

## Supplementary information for

# A multi-dimensional investigation on water quality of urban rivers with emphasis on implications for the optimization of monitoring strategy

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**Table S1.** Water quality assessment results of different sampling sites using five indexes.

Sampling site	SF			MPI	NPI	WQII			WQI		
	TP	NH <sub>3</sub> -N	COD <sub>Cr</sub>			TP	NH <sub>3</sub> -N	COD <sub>Cr</sub>	TP	NH <sub>3</sub> -N	COD <sub>Cr</sub>
S1	0.30	0.12	0.47	0.30	0.39	2.9	2.1	1.9	1.88	1.09	0.93
S2	0.13	0.12	0.37	0.21	0.30	2.3	2.1	1.7	1.25	1.10	0.73
S3	0.10	0.00	0.50	0.20	0.38	2.1	1.0	2.0	1.13	0.00	1.00
S4	0.10	0.14	0.33	0.19	0.27	2.1	2.2	1.7	1.13	1.15	0.67
S5	0.10	0.04	1.03	0.39	0.78	2.1	1.4	5.1	1.13	0.41	4.10
S6	0.10	0.02	0.33	0.15	0.26	2.1	1.2	1.7	1.13	0.24	0.67
S7	0.10	0.04	0.47	0.20	0.36	2.1	1.4	1.9	1.13	0.37	0.93
S8	0.20	0.24	0.47	0.30	0.39	2.5	2.6	1.9	1.50	1.60	0.93
S9	0.30	0.26	0.33	0.30	0.32	2.9	2.7	1.7	1.88	1.70	0.67
S10	0.37	0.09	0.37	0.27	0.32	3.1	1.9	1.7	2.10	0.91	0.73
S11	0.23	0.43	0.37	0.34	0.39	2.6	3.3	1.7	1.63	2.29	0.73
S12	0.30	0.44	0.40	0.38	0.41	2.9	3.3	1.8	1.88	2.33	0.80
S13	0.30	0.20	0.43	0.31	0.38	2.9	2.7	1.9	1.88	1.73	0.87
S14	0.30	0.39	0.40	0.36	0.38	2.9	3.6	1.8	1.88	2.57	0.80
S15	0.30	0.34	0.43	0.36	0.40	2.9	3.3	1.9	1.88	2.35	0.87
S16	0.37	0.52	0.37	0.42	0.47	3.1	4.1	1.7	2.10	3.06	0.73
S17	0.27	0.77	0.47	0.50	0.65	2.8	5.1	1.9	1.75	4.08	0.93
S18	0.77	1.44	0.47	0.89	1.20	4.3	6.4	1.9	3.30	5.29	0.93
S19	0.90	1.74	0.60	1.08	1.45	4.7	6.7	3.6	3.70	5.35	2.90
S20	1.30	0.14	0.63	0.69	1.04	5.9	2.4	3.8	4.90	1.39	2.95
S21	0.93	0.67	0.53	0.71	0.83	4.8	4.7	3.2	3.80	3.68	2.80
S22	1.30	0.03	0.57	0.63	1.02	5.9	1.4	3.4	4.90	0.40	2.85

