A4Store

Smallholder farming families Adapt African Alluvial Aquifers to Strengthen Their Own Resilience

The challenges faced by African countries due to climate change and population growth are huge. There is urgent need to accelerate adaptation measures, in particular to ensure food security. A4Store seeks to address this by strengthening the resilience of vulnerable and resource-poor rural households in fragile African drylands by using nature-based water storage of sand rivers for food production.

In many semi-arid regions of rural Africa significant nature-based water storage exists in the form of ephemeral sand rivers, which for generations have been accessed by riparian communities to meet their domestic and livestock water needs. More than 100 million people in Sub-Saharan Africa live in arid to semi-arid lands close to sand rivers that experience at least one flow event per year. In some of these river basins, farmer-led irrigation activities have emerged utilizing this water source. Yet, in many parts of Africa this resource remains underutilised and therefore offers significant scope for supporting irrigation-based livelihoods.

A4Store vision

A4Store envisages that by 2027 the most marginal communities in various rural drylands of Sub-Saharan Africa use alluvial aquifers to

- enhance their wellbeing,
- strengthen their own resilience to the uncertainties that they face, and
- sustainably manage and conserve the riparian ecosystem.

A4Store aims to help trigger this transformation by assisting the rural poor in drylands to access and use nature-based water stored in sand rivers in sustainable and equitable ways, through a co-learning approach. A4Store focuses on dryland regions in Ethiopia, Mozambique and Zimbabwe and learn from experiences in Kenya, Niger and India.

Key concepts

A4Store is inspired by two concepts, which it aims to critically investigate:

a) *"Farmer-Led Irrigation Development"* (FLID), a concept based on the capacity of smallholder farmers to develop themselves. A challenge is how external actors can support farmer-led development without compromising its bottom-up approach, which is its distinctive strength. Our specific aim is that the poor will be able to lead this development.

b) *"Adaptive Investment Pathways"* (AdIP) is a new approach for planning step-wise investments towards desired development objectives using a co-learning process in the face of an uncertain future. It is an alternative for large lumpsum investment (such as dams and irrigation canals) that locks-in to a fixed future scenario.
The AdIP approach is embedded in the landscape that supports a diversity of livelihoods, of which irrigated agriculture is one. Achieving sustainable development through AdIP requires engagement with all local residents to negotiate investment choices for achieving social wellbeing and ecosystem sustainability, while avoiding mal-adaptation.

Activities

A4Store (2023-2027) will work in a broad spectrum of situations – in certain areas sand rivers are hardly used for irrigation (Zimbabwe), in others intensively (Kenya, India); in some areas the use of sand rivers for irrigation has a long track record (Niger), in others it is recent (Ethiopia, Mozambique). This diversity forms a rich base of experiences to learn from.

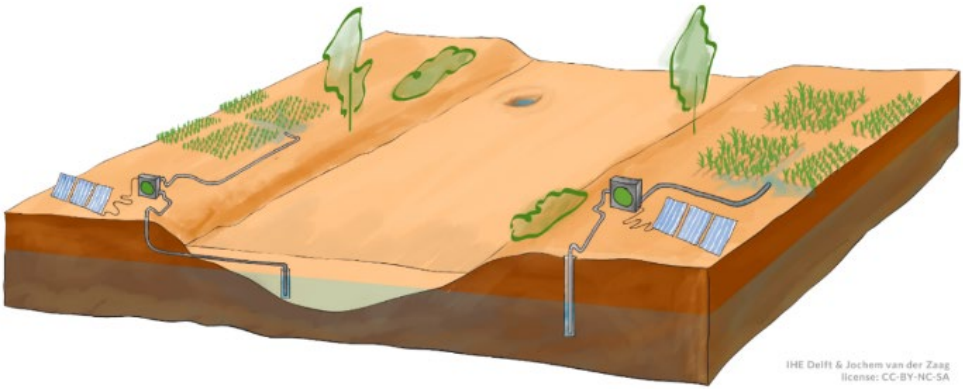
Research

The main research question that A4Store investigates is:

> *How can resource-poor farmers be supported to access and use water stored in sand rivers in socially-just and ecologically-sound ways, which will not only enhance their wellbeing but also their resilience to climate and socio-economic uncertainties and shocks?*

Specific research questions:

1. *Sustainable water potential:* What is the sustainable potential of water stored in sand rivers to support livelihoods and ecosystems services, and to what extent do smallholder farmers currently use this water for irrigated agriculture?
2. *Support for resource-poor and marginal farmers:* What are ways to support resource-poor households to proactively engage in farmer-led irrigation development and become self-reliant and resilient, in areas with sand rivers?
3. *Adaptive Investment Pathways:* How can the Adaptive Investment Pathways concept contribute to a co-learning approach that enhances the wellbeing and resilience of resource-poor farmers, while empowering riparian communities to manage their water resource sustainably and equitably?
4. *Learning from intensely used sand rivers:* What lessons can be learned from regions where sand rivers have been, and are still being intensively used, not only water but also sand (India, Kenya, Niger)?



