Step Change

Deliverable 6.2

Case Studies on RE adoption in agriculture in Uganda

Deliverable description.

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PU	**Public**
CO	**Confidential, only for members of the consortium (including the Commission Services)**
CI	**Classified, as referred to in Commission Decision 2001/844/EC**

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Acronyms

Acronym	Description
ARUWE	Action for Rural Women's Empowerment
CS	Citizen Science
CSI(s)	Citizen Science Initiative(s)
CSOs	Civil Society Organizations
D	Deliverable
EC	European Commission
EU	European Union
FGD	Focus Group Discussion
KII	Key Informant Interviews
NGOs	Non-Government Organizations
RE	Renewable Energy
UNREEA	Uganda National Renewable Energy Efficiency Alliance
WP6	Work Package 6

Summary

The following Deliverable contains a detailed description of the findings from the case studies on Renewable Energy adoption in agriculture in Uganda. WP 6 aims at providing evidence of economic, environmental and societal potential of adopting off-grid renewable energy in agricultural production in rural Uganda. This will be achieved through two main objectives;

i) Identify the impacts achieved by the three ongoing pilot projects in Kyakwanzi, Kiboga and Luwero districts, where agricultural cooperatives have been trained and mobilized to use renewable energy technologies.

ii) Provide evidence on the potential of up-scaling of these technology transfer experiences to the whole region and provide an overview of the upscaling potential at National level.

Research Team, stakeholders and extended participants

The Research Team includes:

- Agnes Mirembe (Leader of the CSI)
- Nakirya Ronah – Project Coordinator
- Dr. Simon Kasasa (member of the Core Team, data protection officer)
- Walter Wandera (member of the Core Team)
- Lutaaya Emmanuel (member of the Core Team)
- Phenny Namataka (member of the Core Team)

Stakeholders and extended actors will include:

- Ministry of Energy and mineral Development
- UNREEA –Uganda National Renewable Energy
- Caritas Kasana Luwero
- Ndejje University
- Political leaders from the districts of Kiboga, Kyakwanzi and Luwero.
- Nkandwa Women's Cooperative
- Gayaza Women's Cooperative

Tasks, related deliverables and timeline

WP6 included five (5) different Tasks:

Task 6.1 - Finalization of the research design took place between October 2021 and February 2022. The detailed design specified the phases of the research, activities, tools, procedures and protocols.

Task 6.2- Analyzing Renewable Energy impact on cooperatives took place between February 2022 and October 2022. The research was based on the case studies analyzing the RE adoption by agricultural cooperatives. The information collected in this task together with those collected in task 6.3 were summarized in the collection of case studies on RE adoption in agriculture in Uganda.

Task 6.3- Analyzing Renewable Energy impact at Community Level. The task analyzed the impacts of RE projects in agricultural cooperatives at the community level such as societal dimension of the ongoing projects.

Task 6.4- Cross-case analysis, based on the data collected in tasks 6.2 and 6.3, a cross–case analysis was conducted for identifying the overall impact of the empowerment actions on RE in agricultural sectors.

Task 6.5- Up-scaling analysis and policy brief. Finally, based on results, multi-stakeholders and fact-based dialogue were triggered on the potential of up scaling at regional and national level.

Case Studies on RE adoption in agriculture in Uganda

Research design

The study adopted a cross-sectional survey design, utilizing a mixed methods approach. Data was collected with a qualitative bias from citizen scientists (farmers from the cooperatives), policy makers - Ministry of Energy and Mineral Development, CSOs, District officials, and the farmers from the communities. Qualitative data was collected through document reviews, direct observations, key informant interviews, focus group discussions, and case study documentation to understand user experience of RE sources and potential for upscaling. Thematic and content analysis techniques were used to describe the relationships between variables using frequency of codes from coded text data. A three-step approach was used to analyze qualitative data including open coding, axial coding and synthesizing.

