



Sustainable Groundwater Development for Improved Livelihoods in Sub-Saharan Africa

KEY POLICY MESSAGES

- There is great potential for groundwater irrigation in much of Sub-Saharan Africa.
- Smallholder farmers are eager to tap reliable new irrigation sources.
- The most critical constraints lie in developing supply chains, finance, and other essential infrastructure.

■ *Woman irrigating plants with bucket, West Africa, Ghana*
© Joe Ronzio / IWMI

WI and IWRA Policy Briefs are published by IWRA with the support of Routledge. They aim to provide high quality analysis and practical recommendations for policy makers on important development issues.

• Access *Water International* by becoming a member of IWRA: www.iwra.org

• or subscribe only to the journal at:
www.tandfonline.com/toc/rwin20/current

IWRA Policy Briefs are based on WI Special Issues and are for the purpose of stimulating discussion and awareness; IWRA, as a neutral forum, does not necessarily endorse the views expressed.

 **Routledge**
Taylor & Francis Group

At least 400 million people in Sub-Saharan Africa source their domestic water supply from groundwater. Yet this often abundant resource only accounts for around 20% of total irrigation. More widespread irrigation could help reduce rural poverty, improve food security, and counter droughts. Why is groundwater so under-tapped?

THERE IS GREAT POTENTIAL FOR GROUNDWATER IRRIGATION IN MUCH OF SUB-SAHARAN AFRICA

Pavelic et al. estimate that groundwater is considerably underutilized, from a study in a subset of 13 countries in the region. Of these, the highest potential is in Zambia, followed by Ghana, Mali, Mozambique, Nigeria, Rwanda, Tanzania and Uganda. Burkina Faso, Ethiopia, Kenya, Malawi and Niger have limited potential. Collectively, these countries could extend groundwater-irrigated area by 13.5 million hectares. Altchenko & Villholth (2015) put the total area of cropland in Africa potentially irrigable with renewable groundwater at anywhere from 27.2 to 64.3 million hectares, after accounting for human needs and environmental requirements. With proper integrated management at all levels, this potential can be developed without compromising domestic water supply.

SMALLHOLDER FARMERS ARE EAGER TO TAP RELIABLE NEW IRRIGATION SOURCES

Smallholders readily embrace groundwater irrigation. According to Villholth, smallholders form the nucleus of growth behind expanding groundwater irrigation, driven by improved access to low-cost technologies for pumps and drilling services. Smallholders favor groundwater irrigation due to the generally reliable year-round access and their autonomy



■ Sprinkler irrigation used in a small scale cash cropping at Sunrise Farm, Camperdown in KZN, South Africa © Steve McCurrach / IWMI

over its utilization. This reduces their risk when making investments in other production inputs (seeds, fertilizers, pesticides and energy), which enables them to intensify through multiple cropping and to diversify, leading to greater productivity and higher net incomes.

A small motor pump, usually less than five horsepower, is the best of the irrigation technologies evaluated for improving the agricultural production of typical smallholders in Sub-Saharan countries. When Shah et al. asked rainfed farmers from nine countries in SSA to name their preferred mode of irrigation, they overwhelmingly chose to have a private well, a small-motor pump, and adequate flexible pipe. Namara et al. find that small-motorized pumps are the most widely used method for extracting groundwater.



■ Planting in a drip irrigation system, Giyani, South Africa
© Marlene Storkborg

Pumps alone are not enough, though. Shah et al. find that improving working capital availability, enhancing security of land tenure, and providing fuel at affordable prices are key complementary factors in stimulating smallholder irrigation development in Sub-Saharan Africa.

THE MOST CRITICAL CONSTRAINTS LIE IN DEVELOPING SUPPLY CHAINS, FINANCE AND OTHER ESSENTIAL INFRASTRUCTURE

Underdeveloped supply chains

While small motor pumps provide a path for smallholders to transition to groundwater irrigation, a web of complicating factors overshadows movement in that direction. Under-developed supply chains complicate the acquisition and use of small motor pumps. Focusing on Zambia, Colenbrander & van Koppen show how centralized provision of sales and services requiring farmers to travel long distances, unreliable availability of spare parts, and limited quality control create unacceptably high transaction costs for the farmers. Remote rural farmers also find it difficult to access adequate information

regarding the available range of pump makes, models, prices, and how to operate and maintain the pumps properly.

Multiple obstacles to smallholders

Other indirect factors hinder smallholders' adoption of groundwater pumps. In Ghana, Dittoh et al. show that smallholders recognize the economic advantages of groundwater irrigation but many cannot acquire the equipment due to inadequate working capital. More broadly across the region, Chokkakula & Giordano reveal obstacles such as borehole investment costs, the price of energy, access to credit, and land tenure security.

