

1 **Supplement of**
2 **History of anthropogenic Nitrogen inputs to Cropland (HaNi-Crop): A Harmonized and**
3 **Gridded Global Dataset of Crop-Specific Nitrogen Inputs from Synthetic Fertilizer and**
4 **Manure**

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Table S1. Global average crop-specific N fertilizer and N manure application amounts (Tg N yr⁻¹) for the 1960s, 1980s, 2000s, and recent decade.

crop	type	1960s	1980s	2000s	Recent decade
barley	N manure	1.66	2.73	1.26	1.09
	N fertilizer	2.62	6.96	3.02	3.17
cassava	N manure	0.03	0.04	0.06	0.07
	N fertilizer	0.02	0.09	0.25	0.3
cotton	N manure	0.36	0.44	0.48	0.52
	N fertilizer	0.88	2.78	2.88	3.09
fruits	N manure	0.31	0.52	0.91	1.02
	N fertilizer	0.58	2.28	4.46	4.95
groundnuts	N manure	0.05	0.07	0.12	0.12
	N fertilizer	0.06	0.33	0.64	0.55
maize	N manure	1.88	2.47	3.01	3.96
	N fertilizer	2.85	9.59	14.08	21.38
millet	N manure	0.06	0.06	0.05	0.05
	N fertilizer	0.08	0.24	0.29	0.44
oil palm fruit	N manure	0.01	0.03	0.08	0.23
	N fertilizer	0.02	0.17	0.61	1.22
others	N manure	1.86	1.78	1.86	1.42
	N fertilizer	2.89	6.21	7.54	6.23
potatoes	N manure	0.72	0.65	0.46	0.3
	N fertilizer	0.83	1.75	1.44	1.19
pulses	N manure	2.07	2.76	3.66	4.29
	N fertilizer	0.76	2.55	2.32	3.32
rapeseed	N manure	0.08	0.21	0.39	0.43
	N fertilizer	0.14	0.92	2.07	2.95
rice	N manure	0.87	1.39	1.89	2.52
	N fertilizer	1.11	8.43	14.16	17.75
rye	N manure	0.51	0.39	0.12	0.08
	N fertilizer	0.56	0.92	0.31	0.27
sorghum	N manure	0.16	0.21	0.2	0.16
	N fertilizer	0.35	0.82	0.71	0.74
soybean	N manure	0.05	0.15	0.18	0.34
	N fertilizer	0.18	0.63	0.88	1.83
sugarbeets	N manure	0.33	0.45	0.21	0.18
	N fertilizer	0.43	1.07	0.51	0.55
sugarcane	N manure	0.14	0.24	0.42	0.56
	N fertilizer	0.24	0.88	1.73	2.71
sunflower	N manure	0.09	0.16	0.22	0.2
	N fertilizer	0.07	0.48	0.6	0.83
vegetables	N manure	0.41	0.61	1.31	1.53
	N fertilizer	0.74	2.58	6.62	7.16
wheat	N manure	2.97	3.4	2.88	3.42
	N fertilizer	4.62	14.97	16.4	19.17

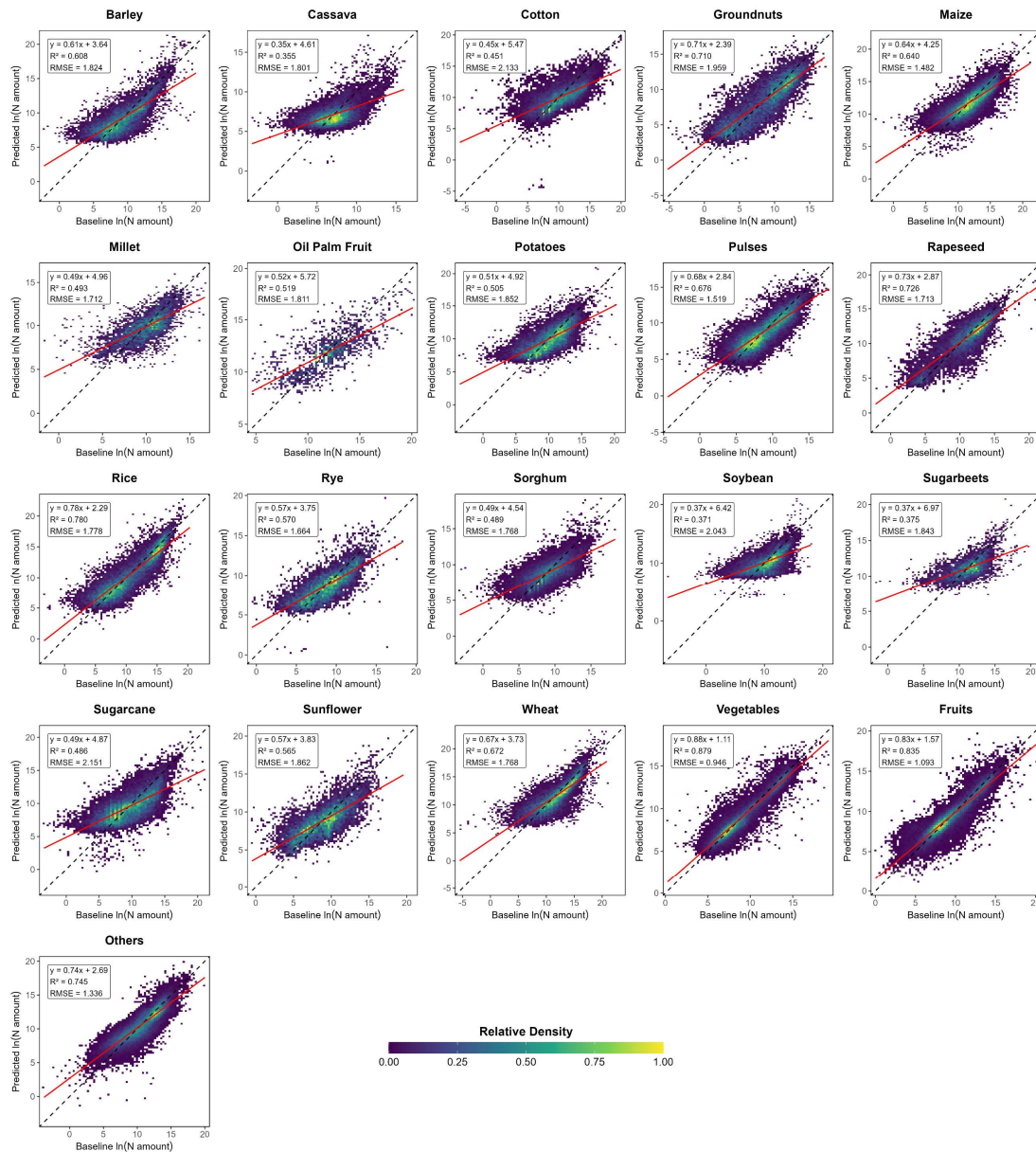


Figure S1. Comparison of baseline and predicted log-transformed crop-specific N fertilizer application amounts across the 21 crop groups used for model evaluation. Dashed lines indicate the 1:1 relationship between baseline and model predictions. The blue lines represent linear regression fits.

