



Supplement of

Diachronic assessment of soil organic C and N dynamics under long-term no-till cropping systems in the tropical upland of Cambodia

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List of supplementary materials

“Diachronic assessment of long-term no-till cropping systems in the tropical upland of Cambodia”

Table S1. Mineral fertilizer rates applied to the main crops during the experimental period (2009-2021).

Annual mineral fertilizer rates (kg ha ⁻¹) ^a	Crops	Year													Total fertilizer input
		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	
N in CO(NH ₂) ₂	Cassava	92	69	69	69	69	69	69	69	69	69	46	46	46	857
	Maize	92	69	69	69	69	46	46	46	46	46	46	46	46	736
	Rice	69	46	46	46	46	46	46	46	46	46	46			529
	Soybean	23	23	23	23	23									115
N in (NH ₄) ₃ PO ₄	Maize						24	24	24	24	24	24	24	24	192
N in (NH ₄) ₂ HPO ₄	Soybean						18	18	18	18	18	18	18	18	144
P ₂ O ₅	All crops	80	32	32	32	32	32	32	32	32	32	32	0	0	400
P in (NH ₄) ₃ PO ₄	Maize						30	30	30	30	30	30	30	30	240
P in (NH ₄) ₂ HPO ₄	Soybean						46	46	46	46	46	46	46	46	368
K ₂ O	Cassava	60	90	60	60	60	60	60	60	60	60	60	60	60	810
	Maize	60	30	30	30	30	30	30	30	30	30	30	30	30	420
	Rice	60	30	30	30	30	30	30	30	30	30	30			360
	Soybean	60	60	60	60	60	60	60	60	60	60	60	60	60	780

^a CO(NH₂)₂: Urea (46.0.0); (NH₄)₃PO₄: Ammonium phosphate (16.20.0); (NH₄)₂HPO₄: Diammonium phosphate (18-46-0); P₂O₅: Thermo phosphate (0.18.0); and K₂O: Potassium chloride (0.0.60).

Table S2. Soil bulk density in 2009, 2011 and 2021.

Experiments ^a	Soil depth (cm)	Sampling years and cropping systems ^b									
		2009		2011				2021			
		PE	CTM	NTM	NTR1	NTR2	CTM	NTM	NTR1	NTR2	
		Bulk density (ρ_b) (g cm^{-3})									
MaiEx	0-5	1.11	1.17	1.20	1.20	1.21	1.14	1.08	1.10	1.10	
	5-10	1.17	1.21	1.20	1.23	1.22	1.22	1.14	1.19	1.18	
	10-20	1.24	1.20	1.20	1.18	1.22	1.19	1.15	1.13	1.19	
	20-40		1.07	1.10	1.13	1.08	1.01	0.98	0.98	1.00	
	40-60		1.00	1.05	1.03	1.09	0.90	0.90	0.97	0.94	
	60-80		1.11	1.05	1.09	1.13	0.92	0.93	0.99	0.94	
	80-100		1.10	1.08	1.16	1.15	0.95	0.95	1.02	0.96	
SoyEx	0-5	1.15	1.16	1.16	1.16	1.14	1.09	1.10	1.16	1.09	
	5-10	1.24	1.22	1.25	1.19	1.18	1.25	1.19	1.19	1.16	
	10-20	1.26	1.25	1.23	1.16	1.22	1.24	1.16	1.18	1.14	
	20-40		1.11	1.20	1.11	1.06	1.09	1.12	1.06	1.07	
	40-60		1.06	1.07	1.08	1.04	0.93	0.95	0.95	0.95	
	60-80		1.07	1.08	1.09	1.05	0.93	0.97	0.94	0.94	
	80-100		1.10	1.07	1.14	1.13	0.92	0.96	0.97	0.93	
CasEx	0-5	1.15	1.10	1.17	1.17	1.17	1.08	1.05	1.12	1.09	
	5-10	1.20	1.11	1.19	1.18	1.18	1.20	1.12	1.21	1.22	
	10-20	1.23	1.15	1.25	1.25	1.24	1.18	1.13	1.21	1.17	
	20-40		1.12	1.18	1.17	1.13	1.09	1.09	1.08	1.01	
	40-60		1.02	1.02	1.04	1.03	0.98	1.00	0.96	0.94	
	60-80		0.99	1.09	1.11	1.04	0.95	0.95	0.97	0.96	
	80-100		1.06	1.11	1.08	1.09	0.94	0.98	0.99	0.99	

^aExperiments: MaiEx = Maize-based experiment, SoyEx = Soybean-based experiment, and CasEx = Cassava-based experiment.

^bCropping systems: PE: pre-experiment (the samples were collected to 20 cm depth in 2009 prior to the establishment of the experiments); CTM: monocropping under conventional tillage; NTM: monocropping under NT systems with no-till mulch-based cropping systems associated with different crop sequences, and NTR1 and NTR2 refer to bi-annual crop rotational systems under NT systems with no-till mulch-based cropping systems associated with cropping systems as described in Table 1.

