ENHANCING THE PRODUCTIVE USE OF SOLAR ENERGY IN UGANDA'S AGRICULTURAL VALUE CHAIN

OPPORTUNITIES, CHALLENGES AND RECOMMENDATIONS

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Abbreviations

ACF	Agricultural Credit Facility
ACODE	Advocates Coalition for Development and Environment
BFPs	Budget Framework Papers
BoU	Bank of Uganda
CCBT	Climate Change Budget Tagging
CETWG	Clean Energy Technical Working Group
CSOs	Civil Society Organizations
DLGs	District Local Governments
DREEM	Distributed Renewable Energy Ecosystem Model
EAC	East African Community
EASP	Energy Access Scale-up Project
GoU	Government of Uganda
ICTs	Information and Communication Technologies
LPG	Liquified Petroleum Gas
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MDAs	Ministries, Departments and Agencies
MEMD	Ministry of Energy and Mineral Development
MFIs	Micro Finance Institutions
MoFPED	Ministry of Finance, Planning and Economic Development
MTIC	Ministry of Trade, Industry and Cooperatives
MW	Megawatts
NDCs	Nationally Determined Contributions
NDP III	Third National Development Plan
NDP IV	National Development Plan
NPA	National Planning Authority
NR-PUSE	National Roadmap for the Productive Use of Solar Energy
NREP	National Renewable Energy Platform
PDM	Parish Development Model
PFIs	Participating Financial Institutions
PIP	Public Investment Plan

PUE	Productive Use of Energy
PUSE	Productive Use of Solar Energy
PV	Photovoltaic
QA	Quality Assurance
REFIT	Renewable Energy Feed-in Tariff
SACCOs	Savings and Credit Cooperative Organizations
SDGs	Sustainable Development Goals
SEDP	Sustainable Energy Development Programme
UECCC	Uganda Energy Credit Capitalization Company
UgIFT	Uganda Intergovernmental Fiscal Transfer Programme
UNBS	Uganda National Bureau of Standards

1. Introduction

The Productive Use of Solar Energy (PUSE)[1] has a big potential to lead to the country's sustainable development, economic growth, and poverty reduction. Solar energy can enhance agricultural productivity, reduce post-harvest losses, and support sustainable agricultural practices. PUSE encompasses more than just lighting solutions. Solar-powered water pumps offer water independence from erratic rainfall, while cold storage facilities powered by the sun preserve harvests and empower farmers to negotiate market prices. Solar dryers for coffee, grains, fruits, vegetables, and other agricultural produce have a huge potential to reduce the time spent on drying products and minimizes spoilage. Diesel-powered mills are giving way to clean-energy alternatives, driving rural entrepreneurship and creating environmental benefits.

The Productive use of solar energy for agriculture not only has the potential to improve the viability of energy access business models, but it is also a means to achieve broader socio-economic goals. For example, a survey on the uses and impacts of off-grid refrigerators in Kenya, Tanzania and Uganda concludes that 72% of the interviewed people experience increased income and business growth after using off-grid refrigeration.[2] Furthermore, promoting PUSE can improve the viability of solar mini-grid projects, by increasing demand for energy and providing stable demand during the day time.

With ample solar radiation throughout the year, Uganda is an ideal location for solar-powered irrigation systems and solar photovoltaic (PV) systems for use in agriculture and agribusiness sector. An improvement in the policy and regulatory framework, coupled with a drop in global prices for solar PV systems has provided an additional window of opportunity for the solar energy in agriculture.[3] However, this window of opportunity may not be fully exploited if policies to contribute to the successful delivery of solar products and rapidly ramp up solar energy development, are not effectively implemented. To address implementation barriers, stakeholders must assess the root cause of the challenge and develop targeted strategies to address each barrier in collaboration with other interested stakeholders.[4]

This brief presents key policy and practice issues and makes recommendations aimed at enhancement and scaling-up of Productive Use of Solar Energy (PUSE) in Uganda's Agricultural Value chain. Its targeting key policy and decision makers (i.e., Ministries, Departments, Authorities, Civil Society Organizations and Private Sector) with mandate and responsibility for implementation of policy and legal frameworks that promote enhancement and scaling up of PUSE in Agricultural value chains in Uganda.