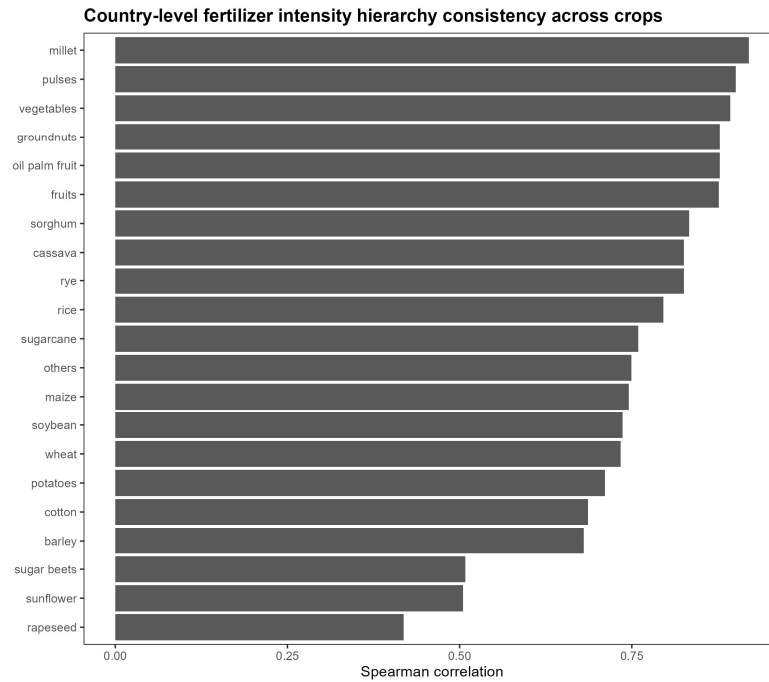


Figure S2. Spearman rank correlations between the 2000 and 2020 baseline fertilizer datasets across all crop groups. The correlations quantify the consistency of country-level fertilizer intensity hierarchies between the two baseline years.

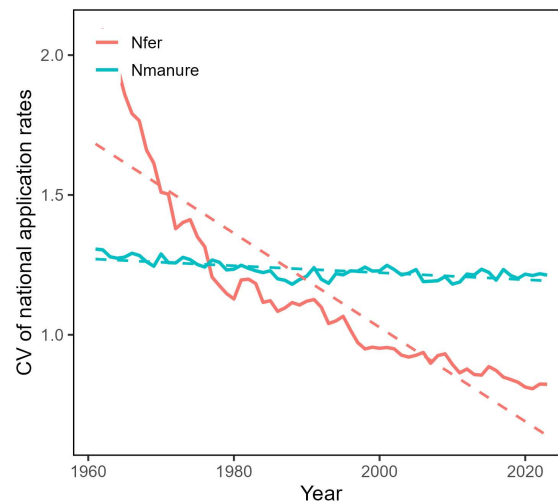


Figure. S3 Temporal trends in cross-country coefficient of variation of manure and N fertilizer application rates across all 21 crop types.

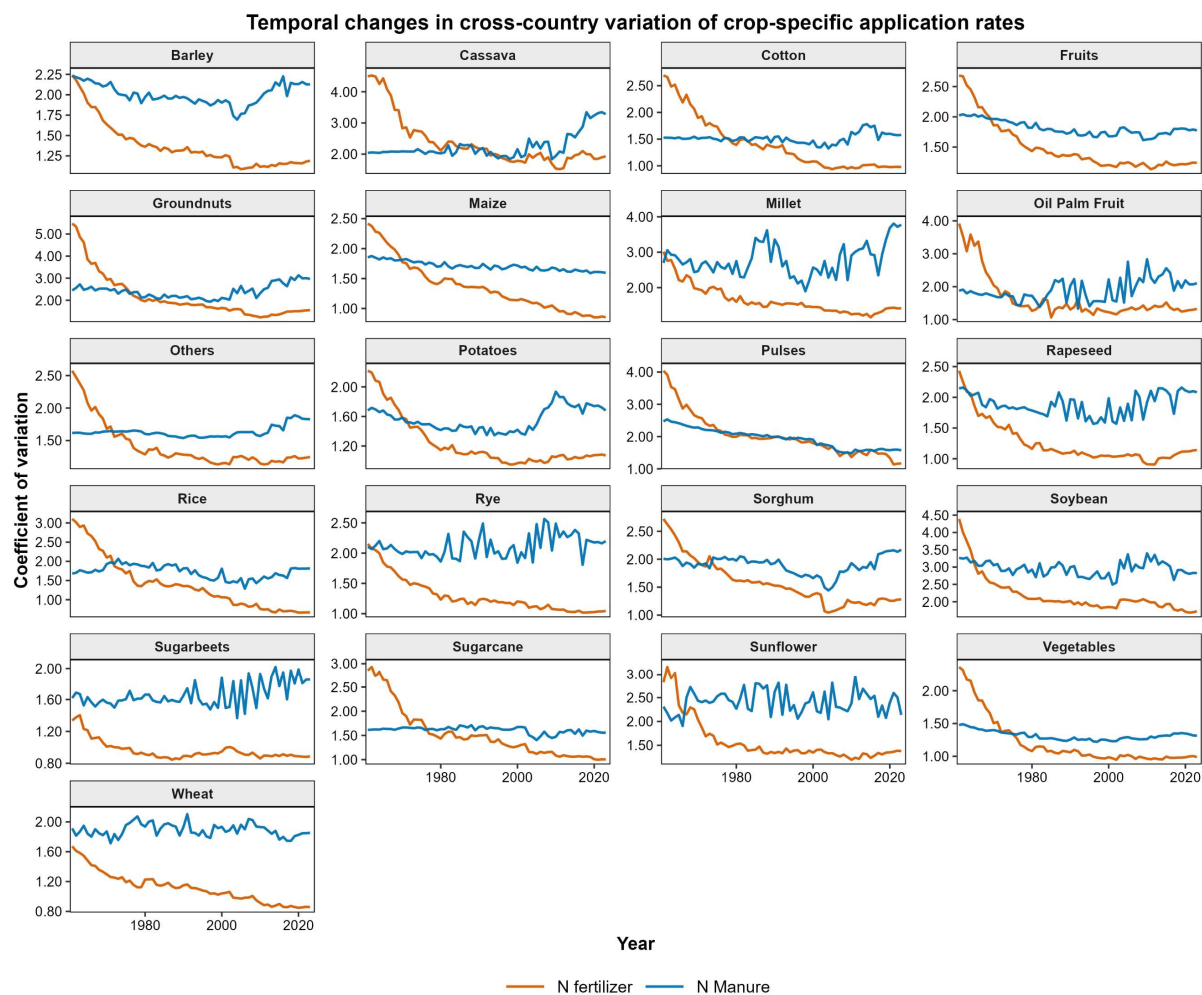


Figure S4. Temporal trends in the relative cross-country spread of crop-specific manure and N fertilizer application rates, measured by the coefficient of variation.

