Appendix A Supplementary calculations and figures

Title: Patterns of crop-specific fertilizer-nitrogen losses and opportunities for sustainable mitigation: A quantitative overview of ^{15}N-tracing studies

Running title: Global patterns and mitigation potential of crop-specific fertilizer-N losses

Authors:

Cong Xu[a,b,‡], Hanshen Zhu[a,b,‡], Haokuang Liu[a,b], Cheng Ji[a,b], Jie Yuan[a], Guanlin Li[b], Jidong Wang[a,b*], Yongchun Zhang[a,b*]

[a] *National Agricultural Experimental Station for Agricultural Environment, Luhe, Institute of Agricultural Resources and Environment, Jiangsu Academy of Agricultural Sciences, Nanjing 210014, China*

[b] *School of the Environment and Safety Engineering, Jiangsu University, Zhenjiang 212013, China*

[‡] These authors contributed equally to this work.

[*]**Corresponding Author:**

Jidong Wang, No. 50 Zhonglingjie Street, Jiangsu Academy of Agricultural Sciences, Nanjing 210014, Jiangsu, China; jidongwang@jaas.ac.cn

Yongchun Zhang, No. 50 Zhonglingjie Street, Jiangsu Academy of Agricultural Sciences, Nanjing 210014, Jiangsu, China; yczhang66@sina.com

Supplementary calculations

The SOC stock (Mg C ha^{-1}) under scenario A or B was estimated according to the following equation:

$$SOC\ stock = SOC \times BD \times H \times 0.1 \quad \text{(S1)}$$

where *SOC* is the average SOC content within each SOC level (g kg^{-1}), *BD* is the soil bulk density (g cm^{-3}), *H* is the thickness of the soil layer (0−20 cm), and 0.1 is a constant to adjust the units. We estimated the *BD* for upland (wheat and maize-cropped soils) and paddy (rice-cropped soils) soils using Eq. (S2) and Eq. (S3), respectively (Han et al., 2018):

$$BD = 1.377 \times \mathrm{Exp}(-0.0048 \times SOC) \quad \text{(S2)}$$

$$BD = -0.22 \times \ln(SOC) + 1.78 \quad \text{(S3)}$$

Supplementary figures

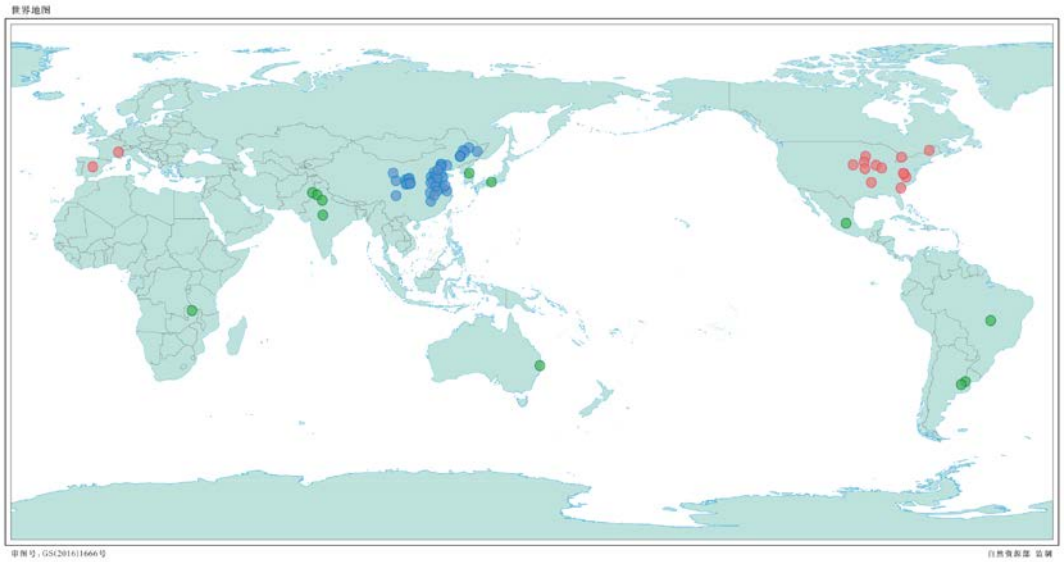

Figure S1 Location of ^{15}nitrogen tracing studies included in this meta-analysis. Red, blue, and green dots indicate studies conducted in the European Union and North America, China, and other countries or regions, respectively.