1 Productive Use of Solar energy (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)

2 Sophia Schneider, Madeleine Raabe, Kimberly Fahsold, María Yetano Roche (wi) productive-use-solutions -smart energy solutions for africa-factsheet-2 https://sesa-euafrica.eu/wp-content/uploads/2024/02/sesa-factsheet-2-productive-use-solutions_approved.pdf accessed on 13th June,2025

3 HEIFER. 2025."A Baseline Assessment of the Policy Environment for Productive use of Solar Energy in Agriculture ", Research Report, Kampala: Heifer International Uganda. (unpublished)

4 USAID (Health Policy Project). 2014. "Capacity Development Resource Guide: Implementation Barriers." Washington, DC: Futures Group, Health Policy Project

The policy brief was compiled through the review and synthesis of the literature, dialogue reports and relevant policies on renewable energy and solar energy utilization in Uganda. The purpose was to identify the opportunities, gaps and challenges for productive use of solar energy in Uganda's Agricultural Value chain. Based on this review, key policy and practice issues were identified through multi-stakeholder engagements and dialogues on the uptake and integration of solar energy in the agriculture value chain. All this informed the recommendations for enhancing and scaling up of PUSE in Uganda's agricultural value chain. The draft policy brief was presented at a meeting of selected stakeholders for validation and further inputs.

1.1. Key Policy Issues

The key issues identified in this process include:

a) Lack of a framework for quality, standards and assurance to inform implementation of PUSE in the agricultural value chains. This makes enforcement difficult to ensure that technologies and products on the market meet the minimum acceptable standards in terms quality and value. It also makes it hard for farmers and other agricultural value chain actors to get value for money and achieve sustainability in their investment in PUSE technologies and products. Besides, this compromises consumer trust and protection.

b) Inadequate incentive mechanisms for promoting access and investment in application of PUSE in agriculture values chains. Appropriate incentive mechanisms would attract private sector investment in PUSE technologies thereby facilitating uptake and adoption at different scales i.e., farm, community, landscape and national.

c) Lack of a comprehensive National Strategy for guiding effective implementation and coordination of the policy commitments targeting enhancement and scaling up of PUSE as stipulated in the existing policy legal and institutional framework. The National Road Map for scaling up Productive Use of Solar Energy is not supported by required financial resources and its implementation is also limited. Consequently, several actors and players are operating in silos with inadequate institutional coordination and collaboration for tapping into synergies to deliver on the shared goals and aspiration. This equally makes consolidation of the results into regular and progressive reports against outputs and outcome targets difficult.

1.2. Key messages

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

a) There is great potential for PUSE to advance agricultural value chains in terms of productivity, income, profits at different levels, while contributing to sustainable development and socio-economic transformation through livelihoods improvement, job creation and post-harvest loss reduction.

b) There are several barriers limiting the enhancement and scaling up of PUSE in agricultural value chains. Some of the barriers are of a policy nature, while others are structural & programmatic. Both barriers should be addressed by implementing

responsive and targeted actions.

c) The enhancement and scaling up of PUSE in agricultural value chains provides additional benefits beyond the energy demands of the value chains. One example of such benefits is lighting and phone charging at the household level, which contributes towards achievement of broader socio-economic development goals.

d) The enhancement and scaling up of PUSE is aligned and contributes towards achievement of the Uganda Nationally Determined Contribution commitments on both adaptation and mitigation. It also contributes towards achievement of the SDG 7 that ensures access to affordable, reliable, sustainable and modern energy for all.

2. Background

Uganda's energy system currently comprises hydropower, bio mass, solar energy, geothermal, peat, and wind.[5] The country's physical energy resource potential includes an estimated 2,000 MW of hydroelectric power, 450 MW of geo-thermal energy, 1,650 MW of biomass cogeneration (often at sugar manufacturing plants), 460 million tons of biomass in stock with a sustainable annual output of 50 million tons, an average of 5.1 kWh/m2/day of solar energy, and about 250 million tons of peat (800 MW) (GIZ, 2022). The total potential of renewable energy power generation is estimated at 5,300 MW (UNREEEA 2024). However, this energy potential is not yet fully utilised to address Uganda's energy poverty.[6] Around 50% of the country's population have access to any form of electricity and about only about 24 % have access to electricity for more than 4 hours per day.