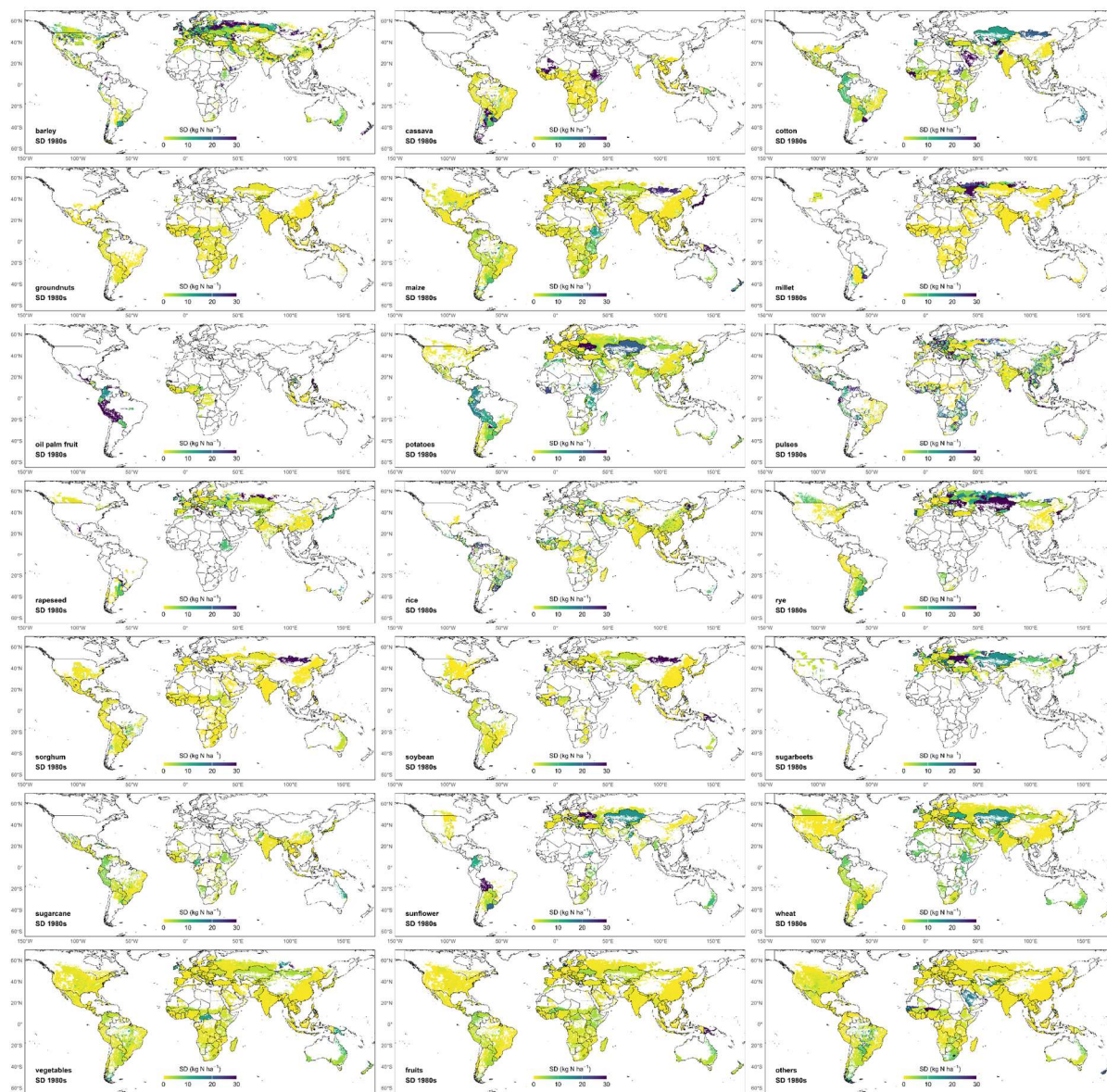


Figure S5 Spatial distribution of uncertainties in crop-specific N manure application rates during the 1980s for all crop groups, quantified as the standard deviation of Monte Carlo ensemble simulations.

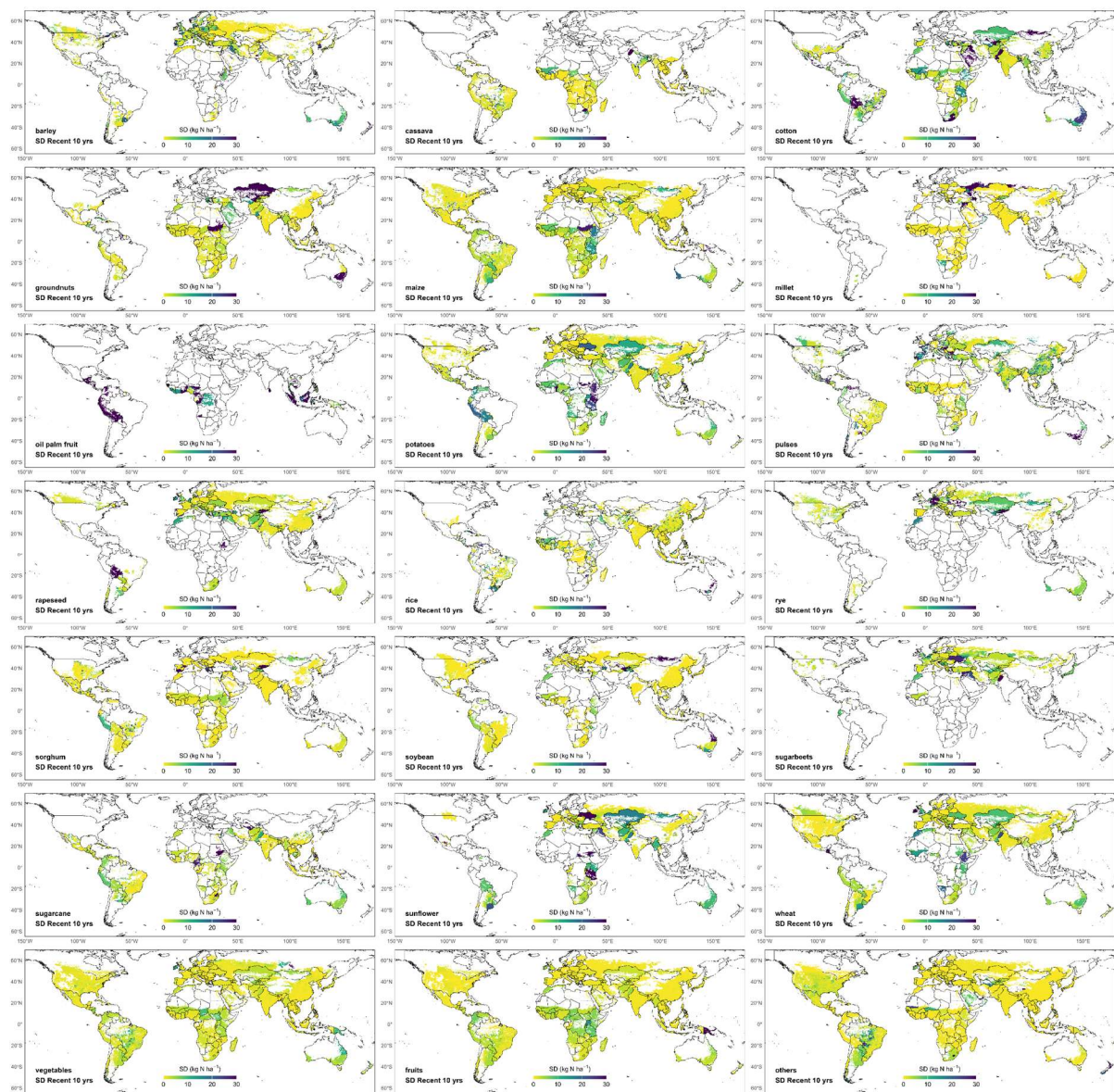


Figure S6 Spatial distribution of uncertainties in crop-specific N manure application rates during the recent 10 years (2014-2023) for all crop groups, quantified as the standard deviation of Monte Carlo ensemble simulations.

