Table S2. Typical Association Rules Related to Total Phosphorus Sources.

rule_id	lhs	rhs	support	confidence	lift
R3	population=High,crop_sown_area=Low,agricultural_output_value=Low	per_capita_GDP=High	0.114878341	1	4.185308848
R6	population=High,main_crop_yield=Low,agricultural_output_value=Low	per_capita_GDP=High	0.114878341	1	4.185308848
R9	population=High,agricultural_output_value=Low,animal_husbandry_output_value=Low	per_capita_GDP=High	0.114878341	1	4.185308848
R12	population=High,agricultural_output_value=Low,secondary_industry_output_value=Low	per_capita_GDP=High	0.114878341	1	4.185308848
R211	crop_sown_area=Medium,main_crop_yield=Medium,animal_husbandry_output_value=Medium	secondary_industry_output_value=Medium	0.191463901	1	4.178333333
R212	crop_sown_area=Medium,animal_husbandry_output_value=Medium,secondary_industry_output_value=Medium	main_crop_yield=Medium	0.191463901	1	4.178333333
R228	main_crop_yield=Medium,animal_husbandry_output_value=Medium,per_capita_GDP=Low	secondary_industry_output_value=Medium	0.181890706	1	4.178333333
R229	animal_husbandry_output_value=Medium,secondary_industry_output_value=Medium,per_capita_GDP=Low	main_crop_yield=Medium	0.181890706	1	4.178333333
R201	monthly_average_wind_speed=Low,main_crop_yield=Medium,animal_husbandry_output_value=Medium	secondary_industry_output_value=Medium	0.165137615	1	4.178333333
R202	monthly_average_wind_speed=Low,animal_husbandry_output_value=Medium,secondary_industry_output_value=Medium	main_crop_yield=Medium	0.165137615	1	4.178333333
R208	monthly_average_wind_speed=Low,main_crop_yield=Medium,per_capita_GDP=Low	secondary_industry_output_value=Medium	0.163542082	1	4.178333333
R209	monthly_average_wind_speed=Low,secondary_industry_output_value=Medium,per_capita_GDP=Low	main_crop_yield=Medium	0.163542082	1	4.178333333
R247	monthly_average_wind_speed=Low,animal_husbandry_output_value=Medium,per_capita_GDP=Low	main_crop_yield=Medium	0.163542082	1	4.178333333

R273	monthly_average_wind_speed=Low,animal_husbandry_output_value=Medium,per_capita_GDP=Low	secondary_industry_output_value=Medium	0.163542082	1	4.178333333
R63	main_crop_yield=High,secondary_industry_output_value=High,per_capita_GDP=Medium	agricultural_output_value=High	0.143597926	1	4.178333333
R64	main_crop_yield=High,agricultural_output_value=High,secondary_industry_output_value=High	per_capita_GDP=Medium	0.143597926	1	4.178333333
R67	population=Medium,secondary_industry_output_value=High,per_capita_GDP=Medium	agricultural_output_value=High	0.143597926	1	4.178333333
R68	population=Medium,agricultural_output_value=High,secondary_industry_output_value=High	per_capita_GDP=Medium	0.143597926	1	4.178333333
R71	population=Medium,main_crop_yield=High,per_capita_GDP=Medium	agricultural_output_value=High	0.143597926	1	4.178333333
R72	population=Medium,main_crop_yield=High,agricultural_output_value=High	per_capita_GDP=Medium	0.143597926	1	4.178333333
R216	crop_sown_area=Medium,main_crop_yield=Medium,per_capita_GDP=Low	secondary_industry_output_value=Medium	0.134024731	1	4.178333333
R217	crop_sown_area=Medium,secondary_industry_output_value=Medium,per_capita_GDP=Low	main_crop_yield=Medium	0.134024731	1	4.178333333
R222	population=Low,main_crop_yield=Medium,animal_husbandry_output_value=Medium	secondary_industry_output_value=Medium	0.134024731	1	4.178333333
R223	population=Low,animal_husbandry_output_value=Medium,secondary_industry_output_value=Medium	main_crop_yield=Medium	0.134024731	1	4.178333333
R234	population=Low,main_crop_yield=Medium,per_capita_GDP=Low	secondary_industry_output_value=Medium	0.134024731	1	4.178333333
R235	population=Low,secondary_industry_output_value=Medium,per_capita_GDP=Low	main_crop_yield=Medium	0.134024731	1	4.178333333
R255	crop_sown_area=Medium,animal_husbandry_output_value=Medium,per_capita_GDP=Low	main_crop_yield=Medium	0.134024731	1	4.178333333
R261	population=Low,animal_husbandry_output_value=Medium,per_capita_GDP=Low	main_crop_yield=Medium	0.134024731	1	4.178333333

