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PUMPING UP CLIMATE TECHNOLOGY IN UGANDA:

Business and financing models for the roll-out of solar-powered irrigation systems for smallholder farmers

SUMMARY BRIEF

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CONTENTS

1 Solar Powered Irrigation - a Strategic Priority for Uganda

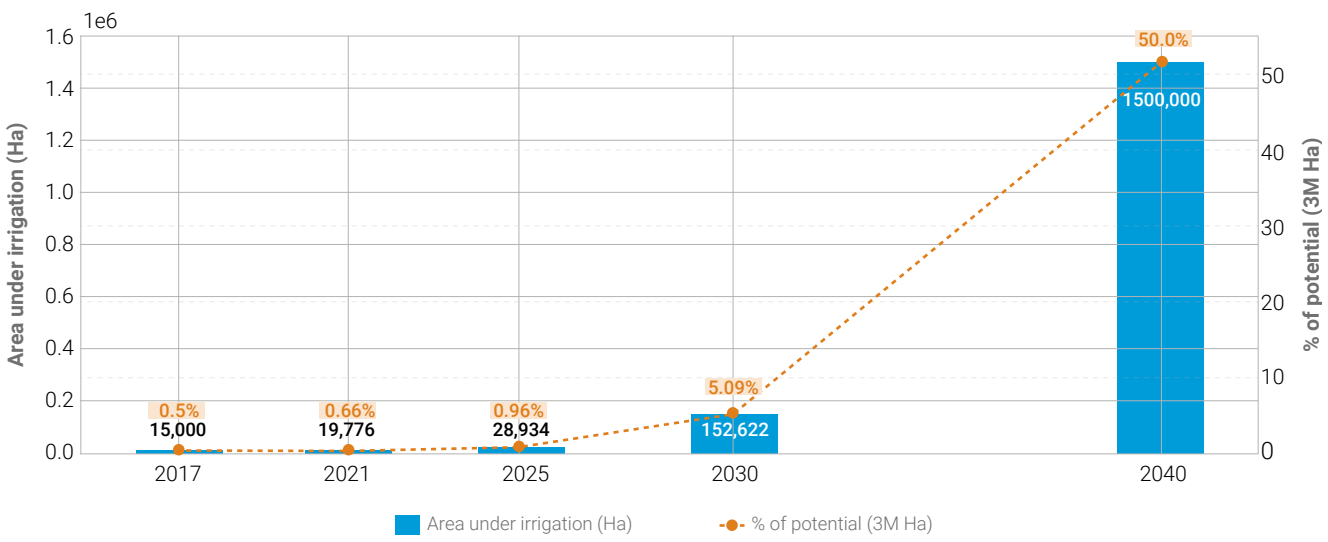
Uganda's agriculture sector underpins livelihoods, food security, and economic development, employing approximately 70 percent of the population (FAO, 2025; World Bank, 2025). Yet the sector remains highly exposed to climate variability, with increasing rainfall uncertainty, more frequent dry spells, and shifting growing seasons already undermining productivity and incomes. National estimates indicate that climate-related shocks—particularly drought and rainfall variability—have reduced agricultural productivity by between 1-7 percent of GDP (Markandya et al., 2015).

Despite an estimated three million hectares of irrigable land, approximately one percent is currently under irrigation in Uganda, which is similar to other countries in the region but below the Sub-Saharan average of 4%. This structural gap represents both a major vulnerability and a significant opportunity. Solar-Powered Irrigation Systems (SPIS) offer a decentralised (meaning they can operate in remote areas without reliable electricity) and low-emission solution with predictable operating costs, independent of fuel or power price fluctuations that directly address climate risk while supporting productivity growth, income diversification, and food-system stability. Moreover, SPIS offer opportunities to implement water-saving measures that support sustainable water management, which is essential for scaling.

Irrigation and SPIS in particular are explicitly prioritized in Uganda's National Adaptation Plan (NAP) (MAAIF, 2018), Nationally Determined Contribution (NDC) (MWE, 2022), National Irrigation Policy (MAAIF and MWE, 2017), Technology Needs Assessment (The Republic of Uganda, 2021) and Fourth National Development Plan (NDP IV)(National Planning Authority, 2025) with a target of 1.5 million Ha under irrigation by 2040, or 50% of the total irrigable land in Uganda.

This brief focuses on business and financing models as key enablers for scaling solar-powered irrigation. The evidence presented confirms that SPIS is not a pilot-stage technology, but rather a viable investment for farmers under the right conditions. The core challenge is now how to scale deployment sustainably and inclusively, moving beyond donor-driven projects toward coordinated public-private market systems[1].

Figure 1 Area under irrigation trend based on Uganda NDC Targets and the National Irrigation Policy



Source. (MAAIF and MoWE, 2017; MoWE, 2022)

1 This summary is based upon a detailed market assessment that is available upon request

2 What the Evidence Shows: Impact, Economics, and Sustainability

Climate and Livelihood Impact

Data from several organizations (AbiDevelopment, 2018; ENDEV, 2021; GGGI, 2024; GIZ, 2024) and pilot interventions including the Danida-funded Pump-Up project implemented by MerycCorp (Mercy Corps, 2024, 2025) demonstrate that SPIS, when combined with appropriate agronomic practices:

- Increase yields for high-value crops (e.g. tomatoes, cabbage, watermelon) by 150–250 percent;
- Enable off-season production and reduce exposure to rainfall shocks and thus risk of crop losses;
- Strengthen food availability and income stability for smallholder households.

