Table S1 Results of structural equation model (SEM) depicting the direct and indirect effects of N fertilization, mowing, year, and plant and soil attributes on ecosystem multifunctionality index (EMF), as illustrated in Figure 4a. The standardized path coefficient (estimate), standard error of the regression weight (S.E.), z value for the regression weight, and the level of significance for the regression weight (*P*) were given. For more information on the exogenous and endogenous variables and on the model fit, see the main text. **P* < 0.05, ***P* < 0.01; ****P* < 0.001

Variable	Direction	Variable	Estimate	S.E.	z value	***P*(>|z|)**
pH	<---	N fertilization	-0.325	0.061	-5.332	***
pH	<---	Mowing	0.131	0.065	2.004	*
pH	<---	Year	-0.201	0.064	-3.143	**
SMC	<---	N fertilization	0.079	0.023	3.398	**
SMC	<---	Mowing	-0.070	0.023	-3.032	**
SMC	<---	Year	-0.941	0.006	-153.8	**
Plant richness	<---	N fertilization	-0.417	0.055	-7.556	***
Plant richness	<---	Mowing	0.245	0.058	4.249	***
Plant richness	<---	Year	0.303	0.057	5.307	***
Plant richness	<---	pH	-0.203	0.063	-3.252	**
Plant richness	<--->	Bacteria biomass	-0.203	0.061	-3.339	**
Bacteria biomass	<---	Mowing	0.391	0.060	6.520	***
Bacteria biomass	<---	Year	0.335	0.173	1.937	*
Bacteria biomass	<---	SMC	0.461	0.169	2.732	**
Bacteria biomass	<--->	AMF biomass	0.479	0.054	8.802	***
AMF biomass	<---	N fertilization	-0.334	0.046	-7.240	***
AMF biomass	<---	Mowing	0.351	0.051	6.854	***
AMF biomass	<---	Year	0.405	0.049	8.188	***
EMF	<---	Bacteria biomass	0.195	0.066	2.952	**
EMF	<---	N fertilization	0.283	0.063	4.528	***
EMF	<---	Mowing	-0.355	0.063	-5.602	***
EMF	<---	Year	0.256	0.063	4.064	***
EMF	<---	Plant richness	-0.115	0.073	-1.585	0.113

Table S2 Results of structural equation model (SEM) depicting the direct and indirect effects of N fertilization, mowing, year, and plant and soil attributes on carbon cycle multifunctionality index (CCMF), as illustrated in Figure 4b. The standardized path coefficient (estimate), standard error of the regression weight (S.E.), z value for the regression weight, and the level of significance for the regression weight (*P*) were given. For more information on the exogenous and endogenous variables and on the model fit, see the main text. **P* < 0.05, ***P* < 0.01; ****P* < 0.001

Variable	Direction	Variable	Estimate	S.E.	z value	***P*(>|z|)**
pH	<---	N fertilization	-0.325	0.061	-5.332	***
pH	<---	Mowing	0.131	0.065	2.004	*
pH	<---	Year	-0.201	0.064	-3.143	**
SMC	<---	N fertilization	0.079	0.023	3.398	**
SMC	<---	Mowing	-0.070	0.023	-3.032	**
SMC	<---	Year	-0.941	0.006	-153.8	***
Plant richness	<---	N fertilization	-0.417	0.055	-7.550	***
Plant richness	<---	Mowing	0.245	0.058	4.247	***
Plant richness	<---	Year	0.303	0.057	5.311	***
Plant richness	<---	pH	-0.203	0.063	-3.239	**
Plant richness	<--->	Bacteria biomass	-0.203	0.061	-3.344	**
Bacteria biomass	<---	Mowing	0.390	0.060	6.511	***
Bacteria biomass	<---	Year	0.330	0.173	1.903	*
Bacteria biomass	<---	SMC	0.456	0.169	2.693	**
Bacteria biomass	<--->	AMF biomass	0.479	0.054	8.802	***
AMF biomass	<---	N fertilization	-0.335	0.046	-7.246	***
AMF biomass	<---	Mowing	0.351	0.051	6.856	***
AMF biomass	<---	Year	0.405	0.049	8.191	***
CCMF	<---	Bacteria biomass	0.210	0.075	2.809	**
CCMF	<---	N fertilization	0.158	0.068	2.307	*
CCMF	<---	Mowing	-0.363	0.064	-5.704	***
CCMF	<---	Year	0.359	0.069	5.172	***
CCMF	<---	AMF biomass	-0.138	0.090	-1.528	0.127

Table S3 Results of structural equation model (SEM) depicting the direct and indirect effects of N fertilization, mowing, year, and plant and soil attributes on nitrogen cycle multifunctionality index (NCMF), as illustrated in Figure 4c. The standardized path coefficient (estimate), standard error of the regression weight (S.E.), z value for the regression weight, and the level of significance for the regression weight (*P*) were given. For more information on the exogenous and endogenous variables and on the model fit, see the main text. **P* < 0.05, ***P* < 0.01; ****P* < 0.001

Variable	Direction	Variable	Estimate	S.E.	z value	***P*(>|z|)**
pH	<---	N fertilization	-0.325	0.061	-5.332	***
pH	<---	Mowing	0.131	0.065	2.004	*
pH	<---	Year	-0.201	0.064	-3.143	**
SMC	<---	N fertilization	0.079	0.023	3.398	**
SMC	<---	Mowing	-0.070	0.023	-3.032	**
SMC	<---	Year	-0.941	0.006	-153.8	***
Plant richness	<---	N fertilization	-0.416	0.055	-7.542	***
Plant richness	<---	Mowing	0.244	0.058	4.244	***
Plant richness	<---	Year	0.303	0.057	5.316	***
Plant richness	<---	pH	-0.201	0.063	-3.219	**
Plant richness	<--->	Bacteria biomass	-0.203	0.061	-3.342	**
Bacteria biomass	<---	Mowing	0.391	0.060	6.518	***
Bacteria biomass	<---	Year	0.330	0.173	1.903	*
Bacteria biomass	<---	SMC	0.456	0.169	2.693	**
Bacteria biomass	<--->	AMF biomass	0.479	0.054	8.802	***
AMF biomass	<---	N fertilization	-0.335	0.046	-7.246	***
AMF biomass	<---	Mowing	0.351	0.051	6.856	***
AMF biomass	<---	Year	0.405	0.049	8.191	***
NCMF	<---	N fertilization	0.277	0.060	4.661	***
NCMF	<---	Mowing	-0.417	0.056	-7.382	***
NCMF	<---	Year	0.266	0.062	4.290	***
NCMF	<---	AMF biomass	-0.130	0.073	-1.772	0.076