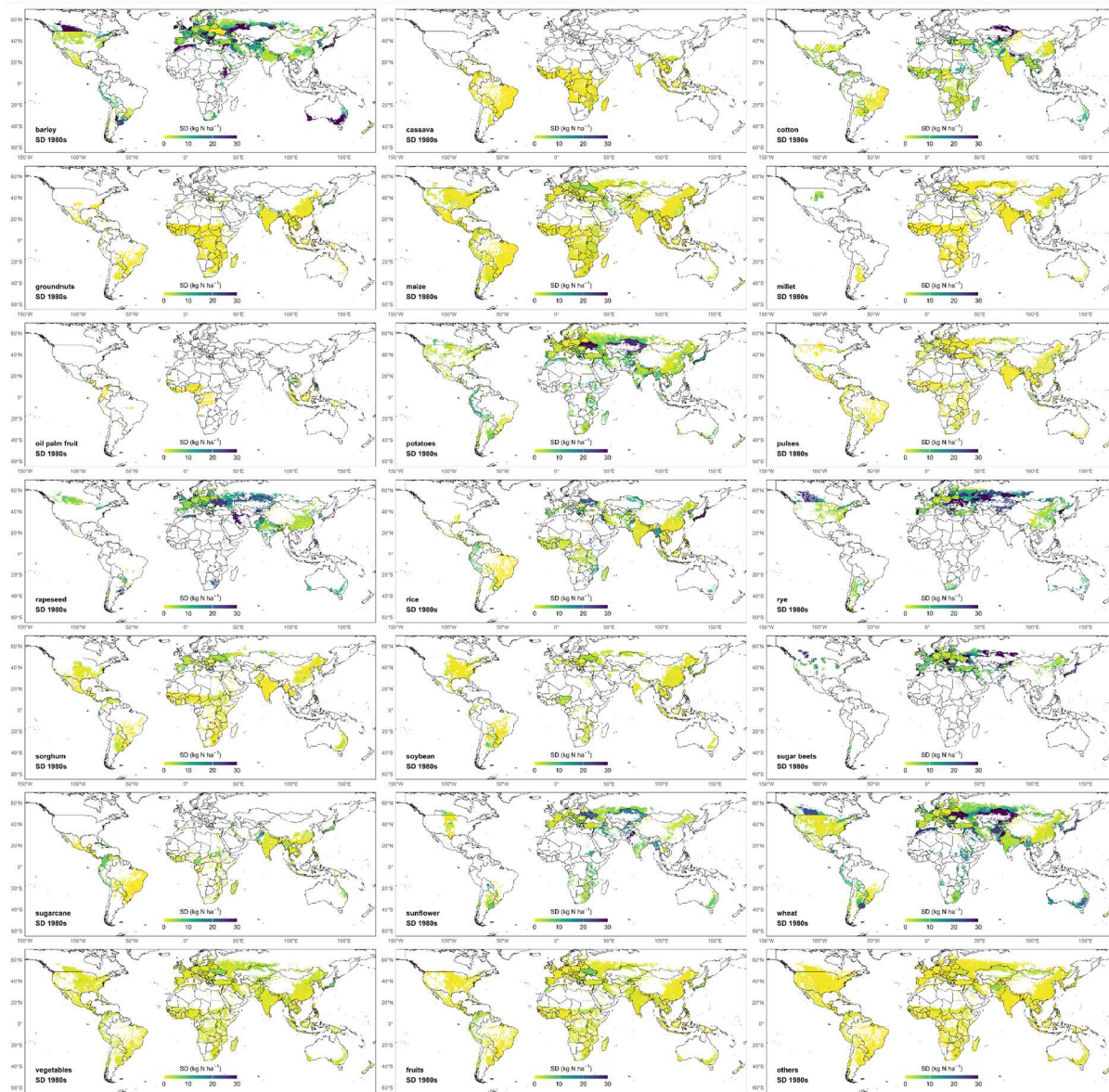


Figure S7 Spatial distribution of uncertainties in crop-specific N fertilizer application rates during the 1980s for all crop groups, quantified as the standard deviation of Monte Carlo ensemble simulations averaged over the decade.

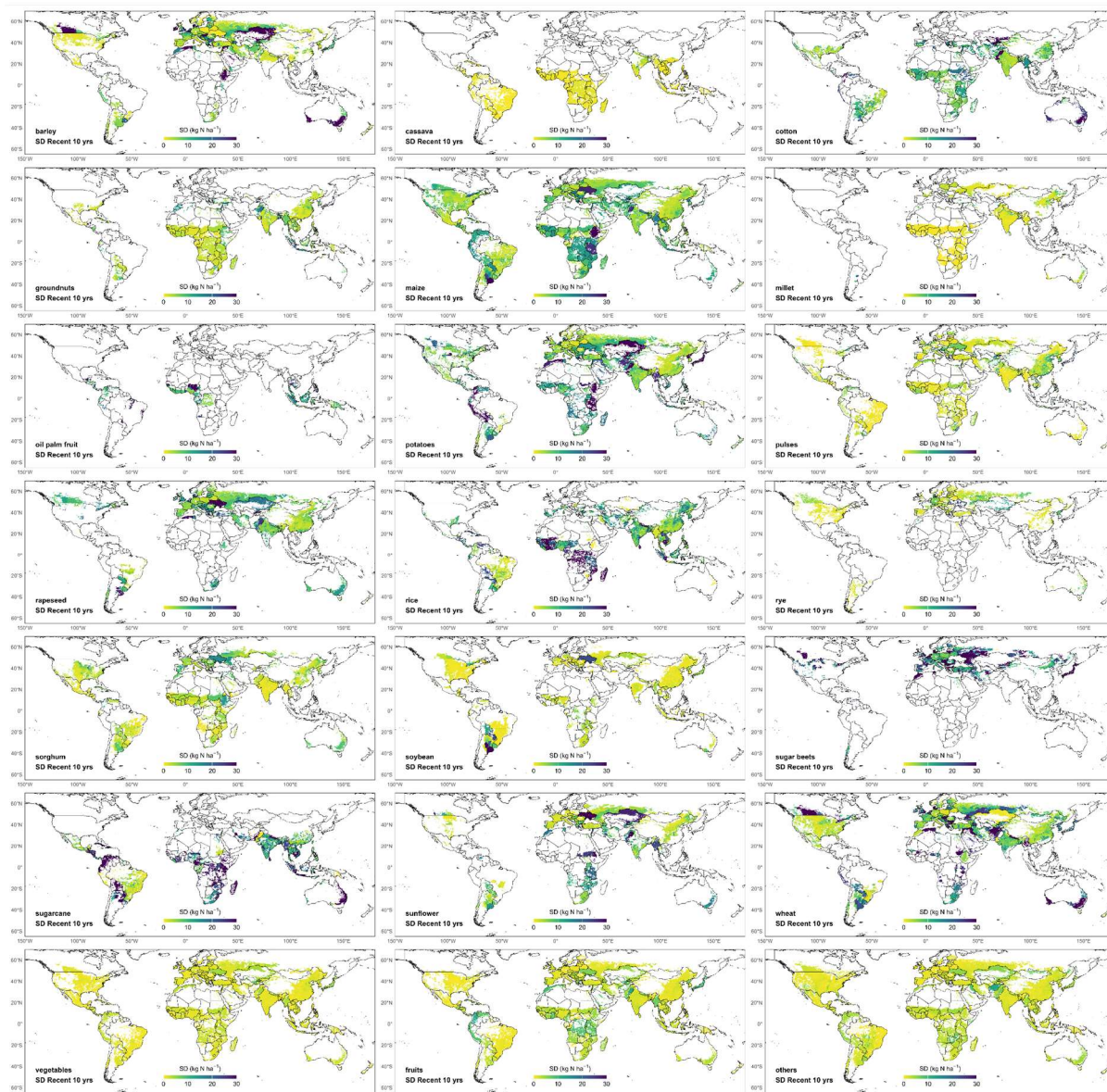


Figure S8 Spatial distribution of uncertainties in crop-specific N fertilizer application rates during the recent 10 years (2014-2023) for all crop groups, quantified as the standard deviation of Monte Carlo ensemble simulations averaged over the decade.

