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Hydrology and Earth System Sciences Discussions

Interactive comment on "Agricultural groundwater management in the Upper Bhima Basin, India: current status and future scenarios" *by* L. Surinaidu et al.

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Referee 2

Response to specific comments

1. The authors have mentioned that they have used rainfall data from 1997 to 2007. But it is unclear whether you have used average rainfall or spatially distributed.

Response: Spatially distributed rainfall data is available and initially utilized, but we found that it did not improve model calibration results. The model was much better

calibrated with uniformly distributed average annual rainfall for the basin over the calibration time period. However, rainfall data was not directly used in the model, but rather, converted into groundwater recharge as described in the response to referee 1.

2. What is the average annual rainfall of the catchment?

Response: This is now provided in the manuscript.

3. You need to add a section describing the data used for modelling (e.g. rainfall, pumping etc).

Response: We agree that the methodology used to derive rainfall and recharge required clarification. The spatial rainfall data from every gauging station in the catchment was averaged for each year between 1997 and 2007. The average of all these years is 872mm/year. This single value however, was not applied directly, rather used in the weighting process described below. In order to calculate the annual groundwater recharge, the groundwater recharge (and draft) budgets for the watersheds in the basin were supplied by the Groundwater Surveys and Development Agency (GSDA). These were averaged and then weighted according to each year's spatially averaged rainfall data. This method reflects variations in recharge and draft according to the annual rainfall, and is now better described in the revised manuscript

4. Did you validate the model using independent data set before modelling the scenarios? What were the RMS and NRMS values during validation?

Response: The model was well calibrated using decadal groundwater data from over 300 locations. However it is not independently validated. The calibration data is shown in Table 2.

5. For better comparison, plot observed head vs. simulated head. Response: This is included in the revised manuscript in figure 4 as suggested.

6. Use notations consistently (Page 10669, line 1 and line 19, Million Cubic Metre). Response: Notations have been correctly modified in the revised manuscript.

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7. Of the recharge coefficient of 11%, what is the breakup between rainfall recharge and recharge from irrigation?

Response: The fluxes from different recharge sources are not explicitly differentiated according to source of recharge. This is an important question especially from a local–scale perspective, and will be varied according to local conditions. We do not have local data for the estimates of the relative recharge. Data sourced from the GSDA for each watershed recharge budgets is inclusive of all fluxes such as rainfall, irrigation return flows and current watershed development. From this work's regional-scale perspective this inclusive method is considered a satisfactory approach.

8. In order to achieve recharge contributions of +20% and +30% how much more storage (WSD) is required? Some case studies conducted in the region reported that these structures may lose 50% of the stored water due to evaporation. Therefore is it a viable solution?

Response: The reviewer is correct in highlighting that according to different studies in the region 50% of the stored water is lost as evaporation and the efficiency of recharge structures can be as low as 50%. This discussion has now been included in the revised manuscript.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 10657, 2012.