ICID Young Professionals e-Forum (IYPeF)

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Solar-Powered Irrigation Systems: Exploring Opportunities and Threats

Background Note for Discussion

15 February - 2 March 2019

Introduction

"Things are changing; new technologies are coming up. You can't resist good technology that offers you cheaper costs for what you need" - *Jackson Mutazamba, Ministry of Water and Irrigation, Tanzania*

Agriculture is the largest consumer of freshwater resources in the world, or so goes the popular refrain but its role in ensuring food security cannot be overemphasised. Rising pressure on Water, Energy, and Food (WEF) nexus is projected to be exacerbated by population growth, urbanisation, economic development, climate change (Hoff, 2011), as well as increasing living standards and changing consumption patterns. A review of the WEF Nexus indicates that more people will mean more food and more food will need more energy and water to produce if efficiency levels remain the same. In addressing the increasing energy demands in agriculture from increased food demand, Solar-Powered Irrigation Systems (SPIS) has been promoted as a sustainable solution (Closas and Rap, 2017) for both developed and developing countries. The increasing demand for SPIS has triggered a duel for projects as it offers a cost-effective, sustainable and renewable energy solution to off-grid farmers while ensuring food security and sustaining livelihoods.

From Asia to Africa, SPIS is becoming increasingly affordable for farmers (with lowering technology costs) as a sustainable energy source to secure food production and sustain livelihoods (World Bank, 2018). This reconciles with the Strategic Plan of the International Commission on Irrigation and Drainage - A Road Map to ICID Vision 2030 – to "Enable Higher Crop Productivity with Less Water and Energy" (ICID, 2017). In climate discussions, the advent of SPIS can improve the reputation of irrigation by reducing fuel-based carbon emissions and energy consumption in irrigation agriculture creating a shift from high cost and environmentally unsustainable fossil fuels to renewable energy.

SPIS is thus poised to play a vital role in achieving the Sustainable Development Goals of the Agenda 2030; pushing governments to increase energy security and electrification through use of renewable energy. In South Africa where irrigation is estimated to consume 28% of the total electricity consumed by agriculture, SPIS has been identified as an innovative, cost-effective solution to reducing agricultural energy demands (Piwe, 2017). In Egypt, existing pilot projects have demonstrated socio-economic benefits of irrigation as installed feed-in tariff system allows farmers to sell surplus energy to the grid with total estimated savings of 560 USD/year (FAO, 2018).

As a result, SPIS is often tagged Africa's brightest climate-smart solution to hunger especially among rural off-grid underserved, or served by costly fuel-driven pump (World Bank, 2018) – with viable models for SPIS in Ethiopia for off-grid smallholder solutions as a typical example (Otoo *et al*., 2018). In Bangladesh, a fast Internal Rate of Return of SPIS (80%) was found higher than diesel-operated irrigation pump (71%) (Hossain *et al*., 2015). In India, SPIS has reduced challenges of intermittent energy supply creating a shift from wasteful flood irrigation to sprinkler and drip irrigation in greenhouses and on open land (FAO, 2018).

It is evident that SPIS will play a key role in solving agriculture's energy challenges whilst increasing reliability and affordability. While attempting to leverage potentials and adoption, subsidies for SPIS access/adoption is not synonymous to increased irrigation efficiency or water availability. This technology-efficiency paradox was reiterated by Grafton *et al*., (2018), where technological water-saving is often muffled by population growth translating into an areal increase for food production. Similar fears are expressed for the use of SPIS, such as in Jordan where the Ministry of Water and Irrigation is reluctant to promote SPIS with farmers due to existing over-exploitation of groundwater resources. In Egypt, despite proven efficiency of SPIS (17 to 41% of water energy needs), fuel subsidies have made diesel-powered pumps more economically advantageous. Same is true for India where SPIS are only economically viable under present subsidised farm-power connection (FAO, 2018) and pumping is regulated by electricity rationing for which off-grid could mean losing potential regulatory tool (Closas and Rap, 2017).

Closas and Rap, (2017) would also argue the lack of strategic coordination and integrated basin management regarding SPIS, resulting in piecemeal approaches with limited exchange and knowledge transfer. This is in addition to lack of formal articulation of the WEF Nexus within agencies and the promotion of renewable energy with a biased focus on technical guidelines without an integrated approach to assessing the effects on water, environment and livelihoods. While proposing suitability and sustainability mapping of SPIS in Ethiopia, Schmitter *et al*., (2018) also confirmed underlining fears that without appropriate governance framework, SPIS in Africa may exceed sustainable limits.

The perceived danger with SPIS is that by providing a steady stream of cheap power and related groundwater pumping capabilities it could fuel water scarcity; jeopardising rural livelihoods in the long term. Hence, it is only logical to conclude that except groundwater governance is appropriately managed by governments and communities, SPIS can further accentuate depletion. This is true as most policies and projects promoting SPIS through subsidies and other economic instruments overlook the real economic and financial costs of this solution as well as local hydrological considerations and the potential adverse environmental impacts of groundwater over-abstraction.

Despite high but reducing initial capital costs, SPIS as a great technology offers a range of benefits including; little to no fuel requirements, no constraints of weak, unreliable or expensive rural fuel supply, relatively clean energy with zero or reduced pollutants as well as longer lifespan with little maintenance, versus diesel pumps (World Bank, 2018).

The enormous benefits of solving the challenges of food, energy and water security all with one technology are however obvious; particularly helping small communities leapfrog poverty to prosperity. Needless to add, good governance and policy framework must be parcelled with water saving/irrigation management tools to improve efficiency and ensure its good management across scales. While SPIS may not be the silver bullet for every agricultural community, it is important that it is made accessible and available as an option for adoption – bearing in mind prevailing land holdings and tenure systems.

In this climate of promises and perils of SPIS, Young Professionals (YPs) and experienced stakeholders from government, industry and academia are invited to discuss and chart a sustainable course for upscaling this technology.

Objectives

The discussion on the topic "Solar-Powered Irrigation Systems: Exploring opportunities and threats" is expected to achieve the following objectives; amongst others:

1. Contribution of SPIS to agriculture at regional, national and global scales.
2. Discuss the benefits of SPIS and potential opportunities for up-scaling the technology beyond environmental sustainability to economic sustainability.
3. Highlight varying views of YPs in Irrigation and Drainage on use of SPIS as well as discuss how to curb the inherent challenges and threats by suggesting pertinent governance frameworks and technology improvement.
4. Discuss innovative ways (technical, financial and institutional) of increasing access to and ensure inclusiveness of SPIS particularly among the rural poor; constrained by land rights and capital.

Expected outcomes

During the IYPeF e-Discussion, Young Professionals will explore answers to following questions:

1. What are the success stories of SPIS in different regions of the world?
2. How can SPIS be used for sustainable agriculture to improve water use efficiency under increasing agricultural water demand and looming water scarcity crises?
3. What are the benefits currently being offered by SPIS in agriculture?

4. Supported with case studies and country experience, what are the legal, institutional frameworks and policy impediments employed to leverage the potential of SPIS while curbing the current threats?
5. How can YPs contribute to promote the use of SPIS bearing in mind the challenges?
6. What technical innovations and financial instruments can be designed to ensure inclusive and equitable access to SPIS, especially among rural farmers?

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