Principles

A4Store builds on action research previously conducted in Ethiopia, Kenya, Mozambique and Zimbabwe (through A4Labs (https://a4labs.un-ihe.org), NaBWIG (http://www.nabwig.com) and associated projects; see also http://sandrivers.org), and adopts the following principles:

a. *Social inclusiveness:* sand rivers offer realistic opportunities for resource-poor households to adaptively develop their well-being and resilience on the basis of irrigated agriculture, because there is no need for expensive infrastructure, such as dams or irrigation canals.

b. *Resilience:* sand rivers can provide reliable irrigation water for individual smallholder farming families. This can enhance their resilience and prosperity while coping with economic and climatic uncertainties.

c. *Ecological sustainability:* sand rivers are relatively shallow (<5m deep) and form a renewable store of water. Each flow event recharges the aquifer fully. This allows water users to experiment, make mistakes, adjust and learn – ideal for bottom-up processes of institution building.

d. *Co-learning:* sand rivers allow for a local development process that is gradual and based on co-learning through monitoring of resource use and ecosystem services, both in terms of sustainability limits and equity. Use rules can be developed adaptively through learning-by-doing.

Recent papers

Chauruka, M., A.E.C. Duker, P. Prasad and P. van der Zaag, 2023. Endogenous irrigation in arid Zimbabwe: farmer perceptions of livelihood benefits and barriers to scaling. *Water SA* 49 (4), 355–362. [doi:10.17159/wsa/2023.v49.i4.4031]

Duker, A., 2023. Viewpoint: Seeing like a farmer – How irrigation policies may undermine farmer-led irrigation in sub-Saharan Africa. *Water Alternatives* 16(3) (www.water-alternatives.org/index.php/alldoc/articles/vol16/v16issue3/721-a16-3-5)

Duker, A., C. Cambaza, P. Saveca, S. Ponguane, T. A. Mawoyo, M. Hulshof, L. Nkomo, S. Hussey, B. Van den Pol, R. Vuik, T. Stigter and P. van der Zaag, 2020. Using nature-based water storage for smallholder irrigated agriculture in African drylands: Lessons from frugal innovation pilots in Mozambique and Zimbabwe. *Environmental Science and Policy* 107, 1-6. [doi:10.1016/j.envsci.2020.02.010]

Duker, A.E.C., T. A. Mawoyo, A. Bolding, C. de Fraiture and P. van der Zaag, 2020. Shifting or drifting? The crisis-driven advancement and failure of private smallholder irrigation from sand river aquifers in arid Zimbabwe. *Agricultural Water Management* 241, 106342 [doi:10.1016/j.agwat.2020.106342]

Duker, A.E.C., B. M. Karimba, G. E. Wani, P. Prasad, P. van der Zaag and C. De Fraiture, 2022. Security in flexibility: accessing land and water for irrigation in Kenya's changing rural environment. *Cahiers Agricultures* 31, 7 [doi:10.1051/cagri/2022003]

Duker, A.E.C., S. Maseko, M.A. Moyo, B.M Karimba, A. Bolding, P. Prasad, C. de Fraiture and P. van der Zaag, 2023. The changing faces of farmer-led irrigation: Lessons from dynamic irrigation trajectories in Kenya and Zimbabwe. *Journal of Development Studies* 59 (9), 1317–1336 [doi:10.1080/00220388.2023.2204176]

Karimba, B. M., A. Duker, P. Prasad, P. Karimi, C. de Fraiture and P. van der Zaag, 2022. Irrigation on the move: How transient farming partnerships facilitate the expansion of smallholder irrigation along ephemeral rivers in dryland areas of Kenya. *Agricultural Water Management* 265, 107526 [doi:10.1016/j.agwat.2022.107526]

Prasad, P., A. Duker, P. van der Zaag and C. de Fraiture, 2023. Irrigation development under uncertainty: a call for adaptive investment pathways approach. *Environmental Science and Policy* 140, 104–110 [doi:10.1016/j.envsci.2022.11.017]

Saveca, P.S.L., A. Abi, T.Y. Stigter, E. Lukas and F. Fourie, 2022. Assessing groundwater dynamics and hydrological processes from sand river deposits in the Limpopo River, Mozambique. *Frontiers in Water* 3, 731642 [doi:10.3389/frwa.2021.731642]

A4Store partners

Mekelle University	Ethiopia
Tigray Bureau of Agriculture and Natural Resources	Ethiopia
Tigray Agricultural Research Institute	Ethiopia
Relief Society of Tigray	Ethiopia
Indian Institute of Technology Delhi	India
Jomo Kenyatta University of Agriculture and Technology	Kenya
Instituto Superior Politécnico de Gaza	Mozambique
Gaza Provincial Directorate of Public Works	Mozambique
IHE Delft	Netherlands
Practica Foundation	Netherlands
Université Abdou Moumouni	Niger
Dabane Trust	Zimbabwe
University of Zimbabwe	Zimbabwe
Department of Irrigation	Zimbabwe

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