Table S3. Mean SOC concentration in bulk soil in 2011 and 2021.

Experiments ^a	Soil depth (cm)	Cropping systems ^b							
		CTM	NTM	NTR1	NTR2	CTM	NTM	NTR1	NTR2
		SOC concentration in 2011 (g C kg ⁻¹ soil)				SOC concentration in 2021 (g C kg ⁻¹ soil)			
MaiEx	0-5	19.68	18.60 B	19.33 B	18.97 B	20.48 b	31.29 Aa	29.23 Aa	28.17 Aa
	5-10	17.55	16.28 B	16.43 B	16.02 B	19.41	19.71 A	20.34 A	19.96 A
	10-20	14.50 B	13.90	13.03 B	13.05 B	16.78 A	14.87	15.42 A	14.62 A
	20-40	9.10	8.02 B	7.42 B	8.63	9.44	9.34 A	10.22 A	9.18
	40-60	6.47 a	5.45 Bb	6.08 b	5.84 b	6.34	6.38	6.60	6.36
	60-80	4.87	4.14 B	4.65	4.49	4.51	5.08	4.89	4.72
	80-100	4.49 Aa	3.45 Bb	4.30 a	4.05 b	3.84 B	3.99	4.23	3.79
SoyEx	0-5	19.27	19.92 B	20.82 B	20.12 B	19.70 b	27.45 Aa	27.39 Aa	28.31 Aa
	5-10	18.60	17.60	17.13	17.07	19.16	17.39	19.83	19.79
	10-20	15.78	15.65	14.22	15.47	16.87	15.51	15.53	15.95
	20-40	9.71	10.11	8.39	8.30	10.80 a	11.58 a	9.30 b	9.86 b
	40-60	6.44	6.60	5.75	5.59	7.28	7.61	6.50	6.49
	60-80	5.22	5.57	4.42	4.33	5.39	5.87	4.52	4.48
	80-100	4.83	5.35	4.26	3.95	4.52	4.67	3.54	3.78
CasEx	0-5	15.65 Bb	15.63 Bb	17.98 Ba	18.68 Ba	17.59 Ab	19.75 Aa	22.26 Aa	24.32 Aa
	5-10	16.42 B	15.23 B	16.68 B	16.08 B	17.28 A	18.26 A	18.36 A	18.06 A
	10-20	15.15 a	12.98 Bb	14.45 ab	13.05 Bb	16.00	15.47 A	15.18	14.80 A
	20-40	9.66 A	7.84 B	8.39 B	7.74 B	8.70 B	9.57 A	10.29 A	9.56 A
	40-60	6.68	5.82 B	6.22	5.79 B	6.79	6.88 A	6.68	6.64 A
	60-80	5.34	4.92 B	5.47	4.98	5.66	5.41 A	5.28	5.19
	80-100	5.12	4.47	5.01 A	4.63 A	5.03	4.46	4.41 B	4.03 B

^aExperiments: MaiEx: Maize-based experiment; SoyEx: Soybean-based experiment; and CasEx: Cassava-based experiment.

^bCropping systems: CTM: monocropping under conventional tillage; NTM: monocropping under NT systems with no-till mulch-based cropping systems associated with different crop sequences, and NTR1 and NTR2 refer to bi-annual crop rotational systems under NT systems with no-till mulch-based cropping systems associated with cropping systems as described in Table 1. The different uppercase letter accompanying the values indicates a significant difference within the same treatment and depth between 2011 and 2021, while the lowercase letter(s) indicate a significant difference between the treatments within the same sampling date at the same depth at $p < 0.05$ (Tukey's test).

Table S4. Mean total N concentration in bulk soil in 2011 and 2021.

