

Analysis of environmental factors associated with cyanobacterial dominance after river weir installation

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SUPPLEMENTARY INFORMATION

Table S1. Bi-variable correlation analysis between parameters relevant to cyanobacterial estimation at the Gangjeong Goryeong weir (GGW; right, gray) and the Dalseong weir (DSW; left, white). Note: see the main document for definitions.

Statistics	APRCP7	Q7day	Temp	ΔT	DO	pH	EC	BOD	COD	TOC	SS	TP	PO ₄ P	TN	NH ₃ -N	NO ₃ -N	Fe	SiO ₂	Chl-a	Cyano	Green	Diatom
APRCP7	1.00	0.87**	0.03	-0.16	-0.14	-0.17	-0.48**	-0.11	0.23*	0.00	0.61**	0.29**	0.24*	-0.17	-0.17	-0.11	0.44**	0.11	-0.27**	-0.14	-0.23*	-0.14
Q7day	0.08**	1.00	-0.04	-0.18	-0.08	-0.06	-0.51**	-0.19	0.09	-0.03	0.57**	0.20*	0.05	-0.17	-0.27**	-0.04	0.53**	0.08	-0.24*	-0.14	-0.23*	-0.04
Temp	0.26**	0.18	1.00	0.46**	-0.25**	0.51**	0.32**	0.28**	0.27**	0.24*	-0.19*	0.33**	0.22*	-0.27**	-0.11	-0.21*	0.06	-0.19*	0.10	0.33**	0.23*	-0.35**
ΔT	-0.14	-0.19*	0.52*	1.00	0.29**	0.14	0.47**	0.43**	0.22*	0.56**	-0.09	0.33**	-0.05	0.02	-0.06	-0.16	-0.18	-0.25**	0.33**	0.59**	0.18	-0.22*
DO	0.03	0.00	-0.23*	0.01	1.00	-0.09	0.09	0.25**	0.07	0.22*	0.06	-0.17	-0.62**	0.19*	-0.25**	0.28**	-0.28**	-0.09	0.48**	0.20*	0.22*	0.30**
pH	-0.29**	-0.35**	0.13	0.10	0.30*	1.00	0.12	0.23*	-0.10	0.08	-0.14	0.15	0.01	-0.43**	-0.47**	-0.03	-0.13	-0.16	0.26**	0.30**	0.12	0.15
EC	-0.18	-0.52**	0.14	0.32**	-0.11	0.24*	1.00	0.48**	0.30**	0.45**	-0.23*	0.13	-0.02	0.47**	0.48**	-0.17	-0.12	-0.57**	0.33**	0.37**	0.24*	-0.12
BOD	0.17	0.11	0.25*	0.05	0.07	0.06	0.04	1.00	0.31**	0.34**	0.09	0.39**	-0.04	0.34**	0.15	-0.12	-0.18	-0.42**	0.56**	0.41**	0.11	0.11
COD	0.27**	0.26**	0.12	-0.09	0.03	-0.08	-0.05	0.87*	1.00	0.24*	0.21*	0.36**	0.18	0.41**	0.32**	-0.04	0.15	-0.17	0.14	0.13	0.30**	-0.22*
