

Supplementary data

Biogeochemical Cycling of Carbon and Nitrogen in Rainfed Rice Production Under Conventional and Organic Rice Farming

Table S1. Site number: (n=63), coordination, and particle size distribution of topsoil samples under conventional farming (CF, n=28) and organic farming (OF, n=35) in Amnat Charoen Province, Thailand

Conventional farming (CF)								Organic Farming (OF)							
Site No.	Latitude	Longitude	BD (g/cm ³)	Sand (%)	Silt (%)	Clay (%)	Soil texture	Site No.	Latitude	Longitude	BD (g/cm ³)	Sand (%)	Silt (%)	Clay (%)	Soil texture
CF01	15.8029N	104.8969E	1.48	51	37	12	Loam	OF01	15.7457N	104.8393E	1.46	76	18	6	Sandy Loam
CF02	15.6000N	104.5611E	1.57	87	8	5	Loamy Sand	OF02	15.7132N	104.8912E	1.54	55	32	13	Sandy Loam
CF03	15.8436N	104.8533E	1.54	85	10	5	Loamy Sand	OF03	15.7484N	104.8705E	1.44	72	20	8	Sandy Loam
CF04	15.7454N	104.7584E	1.59	77	16	7	Sandy Loam	OF04	16.0200N	104.5920E	1.55	77	11	12	Sandy Loam
CF05	15.9355N	104.6165E	1.36	71	20	9	Sandy Loam	OF05	15.7074N	104.6573E	1.33	84	12	4	Loamy Sand
CF06	15.7922N	104.5725E	1.53	72	18	10	Sandy Loam	OF06	15.7719N	104.5688E	1.46	79	16	5	Loamy Sand
CF07	15.8099N	104.6540E	1.56	75	17	8	Sandy Loam	OF07	15.6801N	104.5658E	1.54	87	9	4	Loamy Sand
CF08	15.6961N	104.8368E	1.50	71	19	10	Sandy Loam	OF08	15.8123N	104.8082E	1.31	64	30	6	Sandy Loam
CF09	16.0600N	104.6286E	1.39	69	25	6	Sandy Loam	OF09	15.8450N	104.8824E	1.57	65	20	15	Sandy Loam
CF10	16.0703N	104.6601E	1.53	71	17	12	Sandy Loam	OF10	15.7470N	104.5149E	1.53	73	19	8	Sandy Loam
CF11	16.0142N	104.5345E	1.59	65	23	12	Sandy Loam	OF11	15.7438N	104.6210E	1.69	85	9	6	Loamy Sand
CF12	16.0288N	104.6681E	1.47	46	27	27	Sandy Clay Loam	OF12	15.7453N	104.6420E	1.49	85	8	7	Loamy Sand
CF13	16.0418N	104.7335E	1.39	57	30	13	Sandy Loam	OF13	15.6894N	104.6288E	1.47	49	21	30	Sandy Clay Loam
CF14	15.8460N	104.4785E	1.32	61	31	8	Sandy Loam	OF14	15.6155N	104.5819E	1.55	84	10	6	Loamy Sand
CF15	15.8634N	104.5677E	1.39	63	29	8	Sandy Loam	OF15	15.9679N	104.5695E	1.48	65	20	15	Sandy Loam
CF16	15.8509N	104.6000E	1.49	77	15	8	Sandy Loam	OF16	15.9786N	104.6007E	1.43	73	22	5	Sandy Loam
CF17	15.7933N	104.7402E	1.57	67	24	9	Sandy Loam	OF17	15.9789N	104.6802E	1.30	71	19	10	Sandy Loam
CF18	15.6919N	104.7115E	1.58	85	7	8	Loamy Sand	OF18	15.8450N	104.6647E	1.35	67	26	7	Sandy Loam
CF19	15.6366N	104.8761E	1.47	78	14	8	Sandy Loam	OF19	15.8226N	104.5075E	1.37	73	22	5	Sandy Loam
CF20	15.9524N	104.7710E	1.43	70	15	15	Sandy Loam	OF20	15.7982N	104.6149E	1.46	80	16	4	Loamy Sand
CF21	15.9739N	104.8326E	1.56	40	45	15	Loam	OF21	15.8134N	104.7757E	1.55	72	23	5	Sandy Loam
CF22	15.9837N	105.0051E	1.36	70	12	18	Sandy Loam	OF22	15.7462N	104.4536E	1.25	81	17	2	Loamy Sand
CF23	15.9286N	104.5708E	1.62	88	6	6	Loamy Sand	OF23	15.7506N	104.7259E	1.48	76	19	5	Loamy Sand
CF24	15.9190N	104.7206E	1.46	71	22	7	Sandy Loam	OF24	15.6928N	104.7531E	1.45	60	17	23	Sandy Clay Loam

BD: Bulk density

Table S1. Site number: (n=63), coordination, and particle size distribution of topsoil samples under conventional farming (CF, n=28) and organic farming (OF, n=35) in Amnat Charoen Province, Thailand (cont.)