While Uganda increased its electricity generating capacity from about 320 megawatts (MW) in 2002 to over 1346 MW at the beginning of 2023, with a surplus relative to its peak demand of about 800 MW; only 28% of the Ugandan population have access to electricity from the national grid.[7] A further 10% receive electricity from solar home systems. With around 30% of the population having access to electricity and less than 6% having access to clean cooking fuels, Uganda continues to have one of the lowest electrification and clean cooking rates in sub-Saharan Africa (IEA, 2023).

The Government of Uganda is however committed to advancing renewable energy initiatives in order to attain the Sustainable Development Goals (SDGs); specifically, SDG 7[8] that aims to *"ensure access to affordable, reliable, sustainable and modern energy for all"* by 2030. Uganda's expansive development agenda holds the promise that its future energy system will look very different from today, with universal access to electricity and to clean cooking achieved by 2030. This is a key benchmark in its energy transition plan. Spurred by economic transformation, industrialization and modernization, the nation's primary energy demand is expected to increase threefold by 2050, enabling a measurable rise in

5 International Energy Agency (2023), Uganda 2023 Energy Policy review. https://memd.go.ug/wp-content/uploads/2020/07/Uganda2023-Energy-Policy-Review.pdf accessed on 15th June,2025.
6 International Energy Agency (2023), ibid
7 International Energy Agency (2023, ibid
8 https://sdgs.un.org/goals

living standards for all Ugandans and growth of the nation's economy. Concurrent with this growth is an anticipation of concerted efforts to reduce the use of solid biomass which is almost 90% of current final energy consumption; to modern energy. Solar energy presents a great renewable energy opportunity, for an agro-based country like Uganda. The country receives ample solar radiation throughout the year, making it an ideal location for solar-powered irrigation systems and solar photovoltaic (PV) systems for use in agriculture and agribusiness sector.

Uganda has since embarked on strengthening her policy framework for not only renewable energy but also PUSE In 2023. Uganda government launched the National Roadmap for the Productive Use of Solar Energy (NR-PUSE), whose aim is to improve the policy and regulatory environment for PUSE; increase the level of awareness and information dissemination regarding the available opportunities created by PUSE; provide affordable financing for PUSE, either to PUSE companies or end-users; enhance the capacity of the sector players in PUSE; and promote research and development in PUSE (MEMD, 2023). Nineteen mini-grid projects have been completed and over 60 are planned, most of which are solar-powered (U-Learn, 2023). PUSE technologies promise enhanced agricultural productivity, reduced post-harvest losses, improved product quality, value addition, and product reach to markets.

However, utilising Uganda's significant potential for the use of solar energy in agriculture, and increasing access to modern, reliable, and affordable renewable energy, and energy-efficient technologies requires a strong policy operating environment. While Uganda's agricultural sector presents multiple highly profitable investment opportunities both for profit-oriented investments and partnerships, the country risks missing its key development targets due to low use of productive energy in this sector which is considered the backbone of Uganda's economy (MEMD, 2023a). This window of opportunity may not be fully exploited if policies to contribute to the successful delivery of solar products and rapidly ramp-up solar energy development, are not effectively implemented.

3. Energy Sector Policy Frameworks and the Productive Use of Solar

The 1995 Constitution of the Republic of Uganda provides the mandate to establish an appropriate Energy policy. In 2002, the government released its first Energy Policy for Uganda, with the goal of *"meeting the energy needs of Uganda's population for social and economic development in an environmentally sustainable manner"* and *"to modernize the energy system"*. The policy was revised in 2023 and complements several sub-sectoral policies that were already in place, including the Renewable Energy Policy (2007),[9] the National Oil and Gas Policy (2008, for the petroleum sector, which is currently under review), and the Electricity Connections Policy (2018).[10]

9 Renewable Energy Policy, 2007 was developed in a context of an unprecedented electricity supply deficit caused by low water levels in Lake Victoria following a prolonged drought, leading to the installation of 200 MW of expensive emergency diesel generation (MEMD, 2007). The Renewable Energy Policy notably established a standardised PPA for renewable projects, as well as new, higher feed-in tariffs. It also created a Renewable Energy Department at the MEMD.

10 The Cabinet adopted the revised Energy Policy in April 2023 and it was launched in September 2023.

While the Energy Policy 2002 was set to go a long way in laying the foundation for the country's energy development, its objectives, and strategies, were too thin to promise a scale up of PUSE. The objectives were only limited to the creation of an enabling environment to attract private finance and investment in the energy sector, encourage energy services and partnerships, and work towards aligning Uganda energy sector with global and regional energy trends.