TOC	-0.22*	-0.05	0.20*	0.08	0.03	0.18	-0.27**	0.12	-0.02	1.00	0.22*	0.58**	0.13	0.14	0.00	-0.17	0.15	-0.47**	0.35**	0.63**	0.05	0.01
SS	0.11	0.17	0.14	-0.04	0.43**	0.35**	-0.11	0.22*	0.07	0.36**	1.00	0.35**	0.17	0.10	-0.09	-0.01	0.39**	-0.12	0.11	0.06	-0.23*	0.23*
TP	0.04	0.06	0.26**	0.05	0.25**	0.24*	0.03	0.69**	0.46**	0.33**	0.68**	1.00	0.63*	0.03	0.09	-0.42**	0.20*	-0.26**	0.11	0.33**	-0.02	-0.13
PO ₄ P	0.04	0.27**	0.07	-0.12	-0.10	-0.06	-0.35**	0.04	-0.02	0.26**	0.36**	0.38**	1.00	-0.14	0.32**	-0.53**	0.20*	0.02	-0.30**	-0.05	-0.06	-0.38**
TN	-0.14	-0.15	-0.08	-0.13	0.41**	0.33**	-0.03	0.50**	0.29**	0.45**	0.63**	0.78**	0.15	1.00	0.66**	0.20*	0.11	-0.33**	0.18	0.01	0.13	0.12
NH ₃ -N	0.18	-0.02	-0.01	-0.03	-0.32**	-0.20*	0.43**	-0.07	-0.04	-0.29**	0.01	0.02	0.13	-0.07	1.00	-0.17	0.18	-0.26**	-0.07	-0.14	0.08	-0.25**
NO ₃ -N	-0.21*	-0.10	-0.44**	-0.25**	0.04	-0.05	-0.26**	-0.11	-0.05	0.22*	-0.14	-0.19*	0.03	0.26**	-0.16	1.00	-0.01	-0.04	0.09	-0.10	0.07	0.42**
Fe	-0.03	0.06	-0.03	-0.02	-0.05	-0.21*	-0.10	0.07	0.01	-0.04	0.14	0.26**	0.74**	-0.04	0.17	-0.13	1.00	-0.27**	-0.20*	-0.10	-0.20*	-0.09
SiO ₂	0.45**	0.61**	0.24*	-0.16	0.06	-0.43**	-0.57**	0.05	0.15	0.15	0.10	0.06	0.31**	-0.03	-0.16	0.09	0.29**	1.00	-0.29**	-0.23*	0.06	-0.29**
Chl-a	-0.06	-0.10	0.21*	0.05	0.49**	0.49**	0.10	0.25*	0.06	0.38**	0.84**	0.70**	0.06	0.73**	-0.07	-0.19*	-0.10	-0.08	1.00	0.66**	0.20*	0.33**
Cyano	-0.07	-0.10	0.21*	0.07	0.47**	0.49**	0.09	0.15	-0.01	0.38**	0.84**	0.65**	0.10	0.68**	-0.06	-0.20*	-0.08	-0.07	0.99**	1.00	0.07	0.00
Green	0.05	0.11	0.43**	0.18	0.04	0.02	-0.11	0.13	0.09	0.02	-0.02	-0.01	-0.14	-0.11	-0.32**	-0.17	-0.07	0.34**	0.03	0.02	1.00	-0.14
Diatom	0.01	0.00	-0.57**	-0.41**	0.26**	-0.03	-0.22*	-0.08	-0.03	-0.22*	-0.08	-0.20*	-0.23*	-0.03	-0.24*	0.20*	-0.16	-0.19*	-0.07	-0.11	-0.01	1.00

