Table S1 Responses of soil physicochemical properties to fresh straw addition at 7 and 90 days under long-term straw return.

Site	Treatment	Input	Time (d)	TN (g kg^{-1})	AP (mg kg^{-1})	AK (mg kg^{-1})	pH
QZ	CK	T0	7	0.90 ± 0.01 d	11.59 ± 0.64 b	155.50 ± 0.50 f	7.67 ± 0.01 b
	CK	T1	7	0.95 ± 0.01 c	7.94 ± 0.70 c	317.50 ± 1.04 d	7.67 ± 0.02 b
	CK	T2	7	0.97 ± 0.01 c	7.60 ± 0.46 c	611.50 ± 12.28 b	7.61 ± 0.03 b
	SR	T0	7	1.03 ± 0.02 b	15.72 ± 0.50 a	224.00 ± 0.41 e	7.90 ± 0.06 a
	SR	T1	7	1.11 ± 0.03 a	13.08 ± 0.63 b	457.25 ± 5.15 c	7.71 ± 0.04 b
	SR	T2	7	1.12 ± 0.01 a	13.22 ± 0.71 c	718.50 ± 13.28 a	7.70 ± 0.02 b
	CK	T0	90	0.96 ± 0.01 b	17.14 ± 0.63	155.25 ± 1.11 e	7.78 ± 0.02 b
	CK	T1	90	1.09 ± 0.02 a	16.19 ± 0.32	683.50 ± 1.71 a	7.83 ± 0.01 b
	CK	T2	90	0.96 ± 0.02b	17.00 ± 0.45	607.50 ± 44.98 b	7.81 ± 0.02 b
	SR	T0	90	1.08 ± 0.01a	20.93 ± 1.38	220.00 ± 1.47 d	8.08 ± 0.02 a
	SR	T1	90	1.12 ± 0.02a	21.47 ± 1.11	464.50 ± 8.96 c	7.97 ± 0.02 a
	SR	T2	90	1.13 ± 0.01a	21.26 ± 0.11	736.50 ± 5.56 a	7.91 ± 0.01 a
GZL	CK	T0	7	1.42 ± 0.03 c	15.79 ± 1.18 bc	193.00 ± 1.08 d	5.61 ± 0.01 a
	CK	T1	7	1.43 ± 0.02 bc	13.55 ± 0.56 c	341.75 ± 4.48 c	5.51 ± 0.01 b
	CK	T2	7	1.47 ± 0.02 b	13.42 ± 0.57 c	422.50 ± 26.55 b	5.43 ± 0.03 c
	SR	T0	7	1.68 ± 0.03 a	20.39 ± 0.32 a	206.00 ± 2.12 d	5.43 ± 0.00 c
	SR	T1	7	1.68 ± 0.02a	19.10 ± 1.28 a	390.00 ± 4.02 b	5.43 ± 0.01 c
	SR	T2	7	1.70 ± 0.02a	17.68 ± 1.56 ab	530.50 ± 17.40 a	5.33 ± 0.01 d
	CK	T0	90	1.36 ± 0.01 d	17.14 ± 0.63 b	183.75 ± 0.63 f	5.42 ± 0.03 a
	CK	T1	90	1.40 ± 0.02 c	16.19 ± 0.32 b	361.50 ± 4.66 b	5.34 ± 0.02 b
	CK	T2	90	1.41 ± 0.02 c	17.00 ± 0.45 b	238.75 ± 3.92 d	5.27 ± 0.01 b
	SR	T0	90	1.61 ± 0.03 b	20.93 ± 1.38 a	210.75 ± 3.09 e	5.18 ± 0.02 c
	SR	T1	90	1.64 ± 0.04 ab	21.47 ± 1.11 a	410.25 ± 7.61 a	5.24 ± 0.01 b
	SR	T2	90	1.67 ± 0.02 a	21.26 ± 0.11 a	296.25 ± 2.87 c	5.17 ± 0.01 c

Note: TN, total nitrogen; AP, available phosphorus; AK, available potassium. CK and SR indicate the long-term residue-management treatments, and T0, T1, and T2 represent different levels of fresh straw addition. Values are presented as means (n = 4). Different lowercase letters within the same column indicate significant differences among treatments at $P < 0.05$.