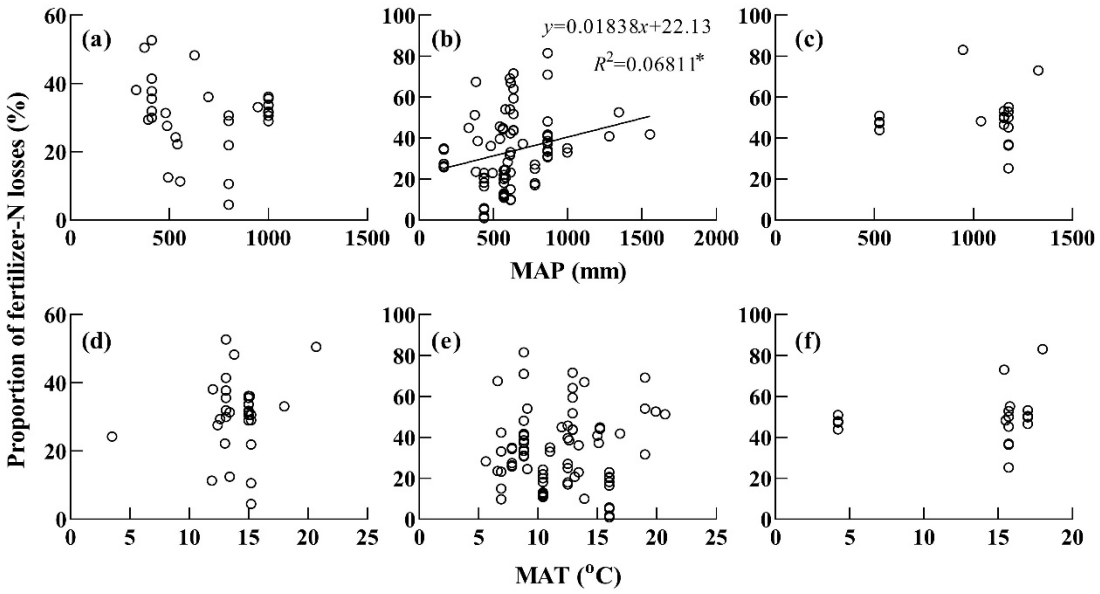

Figure S2 Linear regression analysis illustrating the correlation between the proportion of fertilizer-nitrogen (N) losses to the total applied N and mean annual precipitation (MAP) and mean annual temperature (MAT) in (a and d) wheat-, (b and e) maize-, and (c and f) rice-cropping seasons. * represents 0.05 significance level.

