Supplementary File

Longitudinal Chemical Gradients and the Functional Responses of Nutrients, Organic Matter, and Other Parameters to the Land Use Pattern and Monsoon Intensity

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Table S1. Details of sampling sites, zones with coordinates of Han River watershed

Site Zone	Site	Site Name	Longitude	Latitude
Headwater zone (Hz)	1	Songcheon2	128.72	37.49
Headwater zone (Hz)	2	Joyang River	128.66	37.44
Headwater zone (Hz)	3	Jeongseon 1	128.67	37.38
Headwater zone (Hz)	4	Jeongseon 2	128.66	37.38
Headwater zone (Hz)	5	Gwangha	128.62	37.37
Headwater zone (Hz)	6	Donggang River	128.51	37.21
Headwater zone (Hz)	7	Yeongwol 1	128.48	37.18
Headwater zone (Hz)	8	Yeongwol 2	128.50	37.16
Headwater zone (Hz)	9	Youngchun	128.49	37.08
Headwater zone (Hz)	10	Gagok	128.41	37.04
Headwater zone (Hz)	11	Deokcheon Stream	128.39	37.01
Headwater zone (Hz)	12	Monotone	128.26	36.93
Reservoir zone 1(Rz1; Chungju Reservoir	13	Chungju Dam 4	128.25	36.94
Reservoir zone 1(Rz1; Chungju Reservoir	14	Chungju Dam 2	128.18	37.00
Reservoir zone 1(Rz1; Chungju Reservoir	15	Chungju Dam 3	128.09	36.95
Reservoir zone 1(Rz1; Chungju Reservoir	16	Chungju Dam1	128.00	37.00
Midwater zone (Mz)	17	Chungju	127.98	37.01
Midwater zone (Mz)	18	Mokhaeng Bridge	127.92	37.02
Midwater zone (Mz)	19	Chungju Adjustment Site Dam 2	127.87	37.02
Midwater zone (Mz)	20	Chungju Adjustment Site Dam1	127.86	37.04
Midwater zone (Mz)	21	Jungwon	127.88	37.08
Midwater zone (Mz)	22	Deok Eun-ri	127.80	37.13
Midwater zone (Mz)	23	Wonju-si	127.75	37.20
Midwater zone (Mz)	24	Gangchun	127.69	37.27
Midwater zone (Mz)	25	Yeoju 1	127.65	37.30
Midwater zone (Mz)	26	Dajing	127.61	37.32
Midwater zone (Mz)	27	Yeoju 2	127.57	37.35
Midwater zone (Mz)	28	Epo	127.54	37.40
Reservoir zone 2 (Rz2; Paldang Reservoir)	29	Paldang Dam1	127.43	37.51

Reservoir zone 2 (Rz2; Paldang Reservoir)	30	Paldang Dam 3	127.37	37.53
Reservoir zone 2 (Rz2; Paldang Reservoir)	31	Paldang Dam 2	127.29	37.52
Downwater zone (Dz)	32	Paldang	127.24	37.54
Downwater zone (Dz)	33	Dogok	127.22	37.57
Downwater zone (Dz)	34	Domchion	127.21	37.58
Downwater zone (Dz)	35	Guri	127.16	37.58
Downwater zone (Dz)	36	Amsa	127.14	37.57
Downwater zone (Dz)	37	Guui	127.12	37.54
Downwater zone (Dz)	38	Jamsil	127.10	37.53
Downwater zone (Dz)	39	Tukdo	127.04	37.53
Downwater zone (Dz)	40	Bokgwang	127.02	37.53
Downwater zone (Dz)	41	Noryangjin	126.96	37.52
Downwater zone (Dz)	42	Yeongdeungpo	126.90	37.55
Downwater zone (Dz)	43	Gayang	126.86	37.57
Downwater zone (Dz)	44	Angri	126.82	37.60
Downwater zone (Dz)	45	Kimpo	126.80	37.60
Downwater zone (Dz)	46	Paju	126.72	37.65

Table S2. Land use coverage data of the studied sites.

