

Supplementary Information (Table S1, Table S2, Figure S1)

Soil degradation and herbicide pollution by repeated cassava monoculture within Thailand's conservation region

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Supplementary Table S1. Raw data in the farmland soil properties.

	Property (unit)	Kjeldahl N (g kg ⁻¹)			Available P (mg kg ⁻¹)			Available K (mg kg ⁻¹)			Organic matter (g kg ⁻¹)		
Location	Year	2016	2018	2020	2016	2018	2020	2016	2018	2020	2016	2018	2020
North	Subplot 1	1.4	1.9	2.7	6.1	4.9	7.64	76	59	52.81	8.9	7.7	4.5
	Subplot 2	1.3	1.2	1.9	5.7	2.5	4.19	60	49	30.79	10.1	8	5.6
	Subplot 3	1.2	0.3	4.3	51.3	10	5.22	154	49	37.1	7.9	7.7	6.1
	Subplot 4	1.3	0.3	4.5	2	1.2	7.32	76	61	67.45	11	10.9	9.9
East	Subplot 5	1.4	0.6	0.5	2.2	1.7	13.35	72	54	50.84	13.4	8.2	4.4
	Subplot 6	1	0.8	1.1	5.7	2.3	16.35	56	39	0.51	9.2	3.3	2.3
	Subplot 7	0.7	0.7	3.5	3	2.8	4.15	42	47	31.85	5.6	6.9	4.3
	Subplot 8	0.8	1	2.1	3	20	5.12	36	19	2.67	6.9	6.4	4.5
West	Subplot 9	1.1	1.2	2.1	7.3	4.3	11.85	72	71	68.08	7.9	8.2	5.4
	Subplot 10	0.8	1.1	2.3	6	2.9	5.87	26	16	14.95	3.6	3.3	2.1
	Subplot 11	0.9	4.5	2.7	2	6.6	5.02	43	59	10.27	5.4	4.9	3.4
	Subplot 12	1	1.3	3.4	6.6	1.3	6.87	161	226	356.11	9.8	6.4	5.6
South	Subplot 13	0.8	2.3	3.5	2.6	1	6.86	43	32	28.07	4.7	3.5	2.3
	Subplot 14	0.9	2.2	2.8	2.6	0.7	5.35	49	20	49.06	3.8	2.1	1.2
	Subplot 15	1.2	2	1.9	3.9	1.8	10.62	21	16	355	4.9	4.2	3.3
	Subplot 16	1.4	1.2	2	2.3	1.1	5.87	61	47	234.11	5.3	4.2	3.4

	Property (unit)	pH			Electrical conductivity (mS m ⁻¹)			Cation exchange capacity (cmol (+) kg ⁻¹)			Sand (%)		
Location	Year	2016	2018	2020	2016	2018	2020	2016	2018	2020	2016	2018	2020
North	Subplot 1	6.5	6.4	5.7	4	13	12	6.37	6.34	6.7	56.2	59.1	60.3
	Subplot 2	6.4	6.4	5.8	4	3	11	5.18	5.43	5.4	77.4	74.4	76.1
	Subplot 3	6.2	5.6	5.4	6	3	9	5.88	6.2	7.3	72.2	65.9	66.3
	Subplot 4	6.3	6.2	5.4	2	1	5	5.36	4.3	4.1	66.9	64.3	65.3
East	Subplot 5	5.2	5.3	5.2	4	3	8	7.9	7.8	7.9	67.9	65.3	66.7
	Subplot 6	6	5.5	5.1	4	2	4	4.6	4.3	4.5	69	63.8	65.3
	Subplot 7	5.3	5.2	5.2	2	2	3	2.11	2.1	2.2	52.9	54	55
	Subplot 8	6.1	5.9	5.3	2	1	3	4.34	4.5	4.1	69.2	67.6	68.2
West	Subplot 9	7.6	7.1	6.7	13	7	10	12.53	10.1	9.4	70.1	64.1	67.1
	Subplot 10	5.7	5.5	6.3	1	1	40	2.26	2.1	1.3	87.7	85.5	88.9
	Subplot 11	5.2	5.2	5.1	2	3	4	4.8	3.8	3.2	72.9	79.4	79.5
	Subplot 12	6.4	5.8	4.1	6	3	6	6.37	5.6	6.1	57.1	51.5	60.1
South	Subplot 13	5.8	5.7	5.6	2	1	3	3.12	3.1	2.1	82	78.8	79.8
	Subplot 14	6.1	5.7	5.1	2	1	4	4.34	4.1	4.2	85.9	82.1	85.2
	Subplot 15	5.9	6.5	5.4	2	2	3	4.16	5.2	6.2	89.9	88	80.3
	Subplot 16	5.2	5.3	4.8	2	1	3	4.55	4.2	4.1	71.3	63.9	65.1