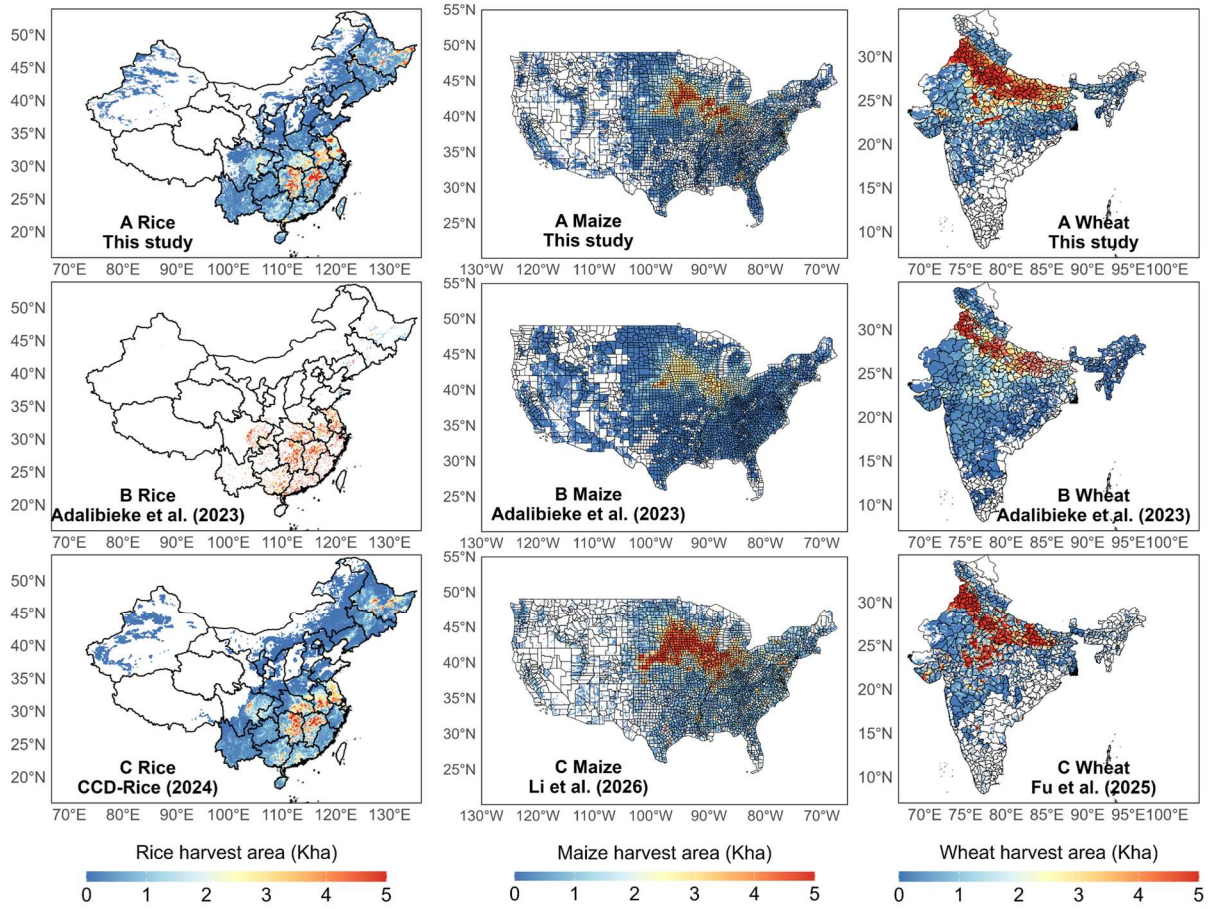


Figure S9. Spatial comparison of harvested areas for rice, maize, and wheat between this study and previously published datasets. Panel A shows the estimates from this study. Panel B shows estimates from Adalibieke et al. (2023). Panel C presents high-resolution remote sensing-based datasets, including rice at 30m resolution (Shen et al., 2025), the maize at 10m resolution (Li et al., 2026) and winter wheat at 30m resolution (Fu et al., 2025), and. The rice comparison is based on 2016, whereas the maize and wheat comparisons are based on 2020, all the data were aggregated to $0.1^\circ \times 0.1^\circ$.

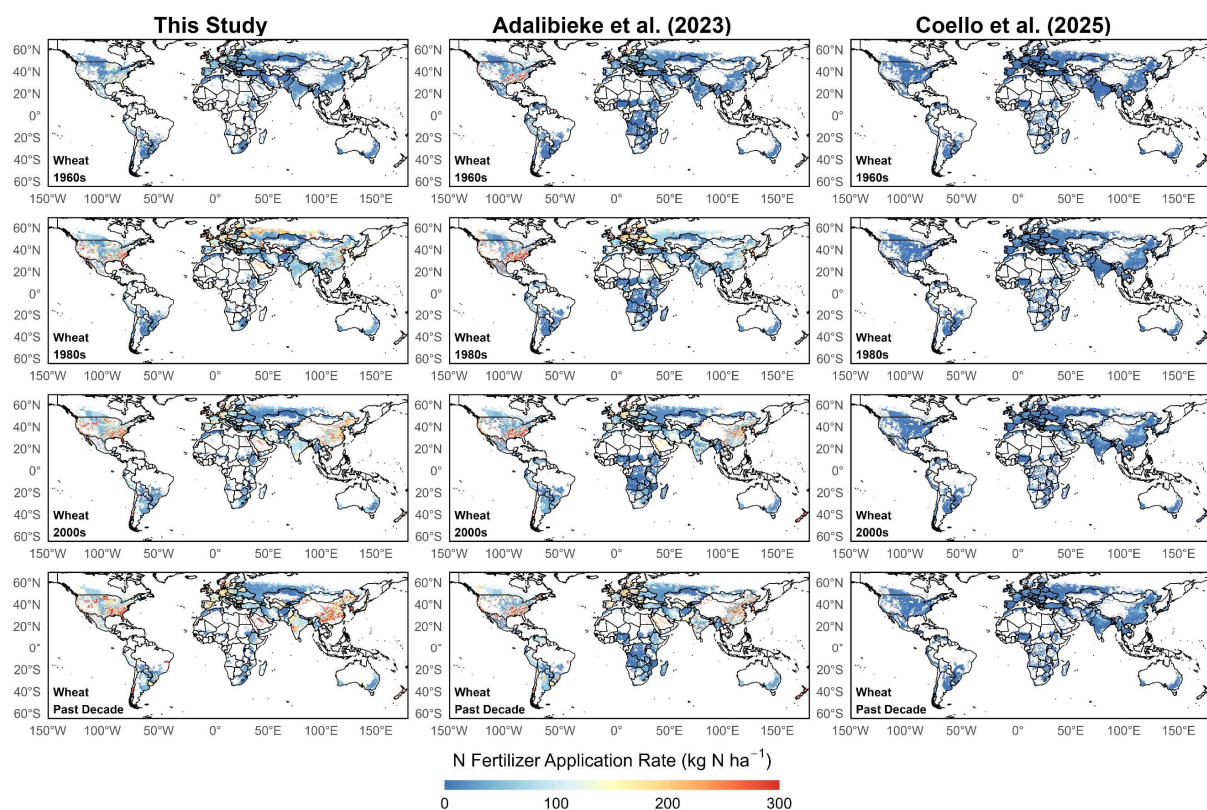
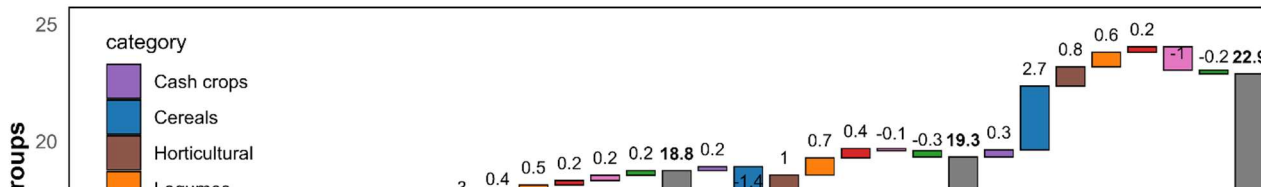


