Optimizing irrigation and fertilization contributes to mitigating nutrients leaching while improving crop yield: Insights from a field experiment and density functional theory calculation

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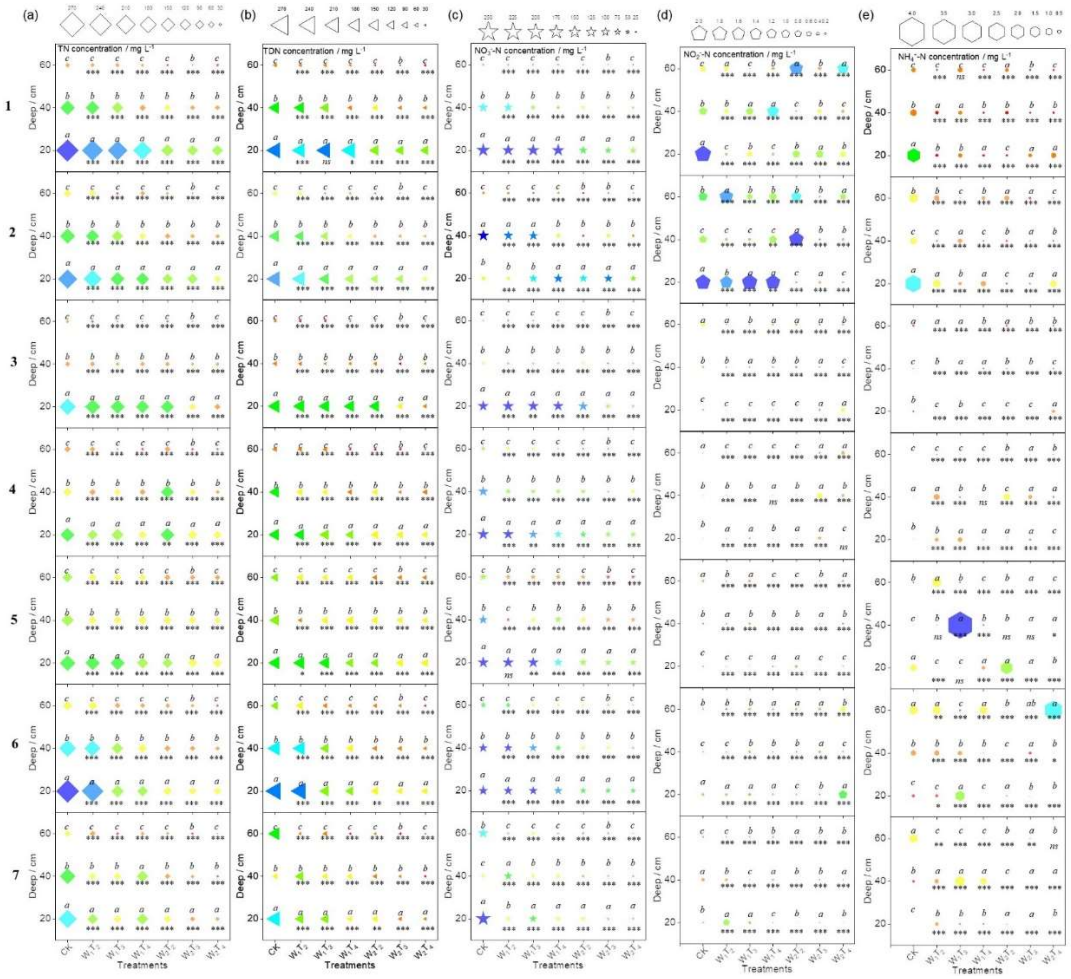

Figure S1. Concentrations of column (a) TN, column (b) TDN, column (c) NO_3^--N, column (d) NO_2^--N and column (e) NH_4^+-N of leachates at different depths of 0-20, 20-40, and 40-60 cm in fields The letters "*a*", "*b*", and "*c*" mark the significant difference of concentration at the different depths. The symbols "*", "**", and "***" indicate the significant differences at levels of "P<0.05", "P<0.01", and "P<0.001" between CK and treatments, respectively. The mark "*ns*" means there is no significant difference between CK and treatments. The numbers on the left represent the nth sampling, for example, the number "6" represents the sixth sampling. The time interval for sampling is 15 days.