Conventional farming (CF)								Organic Farming (OF)							
Site No.	Latitude	Longitude	BD (g/cm ³)	Sand (%)	Silt (%)	Clay (%)	Soil texture	Site No.	Latitude	Longitude	BD (g/cm ³)	Sand (%)	Silt (%)	Clay (%)	Soil texture
CF25	15.9352N	104.7861E	1.50	74	12	14	Sandy Loam	OF25	15.6815N	104.5069E	1.45	75	21	4	Loamy Sand
CF26	15.9056N	104.8535E	1.53	83	10	7	Loamy Sand	OF26	15.6568N	104.8465E	1.47	82	11	7	Loamy Sand
CF27	15.8591N	104.7101E	1.44	81	13	6	Loamy Sand	OF27	16.0304N	104.7782E	1.54	83	11	6	Loamy Sand
CF28	15.9041N	104.9604E	1.42	86	8	6	Loamy Sand	OF28	16.0582N	104.5554E	1.40	69	26	5	Sandy Loam
								OF29	15.9724N	104.7141E	1.41	56	25	19	Sandy Loam
								OF30	15.9824N	104.8698E	1.55	70	10	20	Sandy Clay Loam
								OF31	15.9601N	104.9426E	1.44	62	25	13	Sandy Loam
								OF32	15.9299N	104.6826E	1.50	78	14	8	Sandy Loam
								OF33	15.9192N	104.8951E	1.46	83	12	5	Loamy Sand
								OF34	15.8705N	104.7715E	1.50	69	20	11	Sandy Loam
								OF35	15.8701N	104.9364E	1.52	58	36	6	Sandy Loam
Min			1.32	40	6	5		Min			1.25	49	8	2	
Max			1.62	88	45	27		Max			1.69	87	36	30	
Mean			1.49	71	19	10		Mean			1.47	72	19	9	
Median			1.50	71	17	8		Median			1.47	73	19	6	
SD			0.08	12	10	5		SD			0.09	10	7	6	

BD: Bulk density

Table S2. Carbon and nitrogen influxes from chemical fertilizers, animal manure, and green manure under conventional farming (CF, n=28) and organic farming (OF, n=35).

Site No.	Chemical fertilizer			Chicken manure			Cow manure			Green manure ²			
	Application rate ¹			Application rate	C content	N content	Application rate	C content	N content	Application rate	C content	N content	
	N	P ₂ O ₅	K ₂ O										(g/ha/year)
Conventional farming (CF)													
CF01	40	40	20	-	-	-	1250	356	13	-	-	-	
CF02	28	28	66	-	-	-	-	-	-	-	-	-	
CF03	10	10	5	-	-	-	-	-	-	-	-	-	
CF04	10	13	0	-	-	-	625	356	13	-	-	-	
CF05	10	13	0	-	-	-	625	356	13	-	-	-	
CF06	9	9	9	-	-	-	-	-	-	3125	574	27	
CF07	20	20	10	-	-	-	625	356	13	-	-	-	
CF08	20	25	38	-	-	-	-	-	-	-	-	-	
CF09	28	28	66	-	-	-	231	356	13	-	-	-	
CF10	10	10	5	-	-	-	-	-	-	-	-	-	
CF11	19	19	56	-	-	-	-	-	-	3125	574	27	
CF12	57	14	14	-	-	-	-	-	-	-	-	-	
CF13	25	31	0	-	-	-	1875	356	13	-	-	-	
CF14	10	13	0	938	308	16	-	-	-	-	-	-	
CF15	57	14	14	-	-	-	625	356	13	-	-	-	
CF16	10	10	5	-	-	-	3750	356	13	-	-	-	
CF17	19	19	56	-	-	-	625	356	13	-	-	-	
CF18	10	10	5	-	-	-	-	-	-	-	-	-	
CF19	19	19	56	1250	308	16	-	-	-	-	-	-	
CF20	9	9	9	-	-	-	-	-	-	-	-	-	
CF21	25	25	13	-	-	-	1563	356	13	-	-	-	
CF22	10	13	0	-	-	-	313	356	13	-	-	-	
CF23	25	31	0	-	-	-	1250	356	13	-	-	-	
CF24	48	19	19	-	-	-	1875	356	13	-	-	-	
CF25	10	13	0	-	-	-	-	-	-	-	-	-	
CF26	47	47	122	1250	308	16	-	-	-	-	-	-	

¹ Chemical fertilizer application rate was calculated from chemical fertilizers used in the study area: 46-0-0, 15-15-15, 16-16-8, 16-20-0 and 0-0-60.² Green manure: Sun hemp

Table S2. Carbon and nitrogen influxes from chemical fertilizers, animal manure, and green manure under conventional farming (CF, n=28) and organic farming (OF, n=35) (cont.).

Site No.	Chemical fertilizer			Chicken manure			Cow manure			Green manure ²		
	Application rate ¹			Application rate	C content	N content	Application rate	C content	N content	Application rate	C content	N content
	N	P ₂ O ₅	K ₂ O									
	(kg/ha/year)			(kg/ha/year)	(g/kg)		(kg/ha/year)	(g/kg)		(kg/ha/year)	(g/kg)	
CF27	28	28	66	1250	308	16	-	-	-	-	-	-
CF28	10	13	38	-	-	-	3125	356	13	-	-	-
Organic farming (OF)												
OF01	-	-	-	188	308	16	-	-	-	-	-	-
OF02	-	-	-	-	-	-	2500	356	13	-	-	-
OF03	-	-	-	3125	308	16	-	-	-	-	-	-
OF04	-	-	-	-	-	-	3438	356	13	-	-	-
OF05	-	-	-	-	-	-	2188	356	13	-	-	-
OF06	-	-	-	-	-	-	1875	356	13	-	-	-
OF07	-	-	-	1875	308	16	781	356	13	-	-	-
OF08	-	-	-	-	-	-	2500	356	13	3125	574	27
OF09	-	-	-	1250	308	16	-	-	-	-	-	-
OF10	-	-	-	1563	308	16	625	356	13	-	-	-
OF11	-	-	-	-	-	-	500	356	13	-	-	-
OF12	-	-	-	-	-	-	3125	356	13	-	-	-
OF13	-	-	-	-	-	-	1625	356	13	-	-	-
OF14	-	-	-	-	-	-	625	356	13	3125	574	27
OF15	-	-	-	-	-	-	750	356	13	-	-	-
OF16	-	-	-	-	-	-	625	356	13	-	-	-
OF17	-	-	-	-	-	-	1875	356	13	-	-	-
OF18	-	-	-	-	-	-	5000	356	13	-	-	-
OF19	-	-	-	-	-	-	625	356	13	-	-	-
OF20	-	-	-	-	-	-	1250	356	13	3125	574	27
OF21	-	-	-	-	-	-	5625	356	13	-	-	-
OF22	-	-	-	1250	308	16	313	356	13	-	-	-
OF23	-	-	-	625	308	16	-	-	-	-	-	-
OF24	-	-	-	-	-	-	3125	356	13	-	-	-

¹Chemical fertilizer application rate was calculated from chemical fertilizers used in the study area: 46-0-0, 15-15-15, 16-16-8, 16-20-0 and 0-0-60.² Green manure: Sun hemp

Table S2. Carbon and nitrogen influxes from chemical fertilizers, animal manure, and green manure under conventional farming (CF, n=28) and organic farming (OF, n=35) (cont.).

