

Improving Nitrogen Use Efficiencies in Rice-Wheat Rotations in Southeastern China

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Introduction

Excessive use of mineral nitrogen (N) fertilizer is a common practice in rice-wheat rotations in southeastern China. At the same time N use efficiencies (NUEs) in these rice-based cropping system are very low (Peng et al., 2006). The consequences are high N losses from arable land to water bodies (surface- and groundwater) and to the atmosphere (Richter and Roelcke, 2000). To investigate the scope and scale of reductions in mineral N fertilizer inputs, demonstration field experiments on farmers' field sites were conducted for three consecutive winter wheat-summer rice double crop rotations in two counties of Jiangsu Province from 2008 to 2011. Results from the first two years are presented here.

Materials and Methods

Locations and experimental design

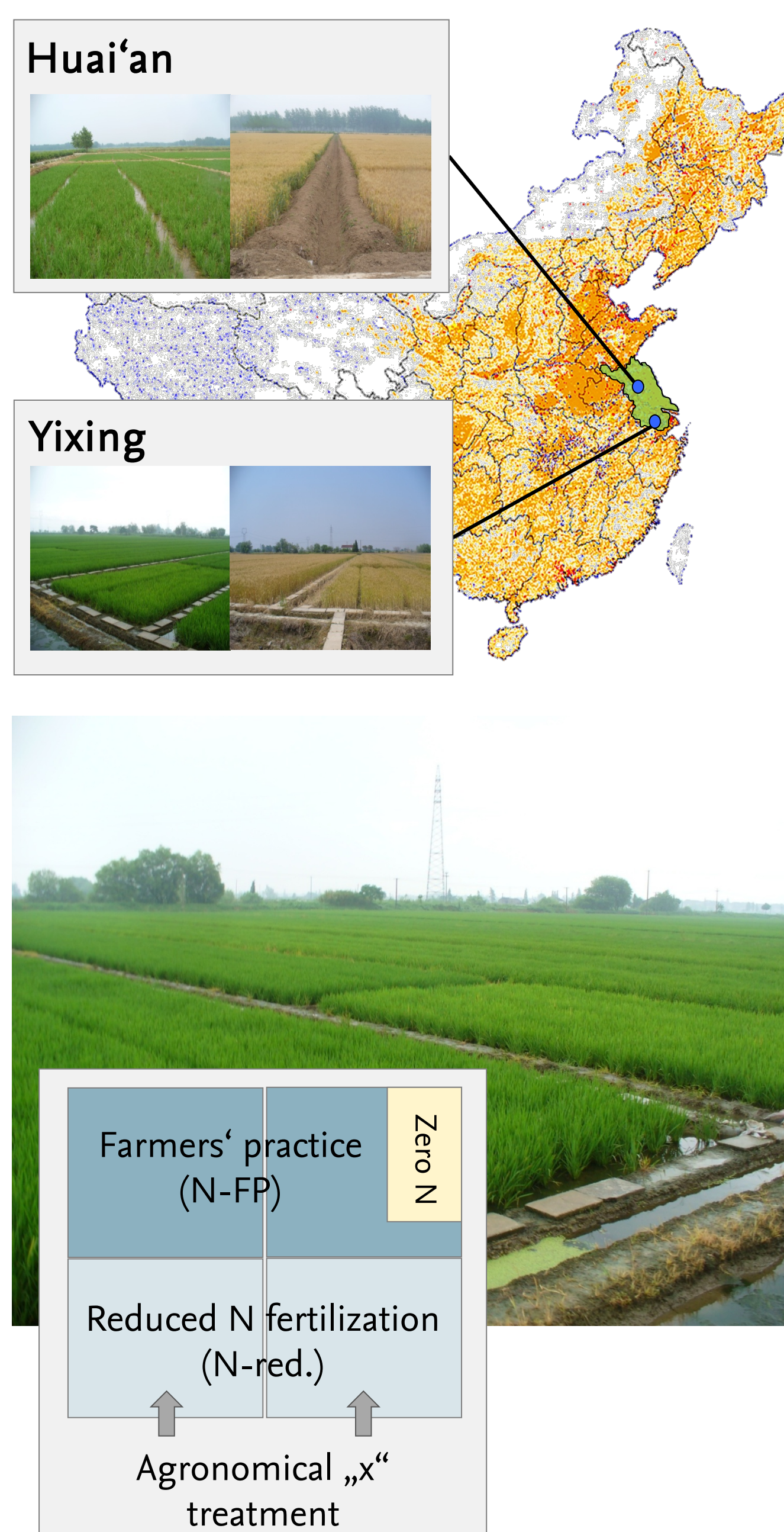
Starting with the winter wheat crop 2008/09, demonstration field experiments on farmers' field sites were established in the two counties of Yixing (31° 17'N, 119° 53'E) und Huai'an (33° 35'N, 118° 53'E), Jiangsu Province, China. The experimental design was according to the so-called "3+x" approach with three different N fertilization treatments (farmers' N fertilization practice (N-FP), "reduced" (by 25-30%) (N-red.) and zero-N application) and two agronomical ("x") treatments within each N treatment. Grain yields were determined, N balances calculated and NUEs derived according to the following equations:

(Apparent) Recovery efficiency:

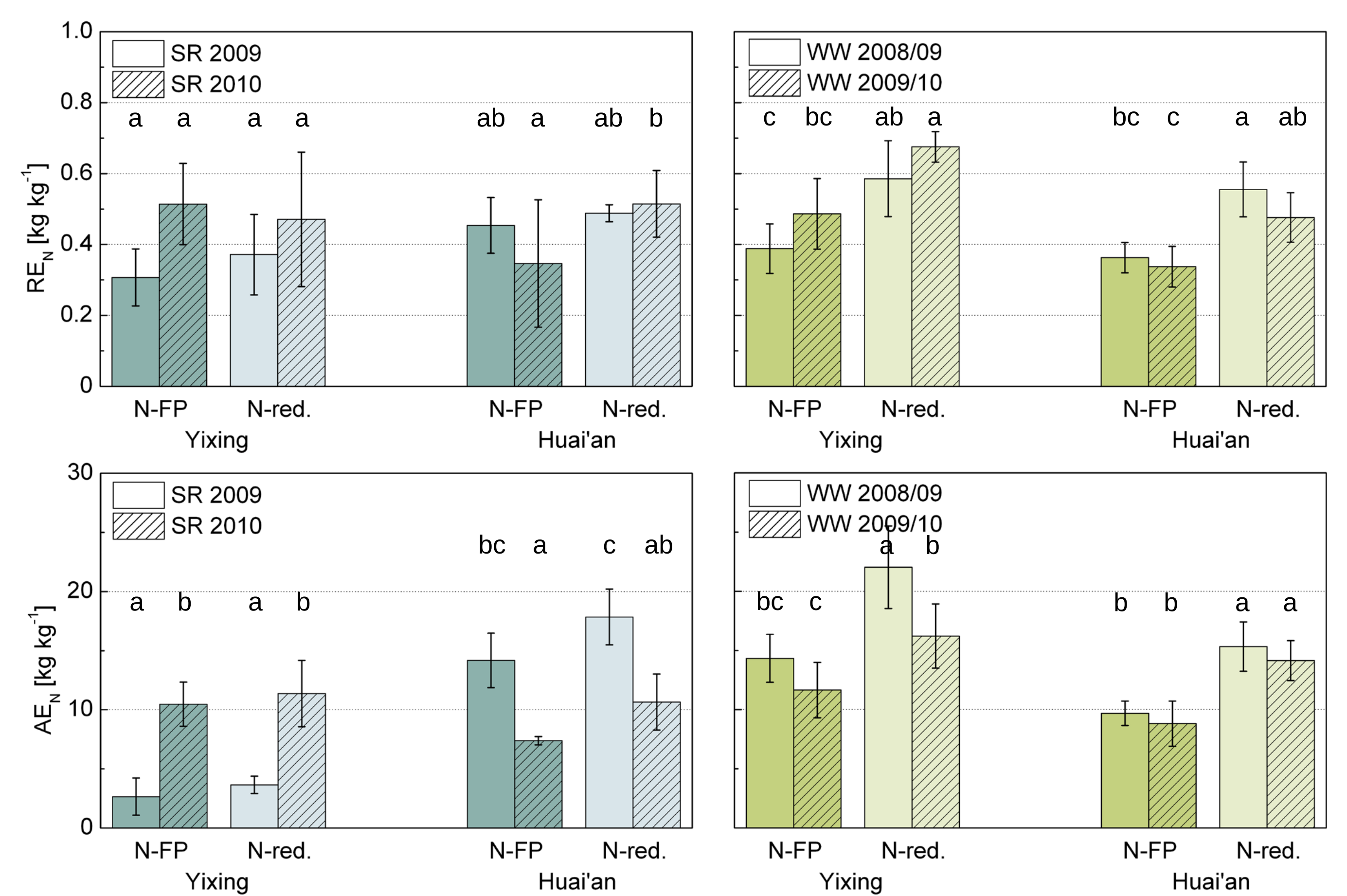
$$RE_N [\text{kg kg}^{-1}] = (U_N - U_0) / F_N$$

Agronomical N efficiency:

$$AE_N [\text{kg kg}^{-1}] = (Y_N - Y_0) / F_N$$



NUEs



Nitrogen balances

Tab.: Nitrogen input-output balances for summer rice 2009 and 2010, and winter wheat 2008/09 and 2009/10 in Huai'an.

N balances - Huai'an	Farmers' practice			Reduced N fertilization		
	Rice	Wheat	Total 1 year	Rice	Wheat	Total 1 year
Grain yields [Mg ha ⁻¹]	7.6-9.2	5.5-7.3	13.2-15.4	7.6-9.1	5.7-7.2	14.0-16.2
Mineral N fertilization [kg N ha ⁻¹]	300	261-266	561-566	225	173-189	398-414
Organic fertilizers [kg N ha ⁻¹]	-	-	-	-	-	-
Atmos. N deposition [kg N ha ⁻¹]	9	16	28	9	16	28
N uptake (grain + straw) [kg N ha ⁻¹]	146-264	160-195	316-460	188-237	156-209	354-410
N surplus/deficit [kg N ha ⁻¹]	45-163	82-117	129-273	-3-47	-4-33	25-72

Conclusions

- No significant differences in grain yields were observed in the "reduced" N fertilization treatments compared to the farmers' N practice for any year and crop and location
- NUEs could be improved by reducing the N application rate by 25-30% for both crops and years, with a greater increase in winter wheat than in summer rice, and a stronger effect in Huai'an than in Yixing
- Calculated N balances for Huai'an showed a clear decrease in annual N balance surpluses in the "reduced" N fertilization treatments compared to farmers' practice
- As recommendations to farmers, reductions in N fertilizer application rates by 15-20% to rice and 20-25% to wheat are recommended.

References

- Peng, S. et al. (2006): Strategies for overcoming low agronomic nitrogen use efficiency in irrigated rice systems in China. *Field crop res.* 97: 37-47
- Richter, J. and M. Roelcke (2000): The N-cycle as determined by intensive agriculture - examples from central Europe and China. *Nutr. Cycl. Agroecosys.* 57: 33-46

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Results

Grain yields