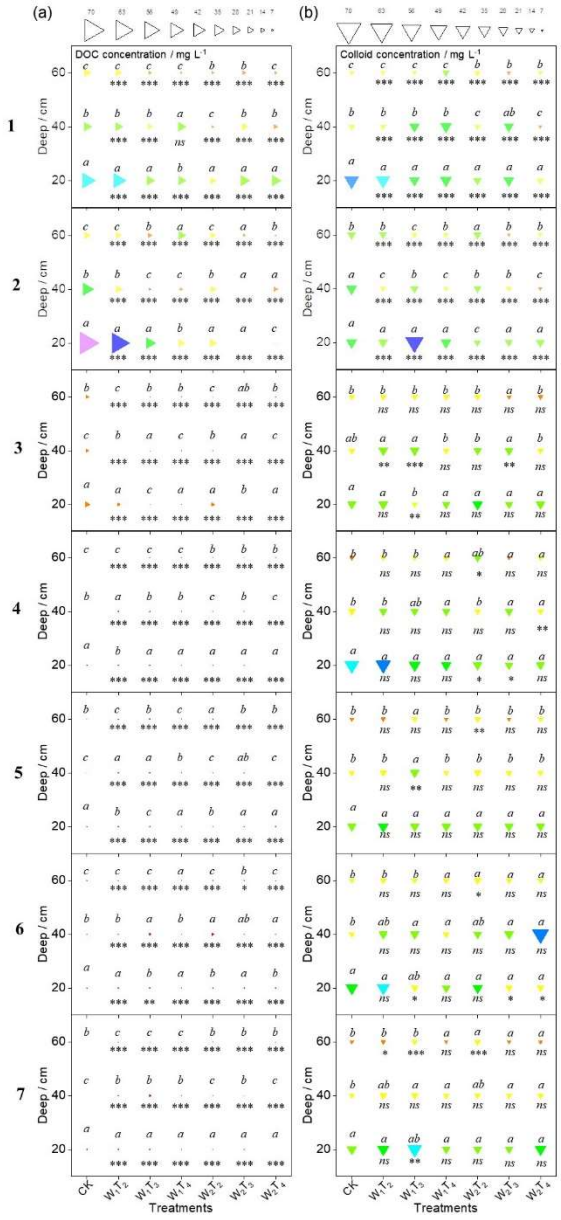

Figure S2. Concentrations of column (a) DOC and column (b) colloid of leachates at different depths of 0-20, 20-40, and 40-60 cm in fields. The letters "*a*", "*b*", and "*c*" mark the significant difference of concentration at the different depths. The symbols "*", "**", and "***" indicate the significant differences at levels of "P<0.05", "P<0.01", and "P<0.001" between CK and treatments, respectively. The mark "*ns*" means there is no significant difference between CK and treatments. The numbers on the left represent the nth sampling, for example, the number "6" represents the sixth sampling. The time interval for sampling is 15 days.

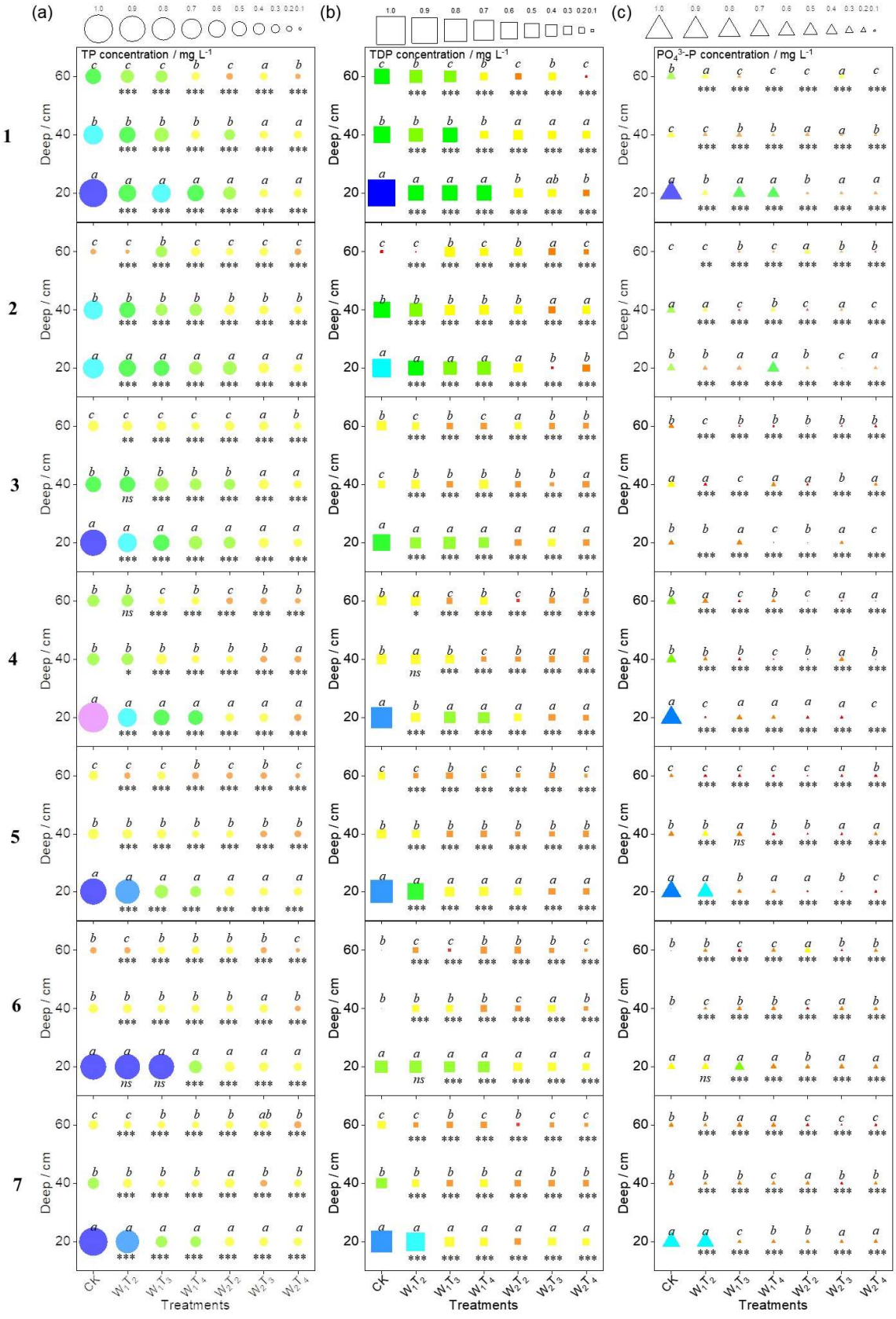

Figure S3. Concentrations of column (a) TP, column (b) TDP, column (c) PO_4^{3-}-P of leachates at different depths of 0-20, 20-40, and 40-60 cm in fields. The letters "*a*", "*b*",

and "*c*" mark the significant difference of concentration at the different depths. The symbols "*", "**", and "***" indicate the significant differences at levels of "$P<0.05$", "$P<0.01$", and "$P<0.001$" between CK and treatments, respectively. The mark "*ns*" means there is no significant difference between CK and treatments. The numbers on the left represent the nth sampling, for example, the number "6" represents the sixth sampling. The time interval for sampling is 15 days.

