Scaling-up Productive Use of Solar Energy in Uganda: Recommendations for Enhancing Smallholder Farmers' Access to Finance

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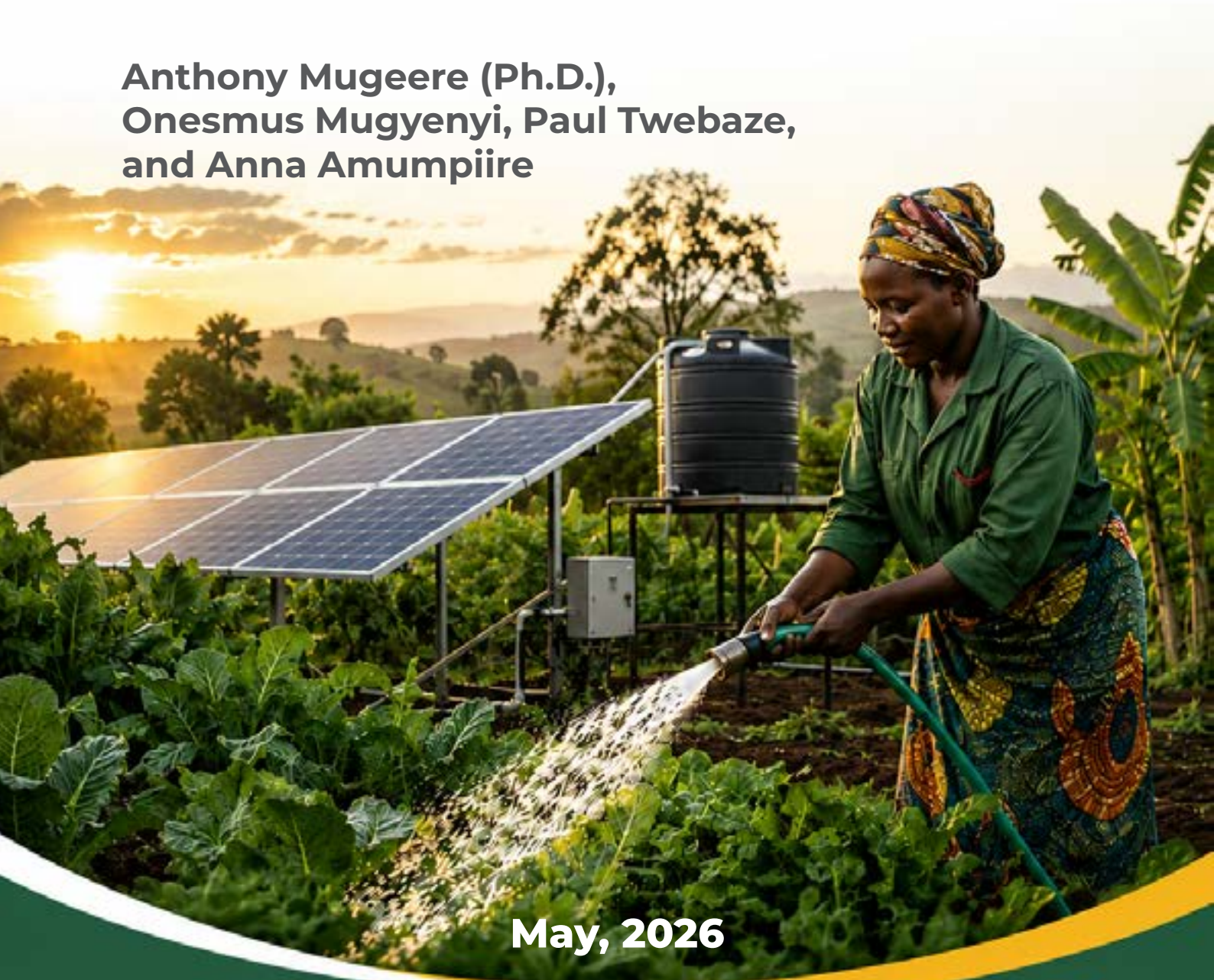

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ABBREVIATIONS AND ACRONYMS

ACF	Agricultural Credit Facility
ACODE	Advocates Coalition for Development and Environment
BFP	Budget Framework Paper
BGFA	Beyond the Grid Fund for Africa
CSOs	Civil Society Organizations
DFI	Development Finance Institutions
DREEM	Distribution Renewable Energy Ecosystem Model
EASP	Electricity Access Scale Up Project
GCF	Green Climate Fund
GDP	Gross Domestic Product
IEC	International Electro-Technical Commission
MAAIF	Ministry of Agriculture, Animal Industries and Fisheries
MDA	Ministries, Departments and Authorities
MEMD	Ministry of Energy and Mineral Development
MFI	Micro Finance Institutions
MoFPED	Ministry of Finance, Planning and Economic Development
NARO	National Agricultural Research Organization
NDCs	Nationally Determined Contributions
NDP	National Development Plan
NES	National Electrification Strategy
NGOs	Non-Government Organizations
NR-PUSE	National Road Map for Scaling Up the Productive Use of Solar Energy
PAYGo	Pay-as-you-go
PBB	Programme-Based Budgeting
PDM	Parish Development Model

PPP	Public Private Partnerships
PUE	Productive Use of Energy
PUSE	Productive Use of Solar Energy
SACCOs	Savings and Credit Cooperative Organizations
USD	United States Dollars

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1 The overall goal of the project is to strengthen the PUSE ecosystem by stimulating access to productive use of solar energy services in agricultural value chains to reduce greenhouse gas emissions.

