

# ***Interactive comment on* “Global and regional phosphorus budgets in agricultural systems and their implications for phosphorus-use efficiency” by Fei Lun et al.**

## **Anonymous Referee #2**

Received and published: 22 September 2017

The overall intent of the submission, to provide data of P budgets and trends (2002-2010) across countries and continents, is laudable. It should be pointed out that this is a large data set and it required a lot of work to develop. All cells are populated - there are no gaps or missing information in this dataset which would be expected given that some of the entities are tiny. The data includes estimates of agricultural P budgets and P Use Efficiencies (PUE) based on crops, pastures, deposition, runoff/leaching) and trade in food and fertilizer, and other uses which was mainly soap. These calculations were made for every country and for continental regions and for every year and finally averaged over the period. The data are presented in an Excel spreadsheet supported by 7 tables and 3 graphs included as supplemental information. There is

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also supporting text which provides additional information on sources, references and calculations. I did not find many anomalies (no fertilizer for Belgium? and a cell ref. issue in Detailed worksheet)

The data in the worksheets are easy to follow. However, there are no units specified on any of the columns which significantly detracted from ease of use. Also, the sources of the data is not readily at hand, this would be very helpful. For example in Table SI-4 FAO is cited as a source of a great deal of data, but the exact reference is not given or even the year of the publication. Is it FAO 2002 cited in the reference? In fact the vast majority of the data is from FAO. Another sources, for the 'Phosphate acid' is the IFA- but again publication is not given and there is no citation. The other source is an atmospheric model reported in Liu et al 2007 but here the citation is not given on the table although it is in the text.

Some of the parameters, too, are curious. For example, the P:N ratios and P contents in SI-3 have no source and it is curious, for example, that the values for dairy and non-dairy cattle is the same. It is not clear why a range is given for P:N and not for P- surely there is uncertainty also for P even if less than P:N. Further, are the same values used for the entire world. And is the P content based on as is or dry weight?

Table SI-5 is a summary for cropland P inputs and outputs. There are ranges given but it is not clear how these were determined. Also, I do not know what recycled crop residue means. Is it crop residue left in the field? I find the values for deposition (atmospheric) for P unexpectedly high. I realize these values have been published and were derived from a model. It would help if the source of the deposition was quantified and presented as a part of the budget, otherwise it looks like it came from outside the boundaries of the model which does not seem correct. The human sewage value also seems high. I tracked the values to Liu et al 2008, which supposed that 30% of urban sewage and 70% of rural sewage was applied to agricultural land. But When I looked at some western countries the ratio was less than 10% which seems more plausible but where did these estimates come from. In any case it is not transparent. In Table

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SI-7 cropland PUE > total PUE; this seems wrong and is in contrast to lines 271-272.

Since the justification for this submission is to provide useful data, which I fully support, I think it is incumbent on the authors to make the data and its sources/ computation as transparent as possible both on the SI and the worksheets. They should clearly explain their uncertainties and how ranges were determined. Certainly there is a vast difference in uncertainties among national entities. Also I could not see where country types are defined, perhaps I missed it. Likewise, what is the difference between crop residues and total crop residues? Where did the labile vs stable (0.8 vs 0.2) coefficients come from?

Overall, this is an interesting data set that will be more useful when it is made more transparent. I look forward to seeing and probably using the data set in the future.

Comments on Abstract.

Globally, half of the total P input (21.3 TgP yr<sup>-1</sup>) into agricultural systems accumulated in agricultural soils during this period, with the rest lost to bodies of water through complex flows. Comment I could not find this in the document

Global P accumulation in agricultural soil increased from 2002 to 2010, despite decreases in 2008 and 2009, and the P accumulation occurred primarily in cropland. Despite the global increase of soil P, 32% of the world's cropland and 43% of the pasture had soil P deficits.

Comment: I could not find this in the document

European and North American pasture had a soil P deficit because continuous removal of biomass P by grazing exceeded P inputs.

Comment: Manure P deposition on pasture will closely match removal of biomass P by grazing; any deficit from harvesting of animals will be quite small, especially if stocking rates are low.

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Based on country-scale budgets and trends we propose policy options to potentially mitigate regional P imbalances in agricultural soils, particularly by optimizing the use of phosphate fertilizer and recycling of waste P.

Comment: self-evident.

The trend of increasing consumption of livestock products will require more P inputs to the agricultural system, implying a low P-use efficiency aggravating the P stocks scarcity in the future.

Comment: While technically this is correct, I don't really see a strong connection with the data set. There is more prospects for recycling animal P than N.

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Interactive comment on Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2017-41>, 2017.

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