In 2007, Uganda also developed the Renewable Energy Policy aimed at increasing the share of renewable energy in the national energy mix to 1420 MW by 2017. Although this target was missed by 2017, it has since been achieved with the commissioning of the 600 MW Karuma hydro power plant.[11] Although the policy aimed at increasing the contribution of renewable energy sources beyond electricity production, with a blending of biofuels with petroleum products, wood fuel and charcoal, it was not aligned with productivity goals, and unfortunately, missed the opportunity to leverage solar energy for productive use in agriculture.

Uganda also developed the Electricity Connections Policy (2018-2027) to address the challenge of low connection rates. The policy also aimed at achieving a 60 percent access to electricity for Uganda by 2027. This was operationalized through the Isolated Grid Regulation, (2020) and the Rural Electrifications Strategy plan (2013-2022). The Renewable Energy Feed-in Tariff (REFIT) framework was also developed to encourage private sector participation in power generation from renewable energy technologies. All these frameworks, and those before them have prioritized domestic use of energy over the productive use of energy (PUE).

In April 2023, the Ugandan Cabinet adopted the Energy Policy. In September 2023, the policy was launched. The Revised Energy Policy for Uganda, 2023 has the goal of ". . . meeting the energy needs of Uganda's population for social economic development in an environmentally sustainable manner . . ." The policy promotes increased access to electricity and enhanced utilization of energy-efficient technologies and biomass (MEMD, 2023b). Regarding renewable energy, the policy states that "The government shall promote the sustainable development and utilization of all renewable energy resources in a socially and environmentally responsible manner" (MEMD, 2023). Again, there is no clear pointer to commitment (from policy perspective) to leveraging solar energy for productive use in agriculture.

In 2007, the Cabinet (GOU) approved the National Vision Statement of: "A Transformed Ugandan Society from a Peasant to a Modern and Prosperous Country within 30 years". The Vision emphasizes access to clean, affordable and reliable energy to facilitate industrialization. Vision 2040 is being operationalized through a series of five-year national development plans. The government has now approved and adopted the National Development Plan (NDP IV), which covers the period 2025/26 to 2029/2030. The NDP IV has maintained program approach and chapter 14 extensively deals with sustainable energy development. NDPIV is designed to deliver the aspirations of the people of Uganda, as articulated in Uganda Vision 2040 and regional aspirations as articulated in Agenda 2030,

11 The 600MW Karuma Hydro Power Plant was commissioned on September 26th, 2024 by H.E. Yoweri Kaguta Museveni in Kiryandongo District. The Karuma Hydro Power Plant Project was constructed by Sino Hydro Construction Company and handed over to Uganda Electricity Generation Company Limited.

Agenda 2063 and the EAC Vision 2050.

However, while the productive use of energy (PUE) has been articulated in the strategies,[12] there is little emphasis on productive use of solar energy in agriculture and the targets have not been articulated. As already alluded to in 2023, the Uganda government launched the National Roadmap for the Productive Use of Solar Energy (NR-PUSE). The roadmap provides a situational analysis and the needed strategic interventions to leverage PUSE in Uganda. It further provides an analysis of the policy and legal framework, an overview of the PUSE applications in the country, and provides a list of challenges, barriers, and opportunities. The national roadmap goes further to provide for financing and implementation actions, a monitoring and evaluation framework and to lay the channels for collaboration between the Government of Uganda, Development Partners, and all sector players to achieve a common vision for the country.

4. Opportunities for the Productive Use of Solar Energy in Agricultural Value Chains

The first opportunity for PUSE in Uganda is demonstrated by the existence of an enabling/supportive policies and institutional frameworks (e.g., Energy Policy 2023; Uganda Green Growth Strategy, 2017/18-2030/31; Clean Energy Technical Working Group (CETWG), inter-ministerial committees, the National Development IV, 2025/26 - 2029/30; and Uganda Vision 2040) that have set the pace for the adaptation of PUSE. These policies and programs have opened up government funding, including that under the Parish Development Model (PDM) to the local levels and farmers. The existence of a dedicated department for renewable energy issue within the ministry (a fully-fledged department of renewable energy in the Ministry of Energy & Mineral Development) and existing platforms (e.g., National Renewable Energy Platform) provide coordination avenues that provide a good starting point for promotion of PUSE.

