

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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General comments:

This manuscript reports a case study on optimizing fertilizer application rate for rice production in Taihu Lake area in China. The manuscript focused on economic analysis with the life cycle method. The results presented in the paper could be potentially useful for the policy makers or managers. However, I'd like to regard this is a counting study with little scientific innovation. I am not sure if the manuscript is very suitable to be published in the natural science-oriented journals such as Biogeosciences. Response: Thank you for your kind criticism. But we think the manuscript is scientifically

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based and suit the subject of Biogeosciences as the following reasons: Scientific based method: Our study introduced an LCA method that integrates the environmental effects stemming from the entire N cycle pertinent for a rice farming system in China. Previous studies focused only one or two pathways of N losses, and solely limited to N losses in the farming process when evaluating environmental impacts of fertilizer N application. The most important reason is that there were no effective methods to combine all possible N pathways and effects. This would result in underestimate in impacts of N losses to the environmental and overestimate of nitrogen application rate. Our method combines different impacts of N losses with an economic index and integrates important material and energy flows resulting from N use into a rice agricultural inventory based on the life-cycle assessment (LCA) method, which designed to study just such impacts starting with the acquisition of raw materials, through to manufacture and use, and finally disposal. Therefore, our incorporation of LCA methodology is scientific based as it could potentially improve accuracy of impacts evaluation of N losses, and the method is a good example of LCA application which could potentially be further extends to other fields. Scientific based results: Our results quantified economically costs of resources consumed and N losses of each process related to 1 kg rice. This is scientifically important because the results not only identified contentious environmental hot-spots in the total production system, but also ranked different aspects of environmental impact through a single unit-based economic evaluation. Scientific based discussion: We discussed several scientific questions which were hotspots currently. For example, what are the advantages of our method to traditional methods in evaluating the environmental impact of N-use in a given rice production system? Which type of N losses impacted environment mostly during rice production? Moreover, we discussed the potential implications to economic optimal N application rates. Our optimal N application rates are mostly reasonable and scientific based as it based on comprehensive data analysis and methods. In this revision, we also discussed the feasibility of economic optimum N fertilization to relate to the practice. Biogeosciences deals with interactions between the biological, chemical and physical processes in terrestrial with

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the geosphere, hydrosphere, and atmosphere. The objective of the journal is to cut across the boundaries of established sciences and achieve an interdisciplinary view of these interactions. Our paper reports on a life cycle assessment of N use in high input rice farming system. As such it is both in scope and of interests to the reader of this Journal.

General comment: The major defect of the paper is lack of scientifically sound basis. All the evaluations are based on several empirical equations describing the environmental impacts of fertilizer production, transportation and field application. However, the authors didn't provide adequate research evidence to prove the reliability of the equations. For example, there are five equations shown on pages 6288-6289 for quantifying effects of fertilizer application rates on yield, N₂O, NH₃, N leaching and runoff loads. The equations are copied here as follows:

$$\text{Fyield (Nrate)} = (-0.032 \pm 0.005) \text{ N2rate} + (16.6 \pm 1.8) \text{ Nrate}$$

$$\text{TEN2O (Nrate)} = (0.31 \pm 0.05) \exp(0.0048 \pm 0.0005) \text{ Nrate}$$

$$\text{FNH3(Nrate)} = (0.18 \pm 0.03) \times \text{Nrate}$$

$$\text{TLTN (Nrate)} = (1.10 \pm 0.21) \exp(0.0038 \pm 0.0006) \text{ Nrate}$$

$$\text{TRTN (Nrate)} = (8.29 \pm 2.11) \exp(0.0042 \pm 0.0009) \text{ Nrate}$$

I tried making calculations with the equations and got strange results as follows: Fertilizer rate, kg N/ha yield, kg/ha N₂O, kg N/ha NH₃, kgN/ha N leaching, kg N/ha N runoff, kg N/ha

50	750	3	9	1.3	193
100	1340	38	18	1.6	2305
150	1770	415	27	1.9	14031
200	2040	4577	36	2.4	43610
250	2150	50454	45	2.8	69220

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300	2100	556163	54	3.4	56109
350	1890	6130685	63	4.2	23227
400	1520	67579620	72	5.0	4910

I am not sure if I made mistakes in the calculation due to my ignorance in math. Anyway, I hope the authors could double check these equations as they were used as foundation for the entire assessment. Response: The aim of this study is to evaluate environmental impacts of N losses of fertilizer N application based on the LCA methodology. We think the scientific bases of this study were related to life cycle assessment of N use in high input rice farming system and weighting different impacts together. The empirical equations are not the objective of this study, but derived from previous study to calculate Life-Cycle Inventories. Therefore, we just gave the reference and did not provide adequate research evidence to avoid repetition. However, as reminded by the reviewer, we thoroughly checked the equations and calculations, and confirmed the results as follows: Fertilizer rate kg N/ha Yield, kg/ha N₂O, kg N/ha NH₃, kg N/ha N leaching, kg N/ha N runoff, kg N/ha

50	750.0	0.4	9.0	1.3	10.2
100	1340.0	0.5	18.0	1.6	12.6
150	1770.0	0.6	27.0	1.9	15.6
200	2040.0	0.8	36.0	2.4	19.2
250	2150.0	1.0	45.0	2.8	23.7
300	2100.0	1.3	54.0	3.4	29.2
350	1890.0	1.7	63.0	4.2	36.1
400	1520.0	2.1	72.0	5.0	44.5

Our above calculations are consistent with the results of the paper. We supposed the

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reviewer made mistakes in the calculation of N₂O and N runoff, such as ignorance 0.0048 to 0.048 when calculating N₂O flux.

General comment: I suggest the authors take serious efforts to improve the manuscript, especially its scientific basis, and then try to submit it to an economy-oriented journal. Response: As mentioned above, we think our study is scientifically based. In this revision, we have considered the comments of the reviewers and the characteristics of the paper, and took serious efforts to improve the manuscript. Since Biogeosciences includes broad topics related to biological, chemical and physical processes in terrestrial with the geosphere, hydrosphere, and atmosphere, the topic of life cycle evaluation of N use in rice farming system should be suitable to the subject of Biogeosciences, such as the field of biogeochemistry and global elements cycles.

Please also note the supplement to this comment:

<http://www.biogeosciences-discuss.net/8/C3378/2011/bgd-8-C3378-2011-supplement.zip>

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