Experiments ^a	Soil depth (cm)	Cropping systems ^b							
		CTM	NTM	NTR1	NTR2	CTM	NTM	NTR1	NTR2
		N concentration in 2011 (g N kg ⁻¹ soil)				N concentration in 2021 (g N kg ⁻¹ soil)			
MaiEx	0-5	1.82	1.88 B	1.89 B	1.96 B	1.65 b	2.70 Aa	2.58 Aa	2.49 Aa
	5-10	1.64	1.66	1.71	1.79	1.50 b	1.71 ab	1.91 ab	1.98 a
	10-20	1.34	1.46	1.47	1.46	1.46	1.32	1.76	1.41
	20-40	1.13	1.08	1.06	1.15	0.98	0.99	1.08	1.08
	40-60	0.88 A	0.92 A	0.99 A	0.99 A	0.78 B	0.70 B	0.79 B	0.83 B
	60-80	0.77	0.80	0.87 A	0.88 A	0.66	0.86	0.66 B	0.72 B
	80-100	0.71 A	0.76	0.85 A	0.79 A	0.53 B	0.64	0.69 B	0.63 B
SoyEx	0-5	1.87	1.92 B	2.02 B	1.95 B	1.70 b	2.39 Aa	2.36 Aa	2.50 Aa
	5-10	1.65	1.67	1.72	1.72	2.15	1.56	1.79	1.85
	10-20	1.39	1.53	1.47	1.61	1.51	1.42	1.62	1.48
	20-40	1.07	1.22	1.20	1.19	1.16	1.19	1.09	1.10
	40-60	0.95	1.01	0.98 A	0.94	0.89	0.93	0.82 B	0.85
	60-80	0.85	0.94 A	0.88	0.86 A	0.73	0.72 B	0.78	0.72 B
	80-100	0.77	0.90 A	0.85 A	0.82	0.79 a	0.64 Bab	0.58 Bb	0.71 ab
CasEx	0-5	1.57 b	1.74 ab	1.70 Bab	1.90 Ba	1.58 c	1.75 cb	1.99 Aab	2.18 Aa
	5-10	1.69 ab	1.72 a	1.53 Bb	1.67 ab	1.58	1.69	1.68 A	1.69
	10-20	1.52	1.54 A	1.37	1.44	1.47	1.29 B	1.45	1.46
	20-40	1.21 A	1.20 A	1.02 B	1.12	1.04 B	1.08 B	1.21 A	1.12
	40-60	1.01 ab	1.07 Aa	0.88 b	0.97 ab	0.92	0.95 B	0.88	0.94
	60-80	0.90	0.99 A	0.80	0.90	0.73	0.77 B	0.84	0.80
	80-100	0.83	0.92 A	0.80	0.81	0.76	0.69 B	0.68	0.74

^aExperiments: MaiEx: Maize-based experiment; SoyEx: Soybean-based experiment; and CasEx: Cassava-based experiment.

^bCropping systems: CTM: monocropping under conventional tillage; NTM: monocropping under NT systems with no-till mulch-based cropping systems associated with different crop sequences, and NTR1 and NTR2 refer to bi-annual crop rotational systems under NT systems with no-till mulch-based cropping systems associated with cropping systems as described in Table 1. The different uppercase letter accompanying the values indicates a significant difference within the same treatment and depth between 2011 and 2021 (diachronic), while the lowercase letter(s) indicate a significant difference between the treatments within the same sampling date at the same depth (synchronic) at $p < 0.05$ (Tukey's test).

Table S5. Mean SOC and TN stocks per soil layer in 2011.

Experiments ^a	Approximate soil depth (cm)	Cropping systems				CTM	NTM	NTR1	NTR2
		CTM	NTM	NTR1	NTR2				
		SOC stock in 2011 (Mg C ha ⁻¹)				Total N stock in 2011 (Mg N ha ⁻¹)			
MaiEx	0-5	9.45	8.93 B	9.28 B	9.10 B	0.87	0.90 B	0.91 B	0.94 B
	5-10	9.29 B	8.70 B	8.85 B	8.67 B	0.87	0.88	0.91	0.95
	10-20	15.99 B	15.24	14.58 B	14.46 B	1.48	1.58	1.61	1.62
	20-40	18.83	17.05	15.81 B	17.92	2.19	2.16	2.12	2.27
	40-60	13.00 a	11.35 ab	11.71 bc	12.13 c	1.71 A	1.73 A	1.80 A	1.86 A
	60-80	10.19 Aa	8.90 a	9.82 a	9.52 b	1.49 A	1.60	1.69 A	1.72 A
	80-100	8.44 Aa	6.99 a	8.15 ab	7.89 b	1.33 A	1.41	1.55 A	1.54 A
	0-100	85.18	77.16 B	78.19 B	79.68 B	9.94	10.26	10.58	10.89
SoyEx	0-5	9.25 a	9.56 Ba	9.99 Ba	9.65 Ba	0.90	0.92 B	0.97 B	0.93 B
	5-10	9.70 b	9.35 a	9.25 Ba	9.11 Bab	0.88	0.89	0.92	0.91
	10-20	17.28 a	17.03 a	15.61 a	16.68 a	1.53 B	1.66	1.60	1.73
	20-40	20.42 a	20.99 a	17.32 a	17.87 a	2.12	2.41	2.32	2.36
	40-60	13.82 ab	14.83 a	11.73 b	11.39 b	1.76	1.98	1.88	1.80
	60-80	10.76 a	11.39 a	9.33 a	8.96 a	1.64 A	1.80 A	1.69 A	1.63 A
	80-100	9.21 a	9.87 a	7.81 a	7.46 a	1.47	1.65 A	1.56 A	1.49 A
	0-100	90.44	93.00	81.05	81.12	10.29	11.29 A	10.93	10.86
CasEx	0-5	7.51 Bb	7.50 Bb	8.63 Ba	8.97 Ba	0.75 b	0.84 ab	0.82 Bab	0.91 Ba
	5-10	8.44 Bab	7.93 Bb	8.78 Ba	8.60 Bab	0.87 ab	0.89 ab	0.81 Bb	0.89 ab
	10-20	16.23 Ba	14.19 Bb	15.74 Bab	14.40 Bab	1.63 ab	1.67 Aa	1.49 b	1.57 ab
	20-40	19.11	16.59 B	17.88 B	16.39 B	2.33 Aa	2.37 Aa	2.03 Bb	2.22 a
	40-60	13.57	11.99	12.78	11.74	1.90 Aab	2.00 Aa	1.68 a	1.83 ab
	60-80	10.91	9.92	10.73	9.75	1.72 A	1.88 A	1.54	1.71
	80-100	9.32	8.61	9.58 A	8.71 A	1.55 a	1.76 Aa	1.42 b	1.55 ab
	0-100	85.09	76.74 B	84.10 B	78.55 B	10.75 A	11.41 Av	9.78	10.68