Table S2. Three-way ANOVA results for soil physicochemical properties, enzyme activities, and ecoenzymatic stoichiometric indices measured at 7 day of incubation.

Variable	Site (S)	Treatment (T)	Input (I)	S × T	S × I	T × I	S × T × I
SOC	$F(1,36) = 4959.04$ $p < 0.001$ $\eta^2 = 0.993$	$F(1,36) = 212.54$ $p < 0.001$ $\eta^2 = 0.855$	$F(2,36) = 5.63$ $p = 0.007$ $\eta^2 = 0.238$	$F(1,36) = 4.27$ $p = 0.046$ $\eta^2 = 0.106$	$F(2,36) = 8.46$ $p < 0.001$ $\eta^2 = 0.320$	$F(2,36) = 2.31$ $p = 0.114$ $\eta^2 = 0.114$	$F(2,36) = 3.64$ $p = 0.036$ $\eta^2 = 0.168$
DOC	$F(1,36) = 1000.13$ $p < 0.001$ $\eta^2 = 0.965$	$F(1,36) = 181.22$ $p < 0.001$ $\eta^2 = 0.834$	$F(2,36) = 150.07$ $p < 0.001$ $\eta^2 = 0.893$	$F(1,36) = 195.69$ $p < 0.001$ $\eta^2 = 0.845$	$F(2,36) = 7.96$ $p = 0.001$ $\eta^2 = 0.307$	$F(2,36) = 4.48$ $p = 0.018$ $\eta^2 = 0.199$	$F(2,36) = 7.63$ $p = 0.002$ $\eta^2 = 0.298$
MBC	$F(1,36) = 21.74$ $p < 0.001$ $\eta^2 = 0.377$	$F(1,36) = 116.26$ $p < 0.001$ $\eta^2 = 0.764$	$F(2,36) = 41.80$ $p < 0.001$ $\eta^2 = 0.699$	$F(1,36) = 0.03$ $p = 0.874$ $\eta^2 = 0.001$	$F(2,36) = 3.25$ $p = 0.050$ $\eta^2 = 0.153$	$F(2,36) = 16.01$ $p < 0.001$ $\eta^2 = 0.471$	$F(2,36) = 9.23$ $p < 0.001$ $\eta^2 = 0.339$
AN	$F(1,36) = 113.03$ $p < 0.001$ $\eta^2 = 0.758$	$F(1,36) = 0.38$ $p = 0.540$ $\eta^2 = 0.011$	$F(2,36) = 214.27$ $p < 0.001$ $\eta^2 = 0.923$	$F(1,36) = 20.96$ $p < 0.001$ $\eta^2 = 0.368$	$F(2,36) = 1.56$ $p = 0.224$ $\eta^2 = 0.080$	$F(2,36) = 15.18$ $p < 0.001$ $\eta^2 = 0.458$	$F(2,36) = 32.05$ $p < 0.001$ $\eta^2 = 0.640$
DON	$F(1,36) = 272.21$ $p < 0.001$ $\eta^2 = 0.883$	$F(1,36) = 13.69$ $p < 0.001$ $\eta^2 = 0.275$	$F(2,36) = 166.18$ $p < 0.001$ $\eta^2 = 0.902$	$F(1,36) = 23.48$ $p < 0.001$ $\eta^2 = 0.395$	$F(2,36) = 13.09$ $p < 0.001$ $\eta^2 = 0.421$	$F(2,36) = 65.99$ $p < 0.001$ $\eta^2 = 0.786$	$F(2,36) = 83.53$ $p < 0.001$ $\eta^2 = 0.823$
MBN	$F(1,36) = 302.09$ $p < 0.001$ $\eta^2 = 0.894$	$F(1,36) = 50.52$ $p < 0.001$ $\eta^2 = 0.584$	$F(2,36) = 10.53$ $p < 0.001$ $\eta^2 = 0.369$	$F(1,36) = 83.32$ $p < 0.001$ $\eta^2 = 0.698$	$F(2,36) = 0.64$ $p = 0.535$ $\eta^2 = 0.034$	$F(2,36) = 3.14$ $p = 0.056$ $\eta^2 = 0.148$	$F(2,36) = 15.16$ $p < 0.001$ $\eta^2 = 0.457$