Survey data was collected from citizen scientists using an extended survey questionnaire, Focus group discussions, Key informant interviews and observations. Data was analyzed descriptively in STATA V16 using frequencies, percentages, means, and medians. Qualitative data was triangulated with data extracted from both project documents and observations.
An informed consent disclaimer was administered to all survey and KIIs and FGD respondents before participation in the study. Data protection, confidentiality and safeguarding measures were put in place where children and vulnerable populations were involved, to uphold all ethical requirements of the research. Data collection followed a phased approach starting with individual interviews (KIIs and surveys), observations, case studies and Focus Group Discussions (FGDs).

Collected data

Surveys results were collected from a total of 1,068 citizen scientists from the three (3) districts of Kyankwanzi (374), Kiboga (372) and Luwero (322), from both males (444) and females (624). Data was collected on RE sources and technologies used and adopted, uses of the RE, motivation for adoption of RE, impact of using RE, as well as factors hindering adoption of RE

use across the communities. The survey questionnaire was also extended to capture demographic characteristics of the respondents.

Results from the data collected

Demographics:

More females (58%) than men (42%) participated in the study, which points to the relationship between gender and use of renewable energy technologies across the communities. Data from the qualitative interviews and discussions also reveal the fact that women are most affected by climate change in terms of gathering firewood for cooking, water collection for domestic use, and do almost 70% of on farm activities including small scale irrigation.

This is further compounded by both cultural and social issues where in the African setting, the primary agricultural production activities and burden is usually left to the females. Males on the other hand come in at the harvest and sales stage. This leaves the biggest burden of the agricultural chain to the females and yet the income is mainly controlled by the males.

Related to this, the majority of the respondents were between the ages of 30-49 years old (52%) and least were between the ages of 60+ years (12%). Figure 1 also shows that adoption of RE energy increases with the increase in age up to 50 years and then starts a declining trend at 60+ years. This means that all intervention to adoption of RE should focus on young to middle aged participants, rather than the elderly.

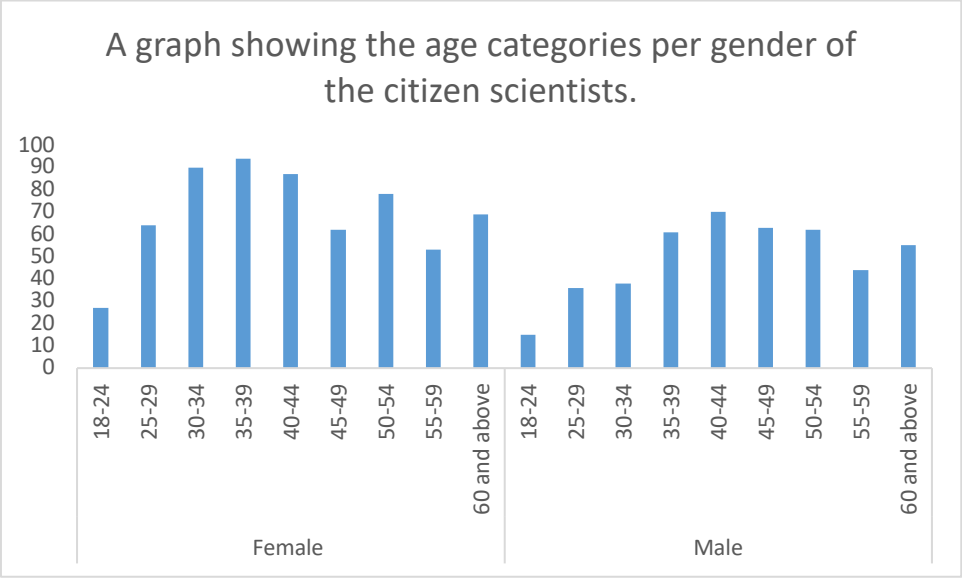

Figure1: Distribution of respondent age and adoption of renewable energy

Most commonly used RE technology in agriculture:

Solar energy (75%) is the most commonly used RE single technology in the agriculture sector, followed by briquettes (4%) and biogas (3%). Relatedly, more than one in ten respondents (11%)

were using a combination of solar and biogas and 4% of all respondents were using solar and biogas. The figure 2 also shows that 1% of all respondents were using all the three RE technologies in agriculture.