^a Experiments: MaiEx = Maize-based experiment, SoyEx = Soybean-based experiment, and CasEx = Cassava-based experiment.

^b Cropping systems: CTM: monocropping under conventional tillage; NTM: monocropping under NT systems with no-till mulch-based cropping systems associated with different crop sequences, and NTR1 and NTR2 refer to bi-annual crop rotational systems under NT systems with no-till mulch-based cropping systems associated with cropping systems as described in Table 1. The different uppercase letter accompanying the values indicates a significant difference within the same treatment and depth between 2011 and 2021 (diachronic), while the lowercase letter(s) indicate a significant difference between the treatments within the same sampling date at the same depth (synchronic) at $p < 0.05$ (Tukey's test).

Table S6. SOC stock in POM fraction (> 53 μm) in 2011 and 2021.

Experiments ^a	Soil depth (cm)	Cropping systems ^b							
		CTM	NTM	NTR1	NTR2	CTM	NTM	NTR1	NTR2
		C stock in POM in 2011 (Mg C ha ⁻¹)				C stock in POM in 2021 (Mg C ha ⁻¹)			
MaiEx	0-5	0.67	0.70 B	0.80 B	0.81 B	0.85 c	2.29 Aa	1.74 Ab	1.83 Ab
	5-10	0.52 B	0.50 B	0.57 B	0.55 B	0.72 A	0.87 A	0.88 A	0.76 A
	10-20	0.65 B	0.65	0.59	0.58	0.97 Aa	0.63b	0.72a	0.66 a
	20-40	0.44	0.47	0.39	0.47	0.57	0.43	0.55	0.44
	40-60	0.21	0.21	0.22	0.23	0.19	0.20	0.23	0.19
	60-80	0.14	0.15	0.18	0.13	0.12	0.15	0.14	0.12
	80-100	0.12	0.13	0.15	0.10	0.09	0.11	0.15	0.09
SoyEx	0-5	0.66	0.65 B	0.77 B	0.79 B	0.79 c	2.04 Aa	1.59 Ab	1.77 Ab
	5-10	0.48 B	0.43 B	0.46 B	0.51 B	0.64 Ac	0.95 Aa	0.82 Ab	0.74 Ab
	10-20	0.66 B	0.61	0.61 B	0.64	0.89 A	0.62	0.77 A	0.74
	20-40	0.54	0.61	0.42	0.49	0.59	0.62	0.48	0.45
	40-60	0.24 ab	0.38 a	0.17 b	0.23 b	0.25	0.32	0.23	0.21
	60-80	0.13 ab	0.22 a	0.10 Bb	0.17 b	0.14	0.17	0.15 A	0.13
	80-100	0.11	0.11	0.09	0.16	0.12	0.13	0.09	0.10
CasEx	0-5	0.40	0.41	0.49	0.95	0.49 b	0.67 ab	0.94 ab	1.34 a
	5-10	0.46	0.43	0.57	0.54	0.46	0.48	0.61	0.62
	10-20	0.70	0.63	0.76	0.60	0.77	0.59	0.68	0.64
	20-40	0.47	0.42	0.56	0.38 B	0.44	0.40	0.53	0.47 A
	40-60	0.24	0.20	0.25	0.19	0.21	0.20	0.25	0.22
	60-80	0.15	0.13	0.15	0.15	0.17	0.11	0.14	0.13
	80-100	0.14	0.11	0.18	0.16	0.17	0.11	0.12	0.10

^a Experiments: MaiEx = Maize-based experiment, SoyEx = Soybean-based experiment, and CasEx = Cassava-based experiment.

^b Cropping systems: CTM: monocropping under conventional tillage; NTM: monocropping under NT systems with no-till mulch-based cropping systems associated with different crop sequences, and NTR1 and NTR2 refer to bi-annual crop rotational systems under NT systems with no-till mulch-based cropping systems associated with cropping systems as described in Table 1. The different uppercase letter accompanying the values indicates a significant difference within the same treatment and depth between 2011 and 2021 (diachronic), while the lowercase letter(s) indicate a significant difference between the treatments within the same sampling date at the same depth (synchronic) at $p < 0.05$ (Tukey's test).

