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Interactive comment on "Shallow groundwater in sub-Saharan Africa: neglected opportunity for sustainable intensification of small-scale agriculture?" *by* J. Gowing et al.

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We are grateful to the anonymous reviewer for his/her support for publication of the AMGRAF experience in HESS.

We have already presented our argument above in our response to Reviewer #1 about the case-study focus of our paper. Reviewer #2 makes a valid point that sources in the grey literature could usefully extend what he/she calls 'Northern' literature, but we were restricted by the word limit for the journal. We note that reviewer #1 has expressed some concern that the existing review of literature is rather long and we would therefore welcome advice from the editor on how to proceed.

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The reviewer advises that the paper should consider the work of “Steenhuis et al / Cornell-Barhidar” (Bahir-Dar) University teams, on rainfall-runoff in the Ethiopian highlands. We are aware of this literature, and in fact some of the papers include our project colleagues and one of the co-authors of this paper as co-authors. These papers address general process understanding and modelling approaches for rainfall-runoff in the Ethiopian highlands, and address related issues of climate impacts, surface water runoff and sediment erosion, with some community-based approaches for water management, focussed on household water supply. They do not include any specific emphasis on groundwater resources, the focus of our paper, but we do appreciate that they are relevant to our general direction of research in Ethiopia and may be usefully included within our review.

The reviewer comments that there is limited discussion of the cultural / non-technical limitations to the expansion of more formalized shallow-GW development in Ethiopia, e.g. lack of secure tenure and farm size. While we acknowledge these issues (“social dimensions of irrigation are as important as the technical dimensions”, lines 566/567), our focus is on emphasising the potential for development, and we argue that “it is feasible to irrigate up to 1 hectare from a single well pumping from 20m deep”, lines 332/333), which indicates that even small farms of less than 1ha can benefit from shallow groundwater resources.

There is a tradition of GW use for domestic use (over 70% of the population use GW for domestic use – see Macalister/Pavelic in Awulachew et al, 2012), including springs used widely for drinking water and even bottling (see Ambo in ET highlands), and for livestock watering (the famous Borena in the south) but irrigation is typically low intensity and localized. This latter comment supports our view that reviewer #1 overstates the extent of existing GW irrigation in SSA. We acknowledge concerns over potential conflicts with domestic uses. We do not regard bottling as an issue as this use involves deeper aquifers.

The reviewer comments that the study did provide a very good example of community

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engagement and this could be made much more of. We are continuing our research in this area, and could readily emphasise this aspect further in this paper. See our summary comments below.

The reviewer mentions the potential for drip irrigation which has had limited success in SSA outside of large commercial horticulture (including the Foreign Direct Investment projects in the Ethiopian Rift Valley) and notes that low efficiency surface methods still dominate. We recognise that any recommendation of more efficient methods, where likely supply rates are low, should also give consideration to the capacity/skill to source and maintain equipment. As reviewer #2 notes, there is a large body of work on the success and failure factors of drip irrigation in SSA.

The reviewer suggests that one recommendation could be that shallow well irrigation could be introduced as supplementary irrigation during dry spells, which are a major threat that is growing more frequent and severe in the changing climate. We fully agree with this point, and further research is planned to address this directly based on our community-monitored observations combined with modelling and scenario analyses. We have presented and discussed the evidence supporting this throughout the paper, for example see our comment related to baseflow assessment "that a degree of buffering and indicates that groundwater is available even in a very dry year" (lines 508/509), and "A single well can support irrigated cropping on a plot up to 1ha provided that crops are planted sufficiently early to make use of rainfall in the later part of the Kiremt season, and avoid the second part of the dry season when groundwater levels have generally declined through natural drainage, and which may be required to support other environmental requirements" (lines 558-562). Any attempt to promote small-scale intensification must offer risk-reduction strategies allowing for vulnerability to climatic variability, and supplementary irrigation is an attractive option which we aim to demonstrate is viable with evidence from our study site.

The reviewer recommends that mention of cash crop potential should necessarily also refer to market access constraints. We agree with this point. We note that our choice

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of general study area was based on “priority given to agricultural transformation in the area and availability of hydrogeological data” (lines 169/170), but that we do not provide detail of how we selected the Dangeshta kebele for the detailed study. We did conduct a detailed preliminary review prior to site selection (line 384), with one of the key criteria being access to a potential market, and it would be possible to indicate this more clearly in the paper.

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