Table S4 Results of structural equation model (SEM) depicting the direct and indirect effects of N fertilization, mowing, year, and plant and soil attributes on phosphorus cycle multifunctionality index (PCMF), as illustrated in Figure 4d. The standardized path coefficient (estimate), standard error of the regression weight (S.E.), z value for the regression weight, and the level of significance for the regression weight (*P*) were given. For more information on the exogenous and endogenous variables and on the model fit, see the main text. **P* < 0.05, ***P* < 0.01; ****P* < 0.001

Variable	Direction	Variable	Estimate	S.E.	z value	***P*(>|z|)**
pH	<---	N fertilization	-0.325	0.061	-5.332	***
pH	<---	Mowing	0.131	0.065	2.004	*
pH	<---	Year	-0.201	0.064	-3.143	**
SMC	<---	N fertilization	0.079	0.023	3.398	**
SMC	<---	Mowing	-0.070	0.023	-3.032	**
SMC	<---	Year	-0.941	0.006	-153.8	***
Plant richness	<---	N fertilization	-0.417	0.055	-7.557	***
Plant richness	<---	Mowing	0.244	0.058	4.250	***
Plant richness	<---	Year	0.303	0.057	5.306	***
Plant richness	<---	pH	-0.204	0.063	-3.256	**
Plant richness	<--->	Bacteria biomass	-0.203	0.061	-3.345	**
Bacteria biomass	<---	Mowing	0.390	0.060	6.511	***
Bacteria biomass	<---	Year	0.330	0.173	1.904	*
Bacteria biomass	<---	SMC	0.456	0.169	2.695	**
Bacteria biomass	<--->	AMF biomass	0.479	0.054	8.791	***
AMF biomass	<---	N fertilization	-0.335	0.046	-7.246	***
AMF biomass	<---	Mowing	0.351	0.051	6.856	***
AMF biomass	<---	Year	0.405	0.049	8.191	***
PCMF	<---	N fertilization	0.414	0.068	6.072	***
PCMF	<---	Mowing	-0.100	0.073	-1.366	0.172
PCMF	<---	Year	0.147	0.078	1.892	0.059
PCMF	<---	AMF biomass	0.048	0.093	0.515	0.607
PCMF	<---	Bacteria biomass	0.082	0.079	1.027	0.304
PCMF	<---	Plant richness	-0.093	0.077	-1.212	0.225

Table S5 Results of structural equation model (SEM) depicting the direct and indirect effects of N fertilization, mowing, year, and plant and soil attributes on numbers of functions beyond the threshold of 10% calculated following the multi-threshold approach, as illustrated in Figure S7a. The standardized path coefficient (estimate), standard error of the regression weight (S.E.), z value for the regression weight, and the level of significance for the regression weight (*P*) were given. For more information on the exogenous and endogenous variables and on the model fit, see the main text. **P* < 0.05, ***P* < 0.01; ****P* < 0.001

Variable	Direction	Variable	Estimate	S.E.	z value	***P*(>|z|)**
pH	<---	N fertilization	-0.325	0.061	-5.332	***
pH	<---	Mowing	0.131	0.065	2.004	*
pH	<---	Year	-0.201	0.064	-3.143	**
SMC	<---	N fertilization	0.079	0.023	3.398	**
SMC	<---	Mowing	-0.070	0.023	-3.032	**
SMC	<---	Year	-0.941	0.006	-153.8	***
Plant richness	<---	N fertilization	-0.417	0.055	-7.557	***
Plant richness	<---	Mowing	0.244	0.058	4.250	***
Plant richness	<---	Year	0.303	0.057	5.306	***
Plant richness	<---	pH	-0.204	0.063	-3.256	**
Plant richness	<--->	Bacteria biomass	-0.203	0.061	-3.345	**
Bacteria biomass	<---	Mowing	0.390	0.060	6.511	***
Bacteria biomass	<---	Year	0.330	0.173	1.904	*
Bacteria biomass	<---	SMC	0.456	0.169	2.695	**
Bacteria biomass	<--->	AMF biomass	0.479	0.054	8.791	***
AMF biomass	<---	N fertilization	-0.335	0.046	-7.246	***
AMF biomass	<---	Mowing	0.351	0.051	6.856	***
AMF biomass	<---	Year	0.405	0.049	8.191	***
EMF	<---	N fertilization	0.239	0.072	3.338	**
EMF	<---	Mowing	-0.261	0.070	-3.737	***
EMF	<---	Year	0.335	0.074	4.550	***
EMF	<---	AMF biomass	-0.087	0.092	-0.948	0.343
EMF	<---	Bacteria biomass	0.276	0.077	3.588	***
EMF	<---	Plant richness	-0.040	0.076	-0.530	0.596

Table S6 Results of structural equation model (SEM) depicting the direct and indirect effects of N fertilization, mowing, year, and plant and soil attributes on numbers of functions beyond the threshold of 25% calculated following the multi-threshold approach, as illustrated in Figure S7b. The standardized path coefficient (estimate), standard error of the regression weight (S.E.), z value for the regression weight, and the level of significance for the regression weight (*P*) were given. For more information on the exogenous and endogenous variables and on the model fit, see the main text. **P* < 0.05, ***P* < 0.01; ****P* < 0.001

Variable	Direction	Variable	Estimate	S.E.	z value	***P*(>|z|)**
pH	<---	N fertilization	-0.325	0.061	-5.332	***
pH	<---	Mowing	0.131	0.065	2.004	*
pH	<---	Year	-0.201	0.064	-3.143	**
SMC	<---	N fertilization	0.079	0.023	3.398	**
SMC	<---	Mowing	-0.070	0.023	-3.032	**
SMC	<---	Year	-0.941	0.006	-153.8	***
Plant richness	<---	N fertilization	-0.417	0.055	-7.557	***
Plant richness	<---	Mowing	0.244	0.058	4.250	***
Plant richness	<---	Year	0.303	0.057	5.306	***
Plant richness	<---	pH	-0.204	0.063	-3.256	**
Plant richness	<--->	Bacteria biomass	-0.203	0.061	-3.345	**
Bacteria biomass	<---	Mowing	0.390	0.060	6.511	***
Bacteria biomass	<---	Year	0.330	0.173	1.904	*
Bacteria biomass	<---	SMC	0.456	0.169	2.695	**
Bacteria biomass	<--->	AMF biomass	0.479	0.054	8.791	***
AMF biomass	<---	N fertilization	-0.335	0.046	-7.246	***
AMF biomass	<---	Mowing	0.351	0.051	6.856	***
AMF biomass	<---	Year	0.405	0.049	8.191	***
EMF	<---	N fertilization	0.157	0.072	3.338	**
EMF	<---	Mowing	-0.380	0.063	-6.005	***
EMF	<---	Year	0.399	0.068	5.863	***
EMF	<---	AMF biomass	-0.093	0.087	-1.071	0.284
EMF	<---	Bacteria biomass	0.175	0.074	2.382	*
EMF	<---	Plant richness	-0.140	0.071	-1.958	*