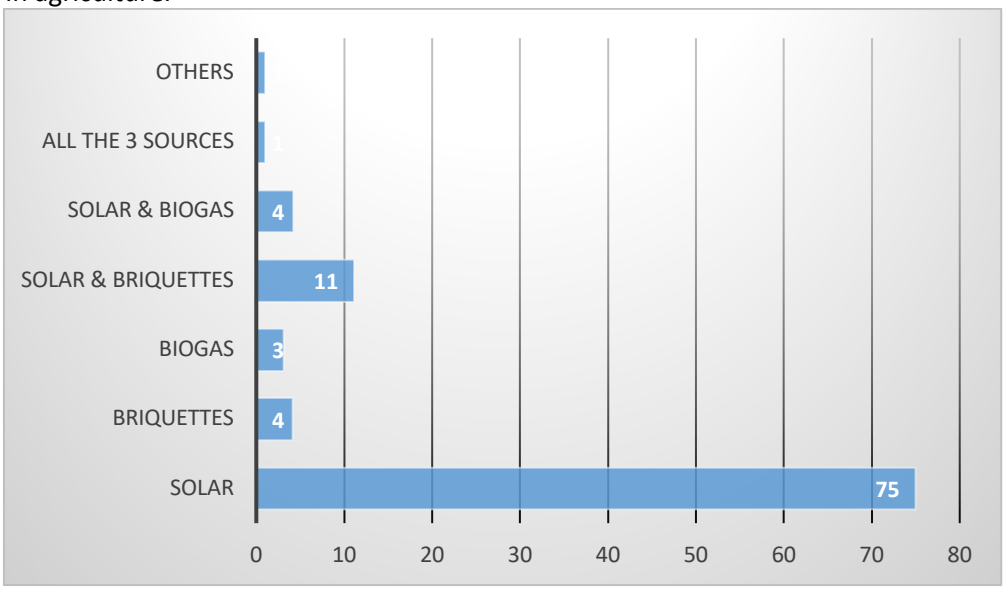

Figure2: Most commonly used RE technology in agriculture:

Qualitative information revealed that Solar was used in both crop and animal husbandry. Where in crop production, it was mainly used as a source of energy for pumping water for irrigation, to increase agriculture production and mitigate the effects of climate change, especially seasonal variation in the rainfall pattern.

		
Solar panels that are used to pump underground water	The water tanks that are used to store the pumped water	The woman standing in the garden of beans that as sprinklers installed to do the irrigation

Unlike, solar energy which was used mostly in agriculture, biogas was the most adopted RE technology used for cooking, and biogas waste used for agricultural purposes, such as manure.

		
The picture shows the equipment that supports the collection and production of biogas that is obtained from animal waste	A woman enjoying cooking a meal using the fuel from biogas.	A woman showing off her garden where she applied biogas slurry as manure

Motivation/reasons for using the RE technologies

Figure 3 indicates that energy efficiency (63%) and safety issues (61%) were the most common reasons for adopting RE technologies while availability of materials (21%) and clearance of the RE sources (24%) were the least reasons of adoption among other reasons.