1.0 INTRODUCTION

This is Policy brief presents key policy, practice issues and responsive recommendations aimed at facilitating access to finance by smallholder farmers for supporting the scaling of application of Productive Use of Solar Energy (PUSE) in Uganda's Agricultural Value chain. It is targeting key policy and decision makers (i.e. Ministries, Departments, Authorities, Civil Society Organizations and Financial Institutions) to implement responsive recommendations for facilitating access to finance by smallholder farmers for supporting the scaling of application of PUSE, in light of their mandate and responsibility as stipulated in the policy, legal and institution framework.

Box 1. Definition of Productive Use of Solar Energy (PUSE)[1]

PUSE refers to energy use that creates value, for example in the form of increased productivity or income, employment creation, or reduced hardship (Lecoque & Wiemann, 2015; Terrapon-Pfaff et al., 2018).

The policy brief was compiled through of review and synthesis relevant policies on solar energy utilization in the Agricultural value chains in Uganda to identify the opportunities, gaps and challenges for Productive use of solar energy in Uganda's Agricultural Value chain. It was also informed by the synthesis of the key issues that emerged from the national and regional dialogues and training workshops on the integration of PUSE in the agricultural value chain. These dialogues and trainings were held in Kampala, Nakaseke, Wakiso, Nakasongola and Kiboga districts between August 2024 and February 2025. Based on this synthesis, key policy and practice issues related to the financing of PUSE for the agricultural value chain were put on table. After the key issues had been synthesised, a set of recommendations for streamlining the financing of PUSE in Uganda's agricultural value were generated.

1.1 Key Policy Issues

The key Policy issues identified through this process include:

(i) Inadequate coordination for effective regulation and enforcement of PUSE financing policy framework;

(ii) Inadequate budgeting and funds allocation for supporting PUSE technology application and scaling up by smallholder farmers in agricultural value chains for agro-industrialization and socio-economic transformation;

(iii) Investment in financing for PUSE application by smallholder farmers in the Agriculture value chain was still considered a high risk venture by Financial Institutions;

(iv) Weak quality standards and post-sale asset protection in respect to solar technologies and equipment was a worry. This is associated with severe financial losses for end-users, safety hazards from faulty equipment, and eroded consumer trust in solar energy.

1 See definition in Box 1.

1.2 Key messages

Through the review and synthesis, the following key messages were generated:

(a) Financial access is a key factor that facilitates smallholder farmers in the application for scaling of PUSE technologies in the agricultural value chain in Uganda. Thus, Credit finance can be invested in solar technologies for lighting, water pumping & irrigation, food processing (e.g. sun drying), and cold storage.

(b) There is a low proportion (11%) of smallholder farmers accessing credit finance (RDFU, 2025). The proportion is much lower of smallholder farmers who access credit finance for application of PUSE technology in agricultural value chains although there are no concrete studies that provide actual percentage.

(c) Smallholder Farmers access to credit finance for application of PUSE technology in agricultural value chains, can be improved through development of financial products and packages, which are targeted and aligned to the needs of the smallholder farmers.

(d) There are several barriers limiting smallholder's farmers in accessing financing for facilitating the application of PUSE technology in agricultural value chains. These should be addressed through targeted responsive practice and policy actions.

(e) Savings and Credit Cooperative Organizations (SACCOs) and Microfinance Institutions remain the most effective avenues for smallholder farmers in Uganda to finance PUSE technologies. Their community-led models offer flexible repayment terms, eliminate rigid collateral requirements, and drastically lower transaction costs.

2.0 BACKGROUND

2.1 The PUSE landscape in Uganda

2.1.1 PUSE Policy and institution framework

In Uganda, the PUSE policy and institutional architecture is firmly anchored in a host of government policies and strategies which foster expanded access to renewable energy. While the Fourth National Development Plan (NDP) IV (2025/26–2029/30) for instance, recognises that access to a reliable energy supply is a critical issue for economic growth and poverty reduction, the Revised Energy Policy for Uganda (2023) has the goal "to meet the energy needs of Uganda's population for social economic development in an environmentally sustainable manner'' (MEMD, 2023a''. Similarly, the amended Electricity Act (2022) grants power to the Electricity Regulatory Authority (ERA) to classify licences according to the size and technology to be used (ALP EAST AFRICA, 2022). In addition to the Rural Electrification Strategy and Plan (2013-2022), the Ministry of Energy and Mineral Development developed the National Electrification Strategy (NES) for the period 2021 - 2030, aimed at achieving universal electricity access (on-grid and off-grid), taking into consideration technical, institutional, policy, regulatory, legal, and financial aspects. The NES

focuses on the productive use of energy, particularly solar PV in agriculture and industrial sectors.

