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Interactive comment on "Determining the optimal nitrogen rate for summer maize in China by integrating agronomic, economic, and environmental aspects" *by* G. L. Wang et al.

G. L. Wang et al.

cuizl@cau.edu.cn

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Author(s): G.L. wang et al.

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We deeply appreciate the reviewers' time and effort to help improve the manuscript. And we have considered the suggestions seriously. Below are our replies to the detailed and constructive comments/suggestions of referee #1.

This study estimates and compares the agronomical, economical and ecological optimum N application rates in maize cropping in the North China Plain. It concludes that the ecological optimum in N application rate yields also the highest financial net benefit. This finding is an argument for discouraging excessive N fertilisation and one may wonder why anyone is still using more fertiliser than is needed to achieve this ecologically and economically desirable goal. Does it have to do with putting a high value on food security?

Yes, in this study, we considered a high value on food security. According to the results, ecologically optimal N rate did not decrease maize yield significantly, though changed maize yield from 8.5 Mg ha-1 with agronomically optimal N rate to 8.2 Mg ha-1 (Table 2 in manuscript).

Is it, because the price of maize is volatile and in years when it is high, the economically optimum fertiliser application rate is also higher? Is too much of N during years with a low price for maize economically over-compensated during years when maize is expensive?

Yes, we added "table 3" in supporting material to describe Necl with different prices of maize, N fertilizer and N losses. The economically optimum fertilizer application rate increased slightly with increasing the price of maize. For example, When the price of maize increased from 360 $ t-1 in this study to 409 $ t-1 (the highest price in recent 10 years), the estimated Necl only increased by 4% from 196 to 206 kg N ha-1. And too much of N during years with a low price for maize is economically over-compensated during years when maize is expensive. For example, when N rate increased from 228 to 250 kg N ha-1, economical benefit changed from 337 to 334 $ ha-1 with 245 $ ha-1 price for maize, and changed from 337 to 678 $ ha-1 with 409 $ ha-1 price for maize

BGD
11, C698–C703, 2014

(Table 3 in supplementary of manuscript),

I find the study is comprehensive and potentially useful in re-evaluating N fertilizer rates not only in China, but also elsewhere, where similar data allows this kind of analyses. Still, I would recommend to go a little bit further in explaining why there is such a discrepancy between economically (ecologically) and actual rates in fertilizer application.

In this study, MN (median N rate) as 231 kg N ha-1 has been recommended based on experience and target economic yields (Table 1 in manuscript). Compared with MN, the ecologically optimal N rate significantly decreased to 171 kg N ha-1, with only a 0.2 Mg ha-1 decrease in maize yield. While, the economically optimal N rate was similar as 237 kg N ha-1, and maintained maize yield as 8.5 Mg ha-1 (Table 1 and 2 in manuscript).

In this context, a small sensitivity analysis for the estimated optima would be desirable. For example, the market price of a CO2 allowance (Pg) in Eq. 7 is set to 23.8 $/t. In the meanwhile, it has dropped considerably. How does this affect the estimated ecological optimum of N application? Estimate of the economical optimum for N application is based on a regional average maize price for 2008 and 2009 of 360 $/t. Over the years, the maize price can be very volatile, sometimes doubling or halving between years (e.g.: http://www.indexmundi.com/commodities/?commodity =corn&months=120). How do such changes affect the conclusions?

The ecologically optimal N rate was affected by the volatility of the market prices of maize, N fertilizer and environmental costs, however, there was no significant increase in ecological optimal N rate. For example, ecologically N rate increased only 2%, as 4 N ha-1, when the market price of CO2 decreased 25% from 23.8 to 17.9 $ t-1. When the price of maize increased from 360 $ t-1 in this study to 409 $ t-1 (the highest price in recent 10 years), the estimated Necl only increased by 4% from 196 to 206 kg N ha-1. Similarly, with the float of the prices of N fertilizer, environmental costs, there was

BGD
11, C698–C703, 2014

little difference in Necl (Supplementary Table 3). Other studies also indicated that the optimal N rate is relatively insensitive to shifts in prices (Scharf et al., 2006; Chen et al., 2011).