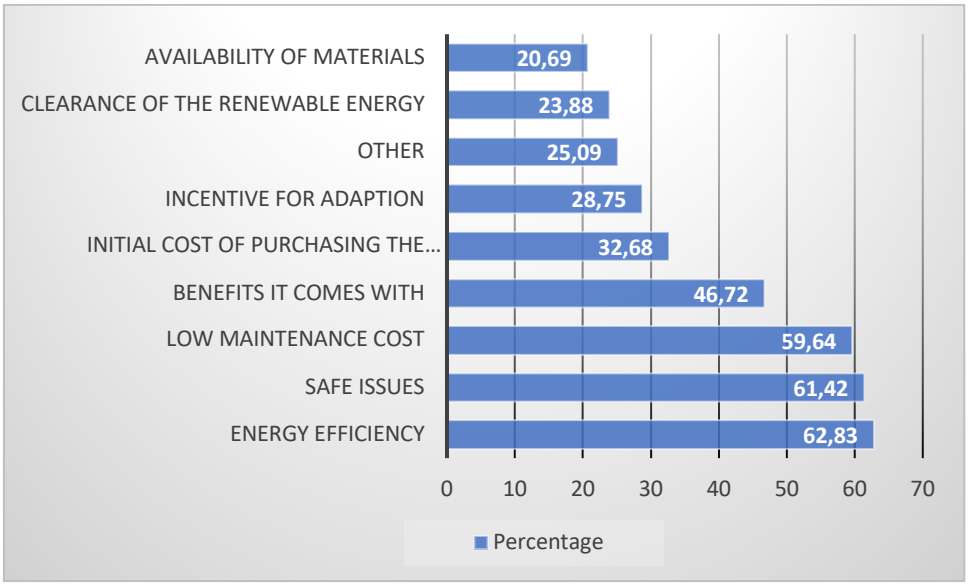

Figure3: Motivation/reasons for using the RE technologies.

These responses were also confirmed by the citizen scientists, quoting:

"*Constant change in seasons attracted me to start using renewable energy technology like solar in agriculture. As a farmer growing coffee on a large scale, I needed to carry out irrigation using a solar pump during the dry season so as to have high productivity at the harvesting time, said Resty, a citizen scientists from one of the FGDs.*

"Previously, I was using the traditional way of drying outside in an open field and the quality of my produce was not good. This attracted me to use a solar dryer because it prevents contamination of produce by dust, insects, etc., thereby ensuring quality. It also allows small-scale farmers like me to

transform our harvest into storable and tradable goods, which we can sell off-season at higher prices, says Namuli, one of the citizen scientists.

" We don't have electricity in this area and yet poultry is one of my main sources of income. I therefore needed solar for lighting, incubation and brooding. I have also avoided the health related issues that result from inhaling smoke from the candles and kerosene lamps', said Mulidwa during the Key Informant Interviews.

Impact of using *these technologies:*

Economic Impact

The economic impact of RE adoption can be traced three folds; one-in generation of additional income from use of RE technologies as a cheap and efficient alternative, compared to more expensive sources of energy; for example substituting solar energy for lighting, warming and heating in poultry brooders, use of solar dryers for cassava, maize and other food stuff, as well as substituting firewood and charcoal and sometimes electricity for cooking with briquettes, which is three times cheaper and is more environmentally friendly . Secondly, some renewable energy waste products are sold for cash to supplement the income for the citizen scientist, for example bio char is used as manure for the gardens to substitute artificial and chemical fertilizers. Lastly increased production through fertilizer use, solar dryers and value addition which fetch more money for the citizen scientist.

The economic impact of using RE technologies is well illustrated by Ms. Namawejje Madrine from Nkandwa women Farmers' cooperative in Kyankwanzi district as narrated below.

As a cooperative, we were excited that briquette production was a new concept in our community, which would make us very unique from other cooperatives.

Climatic change effects like erratic rainfalls and prolonged droughts from human activities like farming and deforestation inspired us to make a difference since our community mainly comprises of farmers.

We have also learnt how to use bio char as organic fertilizers in our gardens which has reduced the amount of money we spend on purchasing fertilizers while keeping our soil healthy. We have also been able to help one another with money for emergencies through briquette sales. The ash/bio char has been very useful as fertilizer in farming and we have definitely experienced more yield because it works way better than inorganic fertilizers and maintains the soil ecosystems. As a result, we have seen an increase in yield and therefore incomes. Briquettes save a lot of money as 2 kg of briquettes can cook the same as a basin of charcoal despite the briquettes costing 1600 Ugx while a basin of charcoal costs 10,000 Ugx.