This strategy is aimed at accelerating the national geographical coverage of and consumer access to energy by supporting the planned growth of off-grid electrification service technologies and on-grid electrification services. The strategy mentions special assistance programmes to support the promotion of PUSE and economic development related to electrification (REA, 2013).

The National Road Map on Scaling up the Productive Use of Solar Energy—NR-PUSE (2023) is the most specific policy document that spells out a set of proposals for the financing of affordable PUSE services at both the service provider and end-user levels (MEMD, 2024). Among the proposed actions is the provision of financial incentives to enable the market to grow (such as tax waivers and subsidies), and to help make renewable energy more affordable and competitive with fossil fuels. It also proposes the design of projects with grant components from international organizations and philanthropic foundations to support the development of renewable energy projects, especially in rural communities far from the main grid.

The NR-PUSE further provides for the provision of additional loans (from banks, financial institutions or other lenders) to both the equipment suppliers and end users at affordable terms and the engagement of investors interested in offering equity financing to be used by start-ups or early stage companies that do not have access to traditional loans or grants. Other proposals include the need to support PUSE projects to register for carbon credits (under which PUSE projects can sell the right to emit carbon to other companies or organizations to provide an additional source of funding for renewable energy projects that reduce carbon emissions), the promotion of Public-Private Partnerships (PPPs) in PUSE under which the public and private sector organizations should combine to finance and implement PUSE projects and promotion of the pay-as-you-go (PAYGo) Solar (MEMD, 2023b) financing that involves providing renewable energy products to customers on a pay-as-you-go basis. However, while the Productive Use of Energy (PUE) has been articulated in the strategies,[2] there is minimal focus on the PUSE financing options and their sustainability plans. Incidentally, the NR-PUSE neither defines PUSE financing nor the relevant credit lines for PUSE financing.

2.1.2 PUSE financing in Uganda

Financing is arguably the most critical and conspicuously absent enabler of agricultural growth in Uganda. Agriculture contributed approximately 24 – 26.5% of the country's Gross Domestic Product (GDP), equivalent to a national GDP of USD 61.3 billion in FY 2024/25, accounts for 35 – 42% of national export earnings, and employs 68 – 72% of the labor force, yet, despite this outsized economic role, the sector receives only 11.3% of private credit flows from the banking sector (World Bank, 2025). Beyond facilitating investment in modern technology and essential inputs such as improved seeds and fertilizers, financing serves as the foundational pillar upon which smallholder farmers, who constitute 89% of all Ugandan farmers and generate up to 80% of total agricultural output (FAO, 2024), can build the infrastructure necessary to transition from subsistence to commercially viable

2 Programme Objective 14.3(iii) of the National Development Plan IV, (2025/2026-2029/2030).

operations. According to CGAP, (2018), this transition remains elusive, with only about 10% of smallholder farmers in Uganda owning a formal bank account.

This imperative is made all the more urgent by the escalating impact of climate change, given that Uganda's agriculture is almost entirely rain-fed, and continues to undermine the sector's productive base. Without decisive climate action, Uganda's GDP could contract by as much as 3.1% by 2050, with crop revenues projected to decline by approximately 30%, and up to 613,200 additional Ugandans could be pushed into poverty (World Bank (2025). Compounding this vulnerability, Uganda currently loses an estimated 30 – 50% of its harvest before it reaches consumers (Chimp Reports, 2025); a silent crisis that translates into hundreds of billions of Uganda shillings in annual post-harvest losses. In this context, innovative financing mechanisms are indispensable for cushioning smallholder farmers, who already face a 46% national prevalence of food insecurity (UBOS, 2025), against mounting climatic and economic shocks. Studies have demonstrated that the PUSE has a big potential to lead to the country's sustainable development, economic growth, and poverty reduction. Solar energy has potential to enhance agricultural productivity by five times and simultaneously reduce energy costs by up to 80% relative to diesel-powered alternatives (BGFA, 2024), reduce post-harvest losses from 40% to below 5% (Ayuda en Accion (2024), and support to sustainable agricultural practices (Twebaze et al., 2025).

Furthermore, some studies have shown that farmers with access to credit achieve significantly higher yields than those without. For instance, Boansi et. al. (2024) concluded that access to agricultural credit is associated with 20.29–29.84% increase in net income from cocoa production in Ghana. In Rwanda, a recent study also demonstrated a 44% higher yield for farmers accessing credit, particularly in maize production Taremwa et. al. (2021). For PUSE financing in particular, strategic financial partnerships are essential for coalescing efforts to pool the much-needed credit to widen access for smallholder farmers

The days when the 'solar' concept was largely associated with lighting bulbs, charging mobile phones or even powering electronic systems such as radio sets and television sets are long gone. PUSE does have the ability to now meet the expense of farmers to use solar-powered pumps to irrigate their crops and to preserve their harvests without necessarily relying on the unpredictable weather patterns. Solar dryers for coffee, grains, fruits, vegetables, and other agricultural produce have a huge potential to reduce the time spent on drying products and to minimise spoilage (Twebaze et al., 2025). Solar reduces the use of diesel and petrol-driven generators in the agricultural value chain, which mitigates carbon emissions but also reduced the costs of production and storage in the long run. By integrating PUSE in the agricultural value chain, Uganda will certainly have the potential to improve the viability of its energy to access business models and achieve broader socio-economic goals. For example, a survey on the uses and impacts of off-grid refrigerators in Kenya, Tanzania and Uganda concluded that 72% of the interviewed people experience increased income and business growth after using off-grid refrigeration (Twebaze et al., 2025). Greater focus on PUSE potentially has the ability to improve the viability of solar mini-grid projects and make Uganda a hub for solar-powered irrigation systems and solar photovoltaic (PV) systems.