* Spearman correlation coefficient r : significant at p -value < 0.05 (two-tailed test), ** r : significant at p -value < 0.01 (two-tailed test)

Table S2. Bi-variable correlation analysis between parameters relevant to cyanobacterial estimation at Hapcheon Changnyeong weir (HCW) (right, gray), and Changnyeong Hama weir (CHW) (left, white). Note: see the main document for definitions.

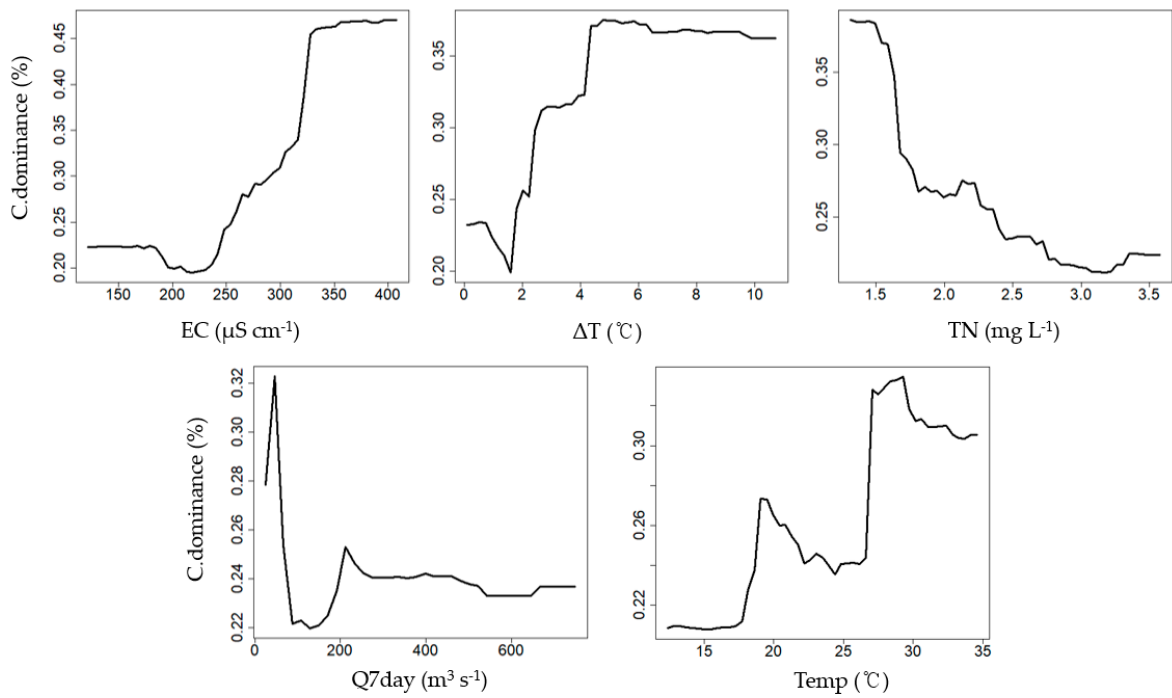
Statistics	APRCP7	Q7day	Temp	ΔT	DO	pH	EC	BOD	COD	TOC	SS	TP	PO ₄ P	TN	NH ₃ -N	NO ₃ -N	Fe	SiO ₂	Chl-a	Cyano	Green	Diatom
APRCP7	1.00	0.75**	-0.02	-0.28**	0.06	-0.49**	-0.11	-0.05	0.18	-0.06	0.42**	0.06	0.11	-0.08	-0.08	0.01	0.44**	0.43**	0.00	-0.09	-0.14	0.24*
Q7day	0.73**	1.00	0.00	-0.21*	-0.09	-0.59**	-0.41**	-0.22*	0.18	-0.13	0.32**	0.15	0.42**	-0.08	-0.12	0.01	0.34**	0.57**	-0.17	-0.12	-0.14	0.15
Temp	0.10	0.05	1.00	0.45**	-0.40**	0.04	0.27**	0.46**	0.25*	0.29**	0.08	0.32**	0.20	-0.48**	0.06	-0.53**	0.05	0.22*	0.24*	0.31**	0.48**	-0.59**
ΔT	-0.15	-0.19	0.49**	1.00	0.22*	0.21*	0.31**	0.58**	0.01	0.30**	0.09	0.32**	-0.04	0.00	0.05	-0.35**	-0.12	-0.05	0.20	0.51**	0.44**	-0.40**
DO	-0.14	-0.12	-0.20*	0.14	1.00	0.36**	-0.14	0.25*	-0.02	0.16	0.15	-0.33**	-0.54**	0.27**	-0.29**	0.11	-0.27**	-0.19	0.39**	0.27**	0.18	0.42**
pH	-0.56**	-0.57**	-0.02	0.16**	0.46**	1.00	-0.02	0.32**	-0.05	0.35**	-0.02	-0.33**	-0.37**	0.01	-0.33**	0.04	-0.72**	-0.47**	0.44**	0.29**	0.36**	0.15
EC	0.12	-0.25*	-0.06	0.02	-0.17	-0.24	1.00	0.29**	-0.09	-0.12	-0.01	0.18	-0.26*	-0.26**	0.56**	-0.41**	0.24*	-0.40**	0.10	0.21*	-0.03	-0.27**
BOD	0.00	-0.16	0.37**	0.25*	0.13	0.16	0.10	1.00	0.22*	0.53**	0.31**	0.11	-0.20	0.05	-0.15	-0.26*	-0.16	-0.08	0.56**	0.51**	0.41**	-0.26**
COD	0.25*	0.11	0.24*	0.00	-0.04	-0.22*	0.27**	0.20	1.00	0.41**	0.39**	0.20*	0.25*	0.21*	-0.22*	0.15	-0.10	0.34**	0.29**	0.06	0.18	0.12
