



Figure S1. Satellite picture of sampling points. The yellow square, triangle and circle in the picture represents the wheat-maize fields, 10-year and 20-year old pepper greenhouses, respectively.

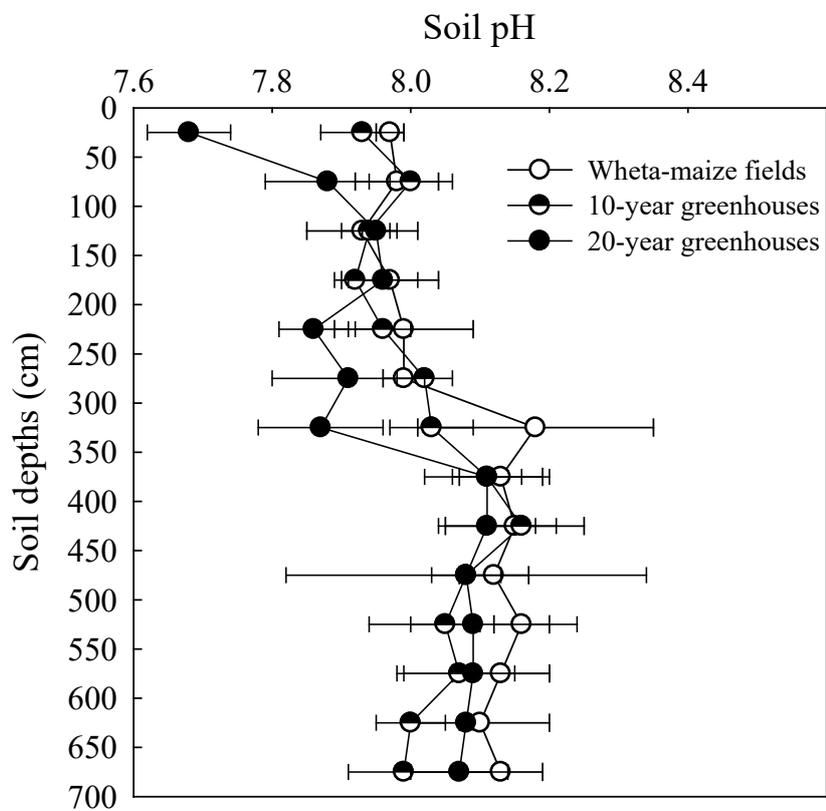


Figure S2. The soil pH of different depths for wheat-maize fields (n=3), 10-year (n=6) and 20-year (n=4) old pepper greenhouses. Given are mean values±SE.

Table S1. The amount of N input, crops yield and N uptake of sampling wheat (W)-maize (M) fields and pepper greenhouses.

	N input (kg N ha ⁻¹ yr ⁻¹)				Yield (t ha ⁻¹ yr ⁻¹)	Crops N uptake ^b (kg N ha ⁻¹ yr ⁻¹)
	Organic fertilizer	Chemical fertilizer	Irrigation water ^a	Total input		
Wheat (W) - maize (M) fields						
1	0	450	65	515	W 7.50 M 9.00	399
2	0	450	65	515	W 7.50 M 9.00	399
3	0	450	65	515	W 7.50 M 9.00	399
Mean	0	450	65	515	W 7.50 M 9.00	399
SE	0	0	0	0	W 0 M 0	0
10-yr old pepper greenhouses						
1	1050	1380	210	2640	165	825
2	922	776	210	1908	150	750
3	1165	772	210	2147	165	825
4	1050	1164	210	2424	165	825
5	1286	776	210	2272	150	750
6	1165	772	210	2147	165	825
Mean	1106	940	210	2256	160	800
SE	51	109	0	103	3	16
20-yr old pepper greenhouses						
1	1133	1669	150	2952	143	713
2	809	1393	150	2352	135	675
3	528	1228	150	1906	150	750
4	729	2328	150	3207	128	638
Mean	800	1655	150	2604	139	694
SE	126	242	0	294	5	24

^a The average N concentration of irrigation water in the sampling area was 13.3 mg N L⁻¹ from 2008 to 2011 [9] and 23.4 mg N L⁻¹ from 2016 to 2019 [13]. The N concentration of irrigation water in wheat-maize fields and 20-year greenhouses is calculated as 13.3 mg N L⁻¹ on average and that in 10-year greenhouses is calculated as 18.3 mg N L⁻¹ on average.