Site No.	Chemical fertilizer			Chicken manure			Cow manure			Green manure ²		
	Application rate ¹			Application rate	C content	N content	Application rate	C content	N content	Application rate	C content	N content
	N	P ₂ O ₅	K ₂ O									
	(kg/ha/year)			(kg/ha/year)	(g/kg)		(kg/ha/year)	(g/kg)		(kg/ha/year)	(g/kg)	
OF25	-	-	-	-	-	-	1125	356	13	-	-	-
OF26	-	-	-	-	-	-	625	356	13	-	-	-
OF27	-	-	-	-	-	-	-	-	-	3125	574	27
OF28	-	-	-	-	-	-	1250	356	13	-	-	-
OF29	-	-	-	-	-	-	625	356	13	3125	574	27
OF30	-	-	-	938	308	16	-	-	-	-	-	-
OF31	-	-	-	1563	308	16	-	-	-	-	-	-
OF32	-	-	-	188	308	16	625	356	13	-	-	-
OF33	-	-	-	1875	308	16	-	-	-	-	-	-
OF34	-	-	-	313	308	16	625	356	13	3125	574	27
OF35	-	-	-	188	308	16	-	-	-	-	-	-

¹Chemical fertilizer application rate was calculated from chemical fertilizers used in the study area: 46-0-0, 15-15-15, 16-16-8, 16-20-0 and 0-0-60.

² Green manure: Sun hemp

Table S3. Range (minimum-maximum) and average (mean±SD) of the carbon and nitrogen concentrations in different parts of rice plants under conventional farming (CF, n=28) and organic farming (OF, n=35).

Nutrients	Practices	C and N concentration							F-test
		Root (g/kg)	Stubble (g/kg)	Straw (g/kg)	Whole grains (g/kg)	Rice husk (g/kg)	Brown rice (g/kg)	White rice (g/kg)	
Total C	CF	153.84-408.8	338.1-465.11	365.9-423-17	368.81-459.46	332.4-437.57	391.4-435.1	387.92-422.8	
		334±65.32 ^c	394.69 ±22.80 ^b	402.2±12.99 ^{ab}	403.84±13.81 ^{ab}	394.2±24.98 ^b	411.98±11.37 ^a	403.88±5.95 ^{ab}	
	OF	188.35-416.2	362.28-429.47	380.8-424.42	391.6-465.39	357.3-444.91	382.14-439.32	344.6-417.66	
		339.39±51.85 ^c	397.61±15.69 ^b	406.2±9.95 ^{ab}	408.98±12.10 ^{ab}	403.9±20.08 ^{ab}	412.44±12.25 ^a	401.05±11.46 ^{ab}	
T-test		ns	ns	ns	ns	ns	ns	ns	
Total N	CF	3.86-8.99	2.61-5.32	2.98-10.35	7.46-13.32	2.75-5.19	9.37-17.41	8.48-12.73	
		6.77±1.44 ^d	3.98±0.76 ^f	5.96±1.41 ^e	10.06±1.32 ^c	3.56±0.52 ^f	12.82±1.56 ^a	10.71±1.07 ^b	
	OF	4.00-10.1	2.67-7.07	3.66-9.08	7.75-14.81	2.75-4.86	9.59-16.74	8.83-14.78	
		7.51±1.49 ^c	4.26±0.90 ^e	6.12±1.25 ^d	10.48±1.48 ^b	3.7±0.53 ^e	12.64±1.64 ^a	10.88±1.47 ^b	
T-test		ns	ns	ns	ns	ns	ns	ns	

Different letters above mean values indicate statistical difference by F-test at p<0.05. ns indicates non statistical difference by T-test at p<0.05.

Table S4. Concentrations of C and N in different rice parts, and C and N influxes and effluxes under conventional farming (CF, n=28) and organic farming (OF, n=35).