2.2 Challenges to PUSE financing for the agricultural value chain in Uganda

Whereas Uganda's formal financial system is currently meeting the demand for financial services from all sectors of the economy including the agricultural production component; access to finance is generally limited to grander clients (Meyer et al., 2014). Overall, access to financing for the agricultural value chain has not only been limited to larger clients but has also been hampered by the lack of packaging that meets the demand for less traditional financial products such as short-term loans for annual crops, price buffering mechanisms and related produce handling, processing and transportation needs (Meyer et al., 2014). Although 58% of farmers are formally financially included, just 11% actually secure credit from formal institutions (RDFU, 2025), hampered by collateral requirements and a lack of tailored products like short-term loans for annual crops or price buffering mechanisms. For instance, UBOS, (2024) noted that commercial banks often prioritize larger loans for machinery and equipment, leaving out subsistence farmers who dominate the sector constituting 68.9% of farmers facing significant barriers. Given that Uganda's agricultural sector is 'heterogeneous' comprised of the subsistence, semi-commercial and commercial farmers (UBOS, 2024), the overall demand for financial services is equally diverse. While some commercial and semi-commercial farmers can afford the required collateral to access loans from the commercial banks to finance machinery, equipment and other farm improvements, subsistence farmers face significant challenges in accessing agricultural finance.

2.2.1 Challenges constraining smallholder farmers from accessing PUSE financing for agricultural value chain

By 2023, the agricultural sector accounted for 11% of the commercial bank credit to the private sector despite employing the highest proportion of Uganda's labour force at 35.9% (FSD Uganda (2024). The key obstacles farmers face includes: lack of traditional collateral (like land titles), land tenure insecurity, high interest rates, limited financial literacy, absence of credit histories, and the high transaction costs associated with servicing small, rural, and often seasonal loans. The situation is compounded by the fact that nearly all the financial institutions face constraints in trying to push the formal financial frontier deeper into rural areas where the majority of the smallholder farmers are based. There is also limited awareness of the few available financial packages by the smallholder farmers.

2.2.2 Challenges constraining financial institutions from financing PUSE in agricultural value chains in Uganda

The agricultural financing conundrum is further compounded by the fact that many of them prefer to concentrate their assets in Treasury Bills (which guarantee high and safe returns). Consequently, this results in having little, or even no appetite to extend credit to high risk small holder farmers. There is also limited awareness of the few available financial packages by the small holder farmers. All these obstacles are compounded by the inability of some financial institutions to profitably expand their branch networks to the countryside where the small holder farmers are based. The case for financing PUSE for the agricultural value therefore calls for a paradigm shift in not only the design of the financing options, but also the policy and regulatory framework. Ramping up the awareness, planning and budgeting

for PUSE at the national and sub-national levels needs to go beyond just addressing the implementation barriers and deal with the key policy and practice issues hampering the access and utilisation of agricultural finance in Uganda.

2.3 PUSE financing packages offered by the financial institutions in Uganda

Some of the leading commercial banks in Uganda have—over the years—developed varying financial packages to support individuals and group enterprises involved in activities that promote the use of clean energy solutions. The commercial banks and Microfinance Deposit-taking Institutions (MDIs) that are listed under the Electricity Access Scale Up Project (EASP) of UECCC include: Centenary Bank, Pearl Bank Limited, Equity Bank Uganda, Opportunity Bank, BRAC Bank, UGAFODE Microfinance Limited, Finance Trust Bank and Stanbic Bank Uganda Limited (specifically for working capital loans). Other Financial Partners (SACCOs/ Microfinance) include: Tujijenge Financial Services, EBO SACCO Limited, Nile Microfinance Limited, Hofokam Limited, Buyanja SACCO Limited, Buturo Peoples' SACCO, Sky Financial Services Limited, Soroti Teachers' SACCO, Sebei Farmers' SACCO and Unique SACCO.

Pearl Bank (U) Limited, for instance, offers financial packages strategically aligned with the four priority value chains (dairy, coffee, poultry and grain). Under the dairy value chain, the bank provides financing products for milk handling equipment, asset finance for milk cooling equipment, refrigerated trucks, milk coolers and 'income-smoothing' loans during low milk yield periods. The bank—formerly Post Bank (U) Limited also funds irrigation systems for pasture and solar-powered pumping systems for livestock water supply and renewable use in dairy farms.

