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Hydrology and Earth System Sciences Discussions

Interactive comment on "The water footprint of electricity from hydropower" *by* M. M. Mekonnen and A. Y. Hoekstra

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I encourage you to discuss more the water footprint concept and what is an appropriate use of the water footprint concept. In the paper you write "We have estimated the water footprint per reservoir by considering the total evaporation from the reservoir, whereas one could argue that before the reservoir was created there was evaporation from the area as well, probably not so much from the original flowing river (since in most cases the reservoir area is much larger than the original river water area) but possibly significant from the inundated land. However, here it is relevant to recall the definition and meaning of the water footprint. The water footprint is not meant to refer to additional evaporation (compared to some reference situation), but for quantifying the

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volume of water consumption that can be associated with a specific human purpose (Hoekstra et al., 2011). From this perspective, the full reservoir evaporation can be attributed to the purpose of the reservoir." Firstly I want to ask you why you have chosen this definition for water footprint. A hydropower plant depends on the water available in the upstream catchment. The input to the catchment is precipitation, the leakage term is evapotranspiration from the land surface, and the remaining water might be used. Building of a new reservoir will prevent evapotranspiration form the land surface that was there before, but create evaporation from the reservoir surface. One of the impacts of the reservoir is therefore a change in annual evapotranspiration and runoff from the catchment. So why is it inappropriate to use this net change in evapotranspiration as water footprint? If you keep your definition, I would like challenge you to discuss more about the appropriate use of the water footprint according to your definition above. Some points that might be addressed are 1: Does natural undisturbed land has a water footprint? Evapotranspiration occurs from natural and undisturbed land, hence giving a certain water footprint, which might be substantial. Is this in line with idea behind the water footprint concept? 2: Can water footprint be used to tell something about the water consumption and the impact on the water resources in a catchment? For me this would be an inappropriate use of the water footprint. In theory, one might install a water reservoir that results in no changes in annual water balance of a catchment, but still have a large water footprint. A catchment in a natural state consumes water (evapotranspiration). A human activity might reduce the water consumption of the natural surface and increase the water consumption attributed to this activity. But the total water consumption of the catchment might remain unchanged. This balance between the water consumption components is important for the water resources management. 3: In many cases dams are build on already existing lakes (e.g. lake Victoria). How should water footprint be estimated then? In such instances the lake used as a reservoir do not necessarily change at all (one example is Norway where this is often the case)– a tunnel may lead water down to lower levels to create head for power purposes, but obviously the evaporation from the lake will be as before.

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It do not seem reasonable to allocate a water footprint – defined as water loss or water consumption – to a water body when the only change is a change of “name” – from “lake” to “reservoir”. 4: Building of dams and reservoirs is often used as a measure to increase the water availability and reduce the vulnerability to droughts. Such reservoirs/dams might be used for several purposes, e.g. drinking water supply, irrigation of farm land, recreation, flood protection and hydro power production. As the reservoir often improves the situation with respect to water availability and at the same time has a very large water footprint seem to contradictory. Could you please comment on this?

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