Table S7. SOC stock in MAOM fraction (< 53 µm) in 2011 and 2021.

Experiments ^a	Soil depth (cm)	Cropping systems ^b							
		CTM	NTM	NTR1	NTR2	CTM	NTM	NTR1	NTR2
		C stock in MAOM in 2011 (Mg C ha ⁻¹)				C stock in MAOM in 2021 (Mg C ha ⁻¹)			
MaiEx	0-5	7.27	7.47 B	7.64 B	7.34 B	7.99 b	11.18 Aa	10.91 Aa	10.65 Aa
	5-10	7.39 B	7.56 B	7.51 B	7.18 B	8.38 A	9.05 A	9.24 A	8.69 A
	10-20	12.95 B	13.53	12.66	12.33	15.21 A	14.37	14.53	13.82
	20-40	15.48	15.29	13.89 B	15.21	17.09	16.40	17.73 A	16.24
	40-60	10.90	10.37	10.45	10.44	10.92	10.75	11.27	10.72
	60-80	8.79	8.31	8.90	8.39	7.96	8.28	8.55	8.24
	80-100	7.37 A	6.67	7.39	6.99	6.32 B	6.61	7.06	6.37
SoyEx	0-5	7.49	8.01 B	8.28 B	8.08 B	7.91	10.22 A	10.10 A	10.06 A
	5-10	7.94	8.04 B	7.87 B	7.74 B	8.36	9.01 A	8.93 A	9.77 A
	10-20	14.53 B	14.92 B	13.59 B	13.91 B	15.59 A	15.65 A	14.78 A	15.26 A
	20-40	17.48	18.55	15.31	15.47	19.03	19.60	16.75	17.00
	40-60	11.73	13.43	10.53	10.16	12.67	13.71	11.28	11.37
	60-80	9.25	10.48	8.50	8.06	9.31	10.35	8.32	8.28
	80-100	8.83	9.02	7.19	6.72	7.36	8.09	6.18	6.57
CasEx	0-5	6.59 B	6.55 B	7.32 B	6.96 B	7.10 A	8.04 A	8.89 A	9.12 A
	5-10	7.17 B	6.87 B	7.62 B	7.12 B	7.63 A	8.20 A	8.42 A	8.20 A
	10-20	14.01 B	12.31 B	13.90 B	12.39 B	14.76 A	14.63 A	14.67 A	14.03 A
	20-40	16.88	14.49 B	15.94 B	13.87 B	16.15	16.61 A	18.09 A	16.84 A
	40-60	12.03	10.56	11.42	9.92 B	11.35	11.87	12.24	11.54 A
	60-80	9.67	8.81	9.53	8.34	9.57	9.62	9.49	9.00
	80-100	8.33	7.69	8.53 A	7.44	8.30	7.87	7.35 B	7.43

^a Experiments: MaiEx = Maize-based experiment, SoyEx = Soybean-based experiment, and CasEx = Cassava-based experiment.

^b Cropping systems: CTM: monocropping under conventional tillage; NTM: monocropping under NT systems with no-till mulch-based cropping systems associated with different crop sequences, and NTR1 and NTR2 refer to bi-annual crop rotational systems under NT systems with no-till mulch-based cropping systems associated with cropping systems as described in Table 1. The different uppercase letter accompanying the values indicates a significant difference within the same treatment and depth between 2011 and 2021 (diachronic), while the lowercase letter(s) indicate a significant difference between the treatments within the same sampling date at the same depth (synchronic) at $p < 0.05$ (Tukey's test).

Table S8. TN stock in POM fraction (> 53 μm) in 2011 and 2021.

Experiments ^a	Soil depth (cm)	Cropping systems ^b							
		CTM	NTM	NTR1	NTR2	CTM	NTM	NTR1	NTR2
		N stock in POM in 2011 (Mg N ha ⁻¹)				N stock in POM in 2021 (Mg N ha ⁻¹)			
MaiEx	0-5	0.041	0.042 B	0.048 B	0.048 B	0.052 c	0.149 Aa	0.116 Ab	0.122 Ab
	5-10	0.032	0.029 B	0.031 B	0.033 B	0.041	0.053 A	0.054 A	0.048 A
	10-20	0.039	0.036	0.034	0.035	0.051 a	0.031 b	0.039 ab	0.033 ab
	20-40	0.026	0.023	0.026	0.033	0.028	0.018	0.027	0.022
	40-60	0.015	0.012	0.017	0.019 A	0.008	0.009	0.010	0.009 B
	60-80	0.014	0.012	0.020	0.011	0.005	0.007	0.006	0.006
	80-100	0.014	0.012	0.020	0.011 A	0.004	0.004	0.008	0.004 B
SoyEx	0-5	0.037	0.038 B	0.046 B	0.044 B	0.050	0.132 A	0.104 A	0.109 A
	5-10	0.029 B	0.023 B	0.025 B	0.027 B	0.039 A	0.057 A	0.049 A	0.040 A
	10-20	0.036 B	0.029 B	0.029	0.031	0.052 A	0.056 A	0.037	0.033
	20-40	0.027	0.023	0.020	0.023	0.023	0.033	0.021	0.017
	40-60	0.014 A	0.013	0.013	0.013	0.007 B	0.013	0.010	0.009
	60-80	0.011 B	0.010	0.010	0.013 A	0.005 B	0.007	0.007	0.006 B
	80-100	0.010	0.010	0.008	0.014 B	0.006	0.006	0.005	0.005 B
CasEx	0-5	0.022	0.023	0.029	0.062	0.026 c	0.041 ab	0.059 ab	0.077 a
	5-10	0.025	0.024	0.033	0.032	0.024	0.028	0.036	0.035
	10-20	0.036	0.034	0.039	0.030	0.038	0.030	0.036	0.032
	20-40	0.028 A	0.024 A	0.030 A	0.022	0.020 B	0.017 B	0.022 B	0.022
	40-60	0.015 A	0.013 A	0.016	0.015	0.009 B	0.009 B	0.013	0.011
	60-80	0.009 b	0.010 Aab	0.012 a	0.014 Aa	0.009	0.006 B	0.009	0.007 B
	80-100	0.009	0.009	0.013	0.018 A	0.011	0.006	0.005	0.005 B

