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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Global Phosphorus Recovery for Agricultural Reuse" *by* Dirk-Jan D. Kok et al.

Anonymous Referee #1

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The manuscript tries to identify potential phosphorus source and demand areas and connect them through market price. Phosphorus is an important input in crop production with potential for causing water pollution if not managed properly. The topic is very interesting for wider audience. The manuscript is well written with a good analysis of the different sources and supply areas. However, some of the assumptions and methods employed need further clarification before the manuscript got accepted.

#1. Manure is an important source of P. However, it is not clear from the text what is included in the manure source. (a) How did you account for the manure that falls on pasture during grazing and the part that falls on roadside? Depending on the production system, part of cattle manure may fall in the pasture and won't easily be collected. Please see Bowuman et al. (2009, 2013) and the associated detailed description

of the model used (http://www.pbl.nl/en/publications/2011/exploring-global-changes-in-nitrogen-and-phosphorus-cycles-in-agriculture-induced-by-livestock-production-over). Please provide detailed description of the method you followed. (b) Manure production per head is dependent on the volume of feed animals consume. It is not right to assume all animals in both developed and developing countries will generate same amount of manure per head as given in Table S1. Sheldrick et al. (2003) provide the manure production per animal as a function of slaughter weight. The same approach was followed by Liu et al. (2010), and Mekonnen and Hoekstra (2017). I suggest you differentiate the amount of manure per head if possible per country if not at least per economic development.

#2. Equation (2) is confusing and no detail on the input provided. The equation by Doorenbos and Kassam (1979) or Steduto et al. (2012) is specified for the growing period:

so I am not sure the need for the additional parameters (Tg, AH, and C). If you are aggregating the actual ET over the growing season, why do you need a correction factor? I would expect both the crop water requirement and the actual ET to be over the growing season and over the cropping area. If that is the case why put Tg and Ah on the nominator but not in the denominator? The other question I have is how did you estimate the crop evapotranspiration (ET) and the crop water requirement (CWR) per grid per crop? There is no detail where and how you got the data. What value did you assume for the maximum yield (Ym)? Does it vary per country or climate region or one value for the global? If you have to estimate the yield please do it properly. Otherwise, one suggestion is to use the yield from other sources such as Monfreda et al. (2008).

#3. Determination of the node: sorry if I have missed it but it is not clear from the manscript how the demand and supply node were determined. How did you define the location of the node? What parameters did you use? Please clarify!

#4. I was wondering if you have accounted for the legacy P or the residual P that

accumulates in the soil in determining the demand nodes. The residual P can be taken up by crops so it can be considered one source of P.

#5. The result are dependent on the number of assumptions and the data used. Therefore, I expect a range of values that describe the uncertainties involved in the modeling. I suggest you provide uncertainty analysis covering the major uncertainties around the input parameters and the model.

#6. Table 1 is not clear. Why the values for Livestock Raster vs Livestock node and Human raster vs urban node are different? Why do you need to provide two estimate of P for livestock and the human? Please add explanation of the values and why they are different. I also not able to find Figure S2a, S2b, and S2c. Do you mean Figure S1 instead of S2?

#7. It will enhance the reliability of your result if you compare the result with earlier estimates such as Bouwman et al. (2013) for manure; Van Drecht et al. (2009) and Moree et al. (2013) for domestic

Reference:

Bouwman, L., K. K. Goldewijk, K. W. Van Der Hoek, A. H. W. Beusen, D. P. Van Vuuren, J. Willems, M. C. Rufino, and E. Stehfest (2013), Exploring global changes in nitrogen and phosphorus cycles in agriculture induced by livestock production over the 1900–2050 period, Proc. Natl. Acad. Sci. USA, 110(52), 20882-20887, doi:10.1073/pnas.1012878108.

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Mekonnen, M.M. & Hoekstra, A.Y. (2017) Global anthropogenic phosphorus loads to fresh water and associated grey water footprints and water pollution levels: A high-resolution global study, Water Resources Research, 54(1): 345–358.

Monfreda, C., N. Ramankutty, and J. A. Foley (2008), Farming the planet: 2. Geographic distribution of crop areas, yields, physiological types, and net primary production in the year 2000, Global Biogeochemical Cycles, 22(1), GB1022, doi:10.1029/2007gb002947. (data available at- http://www.earthstat.org/data-download/)

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