Figure S10. Comparisons of the N fertilizer application rates for wheat in different studies in 1960s, 1980s, 2000s and recent 10 years for wheat. Panels (A1)–(A4) show data in this study. Panels (B1) – (B4) show data from Adalibieke et al. (2023). Panels (C1) – (C4) show data from Coello et al. (2025). The value indicates the N fertilizer use rate per hectare of specific crop harvest area.



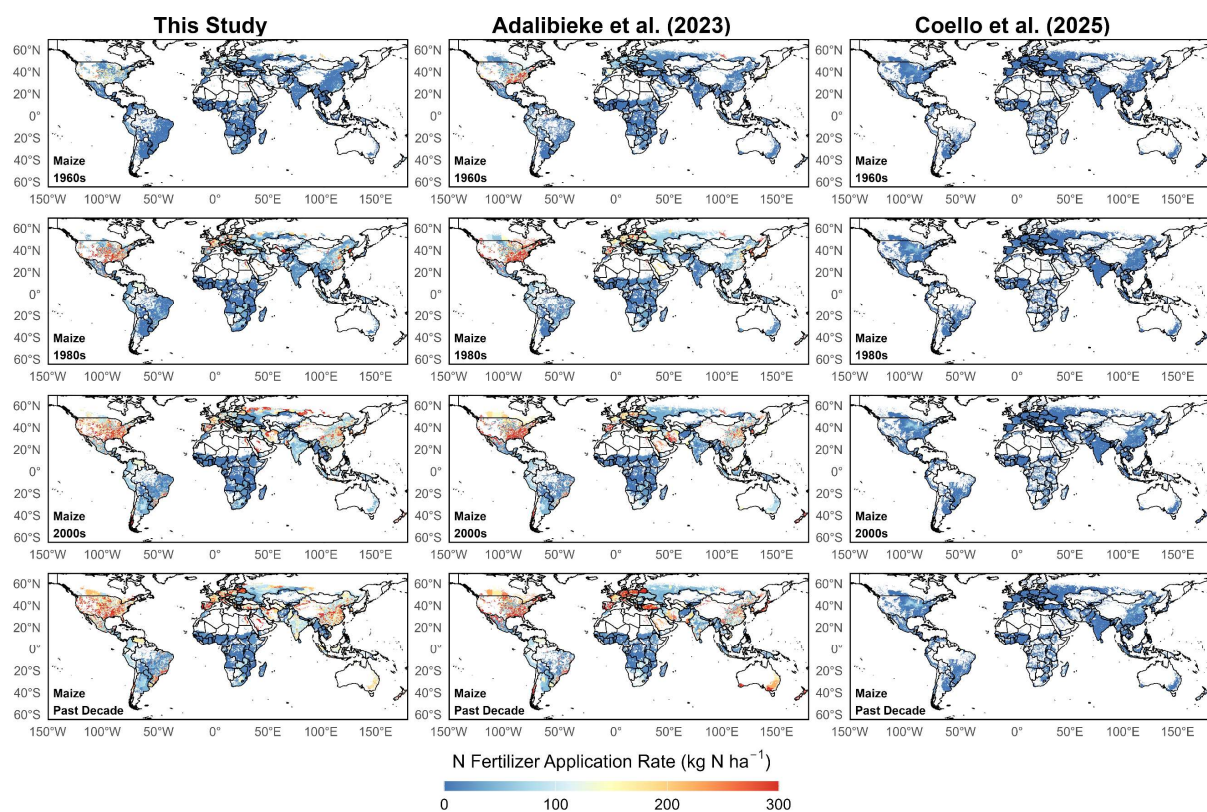


Figure S11. Comparisons of the N fertilizer application rates for maize in different studies in 1960s, 1980s, 2000s and recent 10 years for maize. Panels (A1)–(A4) show data in this study. Panels (B1) – (B4) show data from Adalibieke et al. (2023). Panels (C1) – (C4) show data from Coello et al. (2025). The value indicates the N fertilizer use rate per hectare of specific crop harvest area.