<b>S23</b>	1.73	0.07	0.53	0.78	1.34	6.3	1.9	3.2	5.26	0.92	2.80
<b>S24</b>	2.17	0.63	0.47	1.09	1.71	6.6	4.5	1.9	5.28	3.50	0.93
<b>S25</b>	2.70	0.37	0.47	1.18	2.08	7.0	3.5	1.9	5.29	2.46	0.93
<b>S26</b>	1.40	0.50	0.53	0.81	1.14	6.1	4.0	3.2	5.25	2.99	2.80
<b>L1</b>	0.27	0.12	0.47	0.28	0.39	2.8	2.1	1.9	1.75	1.07	0.93
<b>L2</b>	0.30	0.11	0.53	0.31	0.44	2.9	2.0	3.2	1.88	1.04	2.80
<b>L3</b>	0.30	0.08	0.37	0.25	0.31	2.9	1.8	1.7	1.88	0.83	0.73
<b>L4</b>	0.80	1.01	0.67	0.83	0.92	4.4	5.0	4.0	3.40	4.04	3.00
<b>L5</b>	0.73	0.97	0.50	0.74	0.86	4.2	4.9	2.0	3.20	3.92	1.00
<b>L6</b>	0.77	1.10	0.53	0.80	0.96	4.3	5.3	3.2	3.30	4.30	2.80
<b>L7</b>	1.03	1.94	0.23	1.07	1.57	5.1	6.5	1.5	4.10	5.39	0.47
<b>L8</b>	0.87	2.07	0.57	1.17	1.68	4.6	6.6	3.4	3.60	5.41	2.85
<b>L9</b>	0.47	1.46	0.53	0.82	1.18	3.4	6.5	3.2	2.40	5.39	2.80
<b>L10</b>	0.80	0.04	0.60	0.48	0.66	4.4	1.6	3.6	3.40	0.59	2.90
<b>L11</b>	0.87	1.41	0.57	0.95	1.20	4.6	6.4	3.4	3.60	5.28	2.85
<b>L12</b>	1.00	1.84	0.53	1.12	1.52	5.0	6.8	3.2	4.00	5.37	2.80
<b>L13</b>	1.53	1.74	0.63	1.30	1.54	6.2	6.7	3.8	5.26	5.35	2.95
<b>L14</b>	1.03	1.86	0.60	1.16	1.55	5.1	6.9	3.6	4.10	5.37	2.90
<b>L15</b>	1.10	1.85	0.50	1.15	1.54	5.3	6.9	2.0	4.30	5.37	1.00
<b>L16</b>	1.13	1.84	0.50	1.16	1.54	5.4	6.8	2.0	4.40	5.37	1.00
<b>L17</b>	1.13	1.75	0.53	1.14	1.48	5.4	6.8	3.2	4.40	5.35	2.80
<b>L18</b>	1.07	1.18	0.47	0.90	1.05	5.2	6.2	1.9	4.20	5.24	0.93

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**Table S2.** Judgement matrix of 11 water quality assessment indexes.

	SF-TP	SF-NH <sub>3</sub>	SF-COD <sub>Cr</sub>	MPI	NPI	WQII-TP	WQII-NH <sub>3</sub>	WQII-COD <sub>Cr</sub>	WQLI-TP	WQLI-NH <sub>3</sub>	WQLI-COD <sub>Cr</sub>
<b>SF-TP</b>	1.000	0.143	6.000	0.200	0.333	0.222	0.182	0.500	0.222	0.167	0.500
<b>SF-NH<sub>3</sub></b>	7.000	1.000	9.000	3.000	5.000	4.000	2.000	6.000	4.000	2.000	6.000
<b>SF-COD<sub>Cr</sub></b>	0.167	0.111	1.000	0.127	0.143	0.133	0.125	0.148	0.133	0.118	0.148
<b>MPI</b>	5.000	0.333	7.875	1.000	2.000	3.000	0.500	4.000	3.000	0.333	4.000
<b>NPI</b>	3.000	0.200	7.000	0.500	1.000	0.667	0.296	2.000	0.667	0.250	2.000
<b>WQII-TP</b>	4.500	0.250	7.500	0.333	1.500	1.000	0.500	3.000	1.000	0.333	3.000
<b>WQII-NH<sub>3</sub></b>	5.500	0.500	8.000	2.000	3.375	2.000	1.000	4.000	2.000	0.500	4.000
<b>WQII-COD<sub>Cr</sub></b>	2.000	0.167	6.750	0.250	0.500	0.333	0.250	1.000	0.333	0.200	1.000
<b>WQLI-TP</b>	4.500	0.250	7.500	0.333	1.500	1.000	0.500	3.000	1.000	0.333	3.000
<b>WQLI-NH<sub>3</sub></b>	6.000	0.500	8.500	2.500	4.000	3.000	2.000	5.000	3.000	1.000	5.000
<b>WQLI-COD<sub>Cr</sub></b>	2.000	0.167	6.750	0.250	0.500	0.333	0.250	1.000	0.333	0.200	1.000

**Table S3.** Weight of 11 water quality assessment indexes.

SF-TP	SF-NH <sub>3</sub>	SF-COD <sub>Cr</sub>	MPI	NPI	WQII-TP	WQII-NH <sub>3</sub>	WQII-COD <sub>Cr</sub>	WQLI-TP	WQLI-NH <sub>3</sub>	WQLI-COD <sub>Cr</sub>
0.0254	0.2429	0.0116	0.1197	0.0558	0.0754	0.1368	0.0360	0.0754	0.1851	0.0360

**Table S4.** Range with the permissible values of three parameters at 44 sampling sites along the two rivers during the sampling campaign on December, 2020.