Site No.	Carbon concentration (g C/kg)				Nitrogen concentration (g N/kg)				Carbon influxes/effluxes (kg C/ha)				Nitrogen influxes/effluxes (kg N/ha)			
	Root	Stubble	Straw	Grain	Root	Stubble	Straw	Grain	Root ¹	Stubble ¹	Straw ²	Grain ²	Root ¹	Stubble ¹	Straw ²	Grain ²
Conventional farming (CF)																
CF01	404.82	367.31	365.88	391.65	6.38	3.17	4.66	8.50	51.29	418.66	1856.91	1772.59	0.81	3.61	23.63	38.47
CF02	241.30	410.99	423.12	410.19	5.51	4.74	6.14	9.14	317.74	798.63	1526.03	968.32	7.25	9.22	22.15	21.57
CF03	408.84	406.81	414.92	407.62	7.87	3.83	6.71	10.85	54.29	155.56	1246.49	889.17	1.05	1.46	20.16	23.66
CF04	339.67	399.50	410.22	407.25	5.93	5.02	7.96	11.01	480.47	656.30	1706.96	1257.85	8.38	8.24	33.10	34.00
CF05	380.90	392.63	399.57	402.99	6.46	5.19	10.35	12.55	115.76	329.65	1230.95	1052.72	1.96	4.35	31.90	32.79
CF06	266.03	373.26	392.66	400.16	5.90	4.42	5.66	10.64	148.36	384.72	1600.85	1129.96	3.29	4.56	23.10	30.04
CF07	153.84	360.10	388.45	391.67	3.86	4.89	7.24	10.78	611.22	506.55	2750.28	2113.10	15.36	6.87	51.23	58.15
CF08	263.05	380.72	395.00	392.89	7.38	4.22	5.44	9.02	161.75	143.84	1074.99	893.38	4.54	1.60	14.80	20.50
CF09	309.25	386.84	399.71	397.99	8.83	4.45	6.07	8.29	464.06	714.12	1814.24	1648.53	13.25	8.22	27.56	34.34
CF10	371.67	410.07	408.10	402.12	7.35	4.52	7.22	9.66	274.14	824.77	1857.98	1557.79	5.42	9.08	32.85	37.43
CF11	371.34	376.22	397.14	404.69	7.22	3.58	5.89	10.50	197.51	1035.81	1861.78	1212.56	3.84	9.86	27.62	31.46
CF12	390.11	392.24	399.79	400.75	5.36	3.07	5.46	9.90	240.66	949.03	1443.33	1288.88	3.31	7.43	19.70	31.83
CF13	406.46	405.38	398.77	408.69	5.93	4.02	5.88	10.02	134.42	634.83	1339.82	1444.17	1.96	6.29	19.75	35.40
CF14	387.69	411.26	413.82	407.85	8.08	3.98	4.62	10.55	399.71	726.95	1289.96	1134.05	8.33	7.04	14.41	29.34
CF15	341.70	395.09	396.16	401.40	7.37	3.53	5.92	10.54	298.78	493.98	1602.10	1022.96	6.44	4.41	23.94	26.86
CF16	358.33	400.47	402.70	402.89	8.59	3.45	4.27	8.56	271.08	290.26	1763.79	1566.09	6.50	2.50	18.68	33.26
CF17	366.83	398.50	402.12	400.71	5.41	3.39	5.67	9.32	395.88	844.26	1660.83	1487.32	5.84	7.19	23.42	34.59
CF18	383.12	406.89	396.19	402.62	8.99	5.20	5.40	13.32	631.88	518.90	1603.86	1554.00	14.83	6.63	21.85	51.40
CF19	273.78	389.02	392.91	405.75	7.06	3.92	7.01	11.53	154.58	356.35	1703.26	1039.77	3.99	3.59	30.39	29.54
CF20	315.92	380.19	397.13	402.74	8.44	3.46	5.32	9.62	237.22	897.17	1418.56	1646.19	6.34	8.18	19.02	39.33
CF21	343.32	373.96	380.63	368.81	4.60	2.61	2.98	7.46	216.84	452.34	1051.46	742.64	2.91	3.16	8.23	15.03
CF22	365.37	396.60	409.56	411.67	7.51	2.91	4.35	10.26	147.90	292.45	1079.92	675.69	3.04	2.14	11.47	16.83
CF23	387.16	409.61	423.17	411.93	8.62	4.40	5.63	10.83	119.67	356.69	680.58	713.36	2.66	3.83	9.06	18.75
CF24	266.89	399.62	404.78	399.56	4.70	3.05	5.42	9.09	405.72	815.75	2737.91	1812.50	7.15	6.23	36.63	41.25
CF25	227.01	465.11	395.46	397.68	4.40	5.32	4.68	9.24	568.63	1083.53	1343.53	1291.18	11.01	12.38	15.89	30.01
CF26	273.93	338.10	412.64	405.73	7.41	3.42	7.75	10.22	185.40	215.20	1594.93	840.68	5.02	2.17	29.97	21.18
CF27	406.21	417.45	421.60	459.46	7.86	4.40	6.88	11.87	250.99	777.01	1552.53	1790.88	4.86	8.19	25.35	46.25
CF28	347.38	407.43	420.41	409.98	6.62	3.35	6.30	8.55	88.44	260.43	1319.13	982.03	1.68	2.14	19.78	20.48

¹ and ² indicate influxes and effluxes, respectively.

Table S4. Concentrations of C and N in different rice parts, and C and N influxes and effluxes under conventional farming (CF, n=28) and organic farming (OF, n=35) (cont.).