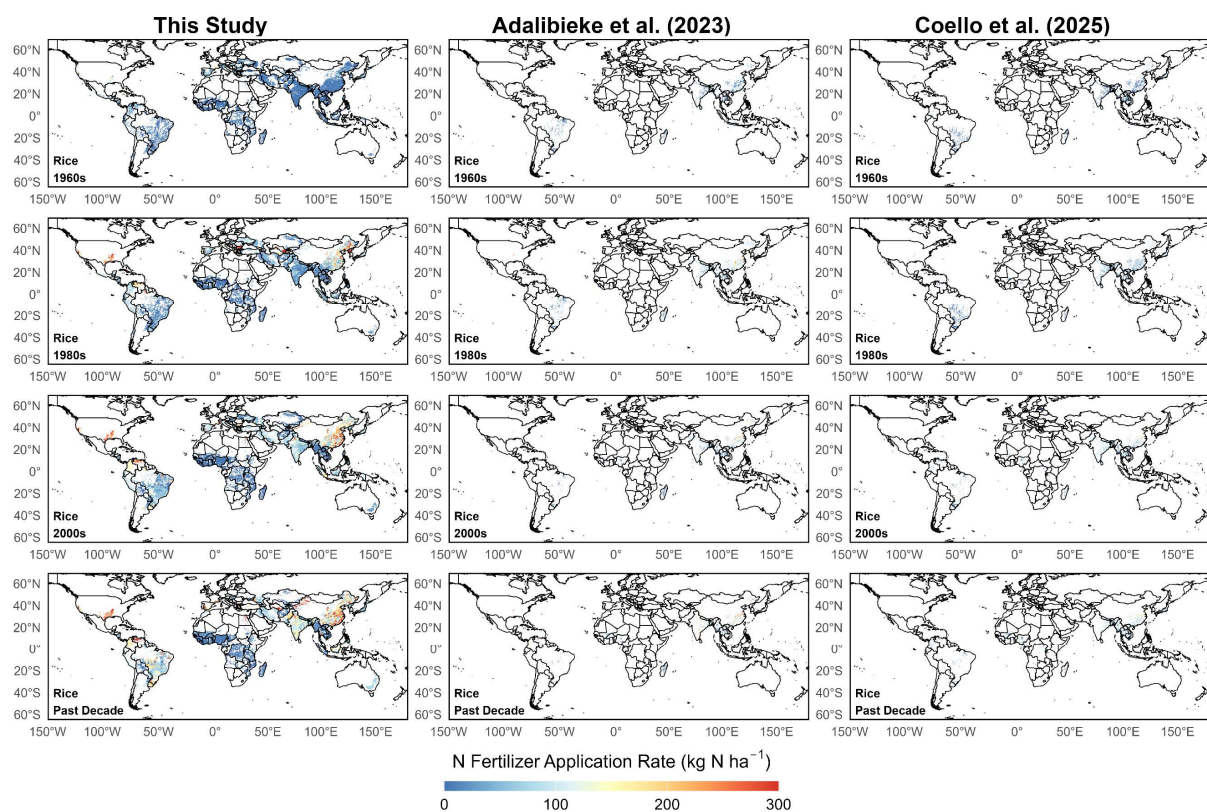


Figure S12. Comparisons of the N fertilizer application rates for rice in different studies in 1960s, 1980s, 2000s and recent 10 years for rice. Panels (A1)–(A4) show data in this study. Panels (B1) – (B4) show data from Adalibieke et al. (2023). Panels (C1) – (C4) show data from Coello et al. (2025). The value indicates the N fertilizer use rate per hectare of specific crop harvest area.

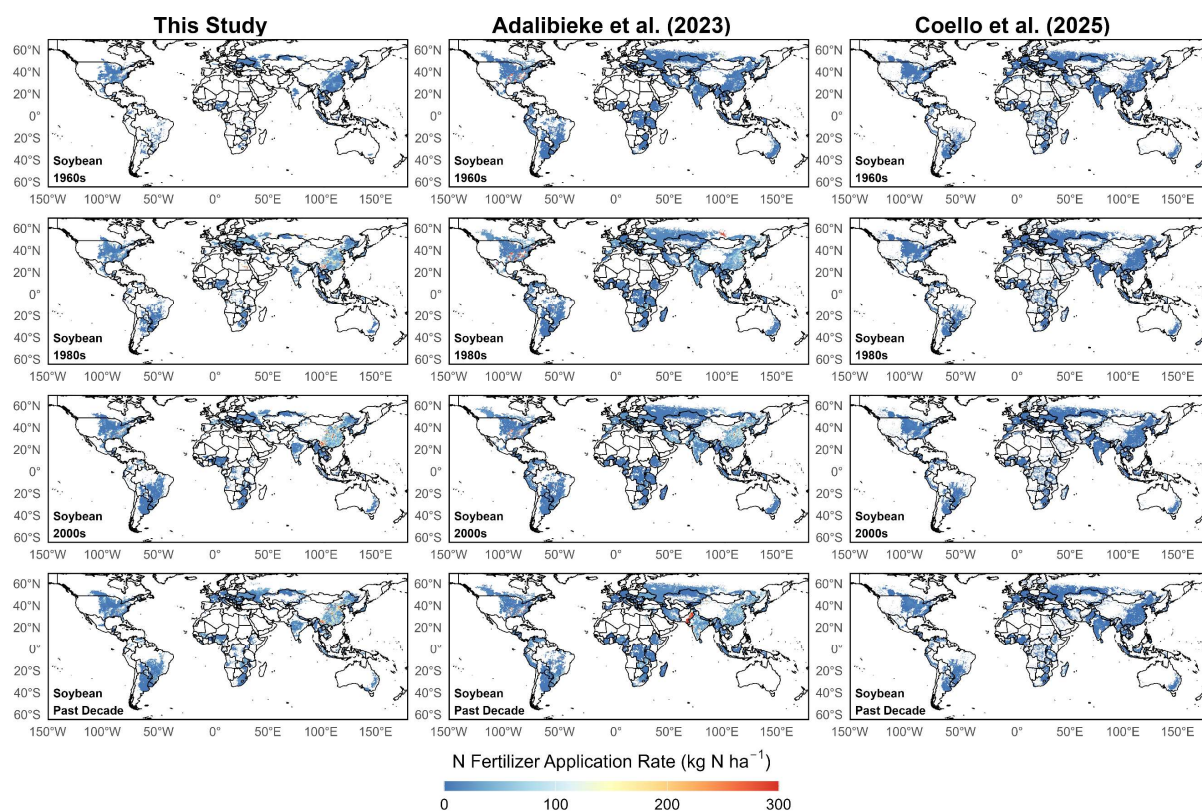


Figure S13. Comparisons of the N fertilizer application rates for soybean in different studies in 1960s, 1980s, 2000s and recent 10 years for rice. Panels (A1)–(A4) show data in this study. Panels (B1) – (B4) show data from Adalibieke et al. (2023). Panels (C1) – (C4) show data from Coello et al. (2025). The value indicates the N fertilizer use rate per hectare of specific crop harvest area.