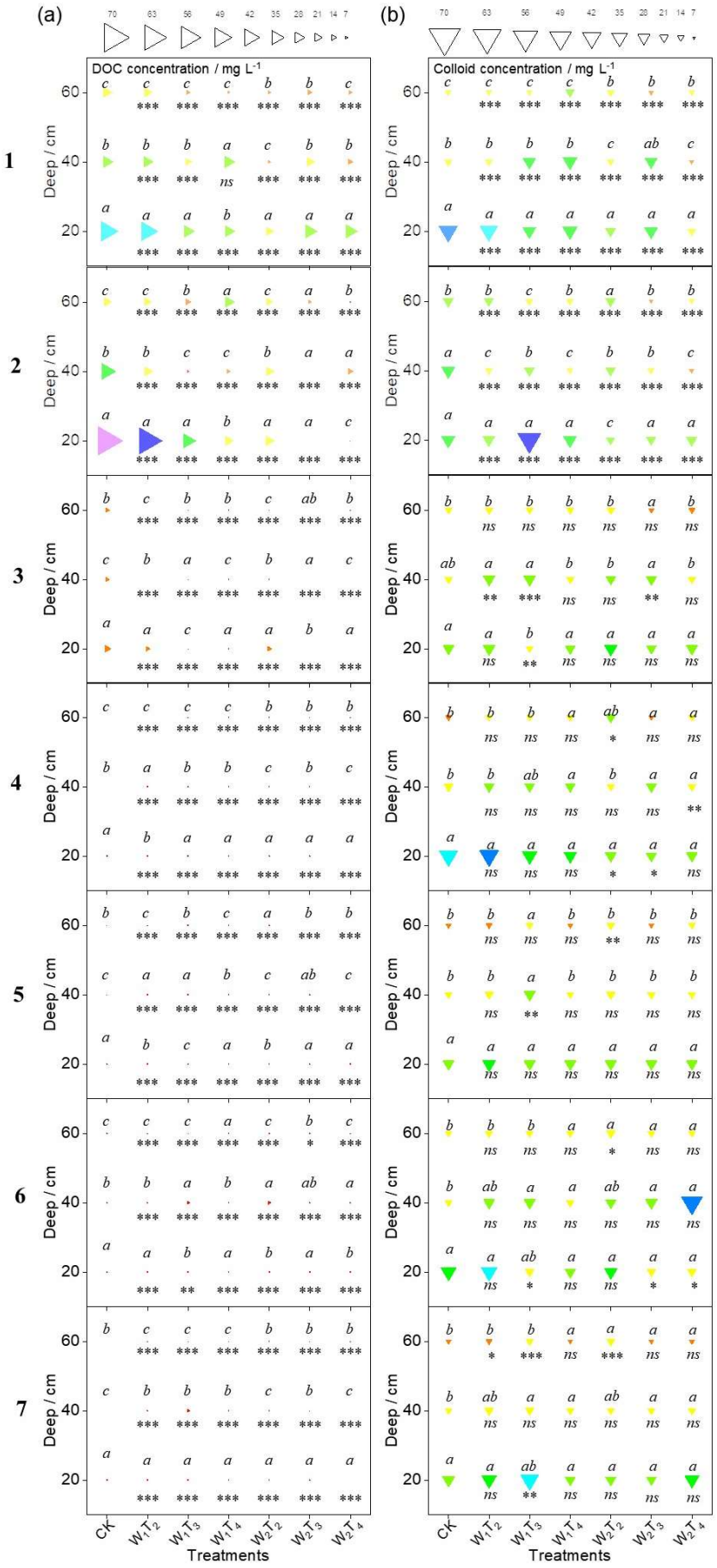
(a)
(b)
70 63 56 49 42 35 28 21 14 7
DOC concentration / mg L-1
Colloid concentration / mg L-1
Deep / cm
60
40
20
1
2
3
4
5
6
7
CK
W1T2
W1T3
W1T4
W2T2
W2T3
W2T4
Treatments

Figure S4. Concentrations of column (a) DOC and column (b) colloid of leachates at different depths of 0-20, 20-40, and 40-60 cm in fields. The letters "*a*", "*b*", and "*c*" mark the significant difference in concentration at the different depths. The symbols "*", "**", and "***" indicate the significant differences at levels of "$P<0.05$", "$P<0.01$", and "$P<0.001$" between CK and treatments, respectively. The mark "*ns*" means there is no significant difference between CK and treatments. The numbers on the left represent the nth sampling, for example, the number "6" represents the sixth sampling. The time interval for sampling is 15 days.

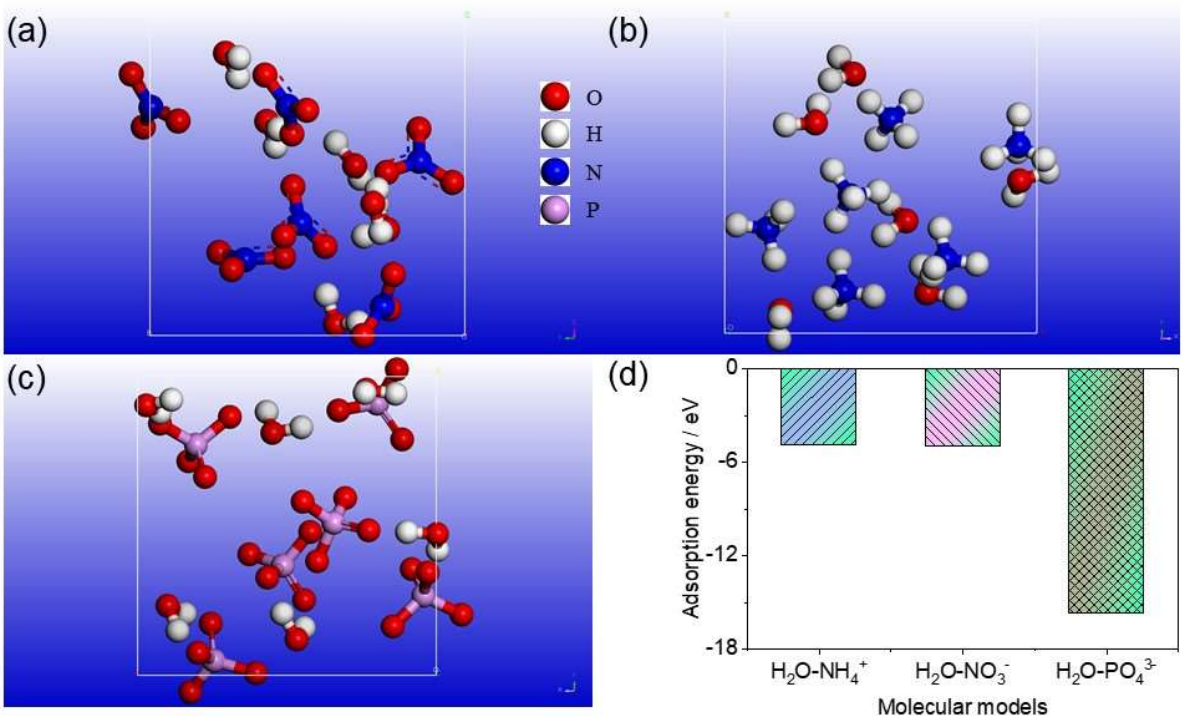

Figure S5. Molecular models of (a) H_2O and NO_3^-, (b) H_2O and NH_4^+, and (c) H_2O and PO_4^{3-}. (d) Adsorption energies between H_2O and solutes. The solutes include NO_3^-, NH_4^+, and PO_4^{3-}.