Other economic uses of RE sources include, but are not limited to:

- Provision of light has boosted alternative income generating activity of bee keeping where much of processing work is done during the night time, and this has reduced cutting of trees as they are reserved for bee forage.
- Value addition thus increased income. For example, some of the citizen scientists were using the RE technologies in milk cooling and preservation, drying of their produce, use of solar energy to make other products from their produce, such as processing maize to create maize flour, cassava to cassava flour, coffee beans to coffee powder among other products. This has greatly boosted their income as farmers.
- Improved security on farms and agricultural products thus reduction of losses through provision of lighting at the farm at night.
- Increased access to information through the radios and TVs about climate change and the good agronomic practices. *By use of T.V powered by solar I watch programs on agriculture and gain knowledge on dealing with climatic change challenges.*

Environmental and health Impact

The impact of RE use on the environment cannot be underestimated, Uganda loses about 2% of its vegetation cover as a result of deforestation for both firewood, timber and other livelihood activities. It is also estimated to further dwindle to about 10% per year because of a population explosion and influx of refugees. Data from citizen scientist indicated that adoption of RE technologies like the use of alternative energy sources, especially solar energy, and the use of energy saving stoves at household level is a direct intervention to reducing the rate of deforestation. Clean energy cooking also reduces the risk of women and children from acquiring lung related diseases due to frequent smoke inhalation while preparing meals. Relatedly RE technologies like the use of organic fertilizers from bio char leads to soil conversation and reduced soil pollution.

Social Impact:

The picture shows a lady weaving a water harvesting tank using bamboo

Socially, citizen scientists were also reported to have more time to participate in other social events like women's meetings, church services, weddings, and funerals since they do not have to worry about spending a lot of time searching for firewood or cooking. Relatedly, the women have been able to obtain income from the sale of bio char and briquettes, which has improved their financial autonomy as well as support their families and social circles where necessary. Women were also reported obtaining knowledge and skills from the cooperatives. Including leadership skills and communication skills, which have enabled them to become green energy ambassadors. These skills have improved women's empowerment, voices and actions to become more resilient and responsive to climate change. This has mainly been through the interventions carried out by different CSOs such as ARUWE and Caritas.

Inhibiting factors for adoption

Limited information about these technologies is one of the biggest inhibitors for adoption. Seven in ten (70%) citizen scientists reported that the only information about the different RE technologies had been received from the trainings carried out by NGOs like ARUWE and Caritas. There are no intentional government programs in their areas that are training people on the use, maintenance and the importance of these interventions.

Figure 4 shows the relationship between education levels and adoption of RE. Low literacy levels have hindered most of the citizen scientists from adopting and advancing their usage of these RE technologies. Citizen scientists who have low/no literacy also reported low usage and adoption of RE technologies especially in utilization of information such as usual manuals for proper operation and maintenance of the technologies.