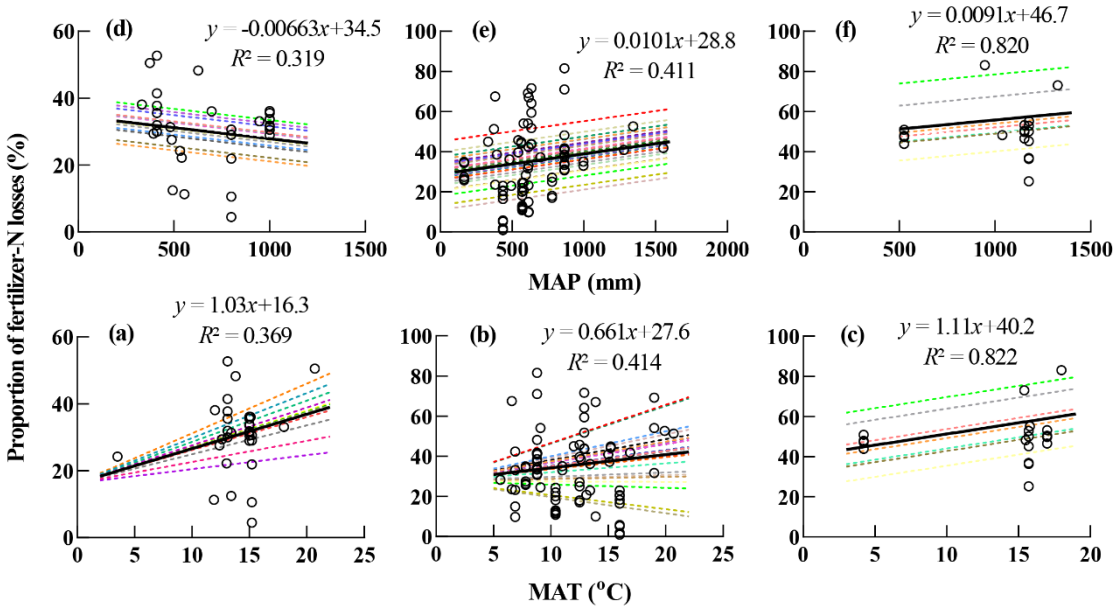

Figure S3 Linear mixed-effect analysis illustrating the correlation between the proportion of fertilizer-nitrogen (N) losses to the total applied N and mean annual precipitation (MAP) and mean annual temperature (MAT) in (a and d) wheat-, (b and e) maize-, and (c and f) rice-cropping seasons. The solid and dotted lines represent the

fitted lines of fixed effects and random effects, respectively. Each color represents a different study.

