**Review of "Reviving the Ganges Water Machine: why?", submitted to HESS by Amarasinghe et al.**

***October 2015***

**General comments**

The authors present a study exploring the potential of increasing subsurface storage before the monsoon season to increase water availability in the Ganges basin on an annual scale. Since the Ganges basin is prone to water stress that is likely to increase in the future when water demands continue to increase, this is an important topic. Exploring the effects of possible measures to increase the water availability are thus of scientific and societal interest. The paper is in general quite well written, and conveys its message. However, some changes should be implemented.

1. The Introduction section could use some reformatting as indicated in the specific comments below. Besides, my suggestion would be to rename the Results section to Results and Discussion. The section discussing the regional differences of the findings should be elaborated, as indicated in the specific comments below.
2. The authors make the general assumption that climate change will cause problems in the future in the Ganges basin. Although this is likely true for climatic extremes (floods, droughts), climate change may also provide opportunities in terms of total water availability. For example, Sharmila et al. (2015) and Krishna Kumar et al. (2011) show that the monsoon's precipitation amounts are likely to increase and that the monsoon season is likely to become longer. On the other hand they show that precipitation events are likely to be more extreme and that the number of dry days during the monsoon increases. Lutz et al. (2014) showed that increases in water availability from the upstream parts of the basin are likely and that low flows outside the monsoon season may increase. The general point here is that the paper would benefit from a short paragraph discussing the projected climatic changes in the Ganges basin, for example in the Introduction section, to place the present study in the context of future changes.
3. I do not understand why the analysis stops here, at their first out of four conditions for successful implementation of a PDRP scheme. Wouldn't it be a better option to include findings on the other three conditions as well? That would certainly have more scientific value. Now the analysis seems incomplete.

**Specific comments**

P8728L5-6: Be specific which months (June-September monsoon season) and also for the other months outside the monsoon season mentioned.

P8728L13: Remove 'necessary'

L16,17: Include the months in parentheses behind Rabi in the abstract as well for readers who are not familiar with Rabi/Kharif

P8728L22: Change 'Importantly' to 'In conclusion'

L21: Change 'in the same year' to 'within the year'

P8729L1-12: Consider moving this part and integrating it with P8730L27-P8731L8. Then the introduction will have a better structure:

1) Importance of Ganga river for society,
2) Problems affecting Ganga water supply,
3) Limitations of increasing surface storage capacity to cope with problems,
4) Introduction to GWM and SSS as possible solution,
5) Conditions for SSS
6) Aim of paper to quantify unmet demand (being first condition for SSS)

P8729L7-9: Provide a reference for this statement

L9-L10: Also for this statement add a reference.

L12: Change ‘woes’ to ‘problems’

L25: Change ‘is’ to ‘are’

P8730L1: Remove ‘other’

L5-6: Provide a reference for this statement

L7: Remove ‘’after dollars

L11-13: Consider citing the more recent paper by (Lutz et al. 2014)

L17-18: Provide a reference for this statement.

L20: Provide a reference for this statement.

P8731L1: Change ‘SSS is increasingly important now more than ever before’ to ‘SSS is now more important than ever before’

L2: What is meant here with ‘outcomes’? That needs clarification.

L2-L4: This sentence is not ‘flowing’ very well. Consider splitting in two sentences.

L26: Change ‘for guaranteeing’ to ‘to guarantee’

L29: Remove ‘resources’

P8732L1: Rephrase: ‘There must be an adequate volume of groundwater available for pumping before the monsoon season.’

L15: Change ‘from’ to ‘for’

L17-19: At what time scale is this increase necessary (decades? Centuries?)

P8733L2: Change ‘Ganges’ to ‘Ganges basin’

P8733L14: Change ‘unmet demand for water’ to ‘unmet water demand’

P8736L1: change ‘varies’ to ‘vary’

P8737L6: change ‘is’ to ‘are’

L14: change to: ‘…meeting the ESS and requirements for socioeconomic activities’

L24: change to: ‘…be considered additionally in WA…’

P8738L1: Change $Bm^3$ to $Bm^3yr^{-1}$, and indicate the location of Hardinge Bridge in Fig. 1

L4-9: See previous comment

L15-16: Change to ‘environmental flows’ or ‘EFs’

P8739L22: Change ‘is’ to ‘are’

L23: GOI should be GoI

P8740L5-6: The figure legend mentions ET and the text mentions CWU. Be consistent and use one of them in both the text and the figure

L7: Change ‘is’ to ‘are’

L8. Change to: ‘…out of 4 years. The river is…’

P8741L1: Additional pumping and depletion of GW is argued here to be the only feasible way to increase SSS here. However other ways to increase SSS are not discussed. The claim that it is the only feasible way needs to be more substantiated.

L4: ‘in the’ is doubled

L25: It is not clear to me how Table 3 is linked to Figure 8. How do you get from the numbers in Table 3 to potential unmet water demand? This needs more elaboration.

P8741L24-P8742L18: The spatial differences are your main findings and therefore deserve some more discussion in the paper. I suggest that this section be elaborated, highlighting regional differences and their causes and consequences.

P8742L26-P8743L14: I think one very important aspect that could be a limiting factor is the time required to recharge the groundwater after pumping. This has to be completed within one monsoon-season, otherwise the situation will be unsustainable. Consider emphasizing this in this section.

P8743L20: Change ‘basin’ to ‘Ganges basin’

P8744L4: Change the wording as the statment is based on future projections with uncertainties: change ‘will’ to ‘could’ or ‘is likely to’

P8745L9: Change ‘in the same year’ to ‘within the year’

Table A1: Include EF as acronym

Table 1: Consider referring to Table A1 in the table caption for meaning of acronyms.

Figure 1: Indicate the location of Hardinge Bridge.

Figure 3: In the caption text about effective rainfall estimates is written, but there is nothing about that in the figure. Panel B is shown here, but not referred to in the text. Either remove the panel or use it in the text to substantiate your findings.

Figure 4: The caption says that the source of trends are author's estimates. This is not necessary to mention in the caption, because it is based on the study described in this paper. Besides change in caption: 'The projections for 2025 and 2050 are from…'

Figure 8: Units are missing and the map needs a legend for the color scale.

**References**

Krishna Kumar, K. et al., 2011. Simulated projections for summer monsoon climate over India by a high-resolution regional climate model (PRECIS). *Current Science*, 101(3), pp.312–326.

Lutz, A.F. et al., 2014. Consistent increase in High Asia ' s runoff due to increasing glacier melt and precipitation. *Nature Climate Change*, (June), pp.1–6.

Sharmila, S. et al., 2015. Future projection of Indian summer monsoon variability under climate change scenario: An assessment from CMIP5 climate models. *Global and Planetary Change*, 124, pp.62–78.