TOC	-0.20*	-0.01	0.39**	0.08	0.02	0.30**	-0.31**	0.22*	0.15	1.00	0.26*	0.16	0.13	0.34**	-0.28**	0.22*	-0.38**	0.28**	0.46**	0.38**	0.34**	-0.15
SS	0.52**	0.51**	-0.17	-0.16	0.07	-0.17	-0.09	0.01	0.30**	0.03	1.00	0.21*	0.14	0.14	-0.24*	-0.03	0.04	0.04	0.33**	0.26*	-0.03	0.31**
TP	0.32**	0.18	0.19	0.09	-0.29**	-0.16	0.21*	-0.11	-0.08	-0.01	0.16	1.00	0.46**	0.05	0.07	-0.16	0.31**	0.25*	-0.08	-0.01	-0.10	-0.29**
PO ₄ P	0.36**	0.39**	0.06	-0.13	-0.46**	-0.29**	0.04	-0.30**	-0.22*	0.10	0.18	0.70**	1.00	0.12	-0.05	0.06	0.24*	0.50**	-0.35**	-0.12	-0.10	-0.23*
TN	0.02	0.32**	-0.29**	-0.24*	-0.01	-0.20	-0.40**	-0.02	-0.16	0.13	0.18	-0.14	0.11	1.00	-0.15	0.56**	-0.19	0.14	-0.13	-0.07	-0.16	0.16
NH ₃ -N	0.17	-0.10	-0.07	-0.08	-0.29**	-0.13	0.39**	-0.09	-0.07	-0.17	0.08	0.27**	0.41**	-0.21*	1.00	-0.19	0.33**	-0.13	-0.31**	-0.07	-0.22*	-0.30**
NO ₃ -N	0.12	0.37**	-0.34**	-0.28**	-0.01	-0.10	-0.47**	-0.11	-0.26*	0.06	0.26*	-0.11	0.05	0.66**	-0.14	1.00	-0.25*	0.10	-0.19	-0.32**	-0.17	0.30**
Fe	0.42**	0.26*	0.07	-0.23*	-0.26*	-0.59**	0.33**	-0.18	0.17	-0.29**	-0.07	0.15	0.27**	-0.04	0.16	-0.19	1.00	0.28**	-0.35**	-0.15	-0.34**	-0.14
SiO ₂	0.60**	0.74**	0.29**	-0.14	-0.25*	-0.49**	-0.26*	-0.13	0.08	0.22*	0.35**	0.27**	0.53**	0.37**	0.02	0.33**	0.45**	1.00	-0.18	-0.09	0.06	-0.24*
Chl-a	0.08	-0.09	0.09	0.12	0.49**	0.29**	-0.01	0.32**	0.45**	0.24*	0.20	-0.08	-0.35**	-0.09	-0.32**	-0.15	-0.11	-0.12	1.00	0.48**	0.24*	0.16
Cyano	-0.13	-0.16	0.19	0.15	0.02	0.11	0.10	-0.02	0.29**	0.09	-0.09	-0.10	-0.14	-0.30**	-0.07	-0.32**	-0.07	-0.10	0.04	1.00	0.17	-0.16
Green	-0.23*	-0.15	0.51**	0.42**	0.05	0.35**	-0.26*	0.28**	0.04	0.37**	-0.16	-0.01	-0.13	-0.04	-0.15	-0.18	-0.34**	-0.01	0.20	0.13	1.00	-0.24*
Diatom	0.16	0.15	-0.56**	-0.36**	0.33**	0.16	-0.12	-0.11	0.18	-0.04	0.41**	-0.20	-0.22*	0.15	-0.21*	0.33**	-0.21*	-0.13	0.43**	-0.15	-0.25*	1.00