Site No.	Carbon concentration (g C/kg)				Nitrogen concentration (g N/kg)				Carbon influxes/effluxes (kg C/ha)				Nitrogen influxes/effluxes (kg N/ha)			
	Root	Stubble	Straw	Grain	Root	Stubble	Straw	Grain	Root ¹	Stubble ¹	Straw ²	Grain ²	Root ¹	Stubble ¹	Straw ²	Grain ²
Min	153.84	338.10	365.88	368.81	3.86	2.61	2.98	7.46	51.29	143.84	680.58	675.69	0.81	1.46	8.23	15.03
Max	408.84	465.11	423.17	459.46	8.99	5.32	10.35	13.32	631.88	1083.53	2750.28	2113.10	15.36	12.38	51.23	58.15
Mean	334.00	394.69	402.24	403.84	6.77	3.98	5.96	10.06	272.30	569.06	1561.18	1268.87	5.75	5.74	23.42	31.56
Median	352.86	397.55	399.75	402.82	7.14	3.95	5.77	10.12	238.94	512.73	1573.73	1235.21	4.94	6.26	22.62	31.65
SD	65.32	22.80	12.99	13.81	1.44	0.76	1.41	1.32	165.21	275.34	438.97	381.63	3.93	2.90	9.07	10.18
Organic farming (OF)																
OF01	416.20	417.18	412.96	413.75	7.88	3.30	4.97	9.44	313.86	599.74	1049.09	626.24	5.95	4.75	12.62	14.29
OF02	400.78	405.37	409.23	412.97	7.33	4.79	5.61	10.01	320.02	456.53	1576.74	1033.30	5.85	5.39	21.62	25.05
OF03	391.73	389.99	405.34	410.10	7.74	4.28	7.18	11.28	280.16	565.02	954.50	964.58	5.54	6.20	16.90	26.53
OF04	360.80	405.94	402.98	405.23	8.79	4.20	6.38	8.51	519.80	770.67	1237.94	1284.37	12.67	7.98	19.60	26.97
OF05	373.37	391.49	401.78	402.83	10.10	4.30	7.00	11.17	512.22	763.41	1540.14	1325.61	13.86	8.38	26.82	36.77
OF06	403.29	362.28	380.80	391.60	8.73	4.18	6.65	10.53	493.43	668.61	1261.14	1098.98	10.68	7.72	22.02	29.55
OF07	345.10	428.18	420.79	410.38	9.22	4.90	5.10	12.05	538.49	808.36	1448.65	839.39	14.39	9.26	17.54	24.64
OF08	381.71	382.59	392.86	401.72	8.01	6.01	9.04	10.89	511.73	843.54	1866.83	1521.42	10.74	13.24	42.97	41.25
OF09	313.18	394.19	409.74	406.58	6.41	3.91	6.32	11.79	550.20	765.12	1486.78	1113.91	11.25	7.60	22.92	32.31
OF10	344.73	389.31	406.12	402.01	7.72	4.18	4.63	8.61	605.49	677.33	1941.72	1198.45	13.55	7.28	22.16	25.66
OF11	309.84	390.02	403.11	403.11	8.93	4.22	5.37	9.54	214.75	579.29	1710.34	1518.38	6.19	6.27	22.78	35.95
OF12	310.57	362.30	390.94	398.51	7.04	3.67	7.73	10.54	376.29	524.47	1140.24	1154.20	8.52	5.32	22.55	30.53
OF13	188.35	368.56	397.12	403.84	5.28	6.19	9.08	14.81	161.40	366.43	958.05	573.22	4.52	6.16	21.91	21.03
OF14	317.22	403.01	419.57	404.56	8.06	5.50	6.67	10.30	442.20	1033.16	1642.20	802.89	11.24	14.09	26.11	20.44
OF15	224.21	392.37	403.71	409.26	4.00	2.67	5.62	9.43	258.45	728.70	1297.03	1090.88	4.62	4.95	18.05	25.14
OF16	306.86	399.11	410.89	415.10	9.53	4.50	6.42	12.81	474.01	1228.05	1172.51	858.93	14.73	13.85	18.33	26.50
OF17	335.81	395.18	410.27	403.96	6.92	3.42	4.54	7.75	226.74	511.32	1171.00	954.04	4.67	4.43	12.97	18.30
OF18	334.23	429.47	420.75	409.56	8.49	5.32	6.65	10.61	552.82	889.83	1712.67	1257.51	14.04	11.03	27.08	32.58
OF19	383.52	395.92	395.79	404.28	8.40	4.48	7.63	10.38	491.71	712.74	1069.26	876.38	10.77	8.06	20.60	22.50
OF20	384.30	395.87	400.87	404.89	6.81	3.49	6.72	10.82	556.04	914.35	1318.22	1199.21	9.86	8.06	22.11	32.04
OF21	322.31	417.58	413.55	403.79	6.25	3.62	4.64	9.59	472.19	785.54	1127.42	976.12	9.16	6.80	12.65	23.17
OF22	347.90	414.37	424.42	428.48	9.35	4.45	7.17	11.35	792.68	846.89	1785.63	1163.91	21.30	9.09	30.17	30.83

¹ and ² indicate influxes and effluxes, respectively.

Table S4. Concentrations of C and N in different rice parts, and C and N influxes and effluxes under conventional farming (CF, n=28) and organic farming (OF, n=35) (cont.).

Site No.	Carbon concentration (g C/kg)				Nitrogen concentration (g N/kg)				Carbon influxes/effluxes (kg C/ha)				Nitrogen influxes/effluxes (kg N/ha)			
	Root	Stubble	Straw	Grain	Root	Stubble	Straw	Grain	Root ¹	Stubble ¹	Straw ²	Grain ²	Root ¹	Stubble ¹	Straw ²	Grain ²
OF23	374.58	409.44	402.10	411.00	7.41	4.13	6.35	9.27	517.78	839.92	1275.26	1220.62	10.24	8.48	20.14	27.54
OF24	318.42	409.70	408.34	407.89	7.31	4.07	3.66	9.20	722.55	1042.48	1822.10	1104.56	16.59	10.36	16.34	24.92
OF25	373.65	417.46	423.10	415.44	8.14	7.07	6.12	12.97	660.91	974.47	1099.86	1214.01	14.40	16.51	15.92	37.91
OF26	289.34	397.79	415.41	405.79	9.43	4.60	5.54	9.12	550.12	964.32	1217.79	810.41	17.94	11.14	16.24	18.21
OF27	370.15	396.79	415.10	407.92	7.89	3.80	4.58	8.14	260.36	296.68	1018.70	839.27	5.55	2.84	11.25	16.75
OF28	335.75	410.72	409.33	406.02	9.66	3.82	5.33	9.64	538.30	965.97	1763.39	1377.36	15.49	8.97	22.98	32.70
OF29	315.97	385.62	403.81	427.80	6.62	4.05	6.47	11.21	499.07	1061.68	1447.55	1285.12	10.45	11.14	23.18	33.66
OF30	293.74	385.74	398.57	403.91	5.25	3.85	5.47	10.08	507.65	863.70	1655.49	1214.51	9.07	8.62	22.71	30.30
OF31	346.47	396.96	396.18	400.11	6.73	3.99	4.70	10.86	493.72	625.61	2446.16	1218.05	9.59	6.29	29.04	33.05
OF32	233.73	386.19	393.87	401.57	4.92	4.21	5.95	11.45	341.61	900.32	1571.16	1398.57	7.19	9.82	23.73	39.88
OF33	383.71	390.76	413.00	409.55	5.56	3.04	6.43	10.02	520.59	858.74	1235.86	1283.36	7.54	6.68	19.24	31.39
OF34	337.65	403.91	409.13	465.39	5.76	3.31	4.84	12.75	320.50	736.21	2419.37	1747.02	5.47	6.03	28.62	47.85
OF35	409.60	395.01	396.47	405.45	7.09	3.72	7.67	9.95	282.46	486.73	1744.24	848.66	4.89	4.59	33.75	20.84
Min	188.35	362.28	380.80	391.60	4.00	2.67	3.66	7.75	161.40	296.68	954.50	573.22	4.52	2.84	11.25	14.29
Max	416.20	429.47	424.42	465.39	10.10	7.07	9.08	14.81	792.68	1228.05	2446.16	1747.02	21.30	16.51	42.97	47.85
Mean	339.39	397.61	406.23	408.98	7.51	4.26	6.12	10.48	453.72	761.60	1462.43	1114.10	10.24	8.21	21.82	28.49
Median	344.73	395.92	406.12	405.79	7.72	4.18	6.32	10.38	493.72	770.67	1447.55	1154.20	10.24	7.98	22.02	27.54
SD	51.85	15.69	9.95	12.10	1.49	0.90	1.25	1.48	147.46	209.10	373.48	256.11	4.27	3.05	6.37	7.42