R281	crop_sown_area=Medium,animal_husbandry_output_value=Medium,per_capita_GDP=Low	secondary_industry_output_value=Medium	0.134024731	1	4.178333333
R287	population=Low,animal_husbandry_output_value=Medium,per_capita_GDP=Low	secondary_industry_output_value=Medium	0.134024731	1	4.178333333
R198	monthly_average_wind_speed=Low,crop_sown_area=Medium,main_crop_yield=Medium	secondary_industry_output_value=Medium	0.125249302	1	4.178333333
R199	monthly_average_wind_speed=Low,crop_sown_area=Medium,secondary_industry_output_value=Medium	main_crop_yield=Medium	0.125249302	1	4.178333333
R51	animal_husbandry_output_value=High,secondary_industry_output_value=High,per_capita_GDP=Medium	agricultural_output_value=High	0.124451536	1	4.178333333
R52	agricultural_output_value=High,animal_husbandry_output_value=High,secondary_industry_output_value=High	per_capita_GDP=Medium	0.124451536	1	4.178333333
R55	main_crop_yield=High,animal_husbandry_output_value=High,per_capita_GDP=Medium	agricultural_output_value=High	0.124451536	1	4.178333333
R56	main_crop_yield=High,agricultural_output_value=High,animal_husbandry_output_value=High	per_capita_GDP=Medium	0.124451536	1	4.178333333
R59	population=Medium,animal_husbandry_output_value=High,per_capita_GDP=Medium	agricultural_output_value=High	0.124451536	1	4.178333333
R60	population=Medium,agricultural_output_value=High,animal_husbandry_output_value=High	per_capita_GDP=Medium	0.124451536	1	4.178333333
R214	crop_sown_area=Medium,main_crop_yield=Medium,agricultural_output_value=Medium	secondary_industry_output_value=Medium	0.124451536	1	4.178333333
R215	crop_sown_area=Medium,agricultural_output_value=Medium,secondary_industry_output_value=Medium	main_crop_yield=Medium	0.124451536	1	4.178333333
R225	main_crop_yield=Medium,agricultural_output_value=Medium,animal_husbandry_output_value=Medium	secondary_industry_output_value=Medium	0.124451536	1	4.178333333
R226	agricultural_output_value=Medium,animal_husbandry_output_value=Medium,secondary_industry_output_value=Medium	main_crop_yield=Medium	0.124451536	1	4.178333333
R253	crop_sown_area=Medium,agricultural_output_value=Medium,animal_husbandry_output_value=Medium	main_crop_yield=Medium	0.124451536	1	4.178333333