Table S7 Results of structural equation model (SEM) depicting the direct and indirect effects of N fertilization, mowing, year, and plant and soil attributes on numbers of functions beyond the threshold of 50% calculated following the multi-threshold approach, as illustrated in Figure S7c. The standardized path coefficient (estimate), standard error of the regression weight (S.E.), z value for the regression weight, and the level of significance for the regression weight (*P*) were given. For more information on the exogenous and endogenous variables and on the model fit, see the main text. **P* < 0.05, ***P* < 0.01; ****P* < 0.001

Variable	Direction	Variable	Estimate	S.E.	z value	***P*(>|z|)**
pH	<---	N fertilization	-0.325	0.061	-5.332	***
pH	<---	Mowing	0.131	0.065	2.004	*
pH	<---	Year	-0.201	0.064	-3.143	**
SMC	<---	N fertilization	0.079	0.023	3.398	**
SMC	<---	Mowing	-0.070	0.023	-3.032	**
SMC	<---	Year	-0.941	0.006	-153.8	***
Plant richness	<---	N fertilization	-0.417	0.055	-7.557	***
Plant richness	<---	Mowing	0.244	0.058	4.250	***
Plant richness	<---	Year	0.303	0.057	5.306	***
Plant richness	<---	pH	-0.204	0.063	-3.256	**
Plant richness	<--->	Bacteria biomass	-0.203	0.061	-3.345	**
Bacteria biomass	<---	Mowing	0.390	0.060	6.511	***
Bacteria biomass	<---	Year	0.330	0.173	1.904	*
Bacteria biomass	<---	SMC	0.456	0.169	2.695	**
Bacteria biomass	<--->	AMF biomass	0.479	0.054	8.791	***
AMF biomass	<---	N fertilization	-0.335	0.046	-7.246	***
AMF biomass	<---	Mowing	0.351	0.051	6.856	***
AMF biomass	<---	Year	0.405	0.049	8.191	***
EMF	<---	N fertilization	0.203	0.081	2.908	**
EMF	<---	Mowing	-0.197	0.074	-2.667	**
EMF	<---	Year	0.268	0.078	3.433	**
EMF	<---	AMF biomass	-0.197	0.095	-2.067	*
EMF	<---	Bacteria biomass	0.234	0.081	2.908	**
EMF	<---	Plant richness	-0.032	0.079	-0.401	0.689

Table S8 Results of structural equation model (SEM) depicting the direct and indirect effects of N fertilization, mowing, year, and plant and soil attributes on numbers of functions beyond the threshold of 75% calculated following the multi-threshold approach, as illustrated in Figure S7d. The standardized path coefficient (estimate), standard error of the regression weight (S.E.), z value for the regression weight, and the level of significance for the regression weight (*P*) were given. For more information on the exogenous and endogenous variables and on the model fit, see the main text. **P* < 0.05, ***P* < 0.01; ****P* < 0.001

Variable	Direction	Variable	Estimate	S.E.	z value	***P*(>|z|)**
pH	<---	N fertilization	-0.325	0.061	-5.332	***
pH	<---	Mowing	0.131	0.065	2.004	*
pH	<---	Year	-0.201	0.064	-3.143	**
SMC	<---	N fertilization	0.079	0.023	3.398	**
SMC	<---	Mowing	-0.070	0.023	-3.032	**
SMC	<---	Year	-0.941	0.006	-153.8	***
Plant richness	<---	N fertilization	-0.417	0.055	-7.557	***
Plant richness	<---	Mowing	0.244	0.058	4.250	***
Plant richness	<---	Year	0.303	0.057	5.306	***
Plant richness	<---	pH	-0.204	0.063	-3.256	**
Plant richness	<--->	Bacteria biomass	-0.203	0.061	-3.345	**
Bacteria biomass	<---	Mowing	0.390	0.060	6.511	***
Bacteria biomass	<---	Year	0.330	0.173	1.904	*
Bacteria biomass	<---	SMC	0.456	0.169	2.695	**
Bacteria biomass	<--->	AMF biomass	0.479	0.054	8.791	***
AMF biomass	<---	N fertilization	-0.335	0.046	-7.246	***
AMF biomass	<---	Mowing	0.351	0.051	6.856	***
AMF biomass	<---	Year	0.405	0.049	8.191	***
EMF	<---	N fertilization	0.075	0.084	0.899	0.369
EMF	<---	Mowing	0.037	0.082	0.450	0.652
EMF	<---	Year	0.052	0.088	0.591	0.555
EMF	<---	AMF biomass	-0.074	0.104	-0.712	0.476
EMF	<---	Bacteria biomass	0.152	0.088	1.717	0.086
EMF	<---	Plant richness	-0.020	0.086	-0.230	0.818

Table S9 Results of structural equation model (SEM) depicting the direct and indirect effects of N fertilization, mowing, year, and plant and soil attributes on numbers of functions beyond the threshold of 90% calculated following the multi-threshold approach, as illustrated in Figure S7e. The standardized path coefficient (estimate), standard error of the regression weight (S.E.), z value for the regression weight, and the level of significance for the regression weight (*P*) were given. For more information on the exogenous and endogenous variables and on the model fit, see the main text. **P* < 0.05, ***P* < 0.01; ****P* < 0.001

Variable	Direction	Variable	Estimate	S.E.	z value	***P*(>|z|)**
pH	<---	N fertilization	-0.325	0.061	-5.332	***
pH	<---	Mowing	0.131	0.065	2.004	*
pH	<---	Year	-0.201	0.064	-3.143	**
SMC	<---	N fertilization	0.079	0.023	3.398	**
SMC	<---	Mowing	-0.070	0.023	-3.032	**
SMC	<---	Year	-0.941	0.006	-153.8	***
Plant richness	<---	N fertilization	-0.417	0.055	-7.557	***
Plant richness	<---	Mowing	0.244	0.058	4.250	***
Plant richness	<---	Year	0.303	0.057	5.306	***
Plant richness	<---	pH	-0.204	0.063	-3.256	**
Plant richness	<--->	Bacteria biomass	-0.203	0.061	-3.345	**
Bacteria biomass	<---	Mowing	0.390	0.060	6.511	***
Bacteria biomass	<---	Year	0.330	0.173	1.904	*
Bacteria biomass	<---	SMC	0.456	0.169	2.695	**
Bacteria biomass	<--->	AMF biomass	0.479	0.054	8.791	***
AMF biomass	<---	N fertilization	-0.335	0.046	-7.246	***
AMF biomass	<---	Mowing	0.351	0.051	6.856	***
AMF biomass	<---	Year	0.405	0.049	8.191	***
EMF	<---	N fertilization	-0.074	0.084	-0.884	0.377
EMF	<---	Mowing	-0.043	0.082	-0.525	0.599
EMF	<---	Year	0.042	0.089	0.475	0.634
EMF	<---	AMF biomass	-0.047	0.105	-0.449	0.653
EMF	<---	Bacteria biomass	0.092	0.089	1.034	0.301
EMF	<---	Plant richness	-0.116	0.086	-1.344	0.179