BG	$F(1,36) = 50.98$ $p < 0.001$ $\eta^2 = 0.586$	$F(1,36) = 120.91$ $p < 0.001$ $\eta^2 = 0.771$	$F(2,36) = 80.01$ $p < 0.001$ $\eta^2 = 0.816$	$F(1,36) = 112.56$ $p < 0.001$ $\eta^2 = 0.758$	$F(2,36) = 10.10$ $p < 0.001$ $\eta^2 = 0.359$	$F(2,36) = 5.93$ $p = 0.006$ $\eta^2 = 0.248$	$F(2,36) = 15.70$ $p < 0.001$ $\eta^2 = 0.466$
BX	$F(1,36) = 95.30$ $p < 0.001$ $\eta^2 = 0.726$	$F(1,36) = 14.01$ $p < 0.001$ $\eta^2 = 0.280$	$F(2,36) = 33.70$ $p < 0.001$ $\eta^2 = 0.652$	$F(1,36) = 12.74$ $p = 0.001$ $\eta^2 = 0.261$	$F(2,36) = 20.38$ $p < 0.001$ $\eta^2 = 0.531$	$F(2,36) = 3.10$ $p = 0.058$ $\eta^2 = 0.147$	$F(2,36) = 1.06$ $p = 0.357$ $\eta^2 = 0.056$
CBH	$F(1,36) = 77.92$ $p < 0.001$ $\eta^2 = 0.684$	$F(1,36) = 0.05$ $p = 0.829$ $\eta^2 = 0.001$	$F(2,36) = 57.05$ $p < 0.001$ $\eta^2 = 0.760$	$F(1,36) = 3.23$ $p = 0.081$ $\eta^2 = 0.082$	$F(2,36) = 21.02$ $p < 0.001$ $\eta^2 = 0.539$	$F(2,36) = 1.80$ $p = 0.179$ $\eta^2 = 0.091$	$F(2,36) = 10.85$ $p < 0.001$ $\eta^2 = 0.376$
NAG	$F(1,36) = 2508.72$ $p < 0.001$ $\eta^2 = 0.986$	$F(1,36) = 59.60$ $p < 0.001$ $\eta^2 = 0.623$	$F(2,36) = 279.92$ $p < 0.001$ $\eta^2 = 0.940$	$F(1,36) = 86.18$ $p < 0.001$ $\eta^2 = 0.705$	$F(2,36) = 137.18$ $p < 0.001$ $\eta^2 = 0.884$	$F(2,36) = 34.68$ $p < 0.001$ $\eta^2 = 0.658$	$F(2,36) = 42.57$ $p < 0.001$ $\eta^2 = 0.703$
LA*P*	$F(1,36) = 109.41$ $p < 0.001$ $\eta^2 = 0.752$	$F(1,36) = 11.58$ $p = 0.002$ $\eta^2 = 0.243$	$F(2,36) = 18.30$ $p < 0.001$ $\eta^2 = 0.504$	$F(1,36) = 18.06$ $p < 0.001$ $\eta^2 = 0.334$	$F(2,36) = 6.36$ $p = 0.004$ $\eta^2 = 0.261$	$F(2,36) = 1.87$ $p = 0.168$ $\eta^2 = 0.094$	$F(2,36) = 2.73$ $p = 0.079$ $\eta^2 = 0.132$
A*P*	$F(1,36) = 1533.63$ $p < 0.001$ $\eta^2 = 0.977$	$F(1,36) = 0.01$ $p = 0.923$ $\eta^2 = 0.000$	$F(2,36) = 30.98$ $p < 0.001$ $\eta^2 = 0.632$	$F(1,36) = 3.76$ $p = 0.060$ $\eta^2 = 0.095$	$F(2,36) = 1.18$ $p = 0.319$ $\eta^2 = 0.062$	$F(2,36) = 4.42$ $p = 0.019$ $\eta^2 = 0.197$	$F(2,36) = 7.54$ $p = 0.002$ $\eta^2 = 0.295$