Under its "tri-engine strategic approach," Equity Bank provides funding for solar powered drip irrigation systems, cold storage milk cooling systems and solar pumping equipment. Similarly, Stanbic bank also offers a wide range of finance, investment and risk management solutions across the entire agricultural value chain. The bank also provides concessional lending to Savings and Credit Cooperatives (SACCOs) for financing farming equipment and production loans for a variety of farming-related production resources at 'good rates.'

On the other hand, the Centenary Bank developed the Cente Agricultural Green loans (ranging between 1-10 years) with flexible interest rates to support climate change mitigation and adaptation activities. For PUSE-specific activities, the bank offers agribusiness solar and Centre Solar Loan products ranging between UGX 0.5 to 50 million shillings at an interest rate of 15% per annum for up to 5 years. The Housing Finance Bank and the Uganda Energy Credit Capitalization Company (UECCC) also formed a partnership to provide a credit facility dedicated to financing solar energy, biogas, and other sustainable energy solutions. The short-term (1-2 years) and long term (up to 7 years) loans are offered at a rate of 10%. They target farmers who need to procure cooling plants in the dairy value chain, irrigation technologies for crop husbandry and livestock sector and value chain processing equipment, among other needs. Under the scheme, farmers who can demonstrate a 'sustainable' running farming enterprise are encouraged to access financing even without collateral. In Table 1, the Agricultural Credit Facility (ACF) options for 3 randomly selected banks are presented as an example.

Table 1: Agricultural Credit Facility financial products for 3 selected banks

Financial Institution	Product Features	Key Requirements	Qualification Criteria
A	• Grace period maximum of 3 years • Interest rate: maximum of 12% per year • Loan amount: UGX 10 billion to a single borrower • Loan processing fees: should not exceed 0.5%	• Current or savings account • Completed loan application form • Payment of loan processing fees	• National ID • The project undertaken must be an activity in the agricultural value chain • Business plan/ feasibility for amounts above UGX100 million • Experience in the project undertaken • Securities can be registered and unregistered land, guarantors, movable assets, household property, business equipment and tools.
B	• -Grace period maximum of 3 years • Interest rate: maximum of 12% per year • Loan amount: UGX 10 billion to a single borrower • Loan processing fees: should not exceed 0.5% • The facility makes it possible for farmers and agribusinesses to access innovative clean energy technologies such as solar irrigation, water pumping systems, water tanks, bio digesters, and grain silos installation.	• 10% - 20% of asset value as customer contribution • Assets financed for purchase will be considered as part of collateral • Depending on the solution or project to finance	

Financial Institution	Product Features	Key Requirements	Qualification Criteria
C	• Grace period maximum of 3 years • Interest rate: maximum of 12% per year • Maximum loan amount UGX 5Bn (facilities above UGX 2.1bn subject to discretionary approval); • Loan processing fees: should not exceed 0.5% • Loan tenures ranging from 6 months to 8 years with the option of grace period of up to three years.	• Working capital limited to 20% of the project cost • Acquisition of agricultural machinery & equipment • Post-harvest handling equipment, • Storage facilities/ warehousing • Farm Structures like paddocking, fencing, dams, irrigation • Agricultural inputs e.g. pesticides & fertilizers limited to 20% • Biological assets e.g. suckers, cows capped at UGX 80M • Smaller borrowers are encouraged to borrow in groups, SACCOs, VSLAs and Associations • Flexible repayment plans depending on the cash-flow cycle of agribusiness; can be monthly, quarterly, bi-annual or even annual instalments as agreed with borrower.	• An Agribusiness that must have been in operation for at least 2 years, with documented proof • Evidence of economic activity e.g. sales records/ receipts, animal movement permits etc. • Proof of registration of borrowing entity e.g. National ID (if individual) or documents (if non-individual) • Facilities above UGX 50m require financial statements

However, while all these and other initiatives have registered varying rates of success, there are policy and operational issues that must be addressed in order to streamline PUSE financing for small holder farmers. These include:

i) Limited awareness and sensitisation among small holder farmers on the availability and access to the financing options;

ii) High interest rates and varying and long 'turn-around' in processing loans for solar powered pumping and other agricultural-value chain equipment;

iii) Unspecified loan processed periods;

iv) Limited access to quality solar powered and other agricultural value chain equipment;

v) Lack of the 'pay for service payment model' to address the prohibitive costs of solar powered equipment;

vi) Uncoordinated implementation of PUSE financing policy framework.

3.0 KEY PUSE FINANCING EMERGING ISSUES

The engagements and associated consultations with key stakeholders at the national and local levels, revealed several emerging issues (i.e. both challenges & opportunities) regarding access to PUSE finance by smallholder farmers in Uganda. The issues raised include the following:

3.1 Key challenges for access to PUSE financing by smallholder farmers

(a) Limited knowledge and awareness about irrigation practices and technologies among smallholder farmers: Improving agricultural productivity requires irrigation, which in turn necessitates reliable and affordable access to energy (Twebaze et al., 2025). The use of varying forms of water for irrigation practices and technologies in agriculture remains low; —especially among smallholder farmers—due to limited awareness about their availability, affordability, inadequacy of the policy supports and limited financing options.