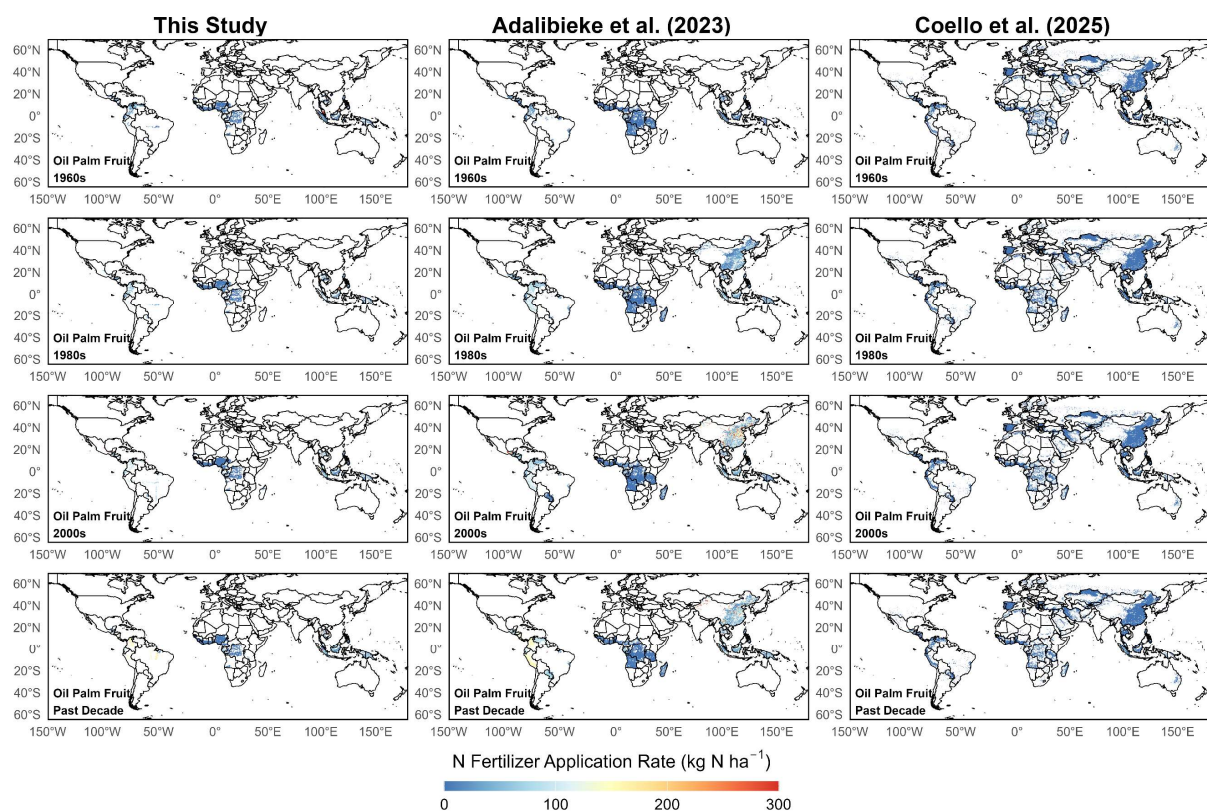


Figure S14. Comparisons of the N fertilizer application rates for oil palm fruit in different studies in 1960s, 1980s, 2000s and recent 10 years for rice. Panels (A1)–(A4) show data in this study. Panels (B1) – (B4) show data from Adalibieke et al. (2023). Panels (C1) – (C4) show data from Coello et al. (2025). The value indicates the N fertilizer use rate per hectare of specific crop harvest area.

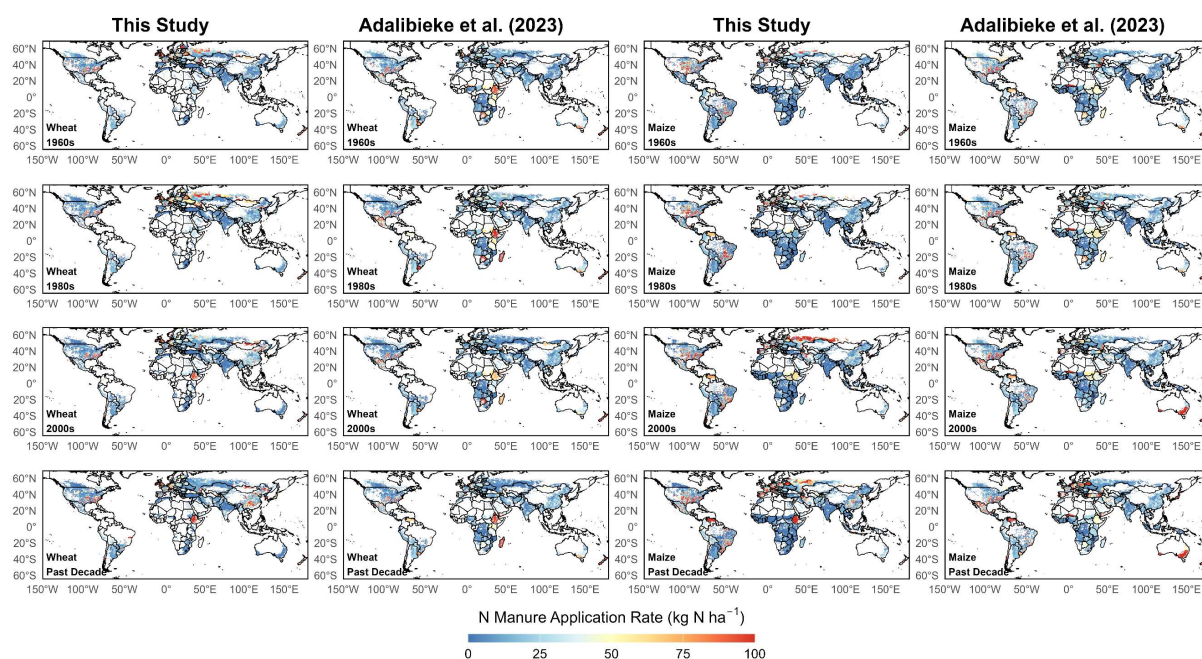


Figure S15. Comparisons of the manure application rates for wheat and maize in different studies in 1960s, 1980s, 2000s and recent 10 years for wheat and maize. Panels (A1)–(A4) show data in this study. Panels (B1) – (B4) show data from Adalibieke et al. (2023). The value indicates the manure use rate per hectare of specific crop harvest.

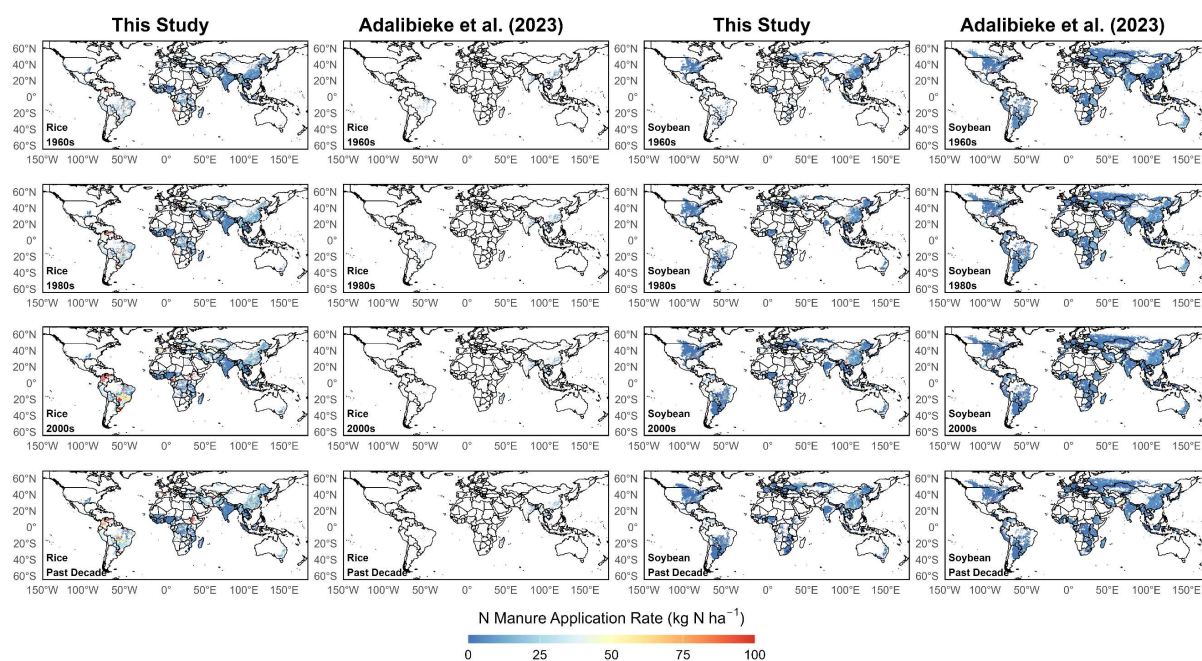


Figure S16. Comparisons of the manure application rates for rice and soybean in different studies in 1960s, 1980s, 2000s and recent 10 years for rice and cotton. Panels (A1)–(A4) show data in this study. Panels (B1) – (B4) show data from Adalibieke et al. (2023). The value indicates the manure use rate per hectare of specific crop harvest.

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