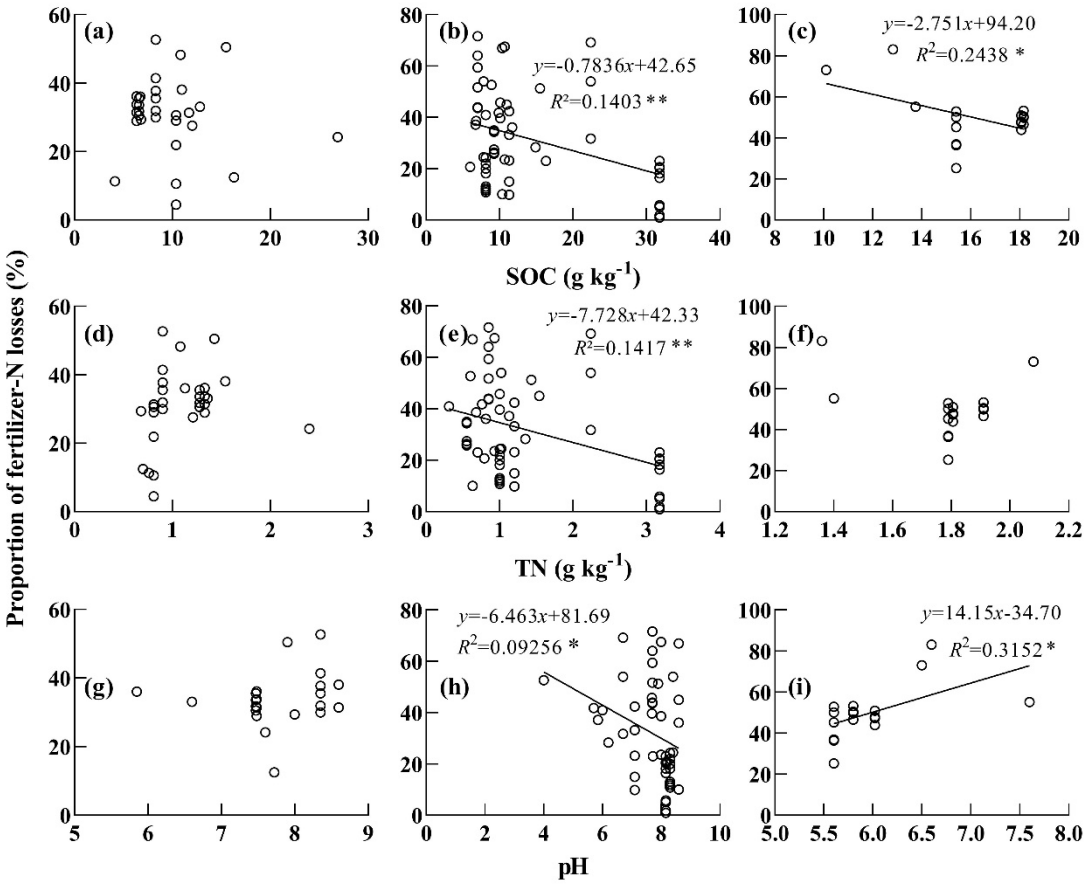

Figure S4 Linear regression analysis illustrating the correlation between the proportion of fertilizer-nitrogen (N) losses to the total applied N and soil organic carbon (SOC) content, soil total N (TN) content, and soil pH in (a, d, and g) wheat-, (b, e, and h) maize-, and (c, f, and i) rice-cropping seasons. * and ** represent 0.05 and 0.01 significance levels, respectively.