For farmers producing high value crops like tomatoes, SPIS investments have been shown to be recovered within one production season, even under flexible repayment arrangements (Mercy Corps, 2024).This lowers barriers to profitable agribusiness, enabling faster returns and positions agriculture as an attractive alternative for young farmers and entrepreneurs.

Economic and Financial Performance

At the system level, SPIS demonstrate:

- High farm-level internal rates of return, particularly for high-value horticultural crops; (30-40%) (GGGI, 2024);
- Short payback periods under Pay-As-You-Go (PAYGo) and lease-to-own models; From as little as one production season to 2 years (depending on variables like cost of system, crop types, etc.) (GGGI, 2024; GIZ, 2024);
- Strong alignment with agricultural cash-flow cycles when financing is appropriately structured.

These characteristics position SPIS as a viable asset class for climate-aligned agricultural finance, provided risks are appropriately allocated and mitigated. Where SPIS replaces diesel pumps, farmers benefit from lower operating cost by avoiding fuel expenses and price volatility, increasing seasonal net profits.

Image 1. A farmer in Katakwi District in Uganda irrigating tomatoes with water pumped from a shallow well using a solar powered submersible pump. Photo Credit: Agatha Ayebazibwe | FAO Uganda

Environmental Sustainability

SPIS generates mitigation co-benefits by replacing or avoiding fossil fuel-based pumping, contributing to Uganda's NDC goals while reducing farmer exposure to fuel price volatility. Environmental sustainability is critical and achievable when SPIS deployment is accompanied by:

- Water-efficient technologies and good agronomic practices; water-efficient technologies like drip irrigation. However, drip technology may significantly increase the cost of the SPIS system;
- Basic water-resource governance and monitoring at catchment level.

3 Market Progress and Remaining Constraints

Public and donor-supported programmes—most notably the World Bank's UgIFT Microscale Irrigation Programme and results-based financing and loan programs managed by Uganda Energy Credit Capitalisation Company (UECCC) under the Electricity Access Scale Up Project—have played a critical role in market development (Denison & Christen, 2025; IFPRI, 2025). Together, these initiatives have:

- Deployed more than 5,000 solar irrigation systems;
- Demonstrated strong latent demand, with over 90,000 expressions of interest from farmers under UgIFT alone.

These programmes confirm that demand is not the binding constraint; rather, affordability, financing, and market coordination remain the key challenges.

Structural Barriers to Scale

Persistent constraints that limit commercial uptake include:

- High upfront system costs relative to smallholder liquidity which means that affordable end-user finance and harvest aligned repayment schedules are critical;
- Limited availability of agricultural finance tailored to irrigation investments;
- Working-capital shortages among SPIS suppliers, exacerbated by long reimbursement cycles under subsidy programmes;
- Weak last-mile service networks and inconsistent product quality;
- Inadequate water-governance frameworks in certain regions.

As a result, SPIS deployment remains heavily subsidy-dependent, and private capital participation remains modest.

Image 2. *A farm in Nakaseke District in Uganda uses solar powered pump to operate impact sprinklers to irrigate tomatoes. Photo credit: Dennis Besigye | FAO Uganda*

4 Scalable Business and Financing Models

Flexible End-User Financing

PAYGo and lease-to-own models reduce affordability barriers and can align payments with crop revenues. These models are particularly effective for first-time irrigation adopters and high-value crop producers. However, they place repayment and liquidity risk on suppliers, limiting scale without external capital and guarantees. Also, inclusion of after sales service and maintenance agreements is crucial for sustainability.

Aggregator-Based Deployment

Aggregator-based models where organized entities like cooperatives, agribusinesses, Non-Governmental Organizations (NGOs), Saving and Credit Co-operatives (SACCOs), produce off-takers and/or input dealers coordinate farmer engagement, market linkages, and service delivery, have emerged as a scalable and inclusive approach for scaling SPIS sustainably. A wide range of organizations currently active in Uganda's agricultural, climate-resilience, and rural finance landscape are well positioned to act as aggregators or co-implementers within a SPIS aggregator model. Aggregators:

- Aggregate demand and lower transaction costs;
- Screen farmers and support creditworthiness;
- Bundle irrigation with agronomy training, market access, and sometimes insurance;
- Improve repayment through group-based or produce-linked mechanisms.

Evidence from Mercy Corps' Pump-Up project shows that these models improve adoption, repayment performance, and inclusion of women and vulnerable farmers.

Image 3. *A farmer in irrigating coffee using drag-hose irrigation practice with water pumped using a solar powered pumping system installed in Kalungu District in Uganda. Photo Credit: Agatha Ayebazibwe | FAO Uganda*

Image 4. Pump-Up consortium staff from Mercy Corps and Tulima Solar deliver hands-on knowledge transfer on KK pumps to the Acholi Chiefdom Chief at Ker Kwar, Acholi, Gulu City. Photo Credit: Mercy Corps Uganda.