The policies, regulatory framework, and tools such as feed-in tariffs, net metering plans, and interconnection regulations are making it possible for solar energy to be integrated into current energy systems. They also provide a mechanism for government to support agriculture and initiatives to promote production such as the Uganda Intergovernmental Fiscal Transfer Programme (UgIFT), which allows farmers to have access to agricultural equipment by sharing the cost of acquiring the equipment especially on irrigation.

Uganda receives ample solar radiation throughout the year, making it an ideal location for solar-powered irrigation and solar photovoltaic (PV) systems for use in agriculture and agribusiness sector. The milk industry, one of Uganda's leading export earner, experiences post-production losses of about 20–40 percent due to lack of timely cooling (Heifer International Uganda, 2024). On the other hand, whereas Uganda is the second largest producer of fresh fruits and vegetables in sub-Saharan Africa, this sector also experiences significant losses due to energy access challenges for cooling and preservation. Uganda's fisheries sector also faces similar challenges around spoilage and losses due to a lack of

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

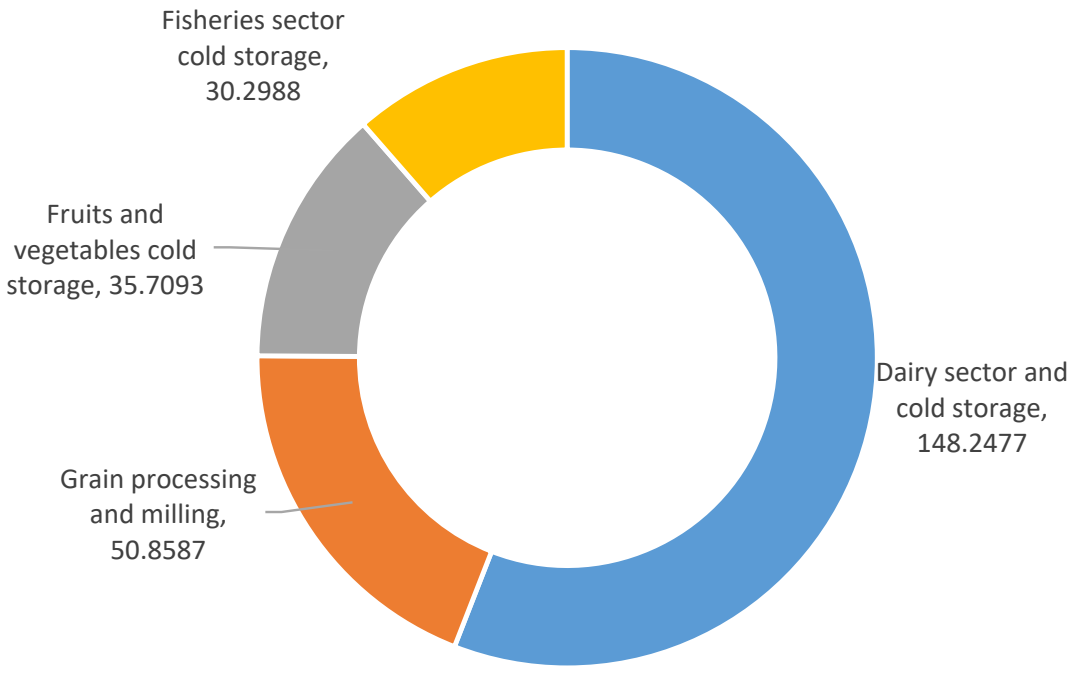
refrigeration and cold storage across its value chain. Grain processing and milling is another sub sector. This strong agricultural base--with unexploited potential for value addition-offers opportunities for solar-powered irrigation and agro-processing.

There are also PUSE opportunities associated with ongoing government programmes such as:

UgIFT, which allows farmers to have access to agricultural equipment by sharing cost of acquiring the equipment especially on irrigation), the Energy Access Scale-up Project - EASP (which aims at increasing access to energy for households, commercial enterprises, industrial parks, and public institutions); and (b) the Parish Development Model (PDM), which stands to integrate solar solutions at the local level.