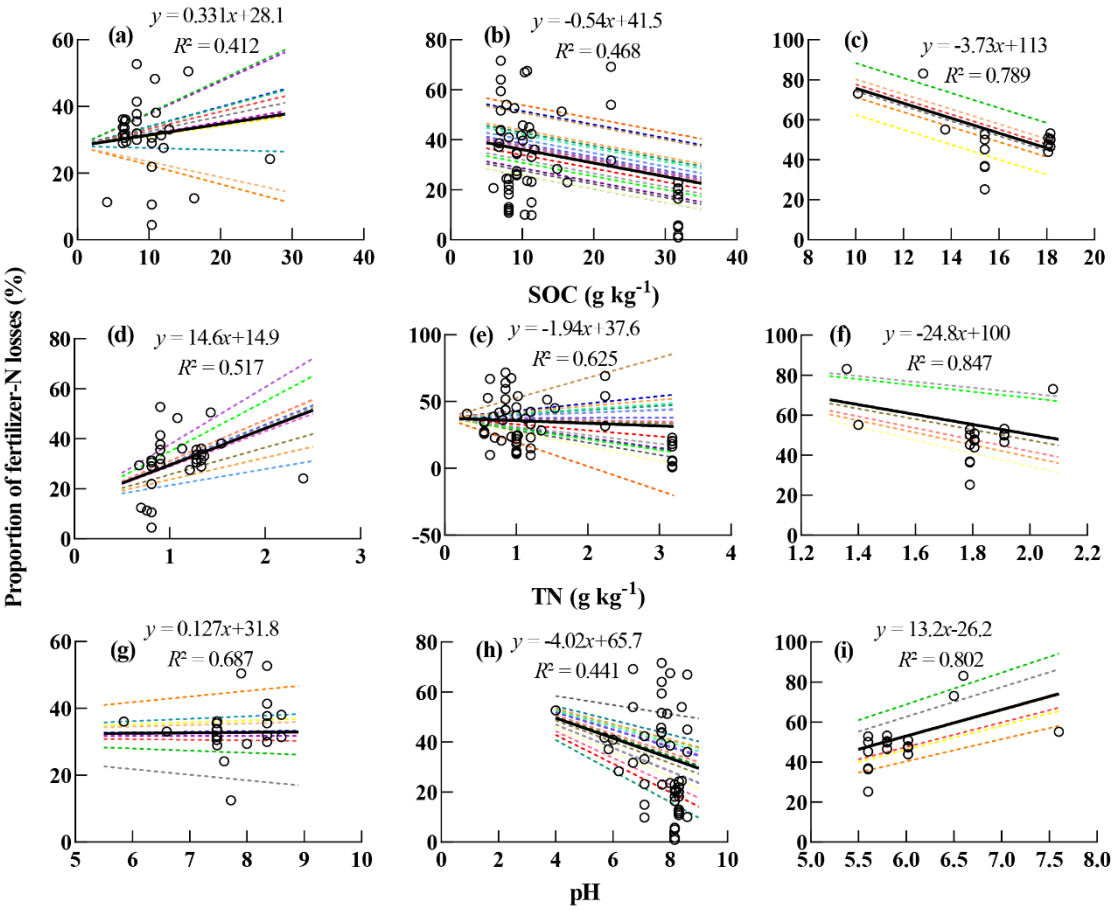

Figure S5 Linear mixed-effect analysis illustrating the correlation between the proportion of fertilizer-nitrogen (N) losses to the total applied N and soil organic carbon (SOC) content, soil total N (TN) content, and soil pH in (a, d, and g) wheat-, (b, e, and h) maize-, and (c, f, and i) rice-cropping seasons. The solid and dotted lines represent the fitted lines of fixed effects and random effects, respectively. Each color represents a different study.

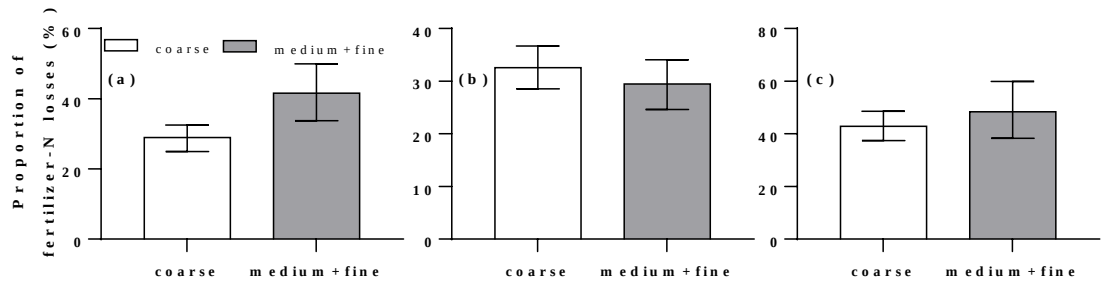

Figure S6 The proportion of fertilizer-nitrogen (N) losses to the total applied N under coarse and medium + fine soil textures in (a) wheat-, (b) maize-, and (c) rice-cropping

seasons. Error bars represent standard error.

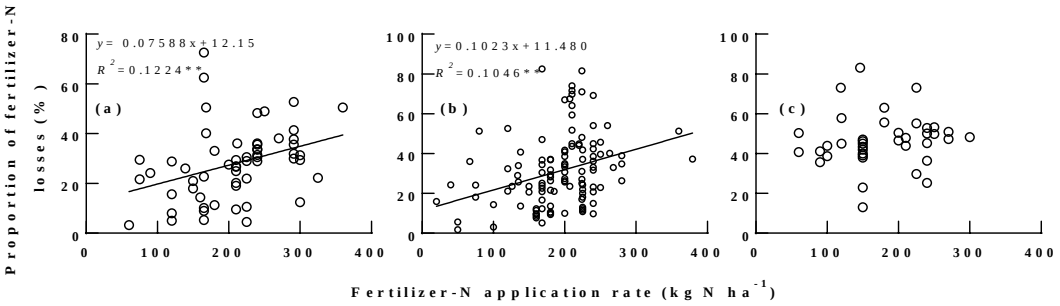

Figure S7 The proportion of fertilizer-nitrogen (N) losses to the total applied N versus fertilizer-N application rates in (a) wheat-, (b) maize-, and (c) rice-cropping seasons. ** represent 0.01 significance level.

Reference

Han, X., Xu, C., Dungait, J.A.J., Bol, R., Wang, X., Wu, W., Meng, F., 2018. Straw incorporation increases crop yield and soil organic carbon sequestration but varies under different natural conditions and farming practices in China: a system analysis. Biogeosciences 15, 1933-1946.