C:N	$F(1,36) = 420.78$ $p < 0.001$ $\eta^2 = 0.921$	$F(1,36) = 98.01$ $p < 0.001$ $\eta^2 = 0.731$	$F(2,36) = 8.19$ $p = 0.001$ $\eta^2 = 0.313$	$F(1,36) = 203.22$ $p < 0.001$ $\eta^2 = 0.850$	$F(2,36) = 20.76$ $p < 0.001$ $\eta^2 = 0.536$	$F(2,36) = 6.19$ $p = 0.005$ $\eta^2 = 0.256$	$F(2,36) = 10.57$ $p < 0.001$ $\eta^2 = 0.370$
C:*P*	$F(1,36) = 54.87$ $p < 0.001$ $\eta^2 = 0.604$	$F(1,36) = 11.80$ $p = 0.002$ $\eta^2 = 0.247$	$F(2,36) = 9.79$ $p < 0.001$ $\eta^2 = 0.352$	$F(1,36) = 12.18$ $p = 0.001$ $\eta^2 = 0.253$	$F(2,36) = 12.91$ $p < 0.001$ $\eta^2 = 0.418$	$F(2,36) = 3.64$ $p = 0.036$ $\eta^2 = 0.168$	$F(2,36) = 2.90$ $p = 0.068$ $\eta^2 = 0.139$
N:*P*	$F(1,36) = 146.33$ $p < 0.001$ $\eta^2 = 0.803$	$F(1,36) = 1.26$ $p = 0.270$ $\eta^2 = 0.034$	$F(2,36) = 15.86$ $p < 0.001$ $\eta^2 = 0.468$	$F(1,36) = 0.52$ $p = 0.477$ $\eta^2 = 0.014$	$F(2,36) = 21.05$ $p < 0.001$ $\eta^2 = 0.539$	$F(2,36) = 1.19$ $p = 0.316$ $\eta^2 = 0.062$	$F(2,36) = 0.86$ $p = 0.431$ $\eta^2 = 0.046$
Vector length	$F(1,36) = 13.84$ $p < 0.001$ $\eta^2 = 0.278$	$F(1,36) = 12.65$ $p = 0.001$ $\eta^2 = 0.260$	$F(2,36) = 7.16$ $p = 0.002$ $\eta^2 = 0.285$	$F(1,36) = 14.98$ $p < 0.001$ $\eta^2 = 0.294$	$F(2,36) = 7.64$ $p = 0.002$ $\eta^2 = 0.298$	$F(2,36) = 3.97$ $p = 0.028$ $\eta^2 = 0.181$	$F(2,36) = 3.99$ $p = 0.027$ $\eta^2 = 0.182$
Vector angle	$F(1,36) = 8932.55$ $p < 0.001$ $\eta^2 = 0.996$	$F(1,36) = 0.03$ $p = 0.859$ $\eta^2 = 0.001$	$F(2,36) = 10.03$ $p < 0.001$ $\eta^2 = 0.358$	$F(1,36) = 10.53$ $p = 0.003$ $\eta^2 = 0.226$	$F(2,36) = 82.90$ $p < 0.001$ $\eta^2 = 0.822$	$F(2,36) = 2.98$ $p = 0.064$ $\eta^2 = 0.142$	$F(2,36) = 2.83$ $p = 0.072$ $\eta^2 = 0.136$

Note: S, site; T, long-term straw return management treatment; I, fresh straw input level. Values are given as F values, corresponding p values, and partial eta-squared (η^2). Significant effects ($P < 0.05$)are shown in bold.

Table S3. Three-way ANOVA results for soil physicochemical properties, enzyme activities, and ecoenzymatic stoichiometric indices measured at 90 day of incubation.