Furthermore, a drop in global prices for solar PV systems has also provided a window of opportunity for solar energy expansion in Agriculture. Figure 1, shows a summary of the estimated market for Solar technologies (at the smallholder level) (Heifer International Uganda, 2025). For example: the market for the dairy sector (estimated at US$148M), grain processing and milling (US$51M), cold storage for fruits and vegetables (US$36M), and cold storage for the fisheries sector (US$30M). The solar energy promises enhanced agricultural productivity, reduced post-harvest losses, and support sustainable agricultural practices.

Figure 1: Estimated market opportunity for PUSE technologies in selected sector in Uganda



Source: GIZ (2022)

Financing opportunities also exist in the form of the Uganda Energy Credit Capitalization Company (UECCC) and the Agricultural Credit Facility (ACF). Working in partnership with Participating Financial Institutions (PFIs), the UECCC has put in place a loan programme that enables households and commercial enterprises to acquire solar systems on credit with a

view to addressing the affordability barrier posed by the initial upfront cost of acquiring solar systems.[13]

The ECCC is currently implementing an On-grid Connection Loan Programme in line with the Government Electricity Connection Policy (2018-2027) under which government provides a free electricity connection; with the households meeting the cost of wiring thus addressing the barrier of affordability posed by initials costs of acquiring an electricity connection. The programme also provides loans for three phase connections. In addition to households, other beneficiaries include; schools, small businesses and health facilities.[14]

On the hand, the ACF was initiated in 2009 to promote commercialization of agriculture through provision of medium- & long-term financing to the agricultural sector focusing mainly on value addition (BoU, 2024). Over the years, the Facility has been used to fund a set of activities along the agricultural value chain such as the acquisition of agricultural machinery and equipment, post-harvest handling equipment, storage facilities, agricultural inputs and irrigation facilities. The funds are contributed by both the Government of Uganda and the PFIs with each contributing 50% of any loan given to a farmer/agro-processor. On the other hand, the MDIs and Credit Institutions contribute 30% and GoU 70% of any loan given to a farmer/agro-processor.[15]

5. Challenges for the Adoption of PUSE in the Agricultural Value Chain

While policy implementation on productive use of solar energy for agricultural value chains has demonstrated notable performance over the years, Uganda still faces numerous challenges to accelerate access and adoption of PUSE in agricultural value chain. They include the following:

5.1. Limited access to financing for PUSE technologies in key agricultural value chains

The technologies that enable sustainable PUE solutions include the energy use appliances (such as water pumps and irrigation equipment, or fridges for cold storage), but also the power source (solar panels), energy storage (batteries), and Information and Communication Technologies (ICTs). These solar technologies are associated with high initial costs. This coupled with high incidences of poverty, and limited financing for acquisition of solar technologies continue to hamper affordability. Uganda Energy Credit Capitalisation Company's (UECCC's) which was operationalised in 2009, works in partnership with Financial Institutions (regulated by the Central Bank of Uganda and the Uganda Microfinance Regulatory Authority) and Energy Service Companies, to scale up the provision of innovative financing facilities to unlock the financing barriers inhibiting access to clean and modern

13 See https://www.ueccc.or.ug/programs/solar-loan-program/
14 Ibid
15 See https://www.bou.or.ug/bouwebsite/ACF/

energy services especially in the rural areas. The Company is working to scale up financial intermediary credit lines and results-based financing facilities by offering price subsidies/ discounts to address affordability barriers and roll out solar systems for households and enterprises, clean cooking solutions powered by solar, ethanol, biogas, briquettes, liquified petroleum gas (LPG) and Productive uses of Energy technologies starting with water pumping, irrigation, refrigeration and cooling, water heating and grain milling.

While some financial institutions in partnership with UECCC have developed some credit facilities for solar financing, accessing financing under these products is still difficult for farmers. They are still characterised by a lot of conditionalities, with too many requirements which farmers cannot meet. In cases where some farmers have tried, their effort has been frustrated by too much bureaucracy of these financial institutions and very long processes. In some cases, the bureaucracy has forced farmers to abandon the process because, agricultural investments also depend on season. On the other hand, there is still limited information and awareness on solar financing opportunities within the public domain. Financing also makes it difficult for companies to distribute solar technologies to last-mile communities, thus limiting supply.

5.2. Limited institutional coordination for PUSE programs

While there are lead responsible agencies of Government such as MEMD, Uganda Energy Credit Capitalisation Company and MAAIF among others, there is still a conflicting mandate for coordination of PUSE. The national renewable platform and its working groups have not prioritised Productive Use of Solar Energy in Agriculture Value Chains. The Off- Grid Energy Working Group (OGEWG) is not strong on PUSE and is not inclusive enough.

