

## ***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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Received and published: 24 April 2016

We are grateful for the informative comments by Dr Turner. We are not familiar with the Thermonics technique to which he refers. We do not agree with his opinion that “the only geophysical groundwater exploration method is Thermonics”. The electrical resistivity method is very well established and is widely used by the Geological Survey of Ethiopia who were our partners in the AMGRAF project. The method is very well suited to investigation of shallow aquifers; fracture zones and the boundary between weathered and unweathered bedrock are easily identified.

We agree with his comment about the utility of lineament analysis particularly for locating higher-yielding boreholes in fracture zones in crystalline bedrock. It is less relevant

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for shallow wells where lower yield is acceptable and the regolith is the target rather than deeper rock. In any case it was not our aim to identify well locations, rather we wished to investigate the extent of the shallow aquifer.

We do not agree with his comment that “the use of shallow groundwater for irrigation was taken for granted”. We recognise that there are indeed hotspots where this does occur and we report that its use is certainly more extensive than we see in official data on groundwater use. Our intention is to question its neglect by public authorities with the remit to develop and manage natural resources for the benefit of poor people living in rural areas.

One reflection of the official neglect is the failure to make available suitable pumping equipment. We agree that a small diesel engine with a belt drive to a centrifugal pump situated close to the water table has been a successful approach in the past but a long belt drive will be inefficient and problematic. We argue that developing a well is achievable and affordable to 20m depth but available pumping technology is not suitable beyond 10m or less. Electric submersible pumps with photovoltaic power sources are now an attractive alternative.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2015-549, 2016.