¹ and ² indicate influxes and effluxes, respectively.

Table S5. Effluxes of C emission from rice production and N emission from managed soils in Amnat Charoen Province under conventional farming (CF, n=28) and organic farming (OF, n=35).

Site No.	C efflux		N efflux				
	SF ₀ ¹	C emission ² (Mg C/ha)	R ³	F _{SOM} ⁴	The direct N ₂ O emission ⁵ (kg N/ha)	The indirect N ₂ O emission ⁶ (kg N/ha)	N emission ⁷ (kg N/ha)
Conventional farming (CF)							
CF01	1.38	0.13	7.96	147.30	0.63	0.54	1.17
CF02	1.48	0.14	6.40	183.42	0.68	0.54	1.23
CF03	1.09	0.10	10.12	115.93	0.37	0.28	0.65
CF04	1.54	0.15	7.95	147.51	0.55	0.44	0.98
CF05	1.28	0.12	5.76	203.59	0.68	0.54	1.23
CF06	1.25	0.12	8.54	137.33	0.69	0.69	1.38
CF07	1.81	0.17	7.97	147.14	0.59	0.48	1.07
CF08	1.16	0.11	7.63	153.78	0.54	0.42	0.96
CF09	1.52	0.14	6.73	174.30	0.68	0.55	1.23
CF10	1.41	0.13	5.80	202.30	0.68	0.52	1.20
CF11	1.48	0.14	5.05	232.17	1.05	0.98	2.02
CF12	1.45	0.14	4.90	239.19	0.92	0.75	1.67
CF13	1.55	0.15	6.64	176.56	0.70	0.60	1.31
CF14	1.54	0.15	9.44	124.27	0.49	0.41	0.90
CF15	1.41	0.13	6.91	169.86	0.74	0.63	1.37
CF16	1.72	0.16	5.50	213.30	0.85	0.75	1.59
CF17	1.55	0.15	7.46	157.16	0.59	0.48	1.07
CF18	1.44	0.14	11.57	101.39	0.40	0.31	0.71
CF19	1.41	0.13	6.08	192.86	0.72	0.60	1.31
CF20	1.46	0.14	8.69	135.03	0.48	0.37	0.84
CF21	1.50	0.14	8.51	137.85	0.57	0.49	1.06
CF22	1.23	0.12	5.04	232.58	0.76	0.59	1.34
CF23	1.37	0.13	4.23	277.26	0.98	0.79	1.77
CF24	1.75	0.17	10.72	109.41	0.59	0.54	1.12

¹ SF₀ was calculated from the application rate of organic amendment applied sources multiply by the conversion factor for organic amendment as follows: $(1 + \sum ROA_i \times CFA_i)^{0.59}$

² C emission was calculated from CH₄ emission by multiplying the emissions factor (SF_w × SF_p × SF₀) by the cultivation period of rice (115 days) in mg C/ha.

³ R was C:N ratio of the soil organic matter in each area.

⁴ F_{SOM} was annual amount of mineralized N in soils related to C loss from soils calculated from $\Sigma[\Delta C_{\text{Mineral}} \times 1/R] \times 1,000$

⁵ The direct N₂O emission from chemical and organic fertilizer was calculated from $[(F_{\text{SN}} + F_{\text{ON}} + F_{\text{CR}} + F_{\text{SOM}}) \times EF_{\text{1FR}}]$

⁶ The indirect N₂O emission was calculated from $[F_{\text{SN}} \times \text{Fra}_{\text{GASF}} + F_{\text{ON}} \times \text{Fra}_{\text{GASM}}] \times EF_4 + [(F_{\text{SN}} + F_{\text{ON}} + F_{\text{CR}} + F_{\text{SOM}}) \times \text{Fra}_{\text{Leach-(H)}} \times EF_5]$

Table S5. Effluxes of C emission from rice production and N emission from managed soils in Amnat Charoen Province under conventional farming (CF, n=28) and organic farming (OF, n=35) (cont.).