Table S10 Results of structural equation model (SEM) depicting the direct and indirect effects of N fertilization, mowing, year, and plant and soil attributes on weighted ecosystem multifunctionality index (EMF), as illustrated in Figure S9. The standardized path coefficient (estimate), standard error of the regression weight (S.E.), z value for the regression weight, and the level of significance for the regression weight (*P*) were given. For more information on the exogenous and endogenous variables and on the model fit, see the main text. **P* < 0.05, ***P* < 0.01; ****P* < 0.001

Variable	Direction	Variable	Estimate	S.E.	z value	***P*(>|z|)**
pH	<---	N fertilization	-0.325	0.061	-5.332	***
pH	<---	Mowing	0.131	0.065	2.004	*
pH	<---	Year	-0.201	0.064	-3.143	**
SMC	<---	N fertilization	0.079	0.023	3.398	**
SMC	<---	Mowing	-0.070	0.023	-3.032	**
SMC	<---	Year	-0.941	0.006	-153.8	**
Plant richness	<---	N fertilization	-0.417	0.055	-7.556	***
Plant richness	<---	Mowing	0.245	0.058	4.249	***
Plant richness	<---	Year	0.303	0.057	5.307	***
Plant richness	<---	pH	-0.203	0.063	-3.252	**
Plant richness	<--->	Bacteria biomass	-0.203	0.061	-3.339	**
Bacteria biomass	<---	Mowing	0.391	0.060	6.520	***
Bacteria biomass	<---	Year	0.335	0.173	1.937	*
Bacteria biomass	<---	SMC	0.461	0.169	2.732	**
Bacteria biomass	<--->	AMF biomass	0.479	0.054	8.802	***
AMF biomass	<---	N fertilization	-0.334	0.046	-7.240	***
AMF biomass	<---	Mowing	0.351	0.051	6.854	***
AMF biomass	<---	Year	0.405	0.049	8.188	***
Weighted EMF	<---	Bacteria biomass	0.211	0.062	3.391	**
Weighted EMF	<---	N fertilization	0.328	0.058	5.659	***
Weighted EMF	<---	Mowing	-0.410	0.058	-7.028	***
Weighted EMF	<---	Year	0.305	0.058	5.239	***
Weighted EMF	<---	Plant richness	-0.094	0.068	-1.375	0.169

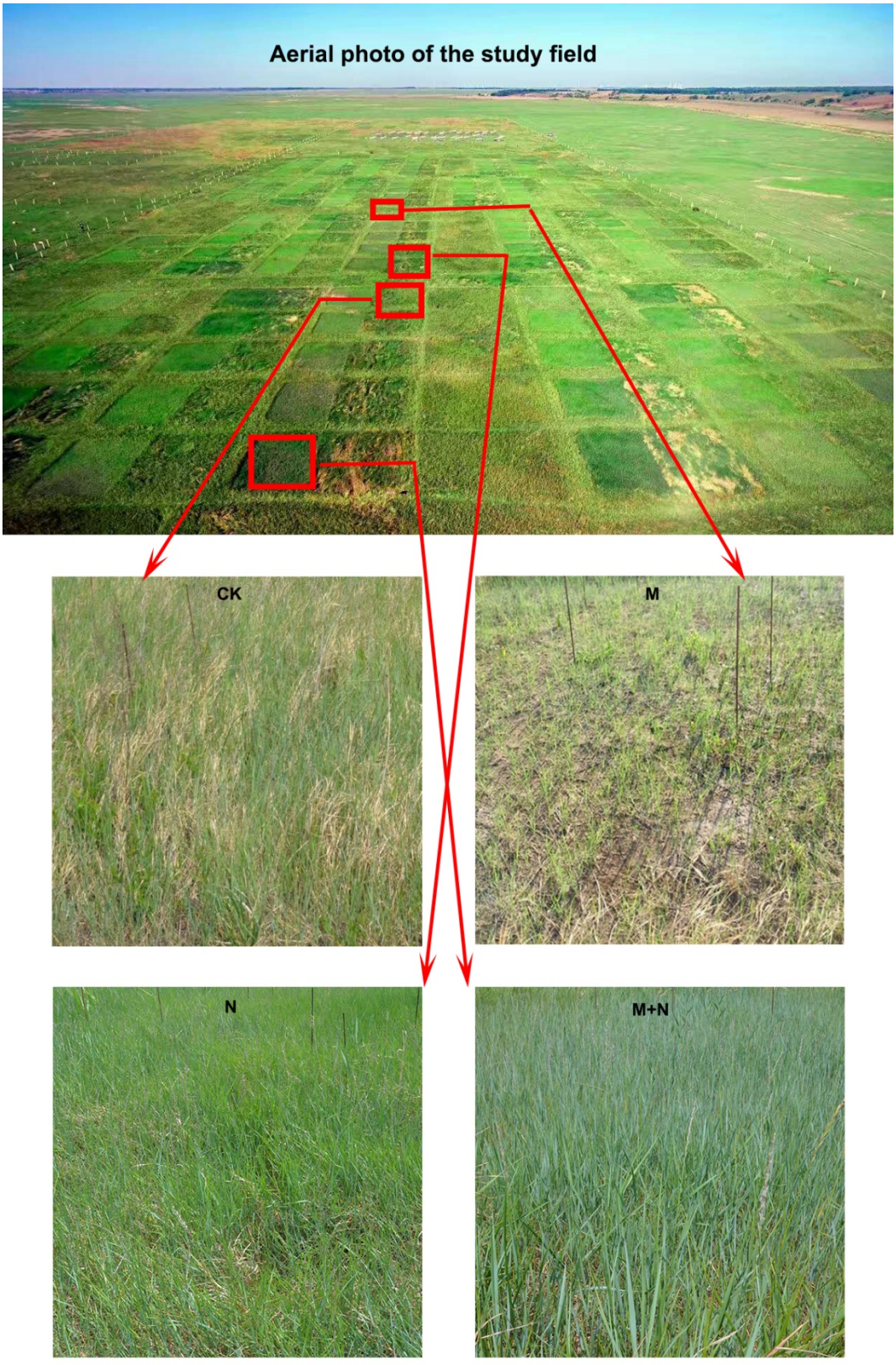

Figure S1 An aerial view of the entire experimental field on 8 June 2017 (Top). Lower four photos showed the experimental treatments - control (CK), nitrogen (N40), mowing (M) and mowing + nitrogen (M+N5) on 18 June 2018.

