.24
Shitalakshya	63.22	-	39.22	-	75	5.01	28.36	-
Buriganga	297		240	280	-	7.7	731	21
Meghna	31.74	442.6	76.1	-	79.02	0.23	9.47	-

ERL = Effects range low (Long et al., 1995)
ERM = Effects range median (Long et al., 1995)
PEL = Probable effect level (MacDonald et al., 2000)
TEL = Threshold effect level (MacDonald et al., 2000)
Shitalakshya river (Islam et al. 2014)
Buriganga river Bangladesh (Islam et al. 2018)
Meghna river Bangladesh (Hasan et al. 2015)

Table 3 Potential Ecological Risk Factor and Potential Ecological Risk Index of Heavy metals in Shitalakshya river sediment

		Potential ecological risk factor				(E^i_r)			
Site	Season	Cr	Ni	Cu	Zn	Cd	Pb	As	Risk Index =$\sum E^i_r$
S-1	dry	2.07	4.28	24.61	1.03	1.53	6.74	97.40	137.67
	rainy	2.03	3.78	23.05	1.04	1.48	6.52	90.00	127.89
S-1	dry	1.97	4.01	21.72	1.53	1.50	6.10	86.67	123.50
	rainy	1.75	3.28	20.47	1.51	1.28	5.93	92.00	126.22
S-3	dry	1.71	4.72	24.69	1.33	1.93	5.94	93.27	133.59
	rainy	1.71	4.31	23.28	1.29	1.83	5.70	96.67	134.82
S-4	dry	2.04	3.78	24.63	1.07	1.52	7.08	94.33	134.46
	rainy	2.00	3.06	24.63	1.06	1.49	6.85	90.40	129.47
S-5	dry	1.92	3.39	20.94	1.33	1.56	6.43	86.60	122.16
	rainy	1.83	3.06	20.16	1.18	1.5	6.25	80.26	114.24
S-6	dry	2.06	4.33	22.63	1.41	1.45	6.66	97.33	135.86
	rainy	2.03	3.83	20.94	1.38	1.28	6.59	88.00	124.05
S-7	dry	1.88	3.67	23.59	1.26	1.49	5.97	101.46	139.34
	rainy	1.80	3.36	24.53	1.11	1.39	5.94	98.00	136.14
S-8	dry	2.00	3.98	20.31	1.07	1.39	5.94	99.33	134.04
	rainy	1.92	3.67	19.06	1.03	1.27	5.92	88.13	121.01
S-9	dry	1.86	4.18	23.11	1.38	1.58	5.72	89.33	127.17
	rainy	1.79	3.78	20.62	1.09	1.59	5.70	87.33	121.90
S-10	dry	2.03	3.89	23.51	1.35	1.43	5.95	83.33	121.51
	rainy	1.94	3.67	23.12	1.33	1.37	5.86	80.67	117.97

Table 4 Table calculated value of Health risk indices implicated by the heavy metal contaminated sediment samples in Dry and Rainy season

Metal	Rfd	Dermal Exposure dose		Non-carcinogenic health risk		SF_{dermal}	Carcinogenic health risk	
		Dry season	Rainy season	Dry season	Rainy season		Dry season	Rainy season
Cr	0.003	3.79 E-07	3.65 E-07	1.26 E-04	1.22 E-04	2.00 E+01	7.59 E-06	7.31 E-06
Ni	0.011	2.16 E-07	1.92 E-07	2.16 E-04	1.92 E-04	-	-	-
Cu	0.040	8.04 E-07	7.69 E-07	2.01 E-05	1.92 E-05	-	-	-
Zn	0.300	8.89 E-07	8.36 E-07	2.96 E-06	2.79 E-06	-	-	-
Cd	0.001	2.73 E-08	2.59 E-08	2.73 E-05	2.59 E-05	-	-	-
Pb	0.0035	1.09 E-07	1.07 E-07	3.12 E-05	3.06 E-05	-	-	-
As	0.0003	7.62 E-08	7.31 E-08	2.54 E-04	2.44 E-04	3.66 E+00	2.79 E-07	2.67 E-07
HI				6.78×10^{-4}	6.36×10^{-4}	TCR	7.87 E-06	7.56 E-06

Table 5 Pearson's correlation coefficient between the determined heavy metals and the matrix of PCA lodgings

	Cr	Mn	Ni	Cu	Zn	Cd	Pb	As	**PC1**	**PC2**	**PC3**
Cr	1								-0.160	**0.896**	-0.304
Mn	**.602****	1							0.173	**0.863**	0.186
Ni	0.017	**.457***	1						**0.636**	0.327	**0.625**
Cu	0.116	0.081	0.295	1					**0.759**	0.097	-0.246
Zn	-0.206	-0.156	0.207	-0.107	1				-0.193	-0.087	**0.712**
Cd	-.460*	-0.009	**.557***	**0.437**	0.037	1			**0.762**	-0.264	0.314
Pb	**.695****	0.297	-0.149	0.288	-0.267	-0.156	1		0.073	**0.596**	-0.588
As	-0.017	0.151	**0.344**	**0.362**	-0.205	0.177	0.105	1	**0.666**	0.074	-0.191
Eigen values									2.370	2.177	1.223
Explained variance (%)									29.622	27.215	15.281
Cummulative variance (%)									29.622	56.838	72.119

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).