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Discussions

Interactive comment on "The socio-ecohydrology of rainwater harvesting in India: understanding water storage and release dynamics at tank and catchment scales" *by* K. J. Van Meter et al.

Anonymous Referee #1

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OVERALL COMMENTS

This study's objective is to quantify the water budget of four rainwater harvesting (RWH) tanks and assess the combined impacts of the RWH tanks on the hydrology of a small budget. The authors use field measurements to attempt to quantify inflows and outflows, and conclude that the RWH tanks significantly decrease runoff and increase groundwater recharge over the catchment.

As the authors note, the hydrology of RWH systems is poorly understood (e.g. Glendenning et al., 2012), and therefore the accurate quantification of the water balance at both a tank and catchment scale would be a valuable scientific contribution. I feel

that HESS is an appropriate venue for this study, which studies the hydrological impacts of small-scale anthropogenic modification at both local and catchment scales, with relevance for region, national, and global agricultural water use.

Overall, the paper is well written, interesting, and sheds light on an important topic. However, I have some concerns regarding the authors' estimation of evapotranspiration and groundwater exchange, specifically related to the specific yield (Sy) parameter, and the potential errors that this may introduce to tank- and catchment-scale results based on this evapotranspiration and groundwater exchange. For this reason, I suggest the editor consider the revisions suggested below prior to making a final decision on this manuscript.

SPECIFIC COMMENTS (major)

The bulk of the authors' results are based on a modified version of the White method, which is widely used for estimating the proportion of evapotranspiration which comes from groundwater recharge. As noted by several studies (Loheide et al., 2005; McLaughlin & Cohen, 2014), accurately estimating specific yield (Sy) is critical for accurately quantifying fluxes using the White Method. Sy is a particularly important parameter in this study, as it controls both the estimated evapotranspiration (ET; via Eq. 1) and groundwater exchange (GE; via Eq. 2).

In this study, the authors assume Sy to be a constant 1.0, and mention some potential problems with this assumption, including referencing a study by McLaughlin & Cohen (2014) (hereafter M&C). M&C also find that using a constant value of Sy can lead to overestimation of ET (and, by the same logic, GE in this study). For example, in Figure 5, the authors note that calculated ET rates are only reasonable when inundated area is >25% of the maximum observed inundated area. It appears that areas with unreasonable values (to the right of dashed lines) represent ∼25-50% of the total time monitored, and include ET estimates up to 30 mm/day (see Tank 2). While seasonal averages compare favorably to PET, as noted in section 4.1.2 of the text, estimates appear to get less and less accurate as the growing season progresses. Because Eq. 1 and Eq. 2 are based mostly on the same parameters, this indicates that during the periods when ET estimates are unreasonable, GE estimates would also likely be off, potentially by a factor of 2-3x.

This potential issue casts some doubt over the authors' other interesting results. Figure 6 shows a general decrease in groundwater exchange over the course of the growing season which is very interesting, particularly the shift from outflow to inflow seen at Tank 4. However, this shift may be driven by increasing overestimation in GE over time, which (as discussed above) is likely due to error in the estimation of specific yield, rather than actual increases in total ET or GE. I feel that results from the periods during which estimates of ET and GE are unreliable should not be included in subsequent graphs. Or, at the very least, it should be noted (perhaps by shading in the background of plots) the periods during which Sy estimates (and therefore ET and GE estimates) are inaccurate.

M&C were able to correct for inaccurate Sy estimates at low tank water levels using an interpolation between estimated soil specific yield and open water specific yield. It is not mentioned whether the authors attempted this correction, but it may improve the reliability of both ET and GE estimates. Considering that the authors generated a stage-inundation relationship as part of their methodology, they should have all the necessary input data to carry out this correction and potentially improve their results. Even better, or if the Sy of the local soils is unknown, calculations could be carried out with a range of Sy values, which would also improve the study by providing a rough estimate of the uncertainty associated with the authors' estimated water balance.

SPECIFIC COMMENTS (minor)

One major assumption of the authors' methodology is that there is no surface inflow to the RWH tanks on days when it is not raining, meaning both overland flow and subsurface runoff occur over very short time intervals. This should be stated more

clearly in the methodology.

Pg. 12125, line 12: "variables" should be "variable"

Pg. 12131, line 19: Section 4.3 is referred to, but does not exist – I believe this should be Section 4.1.2? A scale bar should be added to Figure 1a

Figure 2b is the same as Figure 2 in Van Meter et al. (2014) ES&T – this should be cited appropriately in the figure caption.

Section 4.2.3 refers to Figure 11 several times – I believe this should be Figure 10.

I may be interpreting the x-axis on Figure 3 incorrectly, but it looks like it goes from 0:00 (midnight) to 12:00 (noon) to 0:00 (midnight) – meaning a single day. However, as drawn, it includes two "Night" periods, one beginning shortly after noon. Please check this axis.

I found myself a bit confused by the inputs and outputs used for each step of estimating the water balance components, moreso for the catchment-scale scenario study than for the individual tanks. I suggest that the authors include a simplified diagram (boxes and arrows) showing the calculation of each component of the water balance, and then how they are estimated in both the NT and WT scenarios.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 12121, 2015.