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EDITORIAL
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Editorial: Water Harvesting Methods in Drylands to Increase Climate Resilience

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Editorial on the Research Topic

Water Harvesting Methods in Drylands to Increase Climate Resilience

In drylands short periods of rainfall are followed by long dry seasons. Climate change is making this cycle even more extreme, with less frequent but often heavier rainfall episodes. For communities to have sufficient water for domestic uses and livelihoods, this water needs to be harvested and stored locally to reduce the burden of water collection, which typically falls on women and children. This Research Topic presents a collection of seven papers on technologies and natural systems that harvest and store water in drylands. Three papers are on sand dams, one is on a sand river, one is on check dams, one on hydropower dams, and one on a tank cascade system.

Despite the popularity of sand dams as a Research Topic, two out of the three sand dam papers were critical of sand dams as a technology. The review of Ritchie et al. finds, in field studies (as opposed to numerical models) of sand dams, that they were not able to provide water throughout the entire dry season because of (a combination of): low storage capacity as trapped sand is too fine-grained due to poor construction; water loss through seepage under the dam wall or below the riverbed; and/or water over-abstraction. These shortcomings question the cost-efficiency of sand dams in some areas, even though they are relatively inexpensive compared to other water storage technologies and can be effective in drylands. The survey of Ertsen and Ngugi found that questions around dam or resource ownership meant that sand dams and the associated hand pumps may not be maintained, especially if it is unclear who is responsible for maintaining them, or users have to walk a long way to fetch water from the sand dam. They also question what impact a sand dam could have on a local water table if just one dam is implemented in isolation over a deep water table.

In another field study of the Limpopo sand river in Mozambique, Saveca et al. found that larger sand river systems have a significant natural water storage capacity and large harvesting potential. Natural recharge by runoff occurs almost every year, and this, in combination with the large width (up to 500 m), significant thickness (10–15 m), and high permeability of the sediments, provides good conditions for groundwater development.

The sand-dam modeling study performed by Eisma et al. in Tanzania suggested that the pattern and duration of dry and rainy seasons largely influence sand-dam performance, and that the latter will improve under a changed climate, because of the positive impact of fewer but heavier rainfalls on recharge, promoting infiltration and decreasing evapotranspiration. Nevertheless, increased rainfall could increase erosion that traps more fine sediment behind the sand dam, reducing the amount of water that can be stored.

The studies of Mozzi et al. and Okedu and Al Siyabi on check dams and hydropower dams, respectively, are also both based on modeling methodologies. Mozzi et al. compare their tool, coded in R environment, to field measurements and conclude that the tool is successful in

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simulating the temporal dynamics of check dam storage and fluxes, but also highlight the important role of maintenance, as well as site selection, on dam performance, while acknowledging there can be challenges with desilting. Okedu and Al Siyabi focus their paper on modeling the effect of hydroclimatic variations on the performance of a small hydropower dam in Oman, which is also used for livestock, irrigation, and domestic use. As in the previous cases for sand and check dams, evaporation needs to be minimized, and the authors show that power generation is further threatened by the release of water for irrigation purposes, and the successive occurrence of dry years. Finally, through a mixed method survey, Chinnasamy and Srivastava conclude that rehabilitating urban cascade tanks would be the best way to address unmet water needs; they note that in the rural areas these tanks are functioning very well.

Under this Research Topic, the modeling studies are positive overall about technology implementation whereas field surveys tend to be skeptical. The reality of technology implementation throws up new challenges, linked to complex interactions with the environment and the need for good construction and regular maintenance, that models tend not to reflect. The exception is Chinnasamy and Srivastava, and it is interesting how they reflect that cascade tanks are a centuries old, indigenous technology, as opposed hydropower dams which are a modern development. Check dams and sand dams also have a long history. Ertsen and Ngugi point out that in pre-colonial times, most rural Kenyans could access water close to their house all through the year. The colonial clearing of indigenous vegetation adversely affected water resources.

Technologies such as sand dams and check dams work closely with nature to provide water supplies, so they might be termed nature-based solutions or blue-green infrastructure. This is an idea that could be explored in more detail in future research. Sand rivers, on the other hand, are fully natural systems with a high storage potential, and are common in dryland Africa but remain underexploited. There are known exceptions in countries such as Kenya and Zimbabwe, which face threats from sand mining, as mentioned in the case of sand dams by Ertsen and Ngugi.

The authors include dryland residents researching local water management challenges but some also bring their knowledge and expertise to another continent. Some of the authors live in wet, temperate regions of the US, UK, and the Netherlands; it is important that researchers in these countries work alongside dryland residents as well.

Although there are many other research methods and water-harvesting techniques that have not been covered in this Research Topic, these papers provide a snapshot of ongoing research. This Research Topic of papers highlights the importance of reconciling models with field studies applying social and hydrological field methods to understand how water can be harvested in the wet season and made available for domestic and productive uses throughout the dry season.

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