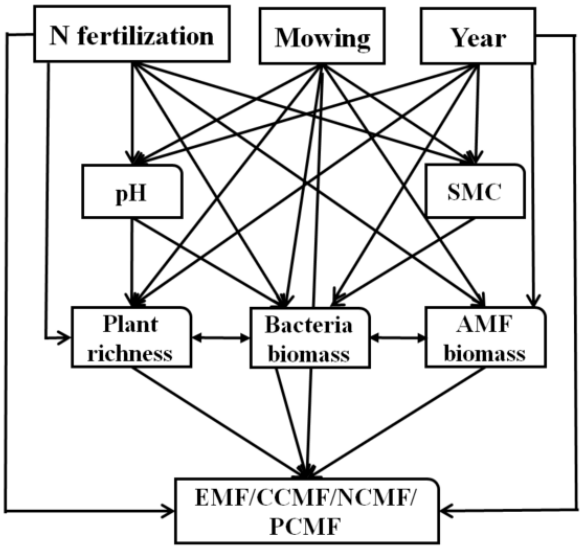

Figure S2 Illustration of all plausible interaction pathways of structural equation model in our ecosystem.

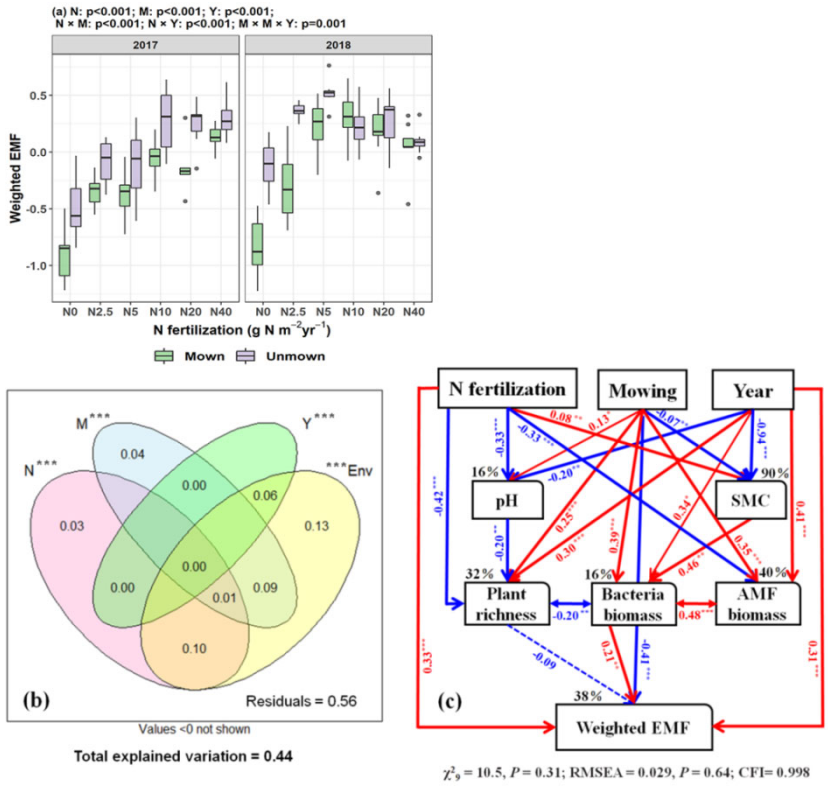

Figure S3 (a) Effects of N fertilization (N), mowing (M), year (Y), and their interactions on the weighted ecosystem multifunctionality index (EMF). Three-way ANOVA were used to test the significance of treatments and year. For clarity, only the significant statistical results ($p < 0.05$) are shown in the figure. (b)Variance partitioning of the total explained variance of weighted EMF using four independent groups of variables: N fertilization, mowing, year, and environmental parameters (Env; including precipitation, plant richness, pH, soil moisture content, bacterial and fungal biomass, MBC, MBN, MBP and soil C:N ratio). The significance of Monte Carlo permutation test (999 permutations) was shown as *$p < 0.05$; **$p < 0.01$, ***$p < 0.001$. (c) Structural equation model (SEM) depicting the direct and indirect effects of N fertilization, mowing, year, plant and soil attributes on weighted EMF. The numbers on the arrows were the standardised path coefficients. The width of the arrows indicated the strength of the relationships. The red and blue arrows indicated significant positive and negative relationships, respectively ($p <$ 0.05). The dashed lines indicated nonsignificant relationships ($p > 0.05$) (see Methods). Percentages close to the endogenous variables indicated the variance explained by the model (R^2). *$p < 0.05$, **$p < 0.01$; ***$p < 0.001$. pH, soil pH; SMC, soil moisture content; AMF biomass, arbuscular mycorrhizal fungal biomass.

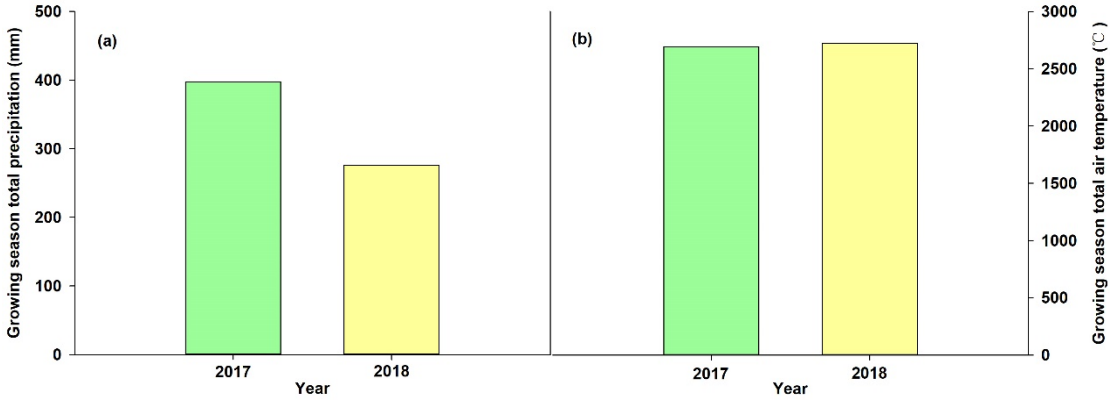

Figure S4 (a) Total precipitation from 1 May to 31 August (in mm) and (b) total air temperature during the growing season from 1 May to 31 August (in °C) at the study site in 2017 and 2018.