	Property (unit)	Silt (%)			Clay (%)			Bulk density (Mg m ⁻³)			Moisture content (g g ⁻¹)		
Location	Year	2016	2018	2020	2016	2018	2020	2016	2018	2020	2016	2018	2020
North	Subplot 1	34.9	32.3	31.1	8.9	8.6	8.6	1.39	1.48	1.56	10.7	5.48	1.21
	Subplot 2	14.1	16.1	14.2	8.5	9.5	9.7	1.34	1.47	1.49	10.33	9.47	5.47
	Subplot 3	20.7	25.2	20.3	7.1	8.9	13.4	1.45	1.46	1.53	4.95	1.46	0.89
	Subplot 4	23.5	25.4	23.1	9.6	10.3	11.6	1.46	1.55	1.67	10.68	4.55	1.55
East	Subplot 5	18.8	20.3	19.8	13.3	14.4	13.5	1.44	1.54	1.65	7.61	8.3	6.54
	Subplot 6	22	25.3	23.5	9	10.9	11.2	1.24	1.57	1.76	7.19	7.27	6.43
	Subplot 7	43.3	41.5	39.8	3.8	4.5	5.2	1.41	1.59	1.75	6.65	8.08	7.1
	Subplot 8	24.3	24.8	23	6.5	7.6	8.8	1.64	1.81	1.9	16.36	11.88	10.89
West	Subplot 9	22.1	25.6	23.5	7.8	10.3	9.4	1.32	1.56	1.7	10.59	6.04	5.43
	Subplot 10	9.3	10.9	10.1	3	3.6	1	1.48	1.48	1.76	5.75	8.94	7.5
	Subplot 11	18	13.1	13.2	9.1	7.5	7.3	1.5	1.6	1.64	7.91	5.95	5.1
	Subplot 12	33.7	34.9	32.4	9.2	13.6	7.5	1.53	1.51	1.87	11.54	6.06	5.2
South	Subplot 13	14.6	16.6	16	3.4	4.6	4.2	1.47	1.53	1.58	6.67	6.97	5.2
	Subplot 14	11.3	14.1	13.7	2.8	3.8	1.1	1.44	1.52	1.65	7.4	7.84	6.4
	Subplot 15	8.4	9.7	8.8	1.7	2.3	10.9	1.43	1.47	1.56	8.27	5.75	4.8
	Subplot 16	19.6	23.1	22.5	9.1	13	12.4	1.45	1.62	1.82	8.73	5.7	4.3

Supplementary Table S2. Raw data in the forest soil properties.

	Property (unit)	Kjeldahl N (g kg ⁻¹)	Available P (mg kg ⁻¹)	Available K (mg kg ⁻¹)	Organic matter (g kg ⁻¹)	pH	Electrical conductivity (mS m ⁻¹)
Location	Year	2020	2020	2020	2020	2020	2020
North	Subplot 1	1.1	1.12	10.83	20.0	6.07	3
	Subplot 2	0.5	0.9	9.17	40.0	6.15	2
	Subplot 3	0.7	0.42	7.5	20.0	6.1	3
	Subplot 4	0.5	1.11	7.5	10.0	6.06	2
East	Subplot 5	2.1	1.43	10	6.0	5.33	2
	Subplot 6	1.7	5.17	16.67	4.5	5.56	16
	Subplot 7	0.8	0.47	5.83	19.0	4.72	1
	Subplot 8	0.8	0.56	9.17	30.0	4.66	2
West	Subplot 9	0.7	2.54	8.33	8.0	6.67	8
	Subplot 10	0.6	3.47	5.83	9.3	6.63	3
	Subplot 11	1.4	3.44	17.5	6.0	6.67	10
	Subplot 12	1.1	0.52	18.33	4.2	5.99	3
South	Subplot 13	0.7	2.78	10	11.0	6.37	2
	Subplot 14	0.9	4.07	11.67	12.0	6.52	10
	Subplot 15	0.5	1.1	10	12.5	5.74	1
	Subplot 16	0.7	2.28	10	20.0	5.13	1

	Property Unit	Sand (%)	Silt (%)	Clay (%)	Bluk density (Mg m ⁻³)	Moisture (g g ⁻¹)	Cation exchange capacity (cmol (+) kg ⁻¹)
Location	Year	2020	2020	2020	2020	2020	2020
North	Subplot 1	60.2	26.6	13.2	1.09	5.62	14.09
	Subplot 2	55.9	24.5	19.6	1.43	3.71	13.35
	Subplot 3	62	24.3	13.7	1.72	3.81	11.25
	Subplot 4	57.7	22.3	20	1.26	1.79	11.89
East	Subplot 5	75	17.9	7.1	0.94	5.12	10.82
	Subplot 6	67.5	16.9	15.6	0.93	3.9	9.02
	Subplot 7	79.4	14	6.6	1.21	4.12	5.96
	Subplot 8	26.4	34.4	39.2	1.32	4.15	6.83
West	Subplot 9	77.3	15.4	7.3	1.36	3.73	7.34
	Subplot 10	73.2	16.2	10.6	1.12	2.78	5.54
	Subplot 11	76.2	16.7	7.1	1.24	5.54	3.74
	Subplot 12	71.3	19.1	9.6	1.38	20.54	2.83
South	Subplot 13	79.5	16.9	3.6	1.39	2.54	4.55
	Subplot 14	83	14.5	2.5	1.18	4.42	5.54
	Subplot 15	80.8	14.6	4.6	0.9	6.07	7.59
	Subplot 16	83.1	14.9	2	1.37	5.41	7.61

Supplementary Figure S1. Variations in soil properties among the locations in the farmland. (a)

Kjeldahl nitrogen (the sum of organic N and ammonia N), (b) available phosphorus (P), (c) available potassium (K), (d) organic matter, (e) pH, (f) electrical conductivity (EC), (g) cation exchange capacity, (h) the fraction of sand, (i) the fraction of silt, (j) the fraction of clay, (k) bulk density, and (l) moisture contents. The boxplot shows the median (horizontal bar), interquartile range (box), 5th and 95th percentiles (whiskers; vertical bars), and outliers (black closed points). Different letters (a, b) show the significant differences among the locations, as follows; ***: $P < 0.001$, **: $P < 0.01$, *: $P < 0.05$, and n.s.: $P \geq 0.05$.