Access to credit

While diesel pumps usually cost more to operate than electric pumps, only 14% of rural Sub-Saharan Africa has electricity infrastructure. Forced to rely on diesel to power pumps, many smallholders find access to credit is a crucial factor, but they face unacceptable interest rates. Women are often particularly disadvantaged in getting access to credit, as they lack land tenure for collateral. van Koppen et al. show that female farmers given equitable opportunities are quite capable of achieving adequate livelihoods

REFERENCES

- From *Water International*, 2013 Issue 4: *Sustainable Groundwater Development for Improved Livelihoods in Sub-Saharan Africa, Part 1* (Paul Pavelic, Karen G. Villholth & Shilp Verma, Eds.)
- Paul Pavelic, Karen G. Villholth & Shilp Verma. *Identifying the barriers and pathways forward for expanding the use of groundwater for irrigation in Sub-Saharan Africa.*
 - Karen G. Villholth. *Groundwater irrigation for smallholders in Sub-Saharan Africa – a synthesis of current knowledge to guide sustainable outcomes.*
 - Paul Pavelic, Karen G. Villholth, Yunqiao Shu, Lisa-Maria Rebelo & Vladimir Smakhtin. *Smallholder groundwater irrigation in Sub-Saharan Africa: country-level estimates of development potential.*
 - Fathi M. Anayah, Jagath J. Kaluarachchi, Paul Pavelic & Vladimir Smakhtin. *Predicting groundwater recharge in Ghana by estimating evapotranspiration.*
 - Emmanuel Obuobie, Deborah Ofori, Sampson Kwaku Agodzo & Collins Okrah. *Groundwater potential for dry-season irrigation in north-eastern Ghana.*
 - Saa Dittoh, Joweph A. Awuni & Margaret A. Akuriba. *Small pumps and the poor: a field survey in the Upper East Region of Ghana.*
 - Bio Mohamadou Torou, Guillaume Favreau, Bruno Barbier, Paul Pavelic, Mahamadou Illou & Fatoumata Sidibe. *Constraints and opportunities for groundwater irrigation arising from hydrologic shifts in the Iullemeden Basin, south-western Niger.*
 - Tenalem Ayenew, Merhawi GebreEgziabher, Seifu Kebede & Sileshi Mamo. *Integrated assessment of hydrogeology and water quality for groundwater-based irrigation development in the Raya Valley, northern Ethiopia.*
 - Willem Colenbrander & Barbara van Koppen. *Improving the supply chain of motor pumps to accelerate mechanized small scale private irrigation in Zambia.*



■ Woman standing next to a solar pump, Southern Africa, Zambia © Adam Öjdahl /IWMI

THE PROMISE OF SOLAR

Solar irrigation pumps can help smallholder farmers in Sub-Saharan Africa overcome the working capital problem. Solar pumps are gaining prominence in Asia and slowly also in parts of Africa, because they provide high quality energy for irrigation at near-zero marginal cost. Their capital cost remains beyond the reach of most smallholders, but in some cases, governments offer significant capital subsidies to promote adoption (Hartung & Pluschke, 2018). If the issues of initial cost and working capital can be overcome, solar and motor pumps provide a path for smallholders' to improve their livelihoods through greater groundwater irrigation.

Key Issues to Address:

- Decentralized supply and maintenance of pumps.
- Smallholder access to reasonable financing options.
- Smallholder access to reliable and low-cost energy sources, particularly solar energy.

DON'T FORGET SUSTAINABILITY!

Developing groundwater for irrigation will improve smallholder incomes. For groundwater to be sustainable, however, this use cannot impinge on the quantity or quality available for domestic and environmental uses. Villholth reminds us of this problem, and points to the necessity to ensure local management of the resource, with appropriate external support, to avoid depletion and intersectoral conflicts.

REFERENCES

From *Water International*, 2013 Issue 6: *Sustainable Groundwater Development for Improved Livelihoods in Sub-Saharan Africa, Part 2*

- Srinivas Chokkakula & Mark Giordano. *Do policy and institutional factors explain the low levels of smallholder groundwater use in Sub-Saharan Africa?*
- Tushaar Shah, Shilp Verma & Paul Pavelic. *Understanding smallholder irrigation in Sub-Saharan Africa: results of a sample survey from nine countries.*
- Regassa E. Namara, Gebrehaweria Gebregziabher, Meredith Giordano & Charlotte De Fraiture. *Small pumps and poor farmers in Sub-Saharan Africa: an assessment of current extent of use and poverty outreach.*
- Barbara van Koppen, Lesley Hope & Willem Colenbrander. *Gender aspects of smallholder private groundwater irrigation in Ghana and Zambia.*
- Gebrehaweria Gebregziabher, Karen G. Villholth, Munir A. Hanjra, Muleta Yirga & Regassa E. Namara. *Cost-benefit analysis and ideas for cost sharing of groundwater irrigation: evidence from north-eastern Ethiopia.*

Additional references

- Alichenko, Y. and K.G. Villholth, 2015. *Mapping irrigation potential from renewable groundwater in Africa – a quantitative hydrological approach.* *Hydrol. Earth Syst. Sci.*, 19, 1055-1067, DOI:10.5194/hess-19-1055-2015.
- Hartung, H. and Pluschke, L. 2018. *The benefits and risks of solar-powered irrigation – a global overview.* Rome: Food and Agriculture Organization of the United Nations (FAO).

ACKNOWLEDGEMENTS

Special Issue Editors: Paul Pavelic, Karen G. Villholth and Shilp Verma, International Water Management Institute (IWMI) and CGIAR Research Program on Water, Land and Ecosystems (WLE).

Policy Brief Editors: Nicholas J. Griffin and James E. Nickum
Layout: Nathalie Lyon-Coen