Sampling site	Range with permissible values (%)			Sampling site	Range with permissible values (%)		
	NH <sub>3</sub> -N	TP	COD <sub>Cr</sub>		NH <sub>3</sub> -N	TP	COD <sub>Cr</sub>
S1	30.0	12.1	46.7	L1	26.7	11.7	46.7
S2	13.3	12.4	36.7	L2	30.0	10.9	53.3
S3	10.0	0.0	50.0	L3	30.0	8.3	36.7
S4	10.0	13.6	33.3	L4	80.0	101.3	66.7
S5	10.0	4.1	103.3	L5	73.3	97.3	50.0
S6	10.0	2.4	33.3	L6	76.7	110.0	53.3
S7	10.0	3.7	46.7	L7	103.3	194.0	23.3
S8	20.0	24.0	46.7	L8	86.7	206.7	56.7
S9	30.0	26.3	33.3	L9	46.7	145.5	53.3
S10	36.7	9.1	36.7	L10	80.0	4.5	60.0
S11	23.3	43.1	36.7	L11	86.7	140.5	56.7
S12	30.0	44.3	40.0	L12	100.0	184.0	53.3
S13	30.0	20.3	43.3	L13	153.3	174.0	63.3
S14	30.0	39.3	40.0	L14	103.3	186.0	60.0
S15	30.0	33.7	43.3	L15	110.0	185.0	50.0
S16	36.7	51.5	36.7	L16	113.3	184.0	50.0
S17	26.7	77.0	46.7	L17	113.3	175.0	53.3
S18	76.7	144.0	46.7	L18	106.7	117.5	46.7
S19	90.0	174.0	60.0				
S20	130.0	14.4	63.3				
S21	93.3	67.0	53.3				
S22	130.0	3.0	56.7				
S23	173.3	6.9	53.3				
S24	216.7	62.5	46.7				
S25	270.0	36.6	46.7				
S26	140.0	49.7	53.3				

**Table S5.** Range with the permissible values of four parameters at sampling sites S23 and S26 along the Shili river from January, 2020 to March, 2021.

Date	Range with permissible values (%)							
	S23				S26			
	COD <sub>Cr</sub>	NH <sub>3</sub> -N	TP	Cu	COD <sub>Cr</sub>	NH <sub>3</sub> -N	TP	Cu
2020.01.15	86.7	387.5	203.3	0.9	66.7	132.0	266.7	0.4
2020.02.18	56.7	26.0	16.7	0.6	33.3	46.0	26.7	3.6
2020.03.10	53.3	64.0	33.3	0.1	66.7	59.0	20.0	0.1
2020.04.14	26.7	65.0	46.7	0.2	40.0	115.0	80.0	0.1
2020.05.12	46.7	124.0	70.0	0.4	36.7	215.0	53.3	0.9

2020.06.11	33.3	70.0	123.3	0.4	56.7	191.0	143.3	0.3
2020.07.02	60.0	60.5	86.7	0.8	196.7	17.5	26.7	1.1
2020.08.14	106.7	77.5	63.3	0.0	220.0	81.5	23.3	0.0
2020.09.15	76.7	120.0	86.7	0.0	23.3	75.5	100.0	0.0
2020.10.21	40.0	82.0	73.3	0.0	46.7	115.0	66.7	0.0
2020.11.12	40.0	107.0	73.3	0.2	53.3	75.5	26.7	0.4
2020.12.17	56.7	108.0	63.3	0.2	56.7	280.0	256.7	0.2
2021.01.13	33.3	95.0	56.7	0.2	50.0	79.0	36.7	0.4
2021.02.23	56.7	73.5	70.0	0.2	86.7	73.5	60.0	0.1
2021.03.10/2021.03.11	46.7	77.0	73.3	0.1	60.0	143.0	16.7	0.2