Variable	Site (S)	Treatment (T)	Input (I)	S × T	S × I	T × I	S × T × I
SOC	$F(1,36) = 4124.48$ $p < 0.001$ $\eta^2 = 0.991$	$F(1,36) = 107.29$ $p < 0.001$ $\eta^2 = 0.749$	$F(2,36) = 13.70$ $p < 0.001$ $\eta^2 = 0.432$	$F(1,36) = 0.07$ $p = 0.788$ $\eta^2 = 0.002$	$F(2,36) = 10.84$ $p < 0.001$ $\eta^2 = 0.376$	$F(2,36) = 2.70$ $p = 0.081$ $\eta^2 = 0.131$	$F(2,36) = 0.19$ $p = 0.831$ $\eta^2 = 0.010$
DOC	$F(1,36) = 46.38$ $p < 0.001$ $\eta^2 = 0.563$	$F(1,36) = 97.07$ $p < 0.001$ $\eta^2 = 0.729$	$F(2,36) = 63.40$ $p < 0.001$ $\eta^2 = 0.779$	$F(1,36) = 10.66$ $p = 0.002$ $\eta^2 = 0.228$	$F(2,36) = 11.39$ $p < 0.001$ $\eta^2 = 0.387$	$F(2,36) = 24.92$ $p < 0.001$ $\eta^2 = 0.581$	$F(2,36) = 9.03$ $p < 0.001$ $\eta^2 = 0.334$
MBC	$F(1,36) = 20.24$ $p < 0.001$ $\eta^2 = 0.360$	$F(1,36) = 39.05$ $p < 0.001$ $\eta^2 = 0.520$	$F(2,36) = 181.85$ $p < 0.001$ $\eta^2 = 0.910$	$F(1,36) = 161.66$ $p < 0.001$ $\eta^2 = 0.818$	$F(2,36) = 15.34$ $p < 0.001$ $\eta^2 = 0.460$	$F(2,36) = 23.28$ $p < 0.001$ $\eta^2 = 0.564$	$F(2,36) = 36.47$ $p < 0.001$ $\eta^2 = 0.670$
AN	$F(1,36) = 190.45$ $p < 0.001$ $\eta^2 = 0.841$	$F(1,36) = 39.14$ $p < 0.001$ $\eta^2 = 0.521$	$F(2,36) = 1242.11$ $p < 0.001$ $\eta^2 = 0.986$	$F(1,36) = 259.80$ $p < 0.001$ $\eta^2 = 0.878$	$F(2,36) = 74.87$ $p < 0.001$ $\eta^2 = 0.806$	$F(2,36) = 16.53$ $p < 0.001$ $\eta^2 = 0.479$	$F(2,36) = 79.33$ $p < 0.001$ $\eta^2 = 0.815$
DON	$F(1,36) = 114.44$ $p < 0.001$ $\eta^2 = 0.761$	$F(1,36) = 4.76$ $p = 0.036$ $\eta^2 = 0.117$	$F(2,36) = 418.18$ $p < 0.001$ $\eta^2 = 0.959$	$F(1,36) = 69.24$ $p < 0.001$ $\eta^2 = 0.658$	$F(2,36) = 82.97$ $p < 0.001$ $\eta^2 = 0.822$	$F(2,36) = 0.20$ $p = 0.818$ $\eta^2 = 0.011$	$F(2,36) = 20.02$ $p < 0.001$ $\eta^2 = 0.527$
MBN	$F(1,36) = 56.20$ $p < 0.001$ $\eta^2 = 0.610$	$F(1,36) = 0.46$ $p = 0.501$ $\eta^2 = 0.013$	$F(2,36) = 2.91$ $p = 0.068$ $\eta^2 = 0.139$	$F(1,36) = 7.59$ $p = 0.009$ $\eta^2 = 0.174$	$F(2,36) = 0.34$ $p = 0.713$ $\eta^2 = 0.019$	$F(2,36) = 3.64$ $p = 0.036$ $\eta^2 = 0.168$	$F(2,36) = 1.74$ $p = 0.190$ $\eta^2 = 0.088$