* Spearman correlation coefficient r: significant at p-value < 0.05 (two-tailed test), ** Spearman correlation coefficient r: significant at p-value < 0.01 (two-tailed test)

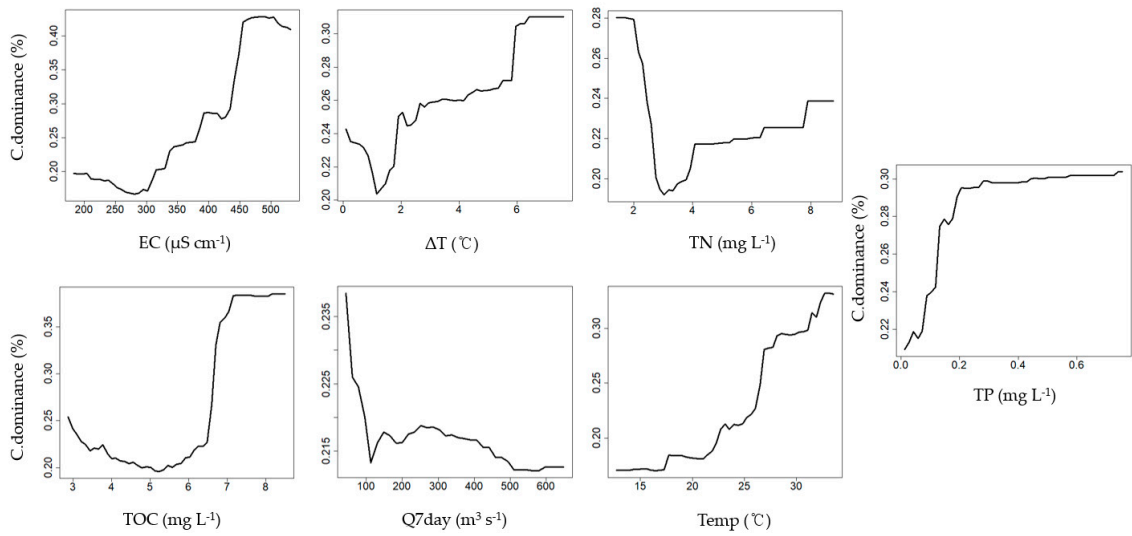
Table S3. Correlation analysis between nutrients (total phosphorous; TP, and total nitrogen; TN) and chlorophyll-a (Chl-a) at the Gangjeong Goryeong weir (GGW), the Dalseong weir (DSW), the Hapcheon Changnyeong weir (HCW), and the Changnyeong Haman weir (CHW).

Weir	TP vs Chl-a		TN vs Chl-a	
	<i>r</i>	<i>p</i> -value	<i>r</i>	<i>p</i> -value
GGW (<i>n</i> = 108)	0.186	0.054	0.103	0.289
DSW (<i>n</i> = 108)	0.702	<0.05	0.728	<0.05
HCW (<i>n</i> = 96)	0.081	0.434	0.135	0.190
CHW (<i>n</i> = 93)	0.078	0.455	0.094	0.371