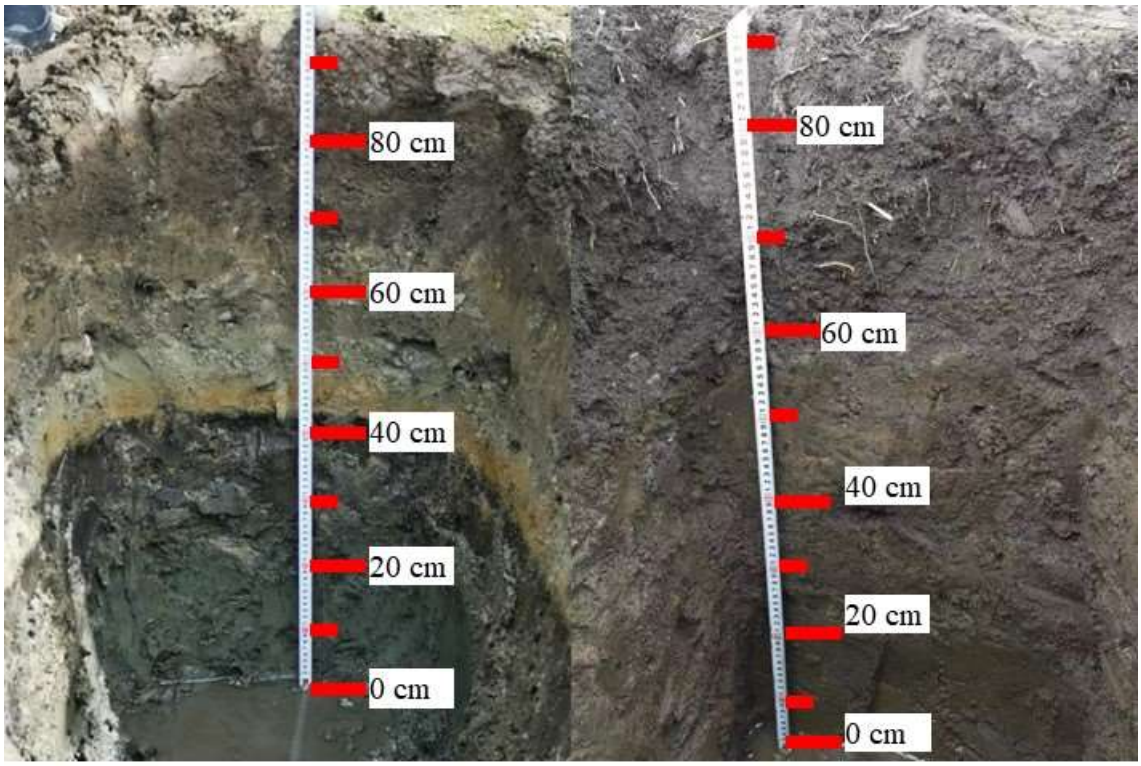

Figure S6. Soil profiles in experimental plots of Erhai Lake basin

Table S1. Soil properties in field.

Deep / cm	Soil texture / %			hydraulic conductivity	Bulk density / g	SOM / g kg^{-1}	TN / g kg^{-1}	TP / g kg^{-1}	K / g kg^{-1}	NO_3^--N /	NH_4^+-N /
	Sand	Silt	Loam	$*10^{-4}$ / cm s^{-1}	cm^{-3}					mg kg^{-1}	mg kg^{-1}
0-20	32	48	20	4.04	1.09	40.88	2.87	2.72	20.11	122.44	0.91
20-40	39	44	17	1.12	1.23	16.98	1.17	1.16	19.68	21.12	1.71
40-60	43	42	15	1.21	1.34	3.38	0.18	0.64	17.63	12.05	1.64

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Table S2. Standard deviation of TN concentration (mg L^{-1}).

Treatments	Depth / cm	The nth sampling							
		1	2	3	4	5	6	7	8
CK	20	1.31494	1.1218	0.95062	0.80563	0.89559	1.34613	1.06386	1.4494
	40	0.84815	0.86834	0.28991	0.48814	0.71038	0.97926	0.8968	1.29898
	60	0.27651	0.43381	0.20669	0.363	0.58008	0.54751	0.3753	0.41787
W_1T_2	20	1.21705	1.05301	0.88117	0.58947	0.84254	1.28203	0.60069	1.22831
	40	0.80232	0.76251	0.32108	0.36009	0.46962	0.93263	0.41512	1.20276
	60	0.24116	0.40735	0.16694	0.3417	0.46063	0.52144	0.33694	0.39422
W_1T_3	20	1.14879	0.81555	0.81933	0.70231	0.82124	0.71277	0.43165	0.84638
	40	0.66218	0.65779	0.21882	0.37829	0.46798	0.65784	0.41466	0.5023
	60	0.2618	0.16483	0.08641	0.10239	0.41995	0.31696	0.17621	0.22039
W_1T_4	20	1.10513	0.75258	0.78842	0.47438	0.64348	0.6113	0.66225	0.66215
	40	0.36247	0.4052	0.26301	0.35546	0.52889	0.50798	0.658	0.24923
	60	0.19288	0.27582	0.08053	0.16443	0.42028	0.28482	0.24076	0.15213
W_2T_2	20	0.72454	0.60416	0.77296	0.81555	0.5814	0.51275	0.43073	0.63458
	40	0.39051	0.31842	0.28165	0.74346	0.47301	0.3544	0.31802	0.24738
	60	0.15451	0.18626	0.14644	0.34646	0.35998	0.2819	0.18666	0.09048
W_2T_3	20	0.64159	0.60059	0.4093	0.54965	0.53643	0.44541	0.28759	0.43695
	40	0.29897	0.28164	0.19195	0.40321	0.45163	0.35109	0.2241	0.21364
	60	0.10094	0.12118	0.0758	0.15875	0.35017	0.23124	0.17343	0.09432
W_2T_4	20	0.63075	0.41464	0.35308	0.48669	0.52121	0.43827	0.24116	0.35771
	40	0.29236	0.25214	0.23071	0.24354	0.37345	0.25637	0.16351	0.11747
	60	0.17825	0.08202	0.07064	0.14829	0.3331	0.15544	0.09472	0.06535