Site No.	C efflux		N efflux				
	SF ₀ ¹	C emission ² (Mg C/ha)	R ³	F _{SOM} ⁴	The direct N ₂ O emission ⁵ (kg N/ha)	The indirect N ₂ O emission ⁶ (kg N/ha)	N emission ⁷ (kg N/ha)
CF25	1.68	0.16	4.97	235.92	0.81	0.62	1.42
CF26	1.39	0.13	6.14	191.03	0.79	0.68	1.48
CF27	1.54	0.15	4.89	239.64	0.90	0.74	1.64
CF28	1.58	0.15	4.69	250.09	0.92	0.78	1.70
Min	1.09	0.10	4.23	101.39	0.37	0.28	0.65
Max	1.81	0.17	11.57	277.26	1.05	0.98	2.02
Mean	1.46	0.14	7.01	179.58	0.69	0.57	1.27
Median	1.47	0.14	6.69	175.43	0.68	0.54	1.23
SD	0.17	0.02	1.95	47.55	0.17	0.16	0.32
OF01	1.36	0.13	2.80	418.70	1.30	0.98	2.28
OF02	1.63	0.15	5.13	228.70	0.82	0.68	1.50
OF03	1.73	0.16	6.85	171.28	0.70	0.62	1.32
OF04	1.90	0.18	2.91	402.57	1.41	1.15	2.56
OF05	1.76	0.17	4.97	235.97	0.86	0.71	1.57
OF06	1.69	0.16	5.49	213.48	0.77	0.63	1.40
OF07	1.82	0.17	3.11	377.71	1.32	1.07	2.40
OF08	1.82	0.17	7.27	161.24	0.91	0.92	1.83
OF09	1.69	0.16	8.01	146.44	0.55	0.46	1.01
OF10	1.78	0.17	6.67	175.86	0.69	0.58	1.27
OF11	1.40	0.13	6.39	183.65	0.61	0.47	1.08
OF12	1.79	0.17	4.43	264.93	0.96	0.81	1.77
OF13	1.51	0.14	9.57	122.61	0.47	0.39	0.86
OF14	1.65	0.16	5.40	217.31	1.01	0.94	1.95
OF15	1.55	0.15	2.68	437.86	1.37	1.05	2.42

¹ SF₀ was calculated from the application rate of organic amendment applied sources multiply by the conversion factor for organic amendment as follows: $(1 + \sum ROA_i \times CFA_i)^{0.59}$

² C emission was calculated from CH₄ emission by multiplying the emissions factor (SF_w × SF_p × SF₀) by the cultivation period of rice (115 days) in mg C/ha.

³ R was C:N ratio of the soil organic matter in each area.

⁴ F_{SOM} was annual amount of mineralized N in soils related to C loss from soils calculated from $\sum [\Delta C_{\text{Mineral}} \times 1/R] \times 1,000$

⁵ The direct N₂O emission from chemical and organic fertilizer was calculated from $[(F_{\text{SN}} + F_{\text{ON}} + F_{\text{CR}} + F_{\text{SOM}}) \times EF_{1\text{FR}}]$

⁶ The indirect N₂O emission was calculated from $[F_{\text{SN}} \times \text{Frac}_{\text{GASF}} + F_{\text{ON}} \times \text{Frac}_{\text{GASM}}] \times EF_4 + [(F_{\text{SN}} + F_{\text{ON}} + F_{\text{CR}} + F_{\text{SOM}}) \times \text{Frac}_{\text{Leach-(H)}} \times EF_5]$

Table S5. Effluxes of C emission from rice production and N emission from managed soils in Amnat Charoen Province under conventional farming (CF, n=28) and organic farming (OF, n=35) (cont.).

Site No.	C efflux		N efflux				
	SF ₀ ¹	C emission ² (Mg C/ha)	R ³	F _{SOM} ⁴	The direct N ₂ O emission ⁵ (kg N/ha)	The indirect N ₂ O emission ⁶ (kg N/ha)	N emission ⁷ (kg N/ha)
OF16	1.73	0.16	1.79	656.05	2.08	1.58	3.66
OF17	1.56	0.15	4.71	249.05	0.85	0.69	1.54
OF18	2.10	0.20	4.69	250.11	1.03	0.90	1.93
OF19	1.54	0.15	5.43	215.88	0.73	0.56	1.29
OF20	1.70	0.16	2.67	439.74	1.68	1.46	3.14
OF21	2.13	0.20	2.28	513.49	1.81	1.51	3.33
OF22	1.80	0.17	4.05	289.46	1.03	0.82	1.85
OF23	1.58	0.15	2.29	512.35	1.62	1.24	2.86
OF24	2.02	0.19	4.61	254.68	0.97	0.81	1.78
OF25	1.72	0.16	3.97	295.69	1.03	0.80	1.82
OF26	1.69	0.16	6.67	175.76	0.64	0.50	1.14
OF27	1.23	0.12	3.52	332.93	1.28	1.13	2.41
OF28	1.72	0.16	3.95	296.89	1.01	0.79	1.81
OF29	1.69	0.16	4.88	240.16	1.07	0.99	2.05
OF30	1.69	0.16	5.73	204.70	0.71	0.56	1.27
OF31	1.64	0.16	6.90	169.88	0.63	0.52	1.15
OF32	1.65	0.16	10.03	117.01	0.44	0.35	0.79
OF33	1.75	0.17	7.95	147.53	0.57	0.49	1.06
OF34	1.54	0.15	7.00	167.67	0.83	0.82	1.65
OF35	1.33	0.13	5.93	197.66	0.63	0.48	1.11
Min	1.23	0.12	1.79	117.01	0.44	0.35	0.79
Max	2.13	0.20	10.03	656.05	2.08	1.58	3.66
Mean	1.68	0.16	5.16	271.00	0.98	0.81	1.80
Median	1.69	0.16	4.97	235.97	0.91	0.80	1.77
SD	0.19	0.02	2.05	126.83	0.39	0.32	0.71

¹ SF₀ was calculated from the application rate of organic amendment applied sources multiply by the conversion factor for organic amendment as follows: $(1 + \sum ROA_i \times CFA_i)^{0.59}$

² C emission was calculated from CH₄ emission by multiplying the emissions factor (SF_w × SF_p × SF₀) by the cultivation period of rice (115 days) in mg C/ha.

³ R was C:N ratio of the soil organic matter in each area.

