

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
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Comment on hess-2021-312

Anonymous Referee #1

Referee comment on "Social dilemmas and poor water quality in private water systems"
by Gopal Penny et al., Hydrol. Earth Syst. Sci. Discuss.,
<https://doi.org/10.5194/hess-2021-312-RC1>, 2021

Summary

In this paper, the author stressed a very important water issue. The private systems and wells contamination issued by septic systems, and this might cause many types of social dilemmas. The author. Has developed a water game theory for private water systems starting with 2 and then with N-players applied then a symmetric as well as an asymmetric game with more uncertainty related mainly with the groundwater flow direction and the different possibility of contamination. All this has been applied to learn more about the interlinkages between the choice of the septic system upgrading, wells contamination, and social dilemmas. To do so, the author applied a groundwater model. To have more clearance about. The different probabilities are related to the uncertainty around the groundwater flow direction and the possibility of contamination (self-contamination and cross-contamination) by the septic systems.

At the end of the game (study), we expect to have a straightforward decision (policy solutions) that can help in solving this social dilemma with less cost.

General comments:

- 1) **Title:** reflect very well the main question of the paper
- 2) **Introduction:** well, framed, and organized, but the author needs to check for more recent references.
- 3) **Two household contamination games:** this part is very well described.
 - However, there is a need to clarify if the game is cooperative or not cooperative before heading to the Nash equilibrium (non-cooperative).
 - The author needs to explain why he has chosen to go with the non-cooperative choice, even if it was very clear that the author wanted to stress out the social dilemma cause. But it would be great to clarify the rationality behind the choice.
 - Why the author did not consider all the parts of the game: elements of action (finite or infinite), information set (complete information or incomplete information game),

numbers of the same play in a game (one-shot game and repeated game).

4) **Symmetric two-player games:** from lines 113 to 121: the paragraph is a bit complicated, there is clear contradiction and redundancy in explaining the upgrading and non-upgrading choice.

5) **Groundwater model:** the author mentioned that the modeling part could be determined by any groundwater model, but he did not explain the rationale behind selecting /using the MODFLOW model.

6) **Case study:**

- The existing groundwater data are mainly based on assumptions, does the author performed any data collection or had access to any national database?
- It is important to have the year of any collected data
- Does wells capture radius (rs) is sufficient to calibrate a groundwater model? In my knowledge in the case of groundwater flow modeling we need more than the Rs parameter, we need for example the recharge and hydraulic conductivity supported by field data.
- The model validation is absent, does the author validate the model data?
- The author took too much space to explain the game (almost 10 pages), however, he didn't well calibrate and validate his groundwater model and he didn't clearly explain and apply the game for the case study.

7) **Discussion:** the discussion is good, but it is too general and does not directly reflect the results from the selected case study. The author here only explained more about the different types of social dilemmas.

8) **Conclusion:** we expected after applying the game to a case study to have some applicable policy recommendations/solutions, but the author didn't provide any straightforward solutions.

Specific comments:

1) **Symmetric two-player games:** from the line 113 to 121: the paragraph is a bit complicated, there is clear contradiction and redundancy in explaining the upgrading and non-upgrading choice

2) **Line 337:** The other player will reciprocate if she (he) has sufficient assurance of the other player's buy-in.

3) I think that the references listed below worth to be sited in this publication:

- Raquel S, Ferenc S, Emery C Jr, Abraham R. Application of game theory for a groundwater conflict in Mexico. J Environ Manage. 2007 Sep;84(4):560-71. DOI: 10.1016/j.jenvman.2006.07.011. Epub 2006 Sep 22. PMID: 16996197.
- Ariel Dinar and Margaret Hogarth (2015), "Game Theory and Water Resources: Critical Review of its Contributions, Progress and Remaining Challenges", Foundations and Trends® in Microeconomics: Vol. 11: No. 1-2, pp 1-139. <http://dx.doi.org/10.1561/07000000066>