Table S3. Standard deviation of TDN concentration (mg L^{-1}).

Treatments	Depth / cm	The nth sampling							
		1	2	3	4	5	6	7	8
CK	20	1.43426	1.45583	1.16315	1.05228	1.09367	1.58221	1.37025	1.82231
	40	1.07287	1.09087	0.4126	0.96933	0.93285	1.25406	0.48783	1.68008
	60	0.35097	0.53952	0.27107	0.4509	0.74817	0.71426	1.12248	0.5367
W_1T_2	20	1.30448	1.36464	1.12223	0.99195	1.10507	1.50687	0.85546	1.54433
	40	1.01212	0.95056	0.3533	0.59366	0.37005	1.19434	0.83209	1.55563
	60	0.30411	0.50445	0.21053	0.436	0.59805	0.68025	0.29587	0.50632
W_1T_3	20	1.42572	1.03545	1.04348	0.89216	1.03159	0.9083	0.77533	1.09753
	40	0.85546	0.83209	0.25911	0.49007	0.61211	0.83209	0.54841	0.64698

	60	0.33077	0.21432	0.18468	0.42284	0.52476	0.41635	0.42845	0.27517
	20	1.41602	0.93864	1.0041	0.77395	0.78867	0.78974	0.50948	0.85546
W_1T_4	40	0.45055	0.52456	0.3073	0.47037	0.68276	0.65522	0.53444	0.32042
	60	0.24764	0.32551	0.10237	0.21782	0.54701	0.37251	0.21046	0.19415
	20	0.94302	0.78535	0.98441	0.70608	0.75624	0.67223	0.53456	0.83358
W_2T_2	40	0.50895	0.4053	0.36193	0.51264	0.62488	0.45985	0.40706	0.32095
	60	0.19415	0.23185	0.09537	0.20976	0.47037	0.37058	0.24501	0.11978
	20	0.82745	0.77532	0.53772	0.63383	0.67539	0.57665	0.35935	0.55596
W_2T_3	40	0.37514	0.36193	0.22729	0.29955	0.5535	0.44792	0.28587	0.28271
	60	0.12189	0.15469	0.08979	0.18468	0.45108	0.29025	0.21484	0.12242
	20	0.81184	0.53443	0.38777	0.58805	0.67785	0.57279	0.29902	0.4516
W_2T_4	40	0.36374	0.31235	0.26956	0.45301	0.48808	0.32533	0.20923	0.15135
	60	0.212	0.09611	0.08366	0.12873	0.44091	0.18976	0.11435	0.08085

Table S4. Standard deviation of NO_3^--N concentration (mg L^{-1}).

Treatments	Depth / cm	The nth sampling							
		1	2	3	4	5	6	7	8
	20	0.97964	0.30681	0.77902	0.84172	0.81926	0.73278	1.0554	1.40276
CK	40	0.73256	0.7413	0.30853	0.73378	0.69351	0.68769	0.34594	1.35479
	60	0.23205	0.19802	0.16071	0.36362	0.5407	0.44094	0.76742	0.41508
	20	0.87471	0.23307	0.85126	0.76555	0.82408	0.69788	0.43059	1.18878
W_1T_2	40	0.68344	0.62786	0.2433	0.42618	0.29572	0.65494	0.61912	1.25443
	60	0.19416	0.16966	0.14708	0.3512	0.41178	0.41994	0.21586	0.39158
	20	0.93698	0.5312	0.79152	0.65613	0.79482	0.67791	0.57572	0.87678
W_1T_3	40	0.4306	0.619	0.17851	0.37787	0.4467	0.61906	0.39839	0.50724
	60	0.22062	0.1067	0.12902	0.32244	0.40809	0.33276	0.33532	0.21546
	20	0.92689	0.62355	0.76165	0.58137	0.63333	0.62017	0.40962	0.43061
W_1T_4	40	0.29513	0.28231	0.19665	0.37905	0.51586	0.46906	0.39532	0.25256
	60	0.1548	0.15003	0.08022	0.16373	0.41291	0.2782	0.16804	0.15125
	20	0.62786	0.51555	0.74672	0.50559	0.55142	0.49544	0.39918	0.65914
W_2T_2	40	0.36002	0.14255	0.27064	0.37054	0.48582	0.336	0.29714	0.24898
	60	0.13619	0.14107	0.07029	0.15868	0.37422	0.2643	0.19396	0.09629
	20	0.53767	0.57584	0.37715	0.4546	0.4972	0.44462	0.25454	0.4196
W_2T_3	40	0.25281	0.27064	0.15659	0.20678	0.41586	0.32448	0.2086	0.21705
	60	0.07981	0.08657	0.07037	0.14791	0.33929	0.21206	0.16719	0.08909
	20	0.52871	0.39533	0.25236	0.4369	0.5128	0.41711	0.21081	0.36362
W_2T_4	40	0.24465	0.21277	0.1725	0.33208	0.37842	0.25698	0.16799	0.12136
	60	0.15724	0.06257	0.06166	0.06702	0.30554	0.10117	0.07978	0.05267

Table S5. Standard deviation of NO_2^--N concentration (mg L^{-1}).