BG	$F(1,36) = 125.21$ $p < 0.001$ $\eta^2 = 0.777$	$F(1,36) = 4.38$ $p = 0.044$ $\eta^2 = 0.108$	$F(2,36) = 35.82$ $p < 0.001$ $\eta^2 = 0.666$	$F(1,36) = 30.92$ $p < 0.001$ $\eta^2 = 0.462$	$F(2,36) = 1.78$ $p = 0.184$ $\eta^2 = 0.090$	$F(2,36) = 6.88$ $p = 0.003$ $\eta^2 = 0.277$	$F(2,36) = 30.43$ $p < 0.001$ $\eta^2 = 0.628$
BX	$F(1,36) = 28.53$ $p < 0.001$ $\eta^2 = 0.442$	$F(1,36) = 29.15$ $p < 0.001$ $\eta^2 = 0.447$	$F(2,36) = 53.45$ $p < 0.001$ $\eta^2 = 0.748$	$F(1,36) = 6.53$ $p = 0.015$ $\eta^2 = 0.153$	$F(2,36) = 2.99$ $p = 0.063$ $\eta^2 = 0.143$	$F(2,36) = 1.23$ $p = 0.303$ $\eta^2 = 0.064$	$F(2,36) = 6.24$ $p = 0.005$ $\eta^2 = 0.257$
CBH	$F(1,36) = 95.22$ $p < 0.001$ $\eta^2 = 0.726$	$F(1,36) = 5.05$ $p = 0.031$ $\eta^2 = 0.123$	$F(2,36) = 55.32$ $p < 0.001$ $\eta^2 = 0.755$	$F(1,36) = 13.52$ $p < 0.001$ $\eta^2 = 0.273$	$F(2,36) = 9.34$ $p < 0.001$ $\eta^2 = 0.342$	$F(2,36) = 7.48$ $p = 0.002$ $\eta^2 = 0.293$	$F(2,36) = 10.46$ $p < 0.001$ $\eta^2 = 0.368$
NAG	$F(1,36) = 649.34$ $p < 0.001$ $\eta^2 = 0.947$	$F(1,36) = 3.99$ $p = 0.053$ $\eta^2 = 0.100$	$F(2,36) = 68.01$ $p < 0.001$ $\eta^2 = 0.791$	$F(1,36) = 0.00$ $p = 0.966$ $\eta^2 = 0.000$	$F(2,36) = 26.38$ $p < 0.001$ $\eta^2 = 0.594$	$F(2,36) = 9.73$ $p < 0.001$ $\eta^2 = 0.351$	$F(2,36) = 23.06$ $p < 0.001$ $\eta^2 = 0.562$
LA*P*	$F(1,36) = 565.85$ $p < 0.001$ $\eta^2 = 0.940$	$F(1,36) = 65.80$ $p < 0.001$ $\eta^2 = 0.646$	$F(2,36) = 42.84$ $p < 0.001$ $\eta^2 = 0.704$	$F(1,36) = 43.55$ $p < 0.001$ $\eta^2 = 0.547$	$F(2,36) = 32.10$ $p < 0.001$ $\eta^2 = 0.641$	$F(2,36) = 11.25$ $p < 0.001$ $\eta^2 = 0.385$	$F(2,36) = 13.27$ $p < 0.001$ $\eta^2 = 0.424$
A*P*	$F(1,36) = 343.13$ $p < 0.001$ $\eta^2 = 0.905$	$F(1,36) = 6.79$ $p = 0.013$ $\eta^2 = 0.159$	$F(2,36) = 4.07$ $p = 0.025$ $\eta^2 = 0.184$	$F(1,36) = 1.85$ $p = 0.182$ $\eta^2 = 0.049$	$F(2,36) = 0.15$ $p = 0.859$ $\eta^2 = 0.008$	$F(2,36) = 4.79$ $p = 0.014$ $\eta^2 = 0.210$	$F(2,36) = 7.50$ $p = 0.002$ $\eta^2 = 0.294$
C:N	$F(1,36) = 1154.43$ $p < 0.001$ $\eta^2 = 0.970$	$F(1,36) = 11.99$ $p = 0.001$ $\eta^2 = 0.250$	$F(2,36) = 0.77$ $p = 0.472$ $\eta^2 = 0.041$	$F(1,36) = 40.11$ $p < 0.001$ $\eta^2 = 0.527$	$F(2,36) = 20.78$ $p < 0.001$ $\eta^2 = 0.536$	$F(2,36) = 4.17$ $p = 0.023$ $\eta^2 = 0.188$	$F(2,36) = 7.13$ $p = 0.002$ $\eta^2 = 0.284$