Sites	Name	Agricultural (%)	Urban (%)	Forest (%)
1	Songcheon2	6.62	0.07	93.31
2	Joyang River	6.03	0.91	93.06
3	Jeongseon 1	9.28	2.37	88.35
4	Jeongseon 2	5.42	1.73	92.85
5	Gwangha	6.33	0.15	93.52
6	Donggang River	4.66	0.27	95.07
7	Yeongwol 1	7.11	15.19	77.71
8	Yeongwol 2	5.68	0.50	93.83
9	Youngchun	21.19	2.17	76.64
10	Gagok	7.86	0.30	91.84
11	Deokcheon Stream	11.42	0.61	87.97

12	Monotone	11.37	0.03	88.61
15	Chungju Dam 3	10.28	0.09	89.63
17	Chungju	11.47	3.93	84.59
18	Mokhaeng Bridge	30.90	28.12	40.97
19	Chungju Adjustment Site Dam 2	38.45	7.53	54.02
20	Chungju Adjustment Site Dam1	43.49	2.88	53.63
21	Jungwon	33.59	1.87	64.54
22	Deok Eun-ri	13.61	0.14	86.25
23	Wonju-si	17.83	0.53	81.65
24	Gangchun	41.65	2.78	55.57
25	Yeoju 1	53.25	21.07	25.68
26	Dajing	46.22	0.64	53.14
27	Yeoju 2	95.57	4.19	0.24
28	Epo	50.96	14.61	34.44
29	Paldang Dam1	30.74	1.64	67.63
30	Paldang Dam 3	13.61	0.81	85.58
31	Paldang Dam 2	16.94	2.01	81.05
32	Paldang	7.78	6.13	86.08
33	Dogok	18.15	4.73	77.12
34	Domchion	57.65	41.76	0.59
35	Guri	23.12	76.03	0.85
38	Jamsil	6.53	59.20	34.28
39	Tukdo	0.05	97.53	2.42
40	Bokgwang	0.00	90.81	9.19
41	Noryangjin	0.00	95.33	4.67
42	Yeongdeungpo	0.00	99.18	0.82
43	Gayang	0.00	90.33	9.67

44	Angri	16.65	49.28	34.07
45	Kimpo	77.47	14.95	7.58
46	Paju	52.25	16.45	31.30

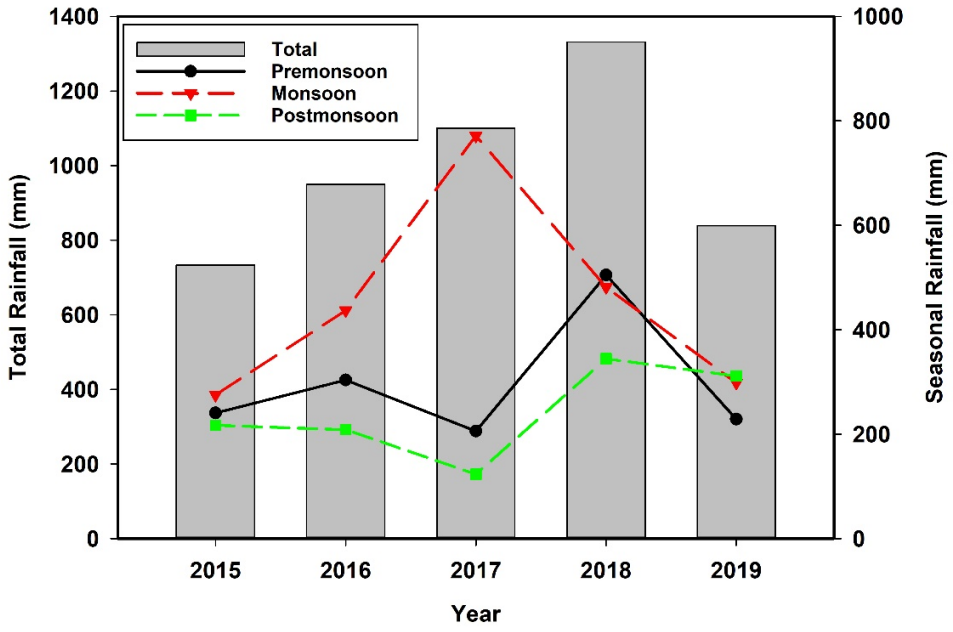

Figure S1. Annual and seasonal rainfall pattern of the study area.