Treatments	Depth / cm	The nth sampling							
		1	2	3	4	5	6	7	8
CK	20	0.01265	0.01269	0.0012	0.0006998	0.0011	0.0024	0.00171	0.0008232
	40	0.0062	0.00665	0.00185	0.0006998	0.00137	0.00102	0.00314	0.00177
	60	0.00491	0.00755	0.00407	0.0008344	0.00231	0.0017	0.00139	0.00197
W_1T_2	20	0.002	0.01074	0.0006444	0.0009017	0.0008344	0.00228	0.00561	0.0006977
	40	0.00375	0.00238	0.00105	0.0007671	0.0011	0.000969	0.00249	0.00164
	60	0.00415	0.01168	0.00133	0.0005652	0.000969	0.00162	0.0007671	0.00186
W_1T_3	20	0.00451	0.01326	0.0005992	0.00131	0.0007671	0.00272	0.00233	0.0008344
	40	0.0056	0.00249	0.00126	0.0006261	0.00208	0.00248	0.0006998	0.00131
	60	0.0006628	0.00507	0.00117	0.0005652	0.00258	0.00245	0.00124	0.00104
W_1T_4	20	0.00211	0.0125	0.0005765	0.0006325	0.00107	0.00184	0.0008344	0.0056
	40	0.00913	0.00651	0.0012	0.0006998	0.0006998	0.0009017	0.00196	0.0004307
	60	0.00267	0.00651	0.00187	0.0004307	0.0004307	0.00184	0.00184	0.00117
W_2T_2	20	0.00577	0.00146	0.0005652	0.0007671	0.00245	0.0011	0.0006325	0.0005652
	40	0.00119	0.01274	0.00162	0.0006325	0.0006312	0.00131	0.0006325	0.0008344
	60	0.01048	0.00859	0.00243	0.0005652	0.000253	0.00205	0.0006998	0.0003634
W_2T_3	20	0.00604	0.00233	0.00153	0.00279	0.0006325	0.00124	0.0011	0.000969
	40	0.00361	0.00162	0.0011	0.0048	0.0009017	0.00238	0.0007671	0.0007671
	60	0.00294	0.00196	0.00164	0.00137	0.0008344	0.00258	0.0007671	0.0009017
W_2T_4	20	0.00482	0.00196	0.00402	0.0006998	0.000969	0.00723	0.0005652	0.0004307
	40	0.00254	0.0024	0.00106	0.00258	0.00144	0.00178	0.0007671	0.0004979
	60	0.00869	0.00523	0.00213	0.00305	0.00211	0.00487	0.0005652	0.0004307

Table S6. Standard deviation of NH_4^--N concentration (mg L^{-1}).

Treatments	Depth / cm	The nth sampling							
		1	2	3	4	5	6	7	8
CK	20	0.03292	0.04216	0.00509	0.0006626	0.01758	0.00788	0.0001395	0.00624
	40	0.0159	0.05544	0.00255	0.00119	0.0008369	0.01424	0.00705	0.00682
	60	0.0946	0.0228	0.00571	0.0001395	0.00415	0.02202	0.02159	0.00606
W_1T_2	20	0.00663	0.01949	0.0007553	0.0099	0.0003138	0.0075	0.00918	0.00529
	40	0.00802	0.00384	0.0009938	0.01461	0.00119	0.01356	0.01139	0.00631
	60	0.00314	0.01408	0.00155	0.00258	0.02333	0.02097	0.00101	0.00572
W_1T_3	20	0.00975	0.00872	0.0007023	0.01234	0.00241	0.02507	0.00438	0.01252
	40	0.00918	0.01144	0.00135	0.00463	0.06568	0.0114	0.02437	0.01374

	60	0.01168	0.00314	0.00136	0.0008369	0.00408	0.00537	0.0004882	0.01217
	20	0.00488	0.01395	0.0006758	0.00258	0.00926	0.0004882	0.00345	0.00918
W_1T_4	40	0.00384	0.00349	0.00398	0.00101	0.00398	0.00188	0.01695	0.01461
	60	0.00349	0.00935	0.00155	0.0006626	0.00136	0.01932	0.00119	0.01339
	20	0.00418	0.00488	0.0006626	0.00136	0.03065	0.0031	0.00188	0.00119
W_2T_2	40	0.00732	0.00558	0.00224	0.01705	0.0002197	0.0001395	0.0004882	0.01165
	60	0.00872	0.01255	0.00517	0.00188	0.0001604	0.00119	0.0008369	0.0001744
	20	0.00837	0.00438	0.0006277	0.00467	0.0001395	0.00119	0.0003138	0.01304
W_2T_3	40	0.00349	0.00224	0.00119	0.01043	0.0001395	0.00729	0.0004882	0.0136
	60	0.00349	0.00697	0.00136	0.0006626	0.0001569	0.0004882	0.00223	0.01444
	20	0.01255	0.01696	0.00837	0.00188	0.00153	0.0003138	0.0001395	0.0003138
W_2T_4	40	0.00453	0.00384	0.00349	0.00485	0.00171	0.00119	0.0008369	0.0004882
	60	0.00331	0.00314	0.00453	0.00275	0.0004882	0.04634	0.0001395	0.0001744

Table S7. Standard deviation of TP concentration (mg L^{-1}).