^b The N uptake of per 100 kg wheat grain, maize grain and pepper yield in the sampling area were approximately 2.98 kg, 1.95 kg and 0.50 kg, respectively, according to literature reports. (Table S4)

Table S2. The amount of N input, crops yield and N uptake of wheat (W)-maize (M) fields and pepper greenhouses according to the interview of individual farmers around the sampling point.

	N input (kg N ha ⁻¹ yr ⁻¹)				Yield (t ha ⁻¹ yr ⁻¹)	Corps N uptake ^b (kg N ha ⁻¹ yr ⁻¹)
	Organic fertilizer	Chemical fertilizer	Irrigation water ^a	Total input		
Wheat (W) - maize (M) fields						
1	0	225	65	290	W 6.75 M 7.50	347
2	0	450	65	515	W 7.50 M 9.00	399
3	0	450	65	515	W 7.50 M 9.00	399

4	0	540	65	605	W 11.3	M 7.50	482
5	0	225	65	290	W 6.75	M 7.50	347
Mean	0	378	65	443	W 7.95	M 8.10	395
SE	0	65	0	65	W 0.84	M 0.37	25
10-year old pepper greenhouses							
1	1006	582	210	1798			675
2	1003	1164	210	2377			713
3	1003	1164	210	2377			713
4	1058	1494	210	2762			938
5	1739	582	210	2531			825
6	1006	582	210	1798			675
Mean	1136	928	210	2274			756
SE	121	162	0	161			43
20-year old pepper greenhouses							
1	582	1739	150	2471			825
2	507	1682	150	2339			675
3	943	1399	150	2492			750
4	1707	1092	150	2949			656
5	569	2010	150	2729			825
Mean	862	1584	150	2596			746
SE	225	157	0	108			36

^a The average N concentration of irrigation water in the sampling area was 13.3 mg N L⁻¹ from 2008 to 2011 [9] and 23.4 mg N L⁻¹ from 2016 to 2019 [13]. The N concentration of irrigation water in wheat-maize fields and 20-year old greenhouses is calculated as 13.3 mg N L⁻¹ on average and that in 10-year old greenhouses is calculated as 18.3 mg N L⁻¹ on average.

^b The N uptake of per 100 kg wheat grain, maize grain and pepper yield in the sampling area were approximately 2.98 kg, 1.95 kg and 0.50 kg, respectively, according to literature reports. (Table S4)

Table S3. Soil bulk density at different depths of wheat-maize fields, 10-year and 20-year old pepper greenhouses.

Depths (cm)	Wheat-maize fields (g cm ⁻³)	10-year greenhouses (g cm ⁻³)	20-year greenhouses (g cm ⁻³)
0–50	1.69	1.74	1.73
50–100	1.79	1.74	1.73
100–150	1.75	1.71	1.64
150–200	1.75	1.71	1.64
200–250	1.61	1.77	1.59
250–300	1.61	1.77	1.59
300–350	1.68	1.74	1.79
350–400	1.68	1.74	1.79

400–450	1.51	1.80	1.67
450–500	1.51	1.80	1.67
500–550	1.60	1.68	1.82
550–600	1.60	1.68	1.82
600–650	1.45	1.69	1.57
650–700	1.45	1.83	1.57

Table S4. Nitrogen (N) requirement of per 100 kg grain or yield for wheat, maize and greenhouse pepper in northern China from references.

	Number of samples	The amount of N uptake (kg N ha ⁻¹)	Reference
Wheat	2824	2.98 ± 0.014	[47]
Maize	391	1.95 ± 0.012	[48]
Pepper	7	0.50 ± 0.066	[49, 50]