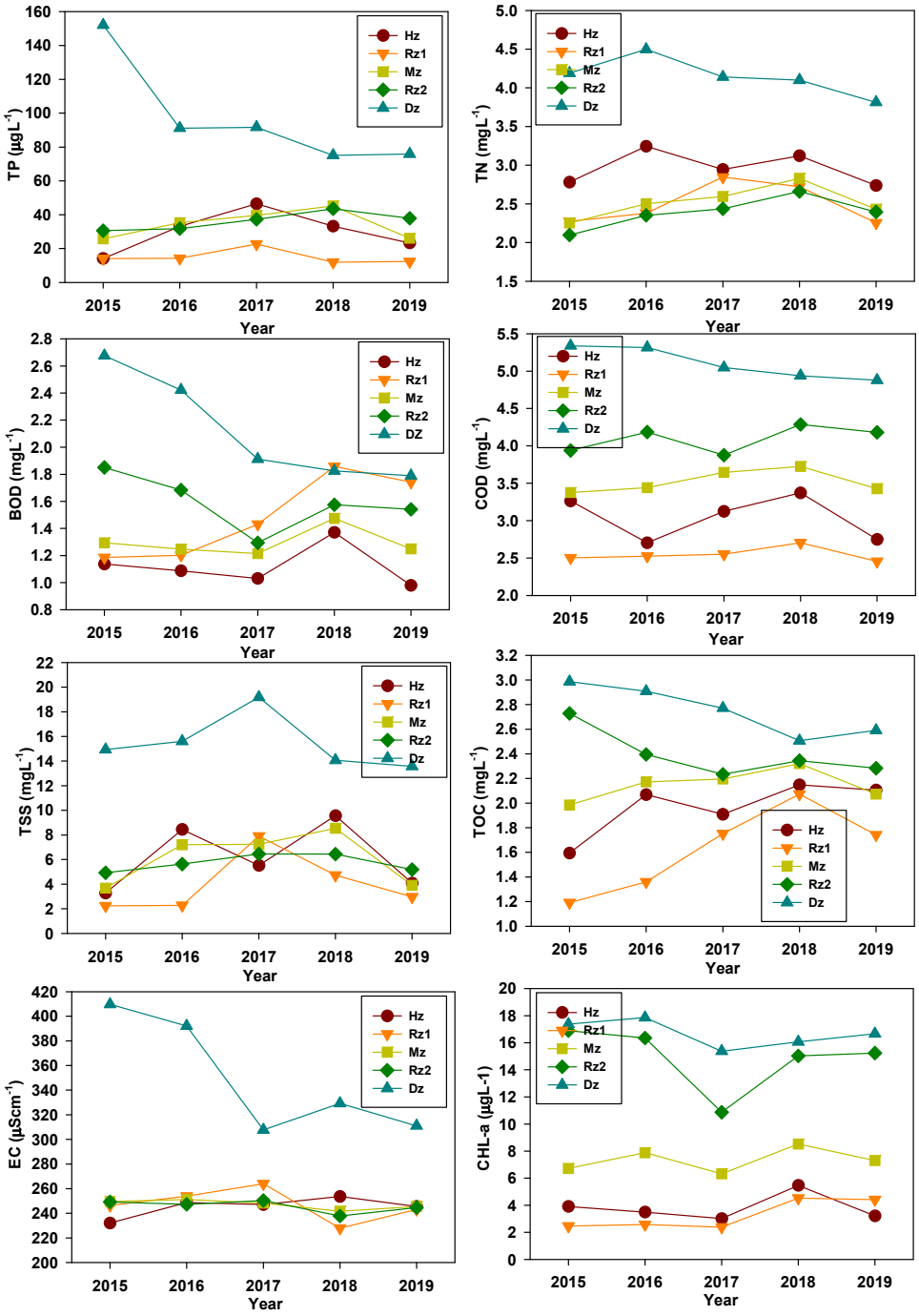

Figure S2. Annual variations of water quality parameters in the Han River. (Hz: headwater zone, Rz_1: reservoir zone 1, Mz: midwater zone, Rz_2: reservoir zone 2, and Dz: downwater zone, TP: total phosphorus, TN: total nitrogen, BOD: biological oxygen demand, COD: chemical oxygen demand, TSS: total suspended solids, TOC: total organic carbon, EC: electrical conductivity, and CHL-a: chlorophyll-a).