^a Experiments: MaiEx = Maize-based experiment, SoyEx = Soybean-based experiment, and CasEx = Cassava-based experiment.

^b Cropping systems: CTM: monocropping under conventional tillage; NTM: monocropping under NT systems with no-till mulch-based cropping systems associated with different crop sequences, and NTR1 and NTR2 refer to bi-annual crop rotational systems under NT systems with no-till mulch-based cropping systems associated with cropping systems as described in Table 1. The different uppercase letter accompanying the values indicates a significant difference within the same treatment and depth between 2011 and 2021 (diachronic), while the lowercase letter(s) indicate a significant difference between the treatments within the same sampling date at the same depth (synchronic) at $p < 0.05$ (Tukey's test).

Table S9. N stock in MAOM fraction (< 53 µm) in 2011 and 2021.

Experiments ^a	Soil depth (cm)	Cropping systems ^b							
		CTM	NTM	NTR1	NTR2	CTM	NTM	NTR1	NTR2
		N stock in MAOM in 2011 (Mg N ha ⁻¹)				N stock in MAOM in 2021 (Mg N ha ⁻¹)			
MaiEx	0-5	0.59	0.75	0.93	0.74	0.62 b	0.97 a	1.09 a	0.83 ab
	5-10	0.64 b	0.69 b	0.98 Aa	0.76 b	0.71	0.78	0.75 B	0.69
	10-20	1.19 b	1.30 b	1.83 Aa	1.35 b	1.32	1.25	0.98 B	1.13
	20-40	1.67 b	1.84 b	2.63 Aa	1.90 Ab	1.69	1.48	1.43 B	1.30 B
	40-60	1.43 A	1.43 A	2.24 A	1.59 A	1.11 B	1.09 B	0.96 B	0.78 B
	60-80	1.34 Ab	1.33 Ab	2.10 Aa	1.47 Aab	0.76 Bb	0.94 Ba	0.70 Bab	0.48 Bb
	80-100	1.14 Ab	1.31 Ab	1.91 Aa	1.25 Ab	0.67 B	0.68 B	0.60 B	0.41 B
SoyEx	0-5	0.69	0.75	0.83	0.79	0.60 b	0.85 a	0.84 a	0.80 ab
	5-10	0.74 A	0.71	0.77	0.76	0.57 Bb	0.75 a	0.71 a	0.78 a
	10-20	1.42 A	1.33	1.48 A	1.34	1.06 Bb	1.41a	1.15 Ba	1.15 a
	20-40	1.93	2.18	2.00 A	1.69	1.47	1.79	1.44 B	1.35
	40-60	1.53 A	1.72 A	1.58 A	1.21	1.07 B	1.23 B	0.98 B	0.97
	60-80	1.42 A	1.35 A	1.43 A	1.06	0.89 B	0.90 B	0.70 B	0.75
	80-100	1.39 A	1.33 A	1.29 A	0.96 A	0.66 B	0.69 B	0.53 B	0.59 B
CasEx	0-5	0.64 A	0.67	0.69	0.77	0.51 Bb	0.60 a	0.68 a	0.71 a
	5-10	0.74 A	0.73 A	0.73 A	0.84 A	0.56 B	0.63 B	0.64 B	0.61 B
	10-20	1.43 A	1.33 A	1.37 A	1.53 A	1.13 B	1.12 B	1.09 B	1.02 B
	20-40	1.99 Aa	1.72 Ab	1.95 Aa	2.19 Aa	1.32 B	1.24 B	1.41 B	1.19 B
	40-60	1.69 Aa	1.44 Ab	1.54 Aa	1.84 Aa	0.92 Ba	0.80 Ba	1.08 Ba	0.67 Bb
	60-80	1.57 Aa	1.31 Ab	1.29 Ab	1.72 Aa	0.76 Ba	0.65 Ba	0.82 Ba	0.51 Bb
	80-100	1.38 Aab	1.15 Ab	1.14 Ab	1.59 Aa	0.68 B	0.58 B	0.61 B	0.49 B

^a Experiments: MaiEx = Maize-based experiment, SoyEx = Soybean-based experiment, and CasEx = Cassava-based experiment.