R279	crop_sown_area=Medium,agricultural_output_value=Medium,animal_husbandry_output_value=Medium	secondary_industry_output_value=Medium	0.124451536	1	4.178333333
R240	monthly_average_wind_speed=Low,crop_sown_area=Medium,per_capita_GDP=Low	main_crop_yield=Medium	0.123653769	1	4.178333333
R266	monthly_average_wind_speed=Low,crop_sown_area=Medium,per_capita_GDP=Low	secondary_industry_output_value=Medium	0.123653769	1	4.178333333
R204	monthly_average_wind_speed=Low,population=Low,main_crop_yield=Medium	secondary_industry_output_value=Medium	0.115676107	1	4.178333333
R205	monthly_average_wind_speed=Low,population=Low,secondary_industry_output_value=Medium	main_crop_yield=Medium	0.115676107	1	4.178333333
R243	monthly_average_wind_speed=Low,population=Low,animal_husbandry_output_value=Medium	main_crop_yield=Medium	0.115676107	1	4.178333333
R250	monthly_average_wind_speed=Low,population=Low,per_capita_GDP=Low	main_crop_yield=Medium	0.115676107	1	4.178333333

Table S3. Relative Contributions of Different TP Sources at Each Sampling Site.

Sampling Point	Clusters (k)	Dominant Type	Planting Source Contribution Rate (%)	Livestock and Poultry Source Contribution Rate (%)	Domestic Source Contribution Rate (%)	Industrial Source Contribution Rate (%)
X1	5	Domestic Source	8.25	17.45	45.77	28.54
X2	5	Domestic Source	8.25	17.45	45.77	28.54
X3	5	Domestic Source	8.25	17.45	45.77	28.54
X4	3	Domestic Source	13.38	29.54	43.44	13.65
X5	5	Domestic Source	8.25	17.45	45.77	28.54
X6	5	Domestic Source	8.25	17.45	45.77	28.54
X7	3	Domestic Source	13.38	29.54	43.44	13.65
X8	3	Domestic Source	13.38	29.54	43.44	13.65
X9	5	Domestic Source	8.25	17.45	45.77	28.54
X10	7	Industrial Source	32.46	20.19	11.72	35.64
X11	6	Planting Source	53.74	15.55	16.32	14.39
X12	5	Domestic Source	8.25	17.45	45.77	28.54
X13	5	Domestic Source	8.25	17.45	45.77	28.54
X14	7	Industrial Source	32.46	20.19	11.72	35.64
X15	6	Planting Source	53.74	15.55	16.32	14.39
X16	6	Planting Source	53.74	15.55	16.32	14.39
X17	6	Planting Source	53.74	15.55	16.32	14.39
X18	6	Planting Source	53.74	15.55	16.32	14.39
X19	6	Planting Source	53.74	15.55	16.32	14.39
X20	8	Industrial Source	8.36	29.98	24.79	36.88
X21	8	Industrial Source	8.36	29.98	24.79	36.88
X22	6	Planting Source	53.74	15.55	16.32	14.39

X23	6	Planting Source	53.74	15.55	16.32	14.39
X24	9	Industrial Source	30.81	27.95	6.70	34.54
X25	9	Industrial Source	30.81	27.95	6.70	34.54
X26	2	Planting Source	54.50	23.28	9.08	13.15
X27	9	Industrial Source	27.95	34.54	6.70	30.81
X28	2	Planting Source	54.50	23.28	9.08	13.15
X29	2	Planting Source	54.50	23.28	9.08	13.15
X30	9	Industrial Source	27.95	34.54	6.70	30.81
X31	2	Planting Source	54.50	23.28	9.08	13.15
X32	2	Planting Source	54.50	23.28	9.08	13.15
X33	9	Industrial Source	30.81	27.95	6.70	34.54
X34	9	Industrial Source	30.81	27.95	6.70	34.54
X35	4	Domestic Source	32.10	13.81	32.31	21.79
X36	4	Domestic Source	32.10	13.81	32.31	21.79
X37	4	Domestic Source	32.10	13.81	32.31	21.79
X38	4	Domestic Source	32.10	13.81	32.31	21.79
X39	4	Domestic Source	32.10	13.81	32.31	21.79
X40	4	Domestic Source	32.10	13.81	32.31	21.79
X41	4	Domestic Source	32.10	13.81	32.31	21.79
X42	4	Domestic Source	32.10	13.81	32.31	21.79
X43	1	Planting Source	45.48	43.20	0.23	11.09