(b) Limited awareness about agricultural credit facilities available in banks: The few 'affordable' credit facilities developed for the commercialisation of agriculture by commercial banks and Financial Institutions remain inaccessible to smallholder farmers. Thus, reports indicate that 11% of the smallholder farmers access credit (RDFU, 2025). This is due to limited information about how to access such facilities and the latter's inability to demonstrate the level of creditworthiness necessary to secure such funding.

(c) Credit processing requirements and the credit facility turnaround time: Loan processing times for smallholder farmers seeking specialised agricultural loans from the traditional commercial financial institutions tend to take longer periods. Thus, sometimes spanning several months and across farming seasons. Quite often, many would be beneficiaries get frustrated and give up efforts to obtain such credit altogether.

(d) The lack of policy coherence and inadequate coordination among key finance regulators: The Ministry of Finance, Planning and Economic Development, the Bank of Uganda and the various departments and agencies often work in isolation, protecting their specific areas of responsibility, rather than cooperating. This leads to competing for political attention and resources. Therefore, there is need for the key finance regulators to coordinate efforts to develop and develop PUSE-specific financing policies and guidelines to enable access to credit for solar powered equipment by small scale holder farmers.

(e) Integration of PUSE right from planning to Budget Call Circular: The planning and integration of PUSE in the national and sub-national budgeting process is a key

process in mobilising financial resources for solar powered equipment for farmers. The inclusion of a paragraph or section on PUSE financing in the annual Budget Call Circulars should ideally guide district planners on prioritising PUSE in their plans and budgets.

(f) Proliferation of low-quality and counterfeit solar products on the market: Efforts by smallholder farmers to use solar powered equipment have been hampered by the proliferation of low-quality and counterfeit products on the market. Some of the sub-standard PUSE-enhancing equipment includes malfunctioning solar water pumps, poor solar batteries and ineffective energy controllers.

(g) Inadequate budgeting and funds allocation: This limits support for PUSE technology application and scaling by smallholder farmers in agricultural value chains for agro-industrialization and socio-economic transformation.

(h) Most individual smallholders have seasonal irregular cash flows. This presents a challenge for the smallholders to pay back the loans within the stipulated time frame, thus rendering them as a risk client compared with medium and large agricultural enterprises. Hence, Commercial Banks prefer working through Apex entities such as the SACCOs to provide financing to the smallholder farmers.

i) Weak quality standards and post-sale asset protection in respect to solar technologies and equipment. This is associated with severe financial losses for end-users, safety hazards from faulty equipment, and eroded consumer trust in solar energy. Thus, 70% of the solar energy products marketed in Uganda do not conform to the quality standards recognized International Electro-Technical Commission (IEC) and Lighting Global Standards (UNBS, 2020).

3.2 Opportunities for unlocking financing for PUSE for empowerment of smallholder farmers

The debate on strategies to unlock agricultural finance rages on. Whereas suggestions such as leveraging de-risking mechanisms, digital technology, and developing tailored products like leasing or insurance to bridge the investment gap for farmers and SMEs have been mooted over the years, key questions remain about how to fuse blended finance, value chain financing, input financing and digital agricultural platforms in the PUSE financing framework. There also seems to be no common strategy among policy makers and financial institutions on the mechanisms to strengthen farmer organizations to enhance creditworthiness.

The following opportunities can be harnessed to promote PUSE in the agricultural value chain:

a) Targeting the Parish Development Model (PDM) and specific demographics: Largely implemented to primarily benefit subsistence households, the PDM financing model can be broadened to support small scale PUSE equipment for smallholder farmers involved in farming enterprises. Specifically, the funding should target small but promising farmers whose livelihood activities depend on rain-fed agriculture.

b) Promoting value chain financing: Financial institutions and solar power equipment suppliers can venture into value chain financing partnerships that link smallholder farmers to input suppliers with flexible payment terms including the deduction of repayments from crop and animal sales. Whereas the success or failure of this arrangement will depend on trust and other socio-economic variables, its implementation certainly can provide better access to finance for smaller producers, reduce risk for financial institutions and strengthen connections between suppliers, producers, and buyers.

c) Capacity building for CSOs and SACCOs: Given the growing network of CSOs involved in promoting agriculture and climate change interventions in many parts of the country, PUSE financing can be enhanced by efforts that seek to strengthen their operations through better governance and technical assistance to improve their access to finance. Such efforts can involve building the capacity of SACCOs to improve their collective risk management strategies. Over time, CSOs and SACCOs will acquire the knowledge, skills, and resources needed to enhance their operational effectiveness, sustainability, and advocacy efforts and play a bigger role in bridging the gap between grassroots farmers and policy-makers.

d) Tap into the Pay-As-You-Go Solar: Financial institutions and solar equipment suppliers can also tap into this opportunity to address the upfront prohibitive costs for solar equipment.

e) Continued sun harvesting: In addition to exploring financing options for solar-powered dryers to process agricultural products and reducing post-harvest losses, local governments can turn 'sun harvesting' into a revenue-generating venture by setting up decentralized solar farms and solar drying center that provide energy for productive uses in rural districts to facilitate agricultural produce enhancement, post-harvest handling and value-addition at grassroots level.