After all, the affects in estimating ecologically optimal N rate because of the volatilities of price of maize, N fertilizer, CO2, and so on, were discussed additionally. The following section was added as the second paragraph from bottom of the Discussion part based on the reviewed manuscript from "AC C559: 'Updated AC C247: 'Response to Referee #2", zhenling cui, 26 Mar 2014".

In addition, the volatile prices of maize yield, N fertilizer and various Nr losses also affected the net benefit, and the estimated Necl rate. When the price of maize increased from 360 $ t-1 in this study to 409 $ t-1 (the highest price in recent 10 years), the estimated Necl only increased by 4% from 196 to 206 kg N ha-1. Similarly, with the float of the prices of N fertilizer, environmental costs, there was little difference in Necl (Supplementary Table 3). Other studies also indicated that the optimal N rate is relatively insensitive to shifts in prices (Scharf et al., 2006; Chen et al., 2011).

Correspondingly, two references and supporting material of table 3 were added.

Chen, J., Huang, Y., Tang, Y.: Quantifying economically and ecologically optimum nitrogen rates for rice production in south-eastern China, Agri. Ecosys. Envir., 142, 195-204, 2011.

Scharf, P.C., Kitchen, N.R., Sudduth, K.A., Davis, J.G.: Spatially variable corn yield is a weak predictor of optimal nitrogen rate, Soil Sci. Soc. Am. J. 70, 2154-2160, 2006.

Discussion: page 2650, lines 14 to 21 are difficult to understand. I can guess what you mean, but try to rewritten these lines in a way that is less ambiguous.

Yes, we have rewritten these lines as followed: For intensive maize systems on the NCP, N fertilizer application rates of 223–240 kg N ha–1 have been recommended by government-supported extension services (Liu, 2009; Wang et al., 2012), which

BGD

11, C698–C703, 2014

are similar to the 237 kg N ha–1 found for Neco in the present study. With Neco management in this study, the grain yield averaged 8.5 Mg ha–1, and estimated N uptake was about 146 kg N ha–1 (Yue, 2013), which is significantly lower than 237 kg N ha–1 of the Neco (Table 2).

References

Chen, J., Huang, Y., Tang, Y.: Quantifying economically and ecologically optimum nitrogen rates for rice production in south-eastern China, Agri. Ecosys. Envir., 142, 195-204, 2011.

Cui, Z. L., Chen, X. P., Zhang, F. S.: Current nitrogen management status and measures to improve the intensive wheat–maize system in China. Ambio 39, 376–384, 2010.

Cui, Z. L.: Optimization of the nitrogen fertilizer management for a winter wheat-summer maize rotation system in the North China Plain-from field to regional scale.Ph.D. diss. China Agric. Univ., Beijing, 2005.

Meng, Q.-F., Chen, X.-P., Zhang, F.-S., Cao, M.-H., Cui, Z.-L., Bai, J.-S., Yue, S.-C., Chen, S.-Y., and MÜLler, T.: In-Season Root-Zone Nitrogen Management Strategies for Improving Nitrogen Use Efficiency in High-Yielding Maize Production in China, Pedosphere, 22, 294-303, 2012.

Scharf, P.C., Kitchen, N.R., Sudduth, K.A., Davis, J.G.: Spatially variable corn yield is a weak predictor of optimal nitrogen rate, Soil Sci. Soc. Am. J. 70, 2154-2160, 2006.

Zhang, F. S., Cui, Z. L., Fan, M. S., Zhang, W. F., Chen, X. P., Jiang, R. F.: Integrated Soil–Crop System Management: Reducing Environmental Risk while Increasing Crop Productivity and Improving Nutrient Use Efficiency in China. J. Environ. Qual, 40(4): 1051-1057, 2011.

Zhang, W. F., M, L., Huang, G. Q., Wu, L., Chen, X. P., Zhang, F. S.: The development and contribution of nitrogenous fertilizer in China and challenges faced by the country,

Scientia Agricultura Sinica, 46, 3161-3171, 2013.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/11/C698/2014/bgd-11-C698-2014-supplement.zip

Interactive comment on Biogeosciences Discuss., 11, 2639, 2014.