^b Cropping systems: CTM: monocropping under conventional tillage; NTM: monocropping under NT systems with no-till mulch-based cropping systems associated with different crop sequences, and NTR1 and NTR2 refer to bi-annual crop rotational systems under NT systems with no-till mulch-based cropping systems associated with cropping systems as described in Table 1. The different uppercase letter accompanying the values indicates a significant difference within the same treatment and depth between 2011 and 2021 (diachronic), while the lowercase letter(s) indicate a significant difference between the treatments within the same sampling date at the same depth (synchronic) at $p < 0.05$ (Tukey's test).

Table S10. Cumulative SOC stock in 2011 and 2021.

Experiments ^a	Approximate soil depth (cm)	Cropping systems ^b							
		CTM	NTM	NTR1	NTR2	CTM	NTM	NTR1	NTR2
		Cumulative SOC stock 2011 (Mg C ha ⁻¹)				Cumulative SOC stock 2021 (Mg C ha ⁻¹)			
MaiEx	0-10	18.74 B	17.63 B	18.12 B	17.77 B	19.98 Ab	25.93 Aa	25.18 Aa	24.40 Aa
	0-20	34.73 B	32.87 B	32.71 B	32.23 B	38.26 A	42.24 A	42.26 A	40.72 A
	0-40	53.56 B	49.92 B	48.51 B	50.15 B	58.16 A	60.85 A	62.55 A	59.37 A
	0-60	66.55	61.27 B	60.22 B	62.28 B	70.74	73.03 A	75.29 A	71.68 A
	0-80	76.74	70.17 B	70.04 B	71.80 B	79.75	82.61 A	84.93 A	81.01 A
	0-100	85.18	77.16 B	78.19 B	79.68 B	86.92	90.13 A	92.90 A	88.27 A
SoyEx	0-10	18.95	18.91 B	19.23 B	18.77 B	19.41b	22.91 Aab	24.19 Aa	24.38 Aa
	0-20	36.23	35.94 B	34.85 B	35.44 B	37.76	39.70 A	41.46 A	41.81 A
	0-40	56.65	56.92	52.17 B	53.31 B	60.10	62.35	60.72 A	61.50 A
	0-60	70.47	71.75	63.90 B	64.70 B	75.30	78.21	73.72 A	74.59 A
	0-80	81.23	83.14	73.24 B	73.66 B	86.45	90.16	83.20 A	83.90 A
	0-100	90.44	93.00	81.05	81.12	95.22	99.53	90.23	91.15
CasEx	0-10	15.95 Bab	15.44 Bb	17.41 Bab	17.57 Ba	17.41 Ac	19.00 Abc	20.50 Aab	21.43 Aab
	0-20	32.18 B	29.63 B	33.14 B	31.97 B	34.56 Ab	35.66 Aab	37.13 Aab	37.66 Aa
	0-40	51.29	46.22 B	51.02 B	48.36 B	52.74	54.50 A	57.90 A	56.93 A
	0-60	64.86	58.21 B	63.80 B	60.10 B	65.86	67.93 A	71.84 A	69.92 A
	0-80	75.77	68.13 B	74.53 B	69.85 B	76.97	78.71 A	82.46 A	80.10 A
	0-100	85.09	76.74 B	84.10 B	78.55 B	86.44	87.42 A	91.07 A	88.01 A

^a Experiments: MaiEx = Maize-based experiment, SoyEx = Soybean-based experiment, and CasEx = Cassava-based experiment.

^b Cropping systems: CTM: monocropping under conventional tillage; NTM: monocropping under NT systems with no-till mulch-based cropping systems associated with different crop sequences, and NTR1 and NTR2 refer to bi-annual crop rotational systems under NT systems with no-till mulch-based cropping systems associated with cropping systems as described in Table 1. The different uppercase letter accompanying the values indicates significant difference within the same treatment between 2011 and 2021 (diachronic) at the same soil depth at $p < 0.05$ (Tukey's test). Values of cumulative SOC stock change in bold indicate changes for a given treatment and depth between 2021 and 2011 are significantly different from 0 at $p < 0.05$ (Tukey's test).