Treatments	Depth / cm	The nth sampling							
		1	2	3	4	5	6	7	8
	20	0.02643	0.01933	0.02471	0.02797	0.02463	0.0241	0.02653	0.02447
CK	40	0.01844	0.01801	0.01463	0.01144	0.0101	0.0008743	0.01067	0.01161
	60	0.01459	0.00526	0.01002	0.01112	0.00876	0.0006104	0.00901	0.00892
	20	0.01631	0.01607	0.01779	0.01773	0.02285	0.02363	0.02186	0.02184
W_1T_2	40	0.01517	0.01501	0.0146	0.01095	0.00898	0.00857	0.00857	0.01075
	60	0.01241	0.00389	0.00928	0.01106	0.00588	0.00598	0.00745	0.00796
	20	0.01748	0.01473	0.01514	0.01481	0.01253	0.02363	0.01082	0.01273
W_1T_3	40	0.01343	0.01116	0.01323	0.01004	0.00857	0.00766	0.00695	0.00837
	60	0.01128	0.01082	0.00894	0.00674	0.00786	0.00705	0.00705	0.00756
	20	0.0155	0.0125	0.01246	0.01369	0.01024	0.01212	0.01014	0.00903
W_1T_4	40	0.00828	0.01152	0.01095	0.00756	0.00674	0.00745	0.00705	0.00816
	60	0.00779	0.00857	0.00738	0.00745	0.00649	0.00735	0.00674	0.00695
	20	0.01193	0.01274	0.01112	0.00796	0.00877	0.00933	0.00877	0.00827
W_2T_2	40	0.01018	0.00986	0.01043	0.00674	0.00695	0.00715	0.00898	0.00735
	60	0.00629	0.00718	0.00893	0.00629	0.00609	0.00705	0.00745	0.00639
	20	0.00795	0.00994	0.00946	0.00816	0.00766	0.00867	0.00806	0.00766
W_2T_3	40	0.00779	0.00877	0.00945	0.00637	0.00639	0.00796	0.00653	0.00745
	60	0.00746	0.00782	0.0086	0.00621	0.00619	0.00588	0.00813	0.00705
	20	0.00771	0.00828	0.00779	0.00664	0.00766	0.00786	0.00786	0.00745
W_2T_4	40	0.00763	0.00763	0.00782	0.00653	0.00639	0.00538	0.00695	0.00725
	60	0.00495	0.00621	0.0071	0.00527	0.00456	0.0039	0.00664	0.00558

Table S8. Standard deviation of TDP concentration (mg L^{-1}).

Treatments	Depth / cm	The nth sampling							
		1	2	3	4	5	6	7	8
CK	20	0.02456	0.01616	0.01546	0.01928	0.02075	0.01164	0.01966	0.01919
	40	0.01495	0.01445	0.00675	0.00895	0.00844	0.0007036	0.00958	0.00895
	60	0.01335	0.00233	0.00887	0.00879	0.00684	0.0005541	0.00727	0.00582
W_1T_2	20	0.01372	0.01301	0.00994	0.00852	0.01499	0.01141	0.01713	0.01714
	40	0.0118	0.01157	0.00771	0.00918	0.00703	0.0069	0.00685	0.00829
	60	0.01126	0.00102	0.00663	0.00918	0.00461	0.00543	0.00477	0.0052
W_1T_3	20	0.0137	0.01157	0.01128	0.01055	0.00879	0.01003	0.00868	0.00805
	40	0.0129	0.00895	0.00558	0.00813	0.00606	0.00637	0.00598	0.00735
	60	0.01047	0.00868	0.00581	0.00551	0.00621	0.00309	0.00606	0.00645
W_1T_4	20	0.01317	0.01196	0.00957	0.01004	0.0086	0.01028	0.00743	0.00758
	40	0.00676	0.00829	0.00842	0.00512	0.00606	0.00621	0.0066	0.00317
	60	0.00645	0.00692	0.00549	0.0066	0.00461	0.00614	0.00621	0.00575
W_2T_2	20	0.00772	0.00782	0.00621	0.00703	0.00684	0.00813	0.00607	0.00535
	40	0.00829	0.00676	0.00551	0.00508	0.00477	0.00528	0.00598	0.0066
	60	0.00543	0.00668	0.00637	0.00309	0.00406	0.00606	0.00277	0.00336
W_2T_3	20	0.00688	0.00207	0.00705	0.00598	0.00621	0.0075	0.00727	0.00629
	40	0.00703	0.00607	0.00399	0.00567	0.00512	0.00696	0.00589	0.00567
	60	0.00629	0.00602	0.00559	0.00508	0.0052	0.00477	0.0045	0.00422
W_2T_4	20	0.00575	0.00606	0.00598	0.00535	0.00598	0.0066	0.0066	0.00543
	40	0.0066	0.00668	0.00602	0.00559	0.00551	0.00406	0.00543	0.00559
	60	0.00145	0.00422	0.00528	0.00504	0.00324	0.00332	0.00352	0.00453

Table S9. Standard deviation of PO_4^{3-}-P concentration (mg L^{-1}).

Treatments	Depth / cm	The nth sampling							
		1	2	3	4	5	6	7	8
CK	20	0.02456	0.01616	0.01546	0.01928	0.02075	0.01164	0.01966	0.01919
	40	0.01495	0.01445	0.00675	0.00895	0.00844	0.0007036	0.00958	0.00895
	60	0.01335	0.00233	0.00887	0.00879	0.00684	0.0005541	0.00727	0.00582
W_1T_2	20	0.01372	0.01301	0.00994	0.00852	0.01499	0.01141	0.01713	0.01714
	40	0.0118	0.01157	0.00771	0.00918	0.00703	0.0069	0.00685	0.00829
	60	0.01126	0.00102	0.00663	0.00918	0.00461	0.00543	0.00477	0.0052
W_1T_3	20	0.0137	0.01157	0.01128	0.01055	0.00879	0.01003	0.00868	0.00805
	40	0.0129	0.00895	0.00558	0.00813	0.00606	0.00637	0.00598	0.00735
	60	0.01047	0.00868	0.00581	0.00551	0.00621	0.00309	0.00606	0.00645

	20	0.01317	0.01196	0.00957	0.01004	0.0086	0.01028	0.00743	0.00758
W_1T_4	40	0.00676	0.00829	0.00842	0.00512	0.00606	0.00621	0.0066	0.00317
	60	0.00645	0.00692	0.00549	0.0066	0.00461	0.00614	0.00621	0.00575
	20	0.00772	0.00782	0.00621	0.00703	0.00684	0.00813	0.00607	0.00535
W_2T_2	40	0.00829	0.00676	0.00551	0.00508	0.00477	0.00528	0.00598	0.0066
	60	0.00543	0.00668	0.00637	0.00309	0.00406	0.00606	0.00277	0.00336
	20	0.00688	0.00207	0.00705	0.00598	0.00621	0.0075	0.00727	0.00629
W_2T_3	40	0.00703	0.00607	0.00399	0.00567	0.00512	0.00696	0.00589	0.00567
	60	0.00629	0.00602	0.00559	0.00508	0.0052	0.00477	0.0045	0.00422
	20	0.00575	0.00606	0.00598	0.00535	0.00598	0.0066	0.0066	0.00543
W_2T_4	40	0.0066	0.00668	0.00602	0.00559	0.00551	0.00406	0.00543	0.00559
	60	0.00145	0.00422	0.00528	0.00504	0.00324	0.00332	0.00352	0.00453

Table S10. Standard deviation of DOC concentration (mg L^{-1}).