f) Blended finance: To de-risk investment in PUSE application in agriculture, combining concessional donor capital with commercial investment would crowd in private money, representing the most powerful structural tool for closing the PUSE financing gap at scale. The grants and first-loss capital from donors would absorb the initial risk, while the concessional loans from Development Finance Institutions (DFIs) would reduce the cost of capital; and commercial banks, Micro Finance Institutions (MFIs), and SACCOs could deploy the on-lent capital to end borrowers.

g) Existing International Climate Finance Mechanisms and Technology Financing Mechanisms: Uganda is a Signatory and Party to the United Nations Framework Convention on Climate Change (UNFCCC), which provides for these financial mechanisms for supporting climate action in terms of adaptation and mitigation at national and community levels. The application and scaling of PUSE technology by smallholder farmers in agricultural value chains aligns very well with the ambitions in the respective Climate Financial Mechanisms.

4.0 CONCLUSIONS

The findings of the literature review and key stakeholder's engagement & consultations (both at the local and national) level, clearly reveal that a small proportion of smallholder farmers are accessing financing for application and scaling of PUSE technology in the agricultural value chain in Uganda, Thus, the current financial products provided by financial institutions are not easily accessible to smallholder farmers. The smallholder farmers are faced by various barriers and challenges, which limit their access to finance. Despite this, there are opportunities that should be tapped into for promoting access to finance by smallholder farmers for PUSE technology application in the agricultural value chain. Overall, a conducive environment through responsive practice and policy change actions is required to address the underlying barriers, challenges and tap into the emerging opportunities. Hence, the policymakers and financial institutions must act decisively. Streamlining regulatory processes and providing appropriate financial incentives are not only essential steps but clear paths to enabling smallholder farmers' break into the agricultural money economy.

5.0 RECOMMENDATIONS

Promoting financial access by smallholder farmers for facilitating their application and scaling of PUSE technologies in the agricultural value chain in Uganda requires implementation of responsive recommendations, aligned to the barriers, challenges and opportunities. These recommendations are at two levels including: at practice change, targeting responsive actions at the programme design, planning and implementation; and at policy change, targeting a shift in the existing policy and legal framework. These are presented as follows:

5.1 Practice change recommendations targeting responsive actions at programme design, planning and implementation

i) Warehouse receipting for farmers: Financing institutions (i.e. Banks, Micro Finance, SACCOs) should consider implementing the warehouse receipt system to support farmers in achieving better returns on investment and increase their market share in agricultural financing. When implemented, this system will allow farmers and agribusiness entrepreneurs to use stored commodities (like grain) as collateral to secure loans from financial institutions. By depositing goods in a certified warehouse and obtaining a receipt, producers can access working capital (often a significant proportion of the goods' value) without immediately selling which would in turn allow them to wait for better market prices. Though this financing option is heavily reliant on the cooperative society model, it will provide small holder farmers with an alternative to land-based security for loan access while also giving them the opportunity to bulk their produce and use it as collateral for PUSE finance.

ii) Heightened awareness and sensitisation efforts: The government media centre should, in collaboration with the Financial institutions (i.e. Banks, Micro Finance, SACCOs), solar powered equipment suppliers and other stakeholders for scaling financial sensitisation by intensifying efforts to disseminate information and

awareness on solar financing opportunities within the public domain, through community outreaches and media engagements (especially radio & television), targeting smallholder farmers and other value chain actors. These can be planned and implemented jointly involving Financial Institutions; Ministry of Agriculture, Animal Industries & Fisheries; Ministry of Energy and Mineral Development; Local Governments and CSOs. Furthermore, Farm Clinics can be organized and rolled out for localization and practical demonstration on solar energy use in the agricultural value chain empowers smallholder farmers to adopt PUSE technology. This will be achieved through collaboration involving Local Governments, Financial Institutions; Ministry of Agriculture, Animal Industries & Fisheries; Ministry of Energy and Mineral Development; and CSOs.

Likewise, the Financial institutions equally need awareness and support by bringing them aboard regarding access of financing by smallholder farmers for application and scaling of PUSE technology in agricultural value chain. Overall, this helps in bridging the knowledge gap within banks, SACCOs, and MFIs by educating credit officers on PUSE economics (e.g., how the technology generates cash flow to repay loans). This targeted awareness can be organized and delivered by CSOs through collaboration with Ministry of Agriculture, Animal Industries & Fisheries; Ministry of Energy and Mineral Development; Local Governments; and Financial Institutions.

iii) Promote agricultural demonstration centres through PPPs: The government (through the Ministry of Agriculture, Animal & Fisheries; and National Agricultural Research Organization) should priorities public-private partnerships to establish and sustain rural demonstration farms across the country that provide evidence-based learning opportunities for smallholder farmers on the economic and productivity benefits of productive-use solar energy technologies across agricultural value chains. A nationwide network of rural demonstration farms where farmers can observe, test, and learn about productive-use solar technologies will reduce information barriers and accelerating technology adoption in agriculture.

