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Biogeosciences Discussions

Interactive comment on "Economic optimal nitrogen application rates for rice cropping in the Taihu Lake region of China: taking account of negative externalities" *by* Y. Xia and X. Yan

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Dear Dr. Mosier,

Thank you very much for giving this paper a chance of revision. In this revised manuscript, we changed the title as "Life-cycle evaluation of nitrogen-use in rice-farming systems: Implications for economically-optimal nitrogen rates" to best highlights our method and implications. We thoroughly checked the calculations and procedures for the life cycle analysis. Moreover, we further discussed feasibility of economic optimum N fertilization to address referees' and your comments. In the following text of revision notes, we have seriously considered the comments of the reviewers and the

characteristics of the paper. However, our revision may still be imperfect. Therefore, we welcome your further comments and criticism to this paper. Thanks a lot!

General comments:

This generally well written manuscript presents a potentially interesting analysis of the economic and environmental costs of N fertilizer use in rice cropping in an important agricultural area of China. Unfortunately, the analysis falls short of my expectations for several reasons, which are addressed by the two Reviewers. Along with other points raised by Reviewers, the authors need to be sure that the documentation of the calculations and procedures for the life cycle analysis are complete. The basis for the empirical equations used to describe environmental impacts of N fertilizer use are based, in large part, on an unpublished paper (Xia and Yan, 2011, in review) so the reader has no means of evaluating how the equations were derived or their reliability. Response: As suggested by the editor, we have thoroughly checked the equations and calculations, and confirmed that the documentation of the calculations and procedures for the life cycle analysis are complete. As regards to the unpublished paper (Xia and Yan, 2011), we are pleased to receive the receipt of the paper by 24-09-2011. We are sure that the paper would soon be published in Sustainability Sciences in the near future and then the reader would access the paper. Attached please find the receipt email and submitted paper of (Xia and Yan, 2011) for your review.

General comments: The second major point is that the life cycle analysis only looks at the rice growing part of the year. As the cropping cycle for the Taihu Lake region is rice-wheat, I am not sure that it is valid to look only at one part of the cropping cycle at a time. Do we know the impact of from 300 kg/ha to 200 kg/ha on the following wheat crop? Do we know the impact of changing wheat production management on the next rice crop?

Response: Your suggestion is considered in the revision. We have supplemented another section in the discussion section titled “Improvement potentials”, which would

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potentially answer your question as follows:

For the rice-wheat cropping cycle in the Taihu Lake region, there are currently no long term experiments conducted to the impacts of decreasing the fertilizer N input in rice season on the following wheat crop and changing wheat production management on the next rice crop. However, many relatively short term experiments indicated that reduction in fertilizer N use in rice does not have any impacts on the following wheat crop. A four-year summer rice and three-year winter wheat (1995-1998) conducted at two sites in the Taihu Lake region showed that reducing synthetic N use by roughly 30%-45% from "standard" application rate (farmer's field practice, about 300 kg N ha-1 for rice season and 250 kg N ha-1 for wheat season) did not statistically decrease wheat yield, regardless reduction of N application rate was happened in rice season or in wheat season(Roelcke et al., 2004). However, Nitrogen balance surpluses under "reduced" fertilization diminished by about 80% for summer rice and 60% for winter wheat compared to the "standard" treatment. In a lysimeter experiment with undisturbed soil profiles carried out in a paddy soil under a rice-wheat system in the same region, reducing synthetic N use from 300 kg N ha^{-1} to 150 kg N ha^{-1} in rice crop did not decrease the following wheat yield significantly, but reduced N losses of NH3 by 68%, runoff by 64%, and leaching by 85%(Wang et al., 2007). By summarizing datasets from field experiments and demonstration trials of rice-wheat between 1995 and 2008(Xia and Yan, 2011c; b), we concluded that decreasing the fertilizer N input from 300 kg N ha^{-1} to our recommendation of 187 kg N ha^{-1} in rice season did not have any impacts on the following wheat crop. The decrease application N rate would otherwise greatly reduce N losses and increase economic benefits for the whole rice-wheat cropping systems.

There also was much evidence that a good management of nutrients in wheat season can improve wheat yield while have less impacts to the next rice crop from short term study. In the site-specific N management (SSNM) system, the N fertilizer rates were applied by three split doses (the ratio of basal fertilizer: first topdressing: second

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topdressing was 3:1:1)(Liang et al., 2008). According to the statistical data of wheat season conducted in the Taihu Lake region, the economic N application rate is around 193ï¡đ218 kg N ha−1, which is 10% to 40% lower than the prevailing N application rate, and nevertheless, would have less impacts on the next rice yield (Xia and Yan, 2011a; Xia and Yan, 2011c). Another possible management was based on knowledge-based optimum N recommendation (KONR), which could cut one-third of the current N application rate without loss of yield (Zhu, 2006; Ju et al., 2009). In a typical study conducted by (Wang et al., 2007) in the Taihu Lake region, reducing N application rate from 250 to 125 kg N ha−1did not affect rice yield significantly, though along with decreasing N application rate from 300 to 150 kg N ha−1 in rice season. (Roelcke et al., 2004) also addressed a reduction or increase fertilizer application would not have any significant effects on the next rice crop. Although some others management of nutrients in wheat season, such as interplanting with zero tillage and wheat straw manuring (Wang, 2002; Liu et al., 2007), may affect the optimal N application rate and rice yield, these managements are relatively not common in the Taihu Lake region.

In summary, though a long term experiments are needed to conduct to the interacts of N management in rice season with that in the wheat season, decreasing the fertilizer N input in rice crop has less impacts on the following wheat crop and vice versa from relatively short term study available, indicating our EONR could both potentially enhance farm profitability and reduce environmental impacts.

General comments: A third point is that when I try to use the equations given to calculate N2O emissions and N leaching I do not obtain reasonable numbers. Are all of the equations written correctly in the manuscript? Response: We have thoroughly checked the equations and calculations, and confirmed that they are correct in the manuscript.

Specific remarks: p. 6282, first line of the abstract: The first few sentences need clarification. You start out by saying that N input is overestimated, but the following sentences suggest reasons that N input is underestimated. Response: The first three sentences of the abstract have been rewritten to make it clear and logical.

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p. 6286, line 25: should planning be planting? Response: Agreed and revised accordingly.

p. 6289, line 7: Should “will be used” be are? Response: Agreed and revised accordingly.

p. 6291, lines 10-11: Sentence needs to be revised:: : :.CO2 is most frequently to emit: : :? Response: As suggested by the editor, the sentence has been revised to make it more logical.

p. 6291, line 19: I think that you need a bit of explanation as to why ammonia is an acidifying agent. To an atmospheric chemist ammonia is a basic component of the atmosphere that neutralizes nitric and sulfuric acid. Ammonia becomes acidifying only during nitrification and protons are released in the process. Response: Though NH3 released into the atmosphere neutralizes acid oxidation products of sulphur and nitrogen oxides in precipitation, this will results in a substantial increase in pH of precipitation. Once deposited in soil or water, the ammonium compounds may be oxidized to nitric acid (Schuurkes and Mosello, 1988; Brentrup et al., 2001). We have supplemented this information in the revision.

Table 2, what is the source of the data? Response: The source of the data has been supplemented in Table 2 note.

Table 3, how was cost established? Response: An overview of cost establishment was supplemented in the context of the revision. Moreover, we added the corresponding reference in table 3 note.

Figure 4, references are needed for the methods used. Response: Agreed and revised accordingly.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/8/C3383/2011/bgd-8-C3383-2011-

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supplement.zip

Interactive comment on Biogeosciences Discuss., 8, 6281, 2011.