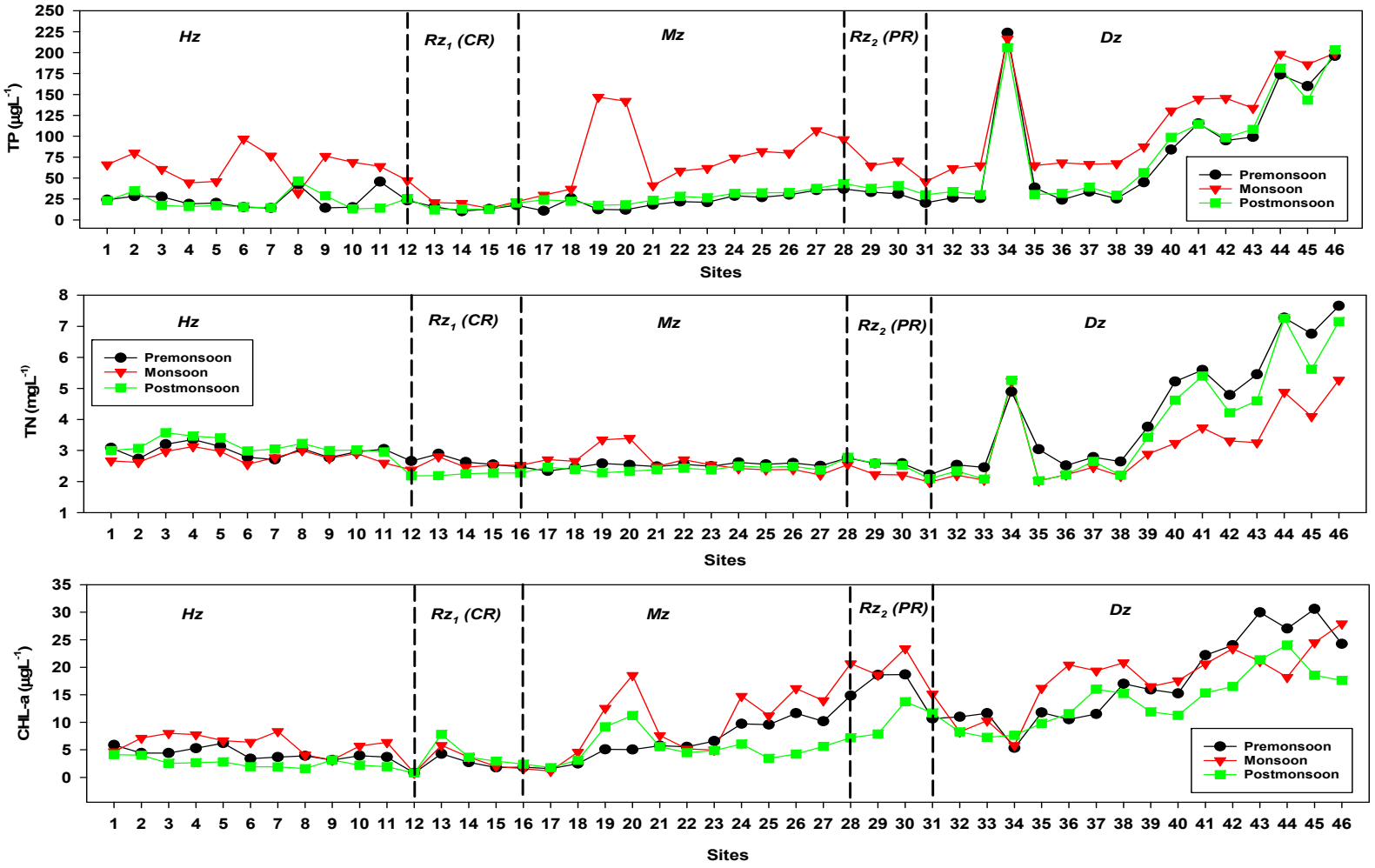

Figure S3. Seasonal variations of TP, TN and CHL-a from Hz to Dz in the HRB (Hz: headwater zone, Rz_1 (CR): reservoir zone 1 (Chugju Reservoir), Mz: midwater zone, Rz_2 (PR): reservoir zone 2 (Paldang Reservoir), and Dz: downwater zone; HRB: Han River basin).