Blended Finance and Risk-Sharing

For financiers, SPIS risks are manageable when addressed through:

- Concessional capital and first-loss structures;
- Partial risk guarantees for commercial lenders;
- Bundled crop and asset insurance;
- Portfolio-based rather than single-borrower exposure.

Blended-finance structures are essential in the current market phase to crowd in private investment at scale. The newly established Humenergi facility, set up by Mercy Corps, is an example of such a blended finance provider and serves to address this gap, particularly in displacement settings by providing affordable loans to technology solution providers including SPIS providers[2].

Bundled Insurance for SPIS Investments

Innovative partnerships that bundle climate-indexed insurance with SPIS financing offer a high-impact pathway to de-risk investment and unlock private capital. Drought and rainfall shocks undermine farmer incomes and lender confidence, limiting credit availability for SPIS investments.

Bundling of insurance and SPIS is still in early stages, but key potential benefits include:

- Stabilizing farm incomes and reducing climate-related loan defaults;
- Improving farmer creditworthiness and lender willingness to finance PAYGo and lease-to-own models;
- Lowering the cost of capital when insurance premiums are embedded in instalments;
- Supporting demand aggregation and better risk pricing through insurers' rural networks and data.

While challenges remain around awareness, data availability, affordability, and basic risk, bundled insurance is a high-potential, market-enabling innovation that can strengthen and lower risk perception of the asset class by investors. The Agri Insurance Consortium, which brings together fourteen Ugandan insurance companies, contributes technical expertise in agricultural insurance through its role in implementing the Uganda Agriculture Insurance Scheme, covering over one million smallholder farmers[3]. Building on this experience and on lessons from bundled-insurance pilots, the Consortium supports the development of insurance approaches aimed at reducing climate and credit risks associated with SPIS investments for farmers and financial institutions.

2 Humanitarian Energy: quality sustainable energy services for all | The Global Compact on Refugees | UNHCR

3 Including the Picture-based insurance scheme funded by UNDP AFCIA implemented by BIRDC, AIC and Acreafrica, facilitated by UNEP as an outcome of the IKI-funded NDC Action Project.

5 Implications for Policy, Donors, and Financiers

For Policy Makers

- SPIS can be treated as a core climate technology investment, embedded in NDC and NAP implementation pipelines;
- Public resources are best used to enable markets—through standards, water governance, and risk-sharing—and to target financing of hardware for the most vulnerable farmers;
- Strengthening farmer organizations and aggregation mechanisms is critical for inclusive scale.

For Donors and Development Partners

- The highest impact lies in catalytic finance, combined with subsidies for lowest income farmer groups;
- Grants and concessional funds can unlock multiples of private capital when deployed through blended-finance facilities, guarantees, and aggregator-led models;
- SPIS is well suited for adaptation finance windows given its strong resilience, income, and mitigation co-benefits.

For Banks and Investors

- SPIS represents a bankable climate-technology opportunity when structured as portfolio-based, cash-flow-aligned finance;
- There is a need for capital designed to enable SPIS suppliers with import and inventory financing;
- Partnerships with aggregators that integrate SPIS, agricultural inputs, other climate technologies and a ready market for agricultural production reduce transaction costs and credit risk;
- Returns can be attractive and impact metrics are clear and measurable.

Image 5: *A movable solar pump system from ApTech to provide 'irrigation as a service' in Jinja, Uganda.*
Photo Credit: David Munyaneza | Daugherty Water for Food Global Institute

6 Safeguards for Sustainable Scale

Scaling SPIS responsibly requires parallel investment in:

- Water-resource governance, including basin-level monitoring and guidance for smallholder abstraction;
- Gender-responsive delivery models, recognizing women's roles and constraints;
- Technical standards and after-sales capacity to protect farmers and lenders.

These safeguards are not barriers to scale but enablers of long-term impact and financial sustainability.

Image 6. A farm in Nakaseke District uses solar powered pump to operate a low pressure butterfly irrigation sprinkler system for production of horticultural crops. Photo credit: Agatha Ayebazibwe | FAO Uganda

7 Conclusion

Solar-powered irrigation systems represent a strong commercial rationale for farmers not only in Uganda, but in the region at large, combining demonstrable productivity gains with resilient, renewable and data driven infrastructure. Pilot evidence confirms that the technology is technically proven, farmer demand is tangible where access barriers are addressed, and well-structured financing can achieve rapid payback and attractive risk-adjusted returns. The principal constraint to scale is not viability, but coordination—specifically the alignment of policy frameworks, catalytic public finance, and private investment around scalable, portfolio-based delivery models. By moving beyond fragmented pilots toward aggregated, blended-finance-enabled deployment pathways, Uganda and its partners can unlock larger pools of commercial and impact capital, accelerate climate-resilient agricultural growth, and ensure that public resources are deployed strategically to crowd in private sector investment.

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