C:*P*	$F(1,36) = 165.54$ $p < 0.001$ $\eta^2 = 0.821$	$F(1,36) = 26.74$ $p < 0.001$ $\eta^2 = 0.426$	$F(2,36) = 0.14$ $p = 0.874$ $\eta^2 = 0.007$	$F(1,36) = 46.59$ $p < 0.001$ $\eta^2 = 0.564$	$F(2,36) = 3.52$ $p = 0.040$ $\eta^2 = 0.164$	$F(2,36) = 8.83$ $p < 0.001$ $\eta^2 = 0.329$	$F(2,36) = 11.25$ $p < 0.001$ $\eta^2 = 0.385$
N:*P*	$F(1,36) = 708.93$ $p < 0.001$ $\eta^2 = 0.952$	$F(1,36) = 2.99$ $p = 0.092$ $\eta^2 = 0.077$	$F(2,36) = 5.28$ $p = 0.010$ $\eta^2 = 0.227$	$F(1,36) = 4.16$ $p = 0.049$ $\eta^2 = 0.104$	$F(2,36) = 17.80$ $p < 0.001$ $\eta^2 = 0.497$	$F(2,36) = 3.29$ $p = 0.049$ $\eta^2 = 0.154$	$F(2,36) = 3.86$ $p = 0.030$ $\eta^2 = 0.176$
Vector length	$F(1,36) = 0.68$ $p = 0.414$ $\eta^2 = 0.019$	$F(1,36) = 20.26$ $p < 0.001$ $\eta^2 = 0.360$	$F(2,36) = 6.90$ $p = 0.003$ $\eta^2 = 0.277$	$F(1,36) = 41.85$ $p < 0.001$ $\eta^2 = 0.538$	$F(2,36) = 0.20$ $p = 0.820$ $\eta^2 = 0.011$	$F(2,36) = 6.70$ $p = 0.003$ $\eta^2 = 0.271$	$F(2,36) = 9.13$ $p < 0.001$ $\eta^2 = 0.337$
Vector angle	$F(1,36) = 12024.63$ $p < 0.001$ $\eta^2 = 0.997$	$F(1,36) = 0.43$ $p = 0.519$ $\eta^2 = 0.012$	$F(2,36) = 3.01$ $p = 0.062$ $\eta^2 = 0.143$	$F(1,36) = 0.23$ $p = 0.631$ $\eta^2 = 0.006$	$F(2,36) = 20.53$ $p < 0.001$ $\eta^2 = 0.533$	$F(2,36) = 1.57$ $p = 0.223$ $\eta^2 = 0.080$	$F(2,36) = 1.32$ $p = 0.281$ $\eta^2 = 0.068$

Note: S, site; T, long-term straw return management treatment; I, fresh straw input level. Values are given as F values, corresponding p values, and partial eta-squared (η^2). Significant effects ($P < 0.05$)are shown in bold.

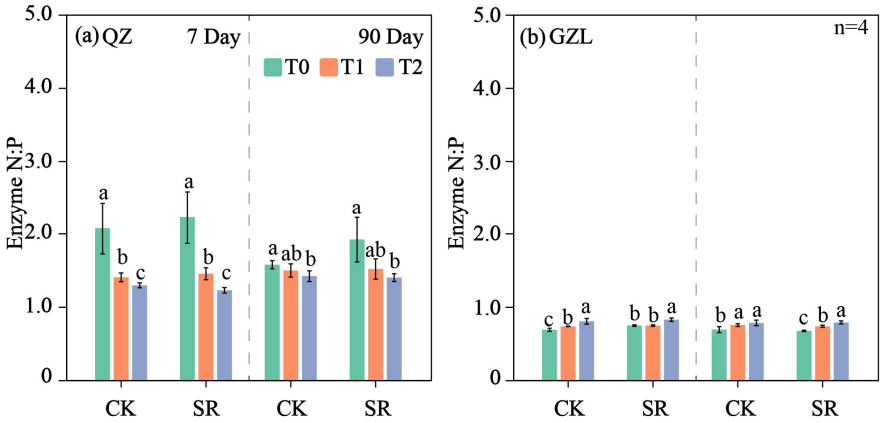


Figure S1. Responses of ecoenzymatic N:P ratios to fresh straw addition at 7 and 90 days under long-term straw return. CK and SR indicate the long-term residue-management treatments, and T0, T1, and T2 represent different levels of fresh straw addition. Error bars represent standard error of the mean (n = 4). Different lowercase letters indicate significant differences at $p < 0.05$; the same lowercase letters indicate no significant difference.