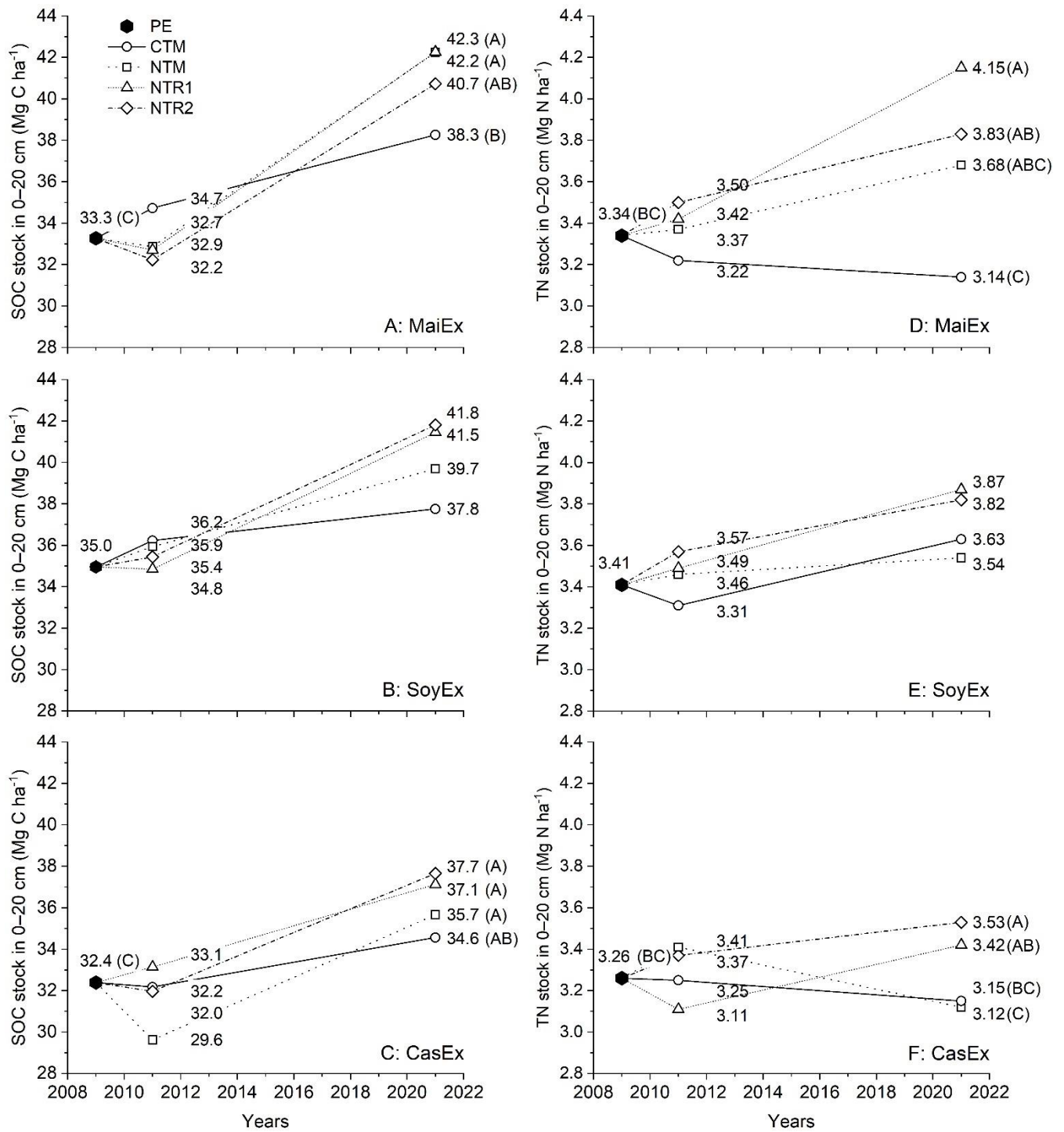


Figure S1. Dynamics of SOC and TN stocks (Mg ha⁻¹) in the 0–20 cm depth from the establishment of the experiments (2009) to 2021 with pre-experiment (PE) in 2009 for comparison with different treatments in 2011

and 2021. CTM: monocropping under conventional tillage; NTM: monocropping under NT systems with no-till mulch-based cropping systems associated with different crop sequences, and NTR1 and NTR2 refer to bi-annual crop rotational systems under NT systems with no-till mulch-based cropping systems associated with cropping systems as described in Table 1. A: MaiEx – SOC stock of PE and the treatments (2011–2021) in maize-based trial; B: SoyEx – SOC stock of PE and the treatments (2011–2021) in soybean-based trial; C: CasEx – SOC stock of PE and the treatments (2011–2021) in cassava-based trial; D: MaiEx – TN stock of PE and the treatments (2011–2021) in maize-based trial; E: SoyEx – TN stock of PE and the treatments (2011–2021) in soybean-based trial; and F: CasEx – TN stock of PE and the treatments (2011–2021) in cassava-based trial. Lowercase letters inside the brackets indicate significant difference between PE and the treatment(s) in 2011 and Uppercase letters inside the brackets indicate significant difference between PE and the treatment(s) in 2021 (Tukey’s test; $p < 0.05$).