

## ***Interactive comment on “Effects of different N sources on riverine DIN export and retention in subtropical high-standing island, Taiwan” by J.-C. Huang et al.***

### **Anonymous Referee #2**

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Review of “Effects of different N sources on riverine DIN export and retention in subtropical high-standing island, Taiwan” by J.-C. Huang, T.-Y. Lee, T.-C. Lin, T. Hein, L.-C. Lee, Y.-T. Shih, S.-J. Kao, F.-K. Shiah, and N.-H. Lin

General Comments: This paper address an important topic of growing concern and interest, the fate of N in watersheds in southeast Asia. The paper is well organized, but needs further editing for English usage. In general the discussion does not provide enough information for the reader (or the authors) to make an informed interpretation of the differences in DIN export among the watershed types. For example, there is no discussion of the sources of wastewater from highly developed lands, are there modern

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wastewater treatment facilities? Are there areas of septic systems? Are there areas with no treatment of wastewater? What types of wastewater treatment are used and how much do they vary among the watersheds? While I understand the authors are presenting a large scale analysis of N input and export from a number of watersheds across Taiwan, a more thorough investigation of the three broad N sources presented would improve the paper. The different types of agriculture are presented with estimates of N fertilizer use, although it is unclear how those estimates are converted into N input estimates on a watershed scale. A similar investigation of the potential N inputs from the highly populated areas seems appropriate and would improve the discussion. In addition, it would be useful to include a short discussion of the forest history in these watersheds. Are the forests in the moderately and highly disturbed watersheds similar to those in the low disturbed watersheds? If so it would be interesting to note that even with the same retention capacity the moderately and highly disturbed watersheds have completely overwhelmed that capacity.

DIN export is estimated based on very few samples which may be one of the reasons the results from this study do not agree with early studies. While the author's explanation of why these results differ may also be true it is very difficult to make the determination based on export calculated with quarterly nitrate samples and monthly ammonium samples. I suspect storm runoff plays an important role in N transport in these watersheds, were any of the samples collected during storms? How well did the sampling strategy capture the range in flow conditions? Furthermore, there is no discussion of organic nitrogen. While the focus of the paper is DIN, I suspect DON is a large contributor to total N export in this region. In general the paper is lacking information for many important components of N inputs and exports and as a result it is difficult to evaluate the accuracy of the conclusions.

Specific Comments: Abstract: The abstract summarizes the paper well, but needs further editing.

Line 15: the term “buffered” is not the best choice because of its association with

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acid-base chemistry, however the whole sentence needs editing – I suggest “The low-disturbance watersheds had high N retention capacity with an export ratio of 0.06–0.18 despite high N input.”

Line 22: a less general term than “built-up lands” would be helpful here: residential, urban, industrial - something that gives the reader a better sense of the type of development.

Line 28: I am not sure what is meant by sewerage systems, does it mean septic systems or a specific type of wastewater treatment facility or is it referring to a type of industrial wastewater treatment?

Introduction: The Introduction provides a good review of pertinent literature

Page 16400 Line 12: I suggest “sources” or “drivers” rather than “indicators”

Page 16400 Line 12: “Levels of proportional riverine DIN export” I think this refers to DIN export ratio? I suggest “N retention and transfer processes control the amount of DIN exported from a watershed, typically less than the total watershed N input.

Page 16400 Line 15: Replace “over” with “divided by”

#### Methods

Page 16402 Lines 10-12: In Table 1 the authors indicate that the fertilizer application rates are prescribed by the COA (please spell out all abbreviations). This should be indicated in the text rather than describing the amounts as crop “needs”.

Page 16404 Lines 5-6: Please provide more information about how dry deposition was estimated. Citing unpublished data is inadequate. We need to know how these percentages were derived. If the method and data used are described they will no longer be unpublished and can be cited in the future.

Page 16404 Lines 18-20: How were rating curves developed, there is no mention of discharge measurements related to the stream stage measurements? The cross-section

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geometry and stage height does not produce a discharge.

Page 16404 Lines 24-25: Stating that laboratories followed standard operating procedures is inadequate. There are only 3 analytical types to describe and they should be described briefly. Quarterly sampling is a very coarse basis for N export calculations. Please describe the limitations of the dataset and the possible error introduced from using such infrequent sampling.

#### Results and Discussion

Page 16406 Lines 23-25: Aren't there other options besides population density control, what about better wastewater treatment facilities?

Page 16407 Lines 20-24: Given that runoff is the primary multiplier in export calculations it is not surprising that export and runoff are strongly related.

Page 16407: It is not at all surprising that there is not a strong relation between Agriculture and DIN export at a global scale. All agriculture is not created equal in terms of N export and as the authors point out total runoff and runoff ratios vary widely across the globe.

Page 16408 Line 3: “. . .even at the global scale. . .” should be “. . .even when compared to the global scale. . .”

Page 16409 Line 7: Typo at the end of the line, should read “greater than” not “greater and”

Page 16410 Lines 2-3: Again this discussion would benefit from a more thorough description of the types of human emissions in these watersheds. Are these mainly from wastewater treatment plants? Are there septic systems? Raw sewage inputs?

Page 16412 Line 3: What about the type of agriculture? There is more bamboo and paddy in the moderately disturbed watersheds as well.

Page 16412 Lines 7-8: To what types of land management are the authors referring?

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Changes in land use? Fertilizer application rates? Erosion control? Are there some types of land management that could provide more benefit than others?

Page 16412 Line 10: What are constructed lands? This sentence is hard to follow, perhaps it can be restructured for better clarity.

Page 16412 Lines 23-25: While this statement is likely true the study presents no data regarding the sewage systems or N fertilizer application methods to support this conclusion.

Concluding remarks Page 16413: "Since the runoff varied only two fold and atmospheric deposition varied less than 30%, the ~10 times greater DIN export of highly disturbed watershed (8000 kgNkm<sup>-2</sup> yr<sup>-1</sup>), compared to low disturbed watersheds (900 kgNkm<sup>-2</sup> yr<sup>-1</sup>) likely resulted from differences in inputs from agricultural lands, total human emission and watershed N retention capacity."

With some additional work this study could provide more quantitative conclusions relating the relative contributions of agriculture, human emissions, and DIN retention.

Page 16413 Lines 15-16: Problems with coastal and downstream eutrophication are not discussed in the paper. If there are such problems they should be discussed in the introduction.

Page 16413 Lines 17-28: While I do not disagree with the final conclusions of the paper, they would be more convincing with a more detailed investigation of the human inputs. What specific sewage treatment methods need improving? How would the authors expect such improvements to compare to reductions in fertilizer application rates? Given the plausible reductions in both of those inputs what impact could be expected given the extremely high rates of DIN export?

Tables:

Table 2: If these values are means for all watersheds in each disturbance category that should be indicated in the caption.

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Table 3: A more explicit description of developed land use is required. Built-up is too general. Please break down the percentages of residential, urban, and industrial land use or some other similar breakdown.

Figures: All figures are very well-drafted and easy to read

Figures 1 and 2: The maps are particularly well drafted.

Figure 3. Please include the time period for which the means apply.

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Interactive comment on Biogeosciences Discuss., 12, 16397, 2015.

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