Treatments	Depth / cm	The nth sampling							
		1	2	3	4	5	6	7	8
	20	0.10178	0.14188	0.03498	0.005	0.00391	0.00427	0.0048	0.00604
CK	40	0.05989	0.08098	0.0208	0.00178	0.00203	0.0036	0.00113	0.00103
	60	0.05232	0.04772	0.02324	0.00148	0.00209	0.00302	0.00137	0.0023
	20	0.09424	0.13186	0.0227	0.00406	0.00438	0.00418	0.005	0.00592
W_1T_2	40	0.05546	0.05093	0.00226	0.0053	0.00546	0.00353	0.00294	0.00101
	60	0.04844	0.04171	0.00148	0.0002005	0.00323	0.00296	0.00201	0.00225
	20	0.06026	0.07252	0.00128	0.00379	0.00296	0.00424	0.0364	0.0364
W_1T_3	40	0.03638	0.01569	0.00168	0.00356	0.00631	0.01569	0.01569	0.00343
	60	0.02613	0.03294	0.0013	0.00323	0.00505	0.00221	0.00237	0.00205
	20	0.05886	0.04796	0.00265	0.00426	0.00553	0.00355	0.00416	0.0043
W_1T_4	40	0.06002	0.0208	0.00183	0.00362	0.00427	0.00324	0.00173	0.00141
	60	0.01928	0.05814	0.00215	0.0017	0.00421	0.00356	0.00125	0.0003744
	20	0.04384	0.04965	0.0227	0.0054	0.00451	0.00802	0.00461	0.00518
W_2T_2	40	0.0202	0.04716	0.00226	0.00309	0.00367	0.01485	0.00275	0.00199
	60	0.02244	0.03779	0.00148	0.00351	0.00479	0.00593	0.00338	0.00121
	20	0.06984	0.00265	0.00128	0.00406	0.0044	0.00504	0.0046	0.00429
W_2T_3	40	0.04945	0.00183	0.00168	0.00318	0.00387	0.00462	0.00216	0.00172
	60	0.02729	0.02228	0.0013	0.00228	0.00163	0.003	0.00204	0.0009073
	20	0.06752	0.00416	0.00265	0.00222	0.00583	0.00355	0.00265	0.0028
W_2T_4	40	0.02993	0.03234	0.00183	0.00185	0.00104	0.0038	0.00134	0.00111
	60	0.02396	0.01323	0.00215	0.00221	0.00137	0.00277	0.00203	0.00132

Table S11. Standard deviation of colloid concentration (mg L^{-1}).

Treatments	Depth / cm	The nth sampling							
		1	2	3	4	5	6	7	8
CK	20	0.06848	0.05061	3.19277	10.7869	2.02241	11.13668	1.6244	0.04697
	40	0.03099	0.05049	4.42473	4.88754	3.19856	6.26667	0.21198	0.02816
	60	0.02396	0.04043	1.2142	1.98317	2.59911	0.76046	0.20887	0.01709
W_1T_2	20	0.06341	0.0428	2.99056	7.85163	4.23296	9.2026	0.22722	0.04605
	40	0.02869	0.02706	0.38555	0.61802	5.80421	1.82293	3.82437	0.02761
	60	0.02218	0.03574	0.59076	0.21198	2.39748	1.61606	1.21262	0.01676
W_1T_3	20	0.04768	0.08348	0.39149	10.40784	8.85355	6.00407	8.04012	0.04713
	40	0.04715	0.03778	0.42056	4.77846	1.23367	0.87109	4.75388	0.04063
	60	0.02218	0.03032	1.39361	1.99634	0.81329	2.41828	0.21285	0.0173
W_1T_4	20	0.05256	0.0493	2.22181	6.83961	1.92307	7.20464	3.69531	0.04117
	40	0.05093	0.02327	1.42293	3.42517	2.59711	4.80864	2.61852	0.01621
	60	0.03303	0.02815	1.01414	6.22917	3.60233	3.3989	0.19431	0.01242
W_2T_2	20	0.03737	0.03357	1.18461	1.42127	2.18916	2.82805	0.78696	0.04008
	40	0.02761	0.03574	3.79682	2.61959	0.02978	4.22855	2.99788	0.03249
	60	0.03086	0.03737	0.39043	3.22459	0.98707	3.39676	0.36105	0.02218
W_2T_3	20	0.04876	0.03457	4.82833	2.82434	0.41973	5.20214	2.79353	0.03846
	40	0.04442	0.02384	1.99001	5.63205	3.79862	0.04008	0.21256	0.01838
	60	0.0211	0.01621	4.20393	1.61261	1.41204	2.61861	1.39689	0.01513
W_2T_4	20	0.0314	0.04144	4.83101	10.41415	3.22375	1.01667	7.87572	0.02544
	40	0.0173	0.01893	1.22237	54.21244	0.79121	55.33483	0.8143	0.0173
	60	0.02272	0.02164	0.39178	3.01879	1.2142	1.19353	2.59911	0.02001

Table S12. Total leachate volumes of experimental plots.

Treatments	Volume / L	Reduction rate of leaching amount / %
CK	18396	--
W_1T_2	15895	13.6
W_1T_3	16066.33	12.66
W_1T_4	15983.33	13.12
W_2T_2	14184	22.9
W_2T_3	13996	23.92
W_2T_4	14111.33	23.29

Table S13. Adsorption energies between colloid and solutes.

Solute categories	Adsorption energy / eV
NO_3^-	-34.31
NH_4^+	-37.64
PO_4^{3-}	-219.21