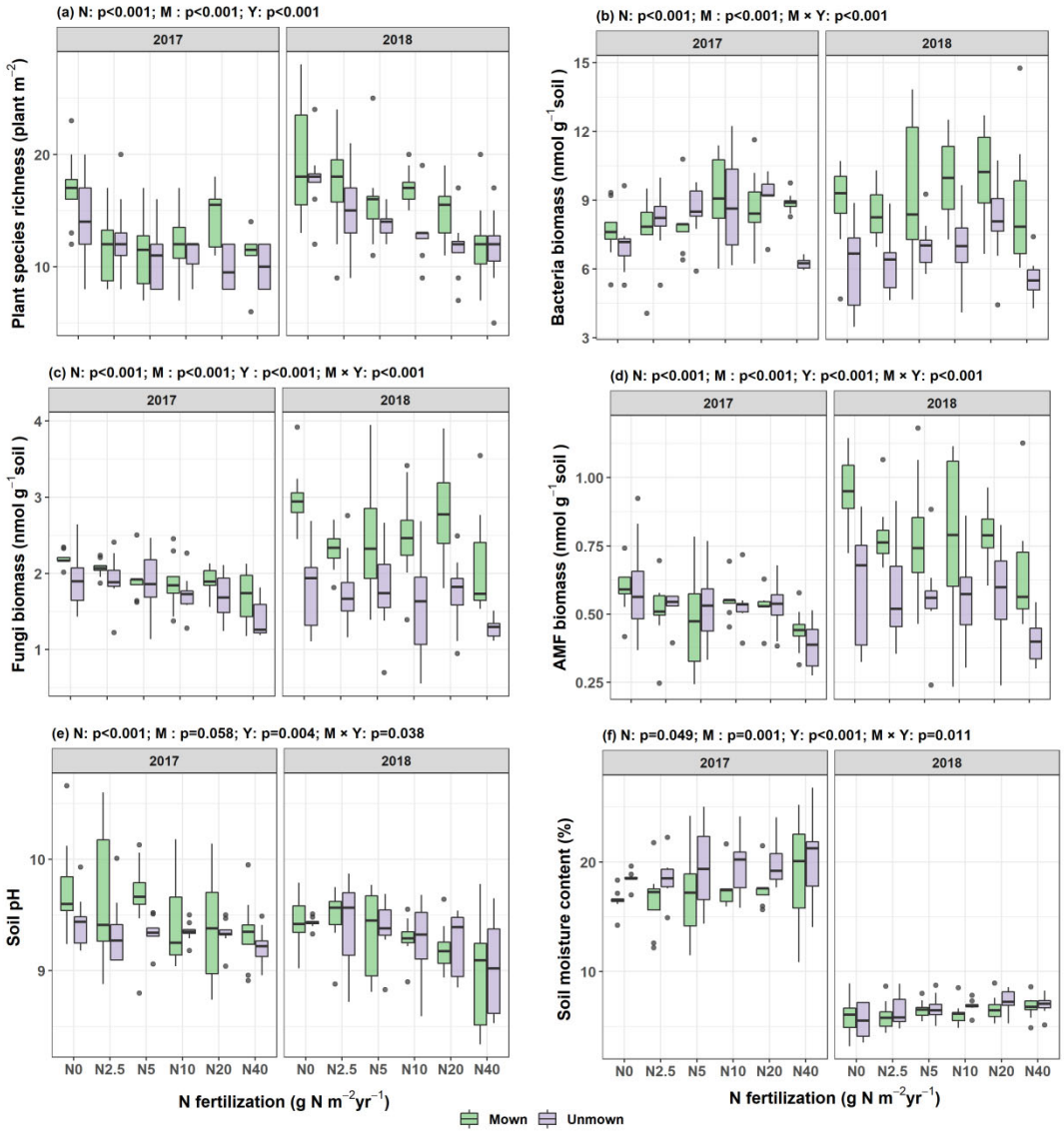

Figure S5 Boxplots showing (a) plant species richness, (b) bacteria biomass, (c) fungal biomass, (d) AMF biomass, (e) soil pH and (f) moisture content in different multiple land use drivers and years. Three-way ANOVA was used to test the significance of N fertilization (N), mowing (M), year (Y), and their interactions on plant and microbial communities. For clarity, only the significant statistical results ($p < 0.05$) are shown in the figure.