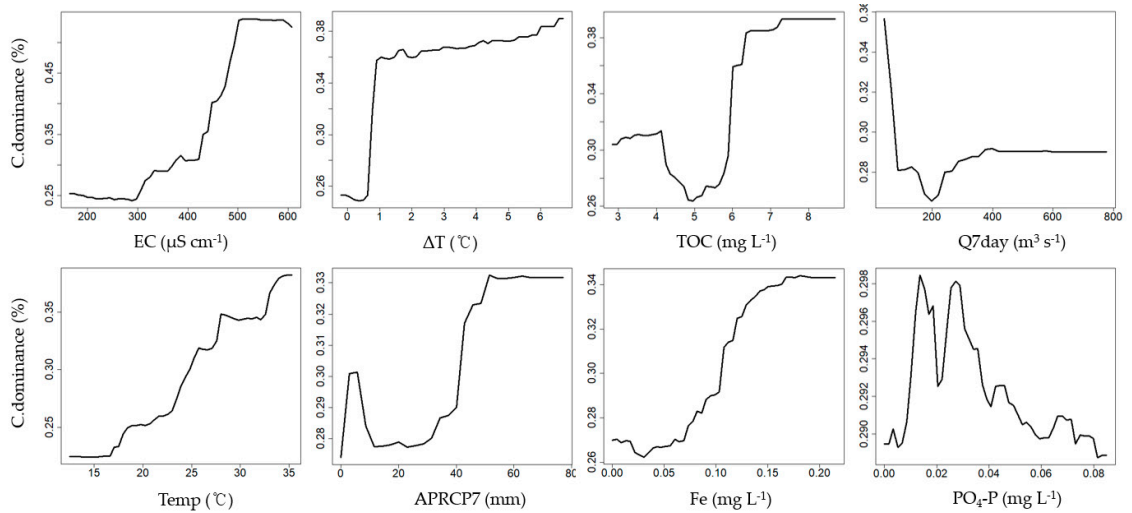
n = number of samples



(a) GGW



(b) DSW



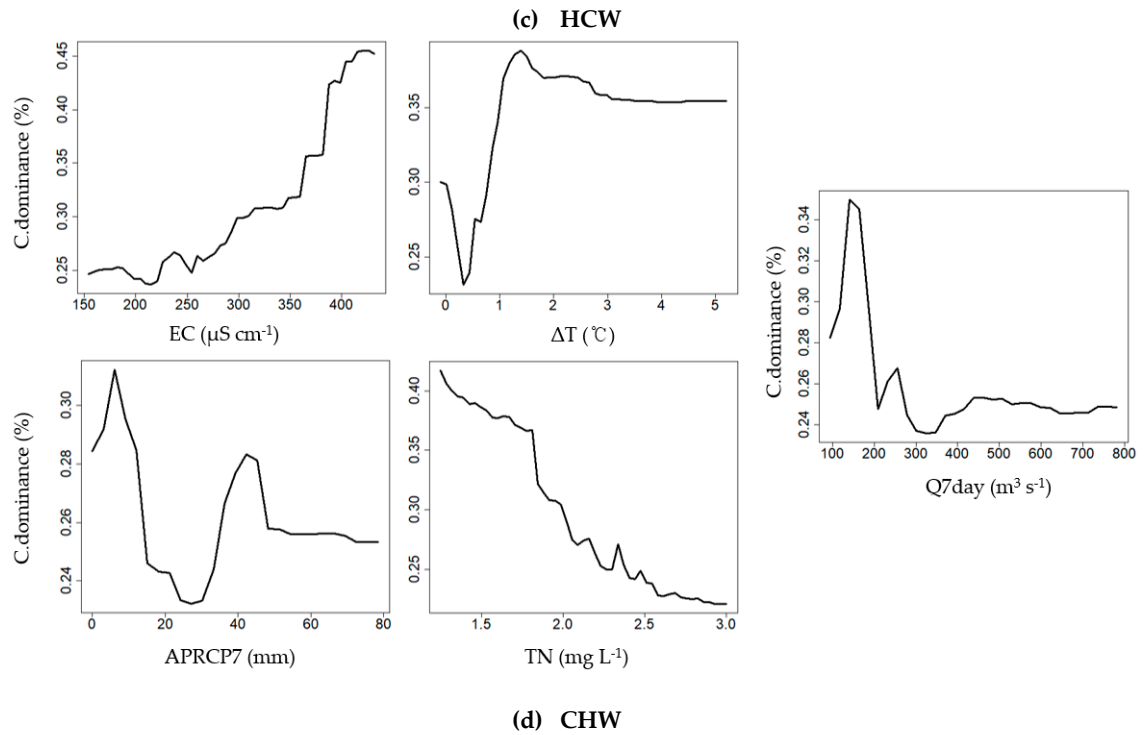


Figure S1. Partial dependence plots of random forest (RF) models, showing marginal effects of single variables on cyanobacterial dominance (C.dominance) at; (a) Gangjeong Goryeong weir (GGW), (b) Dalseong weir (DSW), (c) Hapcheon Changnyeong weir (HCW), and (d) Changnyeong Hama weir (CHW). Note: see the main document for definitions of variables.