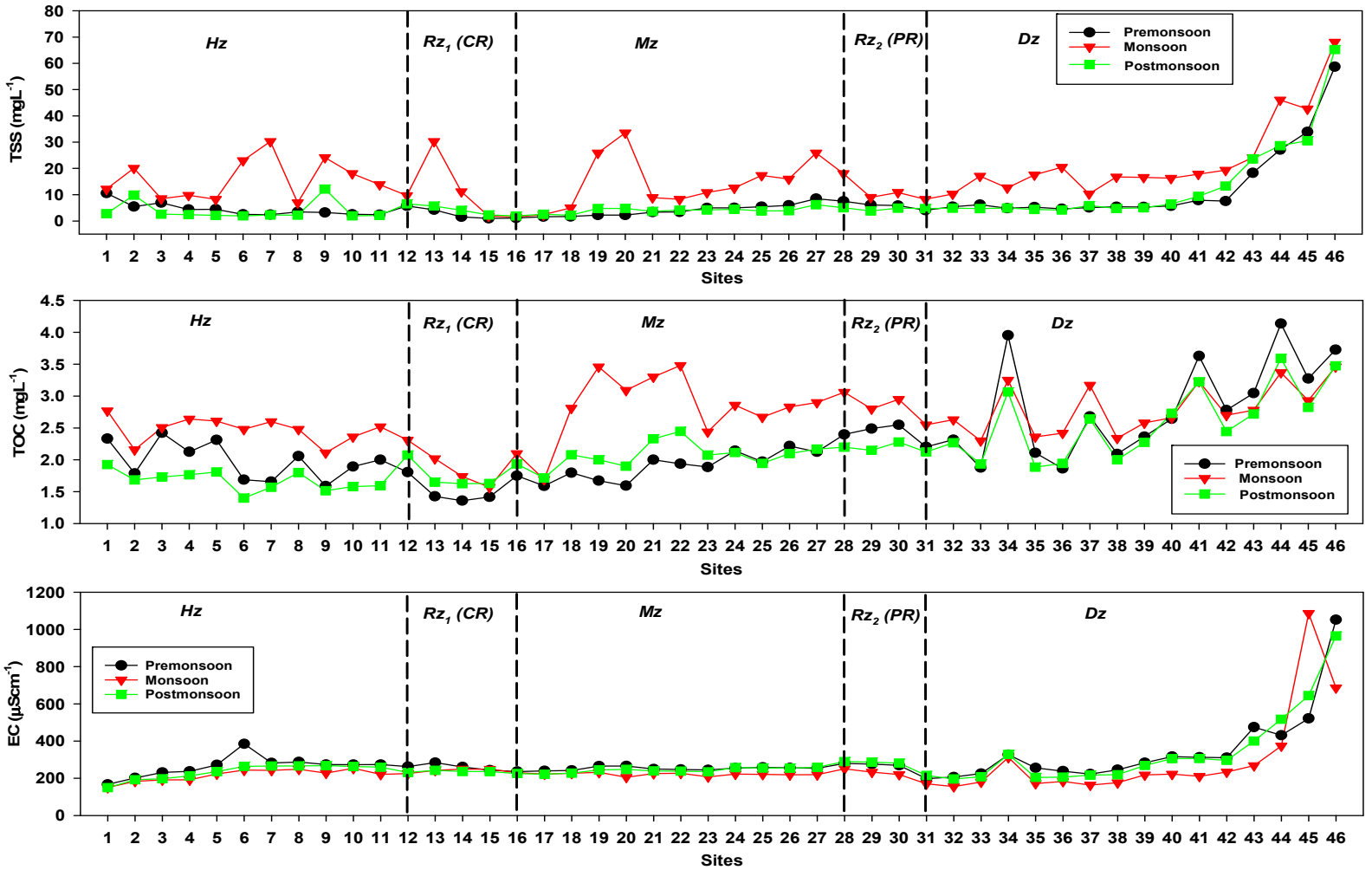

Figure S4. Seasonal variations of TSS, TOC and EC from Hz to Dz in the HRB (Hz: headwater zone, Rz_1 (CR): reservoir zone 1 (Chugju Reservoir), Mz: midwater zone, Rz_2 (PR): reservoir zone 2 (Paldang Reservoir), and Dz: downwater zone; HRB: Han River basin).