5.3. Lack of quality standards

Many solar energy products, especially for productive use, lack standardization and enforcement, leading to the influx of substandard equipment that undermines trust in solar solutions. The importation of substandard systems and poor after-sales service continue to present a formidable barrier to PUSE uptake. Quality regulation enforcement presents challenges such as counterfeit products, substandard manufacturing practices, and inadequate testing facilities. The government standards agency has not developed specific quality assurance (QA) standards or regulations for the import of PUSE products beyond traditional solar PV solar energy kits (lanterns and SHS). Strengthening regulatory frameworks, implementing standards and certification programs, and enhancing market surveillance are essential for improving the quality control of solar products.

5.4. Limited incentives for PUSE technologies

The good quality advanced solar technologies are expensive, and making it difficult to purchase by farmers. Government incentives, such as subsidies, grants, and tax benefits, are still limited hence affecting affordability and discouraging farmers and agri-business enterprises to transition to solar power. Cost reduction should be part of affordability goals. The tax regime for PUE equipment and accessories, remains unclear to the suppliers and the tax body (e.g., some components are tax-free, and others are not).

5.5. Capacity gaps

Limited technical capacity within government ministries and businesses to implement solar technologies continues to be a challenge. Most policy challenges for PUSE for agricultural value chains stem from a combination of inadequate human technical capacity for policy delivery agencies, such as lack of understanding of key policy provisions among some key staff in line agencies which severely limit policy implementation. The existing platforms in the energy sector, such as the National Renewable Energy Platform and annual renewable energy conferences, are underutilized or fragmented. They are associated to limited inclusiveness and limited participation of key stakeholders.

Capacity limitation has also affected integration of Productive Use of Solar Energy in planning and budgeting which have affected financing and implementation at both national and local government level.

6. Recommendations

To accelerate PUSE access and adoption, there is a prerequisite to implement tailored interventions.[16] These are categorized as policy and practice change recommendations, including the following:

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

6.1.1. The Ministry of Energy and Mineral Development in collaboration with Ministry of Agriculture, Animal Industry and Fisheries should take lead enhancing the capacity of the PUSE sector players at the national and local levels.

Government institutions and frontline organisations, including technicians, technology companies, and farmer's cooperatives involved in implementation of energy policy, and installation, operation, maintenance, and dissemination of solar technologies require targeted and responsive capacity training for strengthening their skills and knowledge in various areas related to application of PUSE.

6.1.2. The Ministry of Energy and Mineral Development should create mechanisms for regular provision of PUSE-related information to the various value chain actors including: traders, farmers and other stakeholders regarding opportunities, quality, market and financing.

Government in collaboration with development partners and private sector should: (i) develop and establish Information Management Systems (IMS); (ii) bring all the PUSE information under a single portal and creating an effective information delivery system; and (iii) develop a comprehensive production and PUSE database for key agricultural value

16 Details of these interventions can be accessed from the baseline study by Heifer International in Uganda, (2025).

chains.

6.1.3. Civil Society Organizations (CSOs) in collaboration with relevant Government Ministries and Agencies, and development partners should consolidate awareness creation about application of PUSE in agricultural value chains in Uganda, and pursue the development and implementation of responsive projects and programmes to support the scaling up of the application of PUSE in Uganda.

6.1.4. Government programmes (e.g., PDM) should provide financial support to farmers to access appropriate technologies, and associated training for facilitating the scaling up of the PUSE in agricultural value chains.

6.1.5. Government should leverage the budgeting process to scale up solar investment in agriculture.

- *Integrate Solar in sectoral Budget Framework Papers (BFPs):* Government ministries like MAAIF, MEMD, and Local Government should explicitly include solar-powered agricultural infrastructure (e.g., irrigation, cold chains) in their BFPs to access national and donor financing.

- T*ag Solar Projects in Program-Based Budgeting (PBB):* Under NDP IV's PBB approach, solar-related agricultural initiatives should be tagged under relevant programs like Agro-Industrialization and Sustainable Energy Development, making them visible and fundable.

- *Engage MOFPED on Climate and Green Budgeting Windows:* Leverage emerging budget lines under Climate Change Budget Tagging (CCBT) to position solar-agriculture projects as climate adaptation tools, eligible for special financing or incentives.