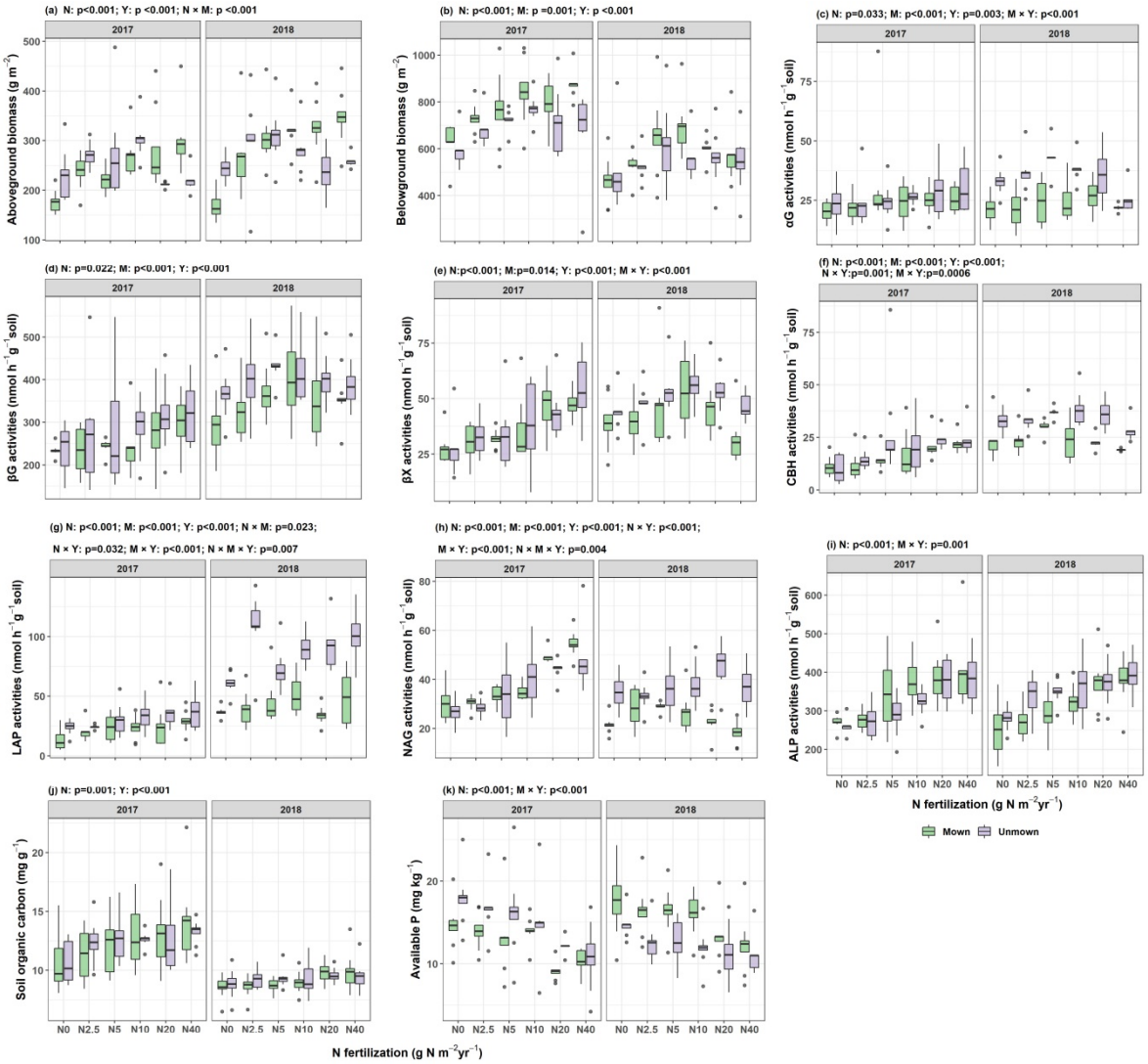

Figure S6 The effects of N fertilization and mowing on multiple ecosystem functions related to the C, N and P cycles, including plant aboveground and belowground biomass, α-1,4-glucosidase (αG), β-1,4-glucosidase (βG), β-1,4-xylosidase (βX), β-D-cellobiohydrolase (CBH), soil organic carbon, N - leucine amino peptidase (LAP), β-1,4-N-acetyl-glucosaminidase (NAG), P - alkaline phosphatase (ALP) and available P. Three-way ANOVA was used to test the significance of N fertilization(N), mowing (M), year (Y) and their interactions on multiple individual functions. For clarity, only the significant statistical results ($p < 0.05$) are shown in the figure.

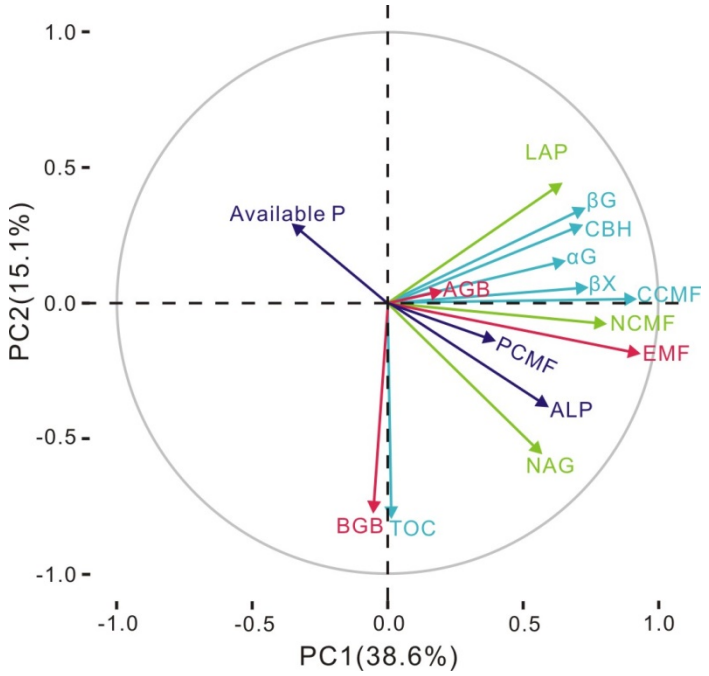

Figure S7 Principal component analysis (PCA) of the eleven individual functions, ecosystem multifunctionality (EMF), C cycle multifunctionality index (CCMF), N multifunctionality cycle index (NCMF) and P cycle multifunctionality index (PCMF). The vectors indicated the direction and strength of each ecosystem function or multifunctionality to the overall distribution. The first two principal axes, PC1 and PC2, explained 53.7% of the variance.