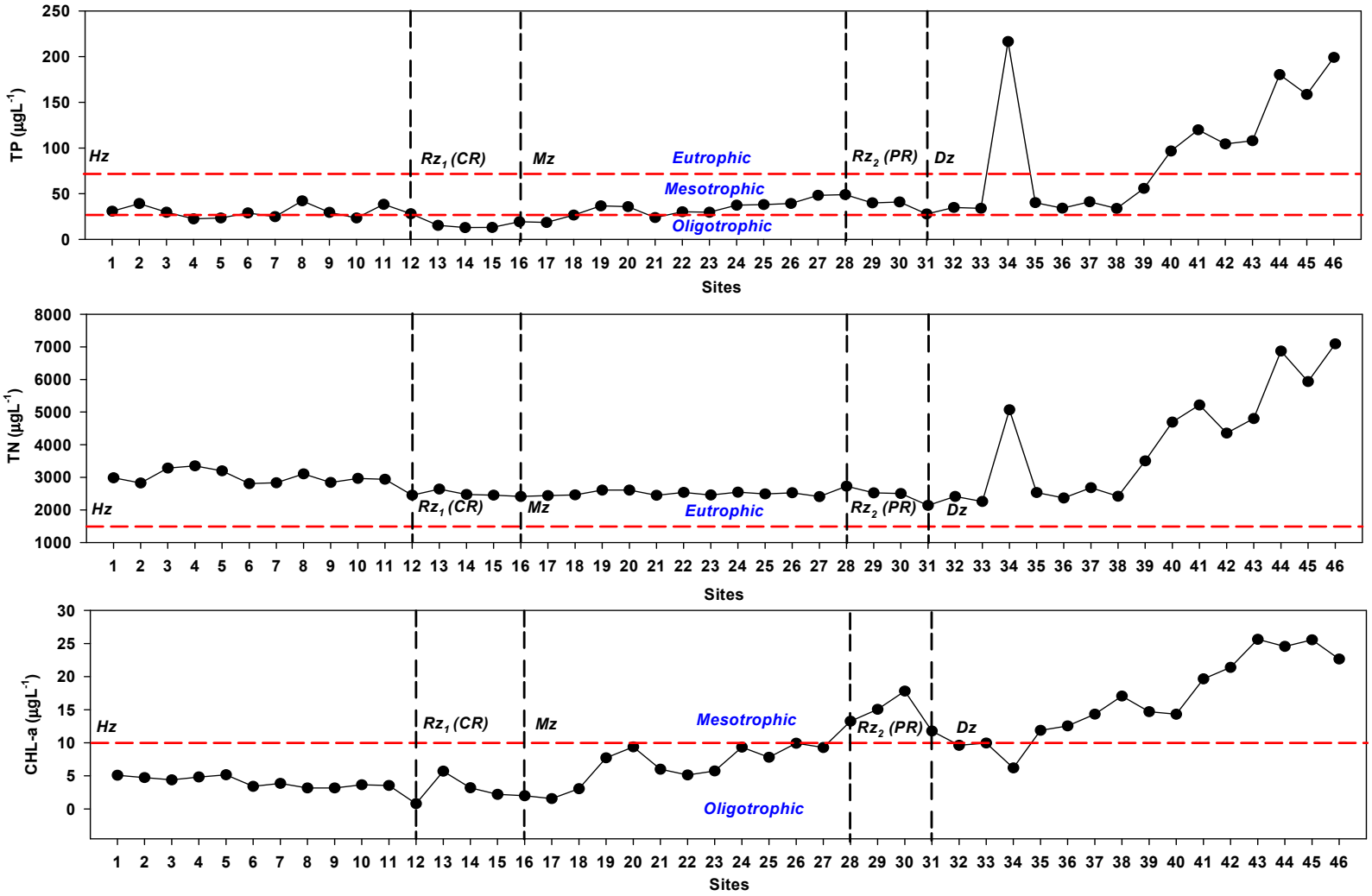

Figure S5. Trophic state condition of Han River. (Hz: headwater zone, Rz_1 (CR): reservoir zone 1 (Chugju Reservoir), Mz: midwater zone, Rz_2 (PR): reservoir zone 2 (Paldang Reservoir), Dz: downwater zone, TP: total phosphorus, TN: total nitrogen, and CHL-a: chlorophyll-a).

