Authors' Response

We would like to thank the reviewer for the constructive comments on the manuscript. We have considered the reviewer's comments and provide the following responses.

It is therefore a bit disappointing that only three dams are considered in this study, and also that there is no attempt to understand the communities' perceptions of the sand dams.

This study's success relied on active participation of community water groups to help collect long-term datasets. Of the 15 sand dams in Tanzania known to us, only three still have active community water groups maintaining the dams. This, in addition to funding limitations and long travel times, prevented us from performing in-depth field studies for more than three sand dams.

We worked very closely with the community water groups over the course of the study and developed a good understanding of their perception of their sand dam. However, the social aspect of sand dams is not the focus of this study, so any related commentary has been omitted.

I am curious as to why FLDAS is selected, there is no justification.

FLDAS was selected as a proxy for climate data, because there is not a consistently reliable source of climate data available for Dodoma or Longido, Tanzania. FLDAS is not the perfect substitute, but it has been specifically designed and validated for use in sub-Saharan Africa. A line will be added to the manuscript explaining the choice of the FLDAS dataset.

It seems to assume that all water loss must be through evaporation rather than considering that there may be leakage from the trapped sand, either under the dam wall or through the riverbed. This could help explain some of the results (e.g. p. 8 line 16-18, p. 10 lines 1-4, p. 10 line 10, p. 10 line 20-21. p. 11 line 2, p. 12 line 16, p. 12 line 19) and would have a big impact on the conclusions. The established literature on evaporation is only referenced right at the end of the discussion (p. 12 line 25).

Based on the relative magnitude of loss terms in Eq. (1) in the manuscript and the prolonged availability of near-surface water resulting from storage in the sand dam, we believe that most of the unaccounted losses are due to evapotranspiration at the Chididimo sand dam. However, we have considered the comments of Reviewer 1, and updated our conclusions regarding water loss at the Soweto sand dam. Unlike the Chididimo sand dam, the Soweto sand dam did exhibit signs of seepage occurring under the dam wall. We will add a statement to the manuscript acknowledging that seepage through the streambed could be contributing to the unaccounted water loss.

In order to calculate the storage in the sand dam (p.6 line 30-31), why not just assume that it is fully saturated at the end of the wet season? This could be supported if you observe water ponded on top of the trapped sand.

Thank you for your suggestion. In response to comments from Reviewer 1, we have updated Eq. (1) and initiated the theoretical water loss model at the end of the rainy season. This will be updated in the manuscript.

I am curious as to why the WTMWs were the only attempt to measure water levels the sand dams. Piezometers or even excavated holes in the sand dam could have provided a more comprehensive picture. In my experience observing the water depth in scoop holes that the communities dig can be an excellent indicator of overall water levels, but I don't know if there were present here.

Borst and de Haas (2006) installed piezometers in the sand dam itself, so we did not think it necessary to repeat this arrangement. Instead, we wanted to focus on how the sand dam affects the water table outside of the stream channel, since the idea that sand dams raise the local groundwater table has really only been explored via modelling. Therefore, we installed WTMWs in the streambanks and the surrounding area to track how the water table was changing over time. We did not consider tracking water levels in the scoop holes dug by community members but will consider this as a viable methodology for future studies.

I am also not surprised by the results of the macroinvertebrate study. That a dry river bed in an arid region contains no macro invertebrates seems hardly to be a surprise. This methodology seems to be more suited to perennial rivers.

Boulton et al. (1992), Stubbington et al. (2009), and Verdonschot et al. (2014) all successfully used variations of the methodology described in the manuscript to sample dry river beds. Boulton et al. (1992) even sampled an ephemeral river in the Arizona desert. We believe that we used the appropriate methodology for collecting macroinvertebrates from an ephemeral streambed. If sand dams were less homogeneous and therefore more suitable habitats for macroinvertebrates, we believe we would have been successful in our sampling attempts.

Macroinvertebrate sampling in perennial rivers is most often conducted by placing a net, typically a surber sampler, facing upstream on the streambed and then disturbing the upstream streambed to release any macroinvertebrates nestled there. The flowing stream then carries the macroinvertebrates into the net, where they are captured and identified.