At such centres, communities will be able to get first hand learning and training on technology adaptation and share experiences on the integration of PUSE in the agricultural value chain.

iv) Turn-around time for payment of interest on loans: Commercial banks should revisit their lending policies to reduce the total time taken to process, approve, and disburse PUSE loans for small holder farmers from the moment the application is submitted. The issues to consider in this policy review might include the time taken for documentation checks, verification, credit assessment, legal evaluations, and final sanctions where necessary.

v) Flexible credit mortgaging for agricultural credit: Financing institutions ((i.e. Banks, Micro Finance, SACCOs) should consider relaxing the conditions/requirements which—under the current circumstances—make it difficult for smallholder farmers to qualify for credit for PUSE finance. Given the fact that smallholder farmers are often frustrated by too much bureaucracy, tedious processes and have in some cases—been forced to abandon the process altogether, a shift to more flexible mortgaging

facilities could well be thought about and maybe the panacea to bring them into the 'PUSE' financing economy.'

vi) The case for strategic financing partnerships: Commercial banks, Micro-Financial Institutions, Savings and Credit Cooperatives (SACCOs), and Private companies supplying solar equipment & technologies, should explore strategic partnerships to raise more affordable and accessible PUSE financing options for smallholder farmers. Whereas the Uganda Energy Credit Capitalisation Company (UECCC), which was operationalized in 2009 works in partnership with most financial institutions under the regulation of the Central Bank of Uganda and the Uganda Microfinance Regulatory Authority, it still faces an uphill task of overcoming the financing barriers inhibiting access to such financing. Establishing strategic partnerships with suppliers of solar equipment should not only boost financial intermediary credit lines and results-based financing facilities through subsidised prices and discounts, but also broaden options for credit facilities for solar financing.

vii) Design appropriate PUSE financing options: There is a need to engage the commercial banks, Micro-Finance Institutions and Savings and Credit Cooperative Societies (SACCOs) and other old and new capital markets that specialise in providing credit to farmers on how to design appropriate financing options for PUSE, — notably for the small holder holders.

5.2 Policy recommendations targeting policy shift through responsive actions and changes

(i) Address the regulatory, coordination and policy barriers: Government (i.e. Bank of Uganda, Uganda Microfinance Regulatory Authority) should enhance the PUSE financing regulatory framework by implementing structural reforms to enhance financial inclusion, strengthen public project management, and foster a green economy with a special focus on small holder farmers. In addition to supporting the implementation of the NR-PUSE, Government should strengthen the micro-financing support mechanisms to support small holder farmers. Furthermore, the Government (i.e. Ministry of Finance, Planning & Economic Development) should also develop the necessary regulatory guidelines for green, sustainable finance across the banking sector.

In addition, the key policy and decision makers such as the Ministry of Finance, Planning and Economic Development (MoFPED), Bank of Uganda and other Departments and Agencies that carry the mandate and responsibility for implementing the policy and regulatory frameworks that promote enhancement and scaling up of PUSE in the agricultural value chain must be engaged to promulgate and enforce the required supporting policy environment. Overall, the scarcity of suitable finance for farmers and other entrepreneurs in rural settings, especially for investment purposes, points to the failures of both the "old" directed credit paradigm and the "new" financial market and systems development paradigm in dealing with the constraints of rural agricultural finance (FAO, 2013).

ii) Mainstream PUSE into National Planning & Budget Frameworks: National Development Plan IV (NDP IV, 2025/26–2029/30) explicitly prioritises agro-industrialisation and sustainable energy as twin pillars of economic transformation. Thus, embedding explicit PUSE line items in the Budget Framework Papers of MEMD, MAAIF, and MoFPED under Programme-Based Budgeting (PBB) would unlock national budget allocations for solar-agri-interventions at scale.

iii) Mobilize international climate finance to support PUSE technology application and scaling in agricultural value chains by smallholder farmers: This requires lobbying and negotiations, within the UNFCCC Financial Mechanisms (e.g. Adaptation Fund & the Green Climate Fund) and Technology Mechanisms by the Government through the Ministry of Finance, Planning & Economic Development; and the Climate Finance Unit for consideration of adaption and mitigation action projects, that integrate access to finance for application of PUSE technology by smallholder farmers in the agricultural value chain. Furthermore, the relevant Government Line Ministries, in collaboration with Financial Institutions & Non-Governmental Organizations should develop bankable projects for submission to the Climate Financial mechanisms.

iv) De-risk agriculture and unlock funding: De-risking agriculture and unlocking solar funding require bridging the gap between smallholder needs and commercial capital through concessional and blended finance. Thus, the grants and first-loss capital from donors would absorb the initial risks, while the concessional loans from Development Finance Institutions (DFIs) would reduce the cost of capital; and commercial banks, MFIs, and SACCOs could deploy the on-lent capital to end borrowers (i.e the smallholder farmers). Such financing should be mobilized by the Government (through the Ministry of Finance, Planning and Economic Development) through structured engagements with Development Banks and bilateral Development Partners.

v) The UNBS should strengthen the enforcement of standards and certification of solar energy products, accessories and the companies involved in the importation of these products.

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