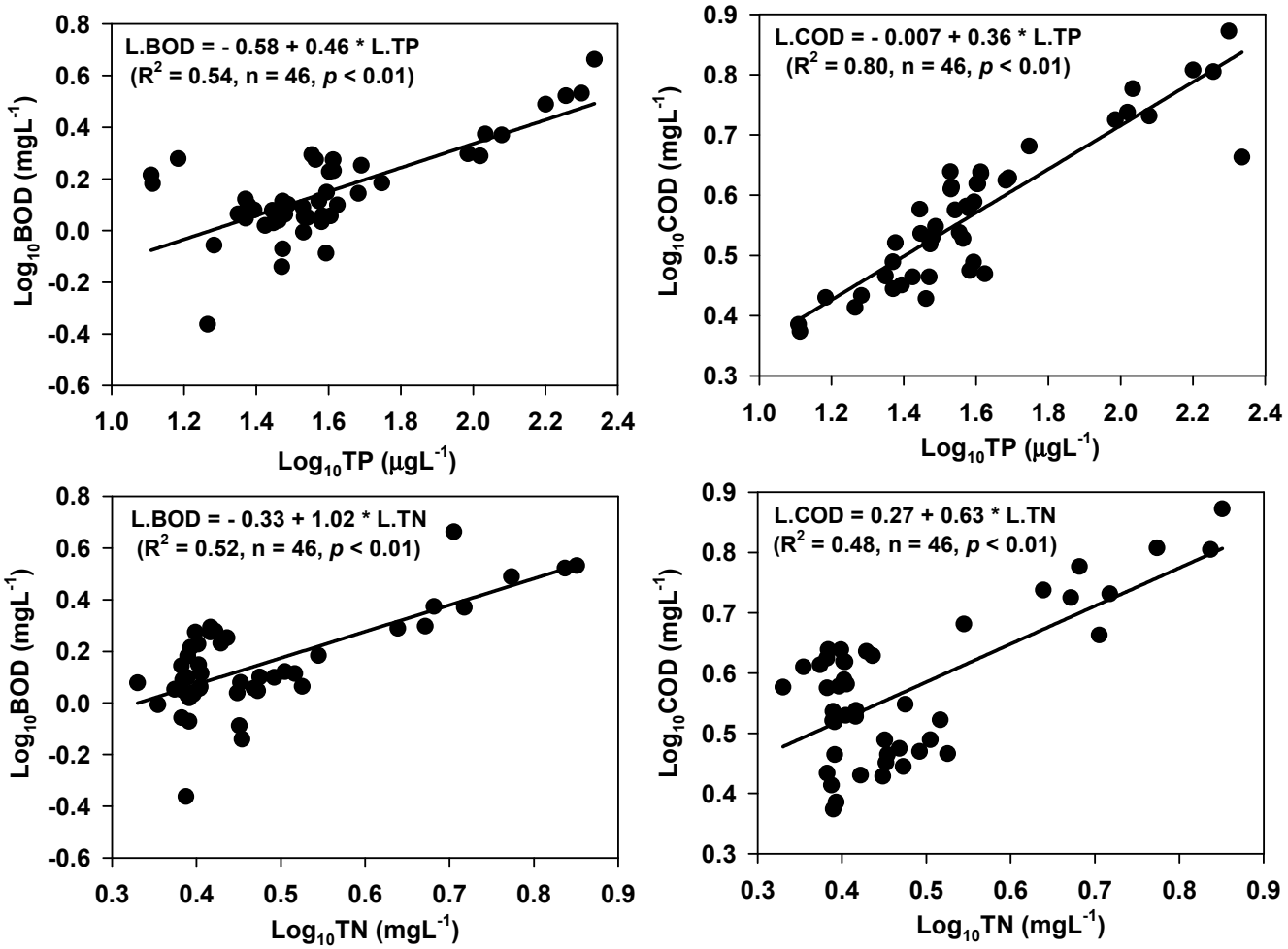

Figure S6. Relations among nutrients (TP: total phosphorus and TN: total nitrogen) and organic matters (BOD: biological oxygen demand and COD: chemical oxygen demand) in the Han River.

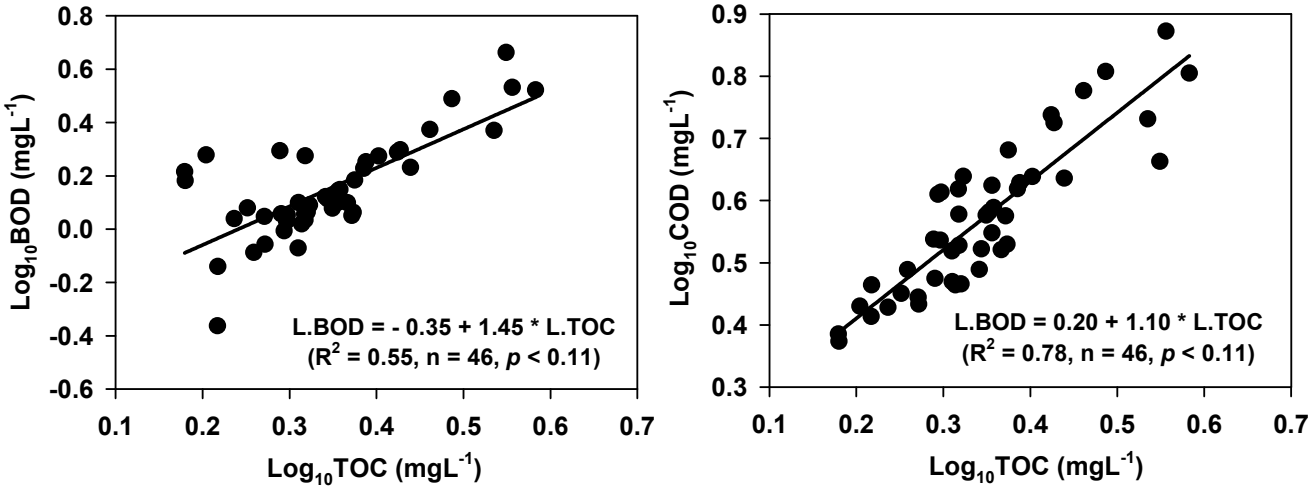

Figure S7. Relations among TOC (total organic carbon), BOD (biological oxygen demand) and COD (chemical oxygen demand) in the Han River.