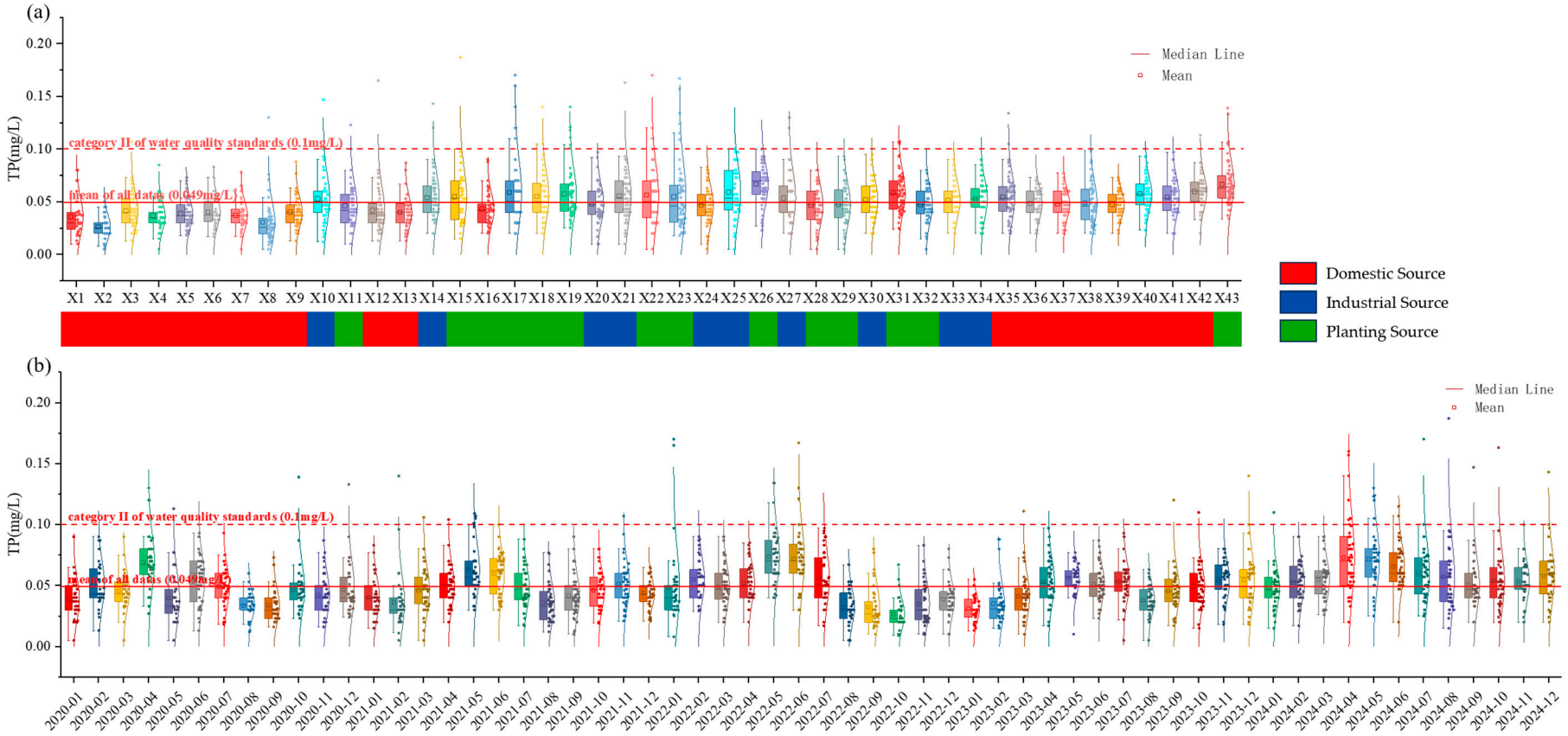

Figure S1. (a) Total Phosphorus Concentrations at Each Sampling Site. (b) Monthly Boxplots of Total Phosphorus Concentrations Across All Sampling Sites.