There are results on the sediment grain size (p 7 line 19) but no methodology to measure it.

A formal sediment grain size analysis was not performed. The determination that the Chididimo and Soweto sand dams consist primarily of fine- and coarse-grained sand was based on a visual and tactile assessment of the material. A statement will be added to the manuscript to clarify this point.

p. 8 line 4 – I am struggling to see how the vegetated cover is correlated to the land slope in figure 3. Could this be confirmed through a statistical test?

The paragraph immediately preceding (p. 7 line 25-p.8 line 2) discusses the relationship between land slope and vegetated cover in the context of Figure 3. This relationship is not immediately apparent from the figure alone. The statement on p. 8 line 4 will be edited to reduce the chance for reader confusion.

We will look into performing an appropriate statistical test to validate our discussion of the relationship between land slope and vegetated cover.

p. 8 line 8-9 – point 1 is poorly explained, and again on p. 11 line 29-32. A figure would help here.

Figure 1, below, will be added to the manuscript to help clarify our point. In addition, further discussion of how flat land can generally support more vegetation than steeply sloping land will be added to the manuscript. Storm surface runoff travels more slowly over flat land than steeply sloping land, allowing more time for water to infiltrate into the ground. The infiltrated water recharges the groundwater and increases the soil moisture, which supports vegetation growth. In addition, when a sand dam creates a locally raised water table in an area with flat land, the water table will be nearer to the ground surface, and therefore plant roots, than if the sand dam were surrounded by steeply sloping land (see Fig. 1, below). The water table has a positive impact on the soil moisture of the unsaturated soil layer just above the water table, and this additional moisture supports higher rates of vegetation growth. Shemsaga et al. (2018) will be

added to the manuscript in support of using healthy vegetated cover as an indication of groundwater in Dodoma.

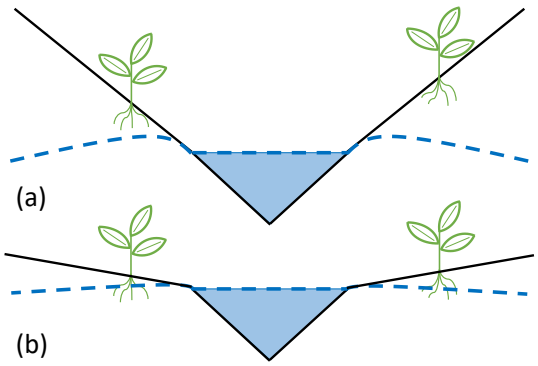

Figure 1: The roots of plants growing on a (a) steep slope will be farther from the locally raised water table created by a sand dam, and therefore have less access to soil water, than vegetation growing on a (b) gentle slope.

p. 9 line 21-25 – this is hard to follow.

These lines will be updated to remove unnecessary detail and clarify the point.

p. 9 line 24 – how can soil be assessed properly in advance to avoid this type of failure?

To our knowledge, this point is not well-discussed in the available literature. However, it is our understanding that the soil composition of the streambed before a sand dam is constructed can be helpful in determining the distribution of grain sizes likely to be captured by a constructed sand dam. This information coupled with knowledge of the sediment load typically carried by the stream when flowing can inform one's decision regarding the necessity of constructing the spillway of a sand dam in stages. A statement with this information will be added to the manuscript.

p.10 line 31 – by "subsurface water reservoir" do you mean the underlying aquifer of the trapped sand?

Yes, we mean the water stored between the grains of sand in the sand dam. The wording of this statement will be altered to reduce reader confusion.

p. 12 line 6 – please be more specific on why the stream channel migration is important.

Noted. We will add a few sentences to the manuscript explaining how increased erosion and stream channel migration can lead to the failure of a sand dam.

Additional References

Shemsanga, C., Muzuka, A.N.N., Martz, L., Komakech, H., and Mcharo, E.: Indigenous knowledge on development and management of shallow dug wells of Dodoma Municipality in Tanzania, Appl. Water Sci. 8, 59, https://doi.org/10.1007/s13201-018-0697-7, 2018.