- *Prioritize Investment in the Public Investment Plan (PIP):* Ensure solar energy for agriculture projects are captured in the PIP, enabling structured appraisal and funding through the Development Committee and accessing concessional funding.

- *Mobilize District Local Governments (DLGs):* Build capacity and create guidelines for DLGs to include solar-powered agricultural technologies in local government budgets under decentralized planning, especially in high-production zones.

6.2 Policy recommendations targeting policy shift through responsive actions and changes

6.2.1. The Ministry of Energy and Mineral Development should work with the National Bureau Standards to develop and implement PUSE quality assurance and quality standards framework to ensure enforcement of product standards.

A high-performing PUSE Quality assurance (QA) and quality standard (QS) frameworks is a prerequisite to (i) building consumer trust and protection in PUSE products, (ii) de-risking investments and purchasing decisions, and (iii) reducing the presence of low-quality

counterfeit products in solar energy markets.

6.2.2. The Ministry of Energy and Mineral Development should establish an effective institutional collaboration and coordination framework and mechanism to ensure effective coordination within PUSE policy landscape.

Evidence suggests that Government Ministries, Departments and Agencies (MDAs) tend to work in silos and focus on their own sector specific targets and objectives with minimal coordination and collaboration with other government bodies or sector actors. PUSE industry stakeholders—notably MDAs do not sufficiently interact or coordinate regularly with other market stakeholders, such as other government institutions, bilateral and multilateral development agencies, and PUSE companies. Multi-stakeholder platforms will help bring market players closer, unify private sector actors, and accelerate information and data sharing. They are effective means for the government to engage with development partners, solar companies, farmers' cooperatives (farmer groups), off-takers, SACCOs, banks and MFIs. Thus, this can be achieved through development and implementation of a National Strategy to guide effective implementation and coordination targeting enhancement and scale up of PUSE in the agricultural value chains in Uganda. While the ministry hosts the National Renewable Energy Platform (NREP),[17] it's too broad and does not take care of PUSE stakeholders' interests.

6.2.3. The Ministry of Energy and Mineral Development in collaboration with Ministry of Finance, Planning and Economic development should create an enabling environment for private sector participation.

An enabling environment is crucial for accelerating the adoption of solar technologies and achieving sustainable energy systems. This includes develop specific guidelines to streamline access to solar financing, guide financial institutions by creating a regulated and harmonised regime of credit facilities among different financing institutions which build farmers trust, raising awareness on relevant policies among solar energy services providers and end-users, strengthening PUSE financing and investment, harmonising and clarifying the inconsistencies in the tax regime criterion for PUSE packages among others.

17 The National Renewable Energy Platform (NREP) is a national initiative established by stakeholders in the Renewable Energy sector and hosted at the Ministry of Energy and Mineral Development (MEMD). https://nrep.ug/about-us/

Conclusion

PUSE for agricultural value chains is driven largely, by levels of awareness and knowledge, technical and institutional capacity of implementing agencies; coordination among stakeholders; incentive regime; investment in research and development, innovation and knowledge sharing; access to affordable financing; and infrastructure quality. The hope lies in harnessing opportunities, creating collaboration between governments, development partners, CSOs, local community organizations and farmer's groups, to foster comprehensive awareness campaigns, securing adequate funding, ensuring, clarity, predictability, and a stable tax regime. Financial incentives—such as tax credits, grants, subsidies, and low-interest loans—are essential in lowering the initial costs of solar adoption. Raising awareness on existing financing mechanisms, developing tailored infrastructure, and implementing innovative financing solutions can lead to a solar-powered future that transcends boundaries and promotes sustainable development.

Low multi-stakeholder participation and enhanced use of productive solar energy in agricultural value chains are attributed primarily to limited access to finance, inadequate stakeholder coordination, lack of quality standards, technological mismatch (advanced solar technologies do not always align with the local market needs and purchasing power), and capacity gaps (limited technical capacity within government ministries and businesses to implement solar technologies). The existing environment for policy implementation on productive use of solar energy for agricultural value chains shows more opportunities that can be harnessed for better policy outcomes than the internal weaknesses, and emerging external threats. Leveraging existing opportunities and negating the emerging threats will put the policy implementation on PUSE in agriculture on a conducive path for scaling up the productive use of solar energy.

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