⁴ F_{SOM} was annual amount of mineralized N in soils related to C loss from soils calculated from $\Sigma[\Delta C_{\text{Mineral}} \times 1/R] \times 1,000$

⁵ The direct N₂O emission from chemical and organic fertilizer was calculated from $[(F_{\text{SN}} + F_{\text{ON}} + F_{\text{CR}} + F_{\text{SOM}}) \times EF_{\text{1FR}}]$

⁶ The indirect N₂O emission was calculated from $[F_{\text{SN}} \times \text{Fra}_{\text{GASF}} + F_{\text{ON}} \times \text{Fra}_{\text{GASM}}] \times EF_4 + [(F_{\text{SN}} + F_{\text{ON}} + F_{\text{CR}} + F_{\text{SOM}}) \times \text{Fra}_{\text{Leach-(H)}} \times EF_5]$

Table S6. Influxes of N from rainwater of rice paddies in Amnat Charoen Province under conventional farming (CF, n=28) and organic farming (OF, n=35).

Conventional farming (CF)					Organic Farming (OF)				
Site No.	N influxes from Rainwater				Site No.	N influxes from Rainwater			
	Amount	NO ₃ ^{-1/}	NH ₄ ^{+ 2/}	N total		Amount	NO ₃ ^{-1/}	NH ₄ ^{+ 2/}	N total
	(mm/year)	(kg N/ha/year)				(mm/year)	(kg N/ha/year)		
CF01	1676	0.058	0.477	0.535	OF01	1262.3	0.0433	0.3593	0.40
CF02	1717	0.059	0.489	0.548	OF02	1262.3	0.0433	0.3593	0.40
CF03	1676	0.058	0.477	0.535	OF03	1262.3	0.0433	0.3593	0.40
CF04	1304	0.045	0.371	0.416	OF04	1653.8	0.0568	0.4708	0.53
CF05	1298	0.045	0.369	0.414	OF05	1303.9	0.0448	0.3712	0.42
CF06	1298	0.045	0.369	0.414	OF06	1297.5	0.0445	0.3694	0.41
CF07	1298	0.045	0.369	0.414	OF07	1717.2	0.0589	0.4888	0.55
CF08	1262	0.043	0.359	0.403	OF08	1297.5	0.0445	0.3694	0.41
CF09	1654	0.057	0.471	0.528	OF09	1675.8	0.0575	0.4770	0.53
CF10	1654	0.057	0.471	0.528	OF10	1717.2	0.0589	0.4888	0.55
CF11	1654	0.057	0.471	0.528	OF11	1303.9	0.0448	0.3712	0.42
CF12	1654	0.057	0.471	0.528	OF12	1303.9	0.0448	0.3712	0.42
CF13	1654	0.057	0.471	0.528	OF13	1303.9	0.0448	0.3712	0.42
CF14	1298	0.045	0.369	0.414	OF14	1717.2	0.0589	0.4888	0.55
CF15	1298	0.045	0.369	0.414	OF15	1297.5	0.0445	0.3694	0.41
CF16	1298	0.045	0.369	0.414	OF16	1297.5	0.0445	0.3694	0.41
CF17	1298	0.045	0.369	0.414	OF17	1297.5	0.0445	0.3694	0.41
CF18	1304	0.045	0.371	0.416	OF18	1297.5	0.0445	0.3694	0.41
CF19	1262	0.043	0.359	0.403	OF19	1297.5	0.0445	0.3694	0.41
CF20	1298	0.045	0.369	0.414	OF20	1297.5	0.0445	0.3694	0.41
CF21	1676	0.058	0.477	0.535	OF21	1297.5	0.0445	0.3694	0.41
CF22	1676	0.058	0.477	0.535	OF22	1717.2	0.0589	0.4888	0.55
CF23	1298	0.045	0.369	0.414	OF23	1303.9	0.0448	0.3712	0.42
CF24	1298	0.045	0.369	0.414	OF24	1303.9	0.0448	0.3712	0.42
CF25	1298	0.045	0.369	0.414	OF25	1717.2	0.0589	0.4888	0.55
CF26	1676	0.058	0.477	0.535	OF26	1262.3	0.0433	0.3593	0.40
CF27	1298	0.045	0.369	0.414	OF27	1653.8	0.0568	0.4708	0.53

^{1/} NO₃⁻ calculated from the amount of rainwater (mm/year) and concentrations of NO₃⁻ in rainwater (15.2 µmol/L).^{2/} NH₄⁺ calculated from the amount of rainwater (mm/year) and concentrations of NH₄⁺ in rainwater (36.6 µmol/L).

Table S6. Influxes of N from rainwater of rice paddies in Amnat Charoen Province under conventional farming (CF, n=28) and organic farming (OF, n=35) (cont.).

Conventional farming (CF)					Organic Farming (OF)				
Site No.	N influxes from Rainwater				Site No.	N influxes from Rainwater			
	Amount (mm/year)	NO ₃ ⁻ ^{1/} (kg N/ha/year)	NH ₄ ⁺ ^{2/}	N total		Amount (mm/year)	NO ₃ ⁻ ^{1/} (kg N/ha/year)	NH ₄ ⁺ ^{2/}	N total
CF28	1676	0.058	0.477	0.535	OF28	1653.8	0.0568	0.4708	0.53
					OF29	1297.5	0.0445	0.3694	0.41
					OF30	1675.8	0.0575	0.4770	0.53
					OF31	1675.8	0.0575	0.4770	0.53
					OF32	1297.5	0.0445	0.3694	0.41
					OF33	1675.8	0.0575	0.4770	0.53
					OF34	1297.5	0.0445	0.3694	0.41
					OF35	1675.8	0.0575	0.4770	0.53
Min	1262	0.043	0.359	0.403		1262	0.043	0.359	0.403
Max	1717	0.059	0.489	0.548		1717	0.059	0.489	0.548
Mean	1455	0.050	0.414	0.464		1439	0.049	0.410	0.459
Median	1301	0.045	0.370	0.415		1304	0.045	0.371	0.416
SD	190	0.007	0.054	0.061		194	0.007	0.055	0.062

^{1/} NO₃⁻ calculated from the amount of rainwater (mm/year) and concentrations of NO₃⁻ in rainwater (15.2 µmol/L).^{2/} NH₄⁺ calculated from the amount of rainwater (mm/year) and concentrations of NH₄⁺ in rainwater (36.6 µmol/L).