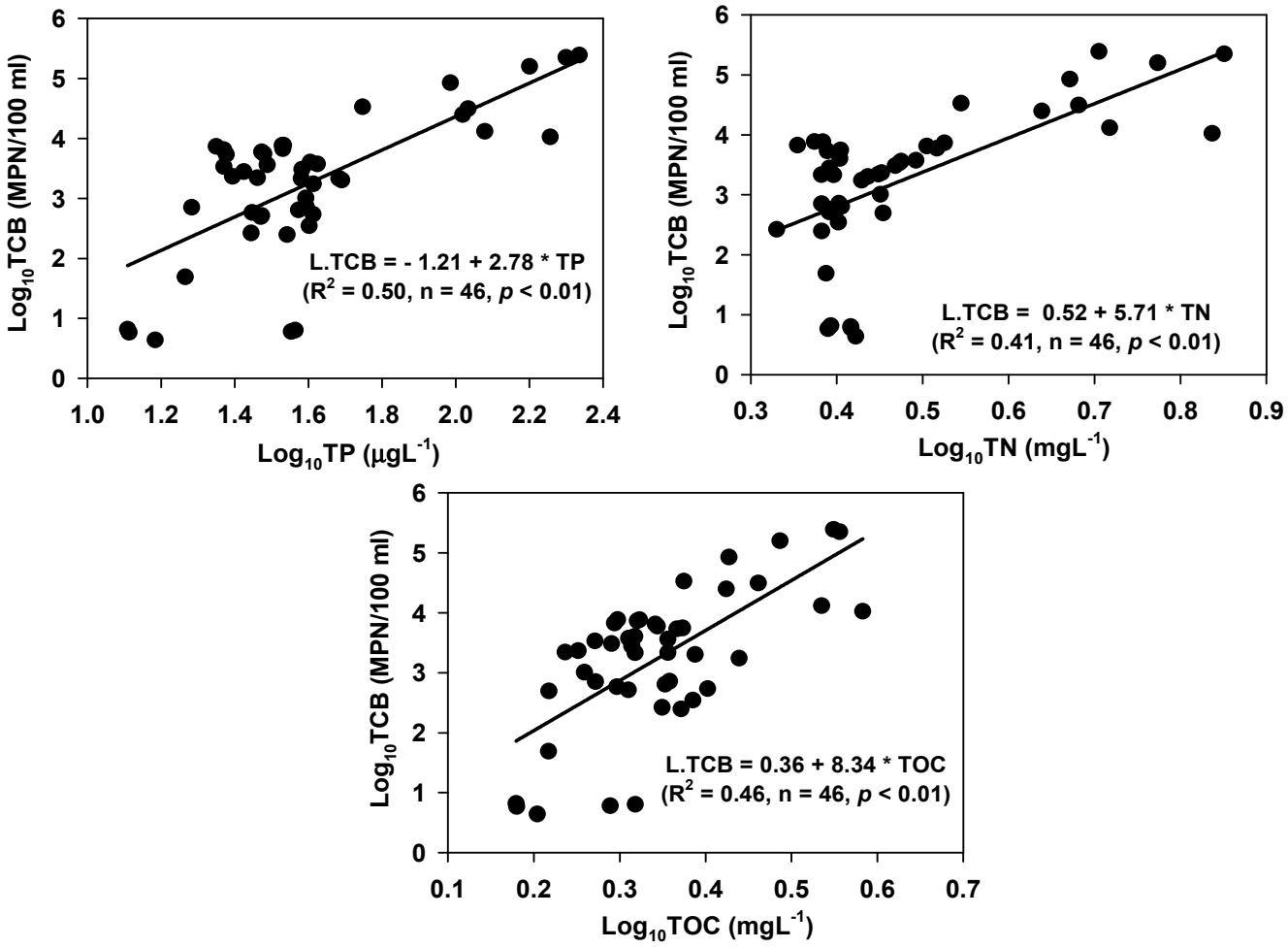

Figure S8. Influence of TP (total phosphorus), TN (total nitrogen), and TOC (total organic carbon) on TCB (total coliform bacteria) in the Han River.