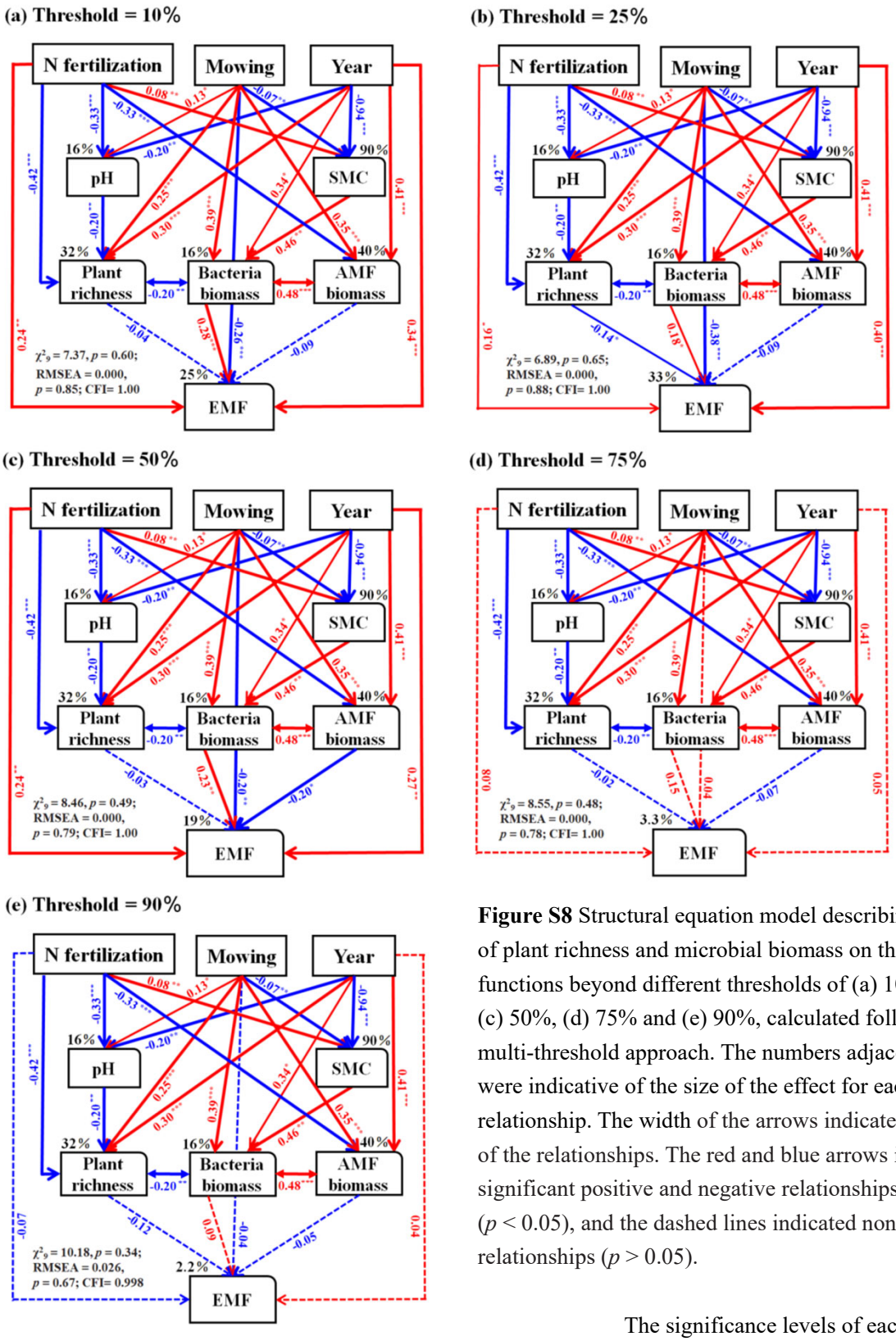

Figure S8 Structural equation model describing the effects of plant richness and microbial biomass on the numbers of functions beyond different thresholds of (a) 10%, (b) 25%, (c) 50%, (d) 75% and (e) 90%, calculated following the multi-threshold approach. The numbers adjacent to arrows were indicative of the size of the effect for each relationship. The width of the arrows indicated the strength of the relationships. The red and blue arrows indicated significant positive and negative relationships, respectively ($p < 0.05$), and the dashed lines indicated nonsignificant relationships ($p > 0.05$).

The significance levels of each predictor were $*p < 0.05$, $**p < 0.01$,$***p < 0.001$. pH, soil pH; SMC, soil moisture content; AMF biomass, arbuscular mycorrhizal fungal biomass;

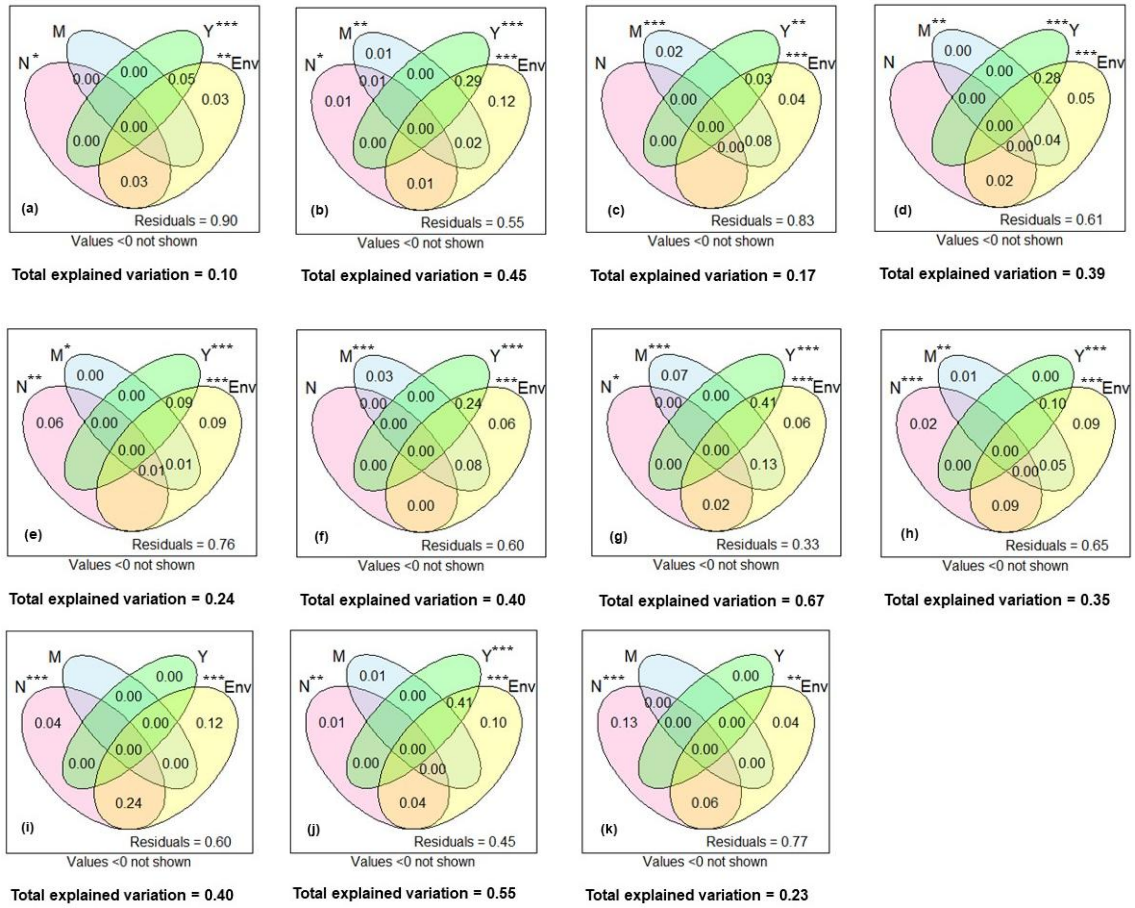

Figure S9 Variance partitioning of the total explained variance of each of the eleven individual functions using four independent groups of variables: N fertilization (N), mowing (M), year (Y) and environmental parameters (Env: including precipitation, plant richness, pH, soil moisture content, bacterial and fungal biomass, MBC, MBN, MBP and soil C:N ratio). (a) AGB; (b) BGB; (c) αG; (d) βG; (e) βX; (f) CBH; (g) LAP; (h) NAG; (i) ALP; (j) TOC; and (k) Available P. The significance of Monte Carlo permutation test (999 permutations) was shown as $*p < 0.05$; $**p < 0.01$, $***p < 0.001$. For clarity, only the significant statistical results ($p < 0.05$) are shown in the figure.