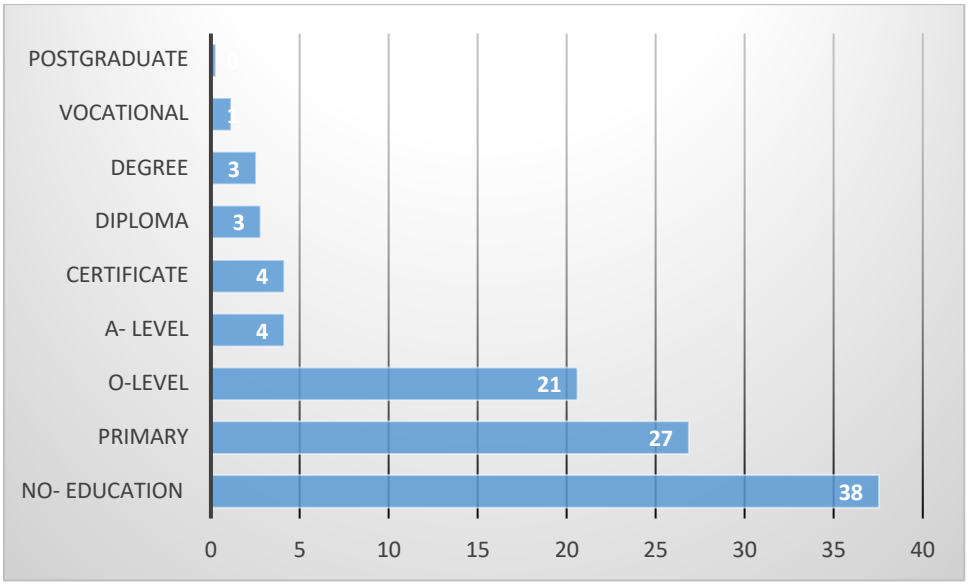

Figure 4: Education level of respondents

High cost of initial purchase of these technologies has also been noted as a limiting factor for adoption. Most of the citizen scientists depend solely on agriculture as a source of livelihood, and have limited alternative sources of income. This therefore limits the income for both livelihood and investment in these technologies.

Government's obligations towards RE technologies in agriculture production

Policy vision: To make modern renewable energy a substantial part of the national energy consumption.

The Overall Policy Goal is: To increase the use of modern renewable energy, from the current 4% to 61% of the total energy consumption.

The Government pledged to do the following as a mechanism for sustainability:

i) Continue with the acquisition and dissemination of technical data and general information on RE to the public, in order to create awareness on consumption options and investment opportunities;

ii) Create a Renewable Energy Department and an Energy Efficiency and Conservation Department in the Ministry of Energy and Mineral Development;
iii) Establish a National Energy Committee at the National Level and District Energy Committees and District Energy Offices at the Local Governments;
iv) Promote research and development, and strengthen local manufacturing capacity in renewable energy technologies;
v) Strengthen the newly adopted financing mechanisms, like the Credit Support Facility and Smart Subsidies which are intended to scale up investments in renewable energy and rural electrification;
vi) In principle, put in place appropriate legislation to operationalize some of the new policy measures which include (a) the feed in tariffs, (b) biofuels production and blending, (c) adoption of alternative technologies (e.g. solar water heating), (d) regulation of charcoal production and transportation, (e) fiscal and financial incentives for renewable energy investment, (f) the institutional framework and (g) environment protection

However, citizen scientists and other KIs' views about policy environment for the RE technologies and the government's obligation are summarized below:

- The policy is there but not implemented fully at the district level, and most of the people do not know what it is about.
- There are no programs available to implement the policy and therefore the Government should do more awareness creation about the policy, but also enforce the implementation of the policy.
- The Government should support the sub-counties to promote RE use through facilitating trainings.
- Renewable energy needs to be streamlined in all extension services.
- Reduction of taxes on RE technologies to attract more farmers to practice renewable energy in agriculture.
- More funds should be budgeted for RE as well as inclusion of RE trainings and awareness campaigns in Local Government work plans to increase on the operationalization of the policy.

Contribution from the CSI towards meeting the governments' goal and objectives

- The CSI has been conducting various awareness campaigns as well as trainings in the use of the different renewable energy technologies. This has supported the government in creating awareness about these technologies although at a small scale.
- ARUWE and Caritas trained different women energy ambassadors that have been at the fore front of advocating for the scale up of these technologies from the government as well as working s trainers of trainers for the use, operation and maintained of these technologies. The government can adopt such strategies of training few people that can be used as trainers of trainers so that more people are reached at minimal cost.
- ARUWE has also created new funding opportunities for the adoption of these Renewable technologies through show casing the impact of the adoption of these technologies through different channels such as reports, media and case studies. This has created more

opportunities for further funding from different partners to ensure that more people can adopt these technologies.

- ARUWE has also partnered with different funding partners to conduct different surveys as well as research which is very important to provide necessary information that can guide the government in planning and budgeting for the scale up of the Renewable technologies.
- ARUWE has also engaged in advocacy in collaboration like-minded CSOs under the umbrella of Uganda National Renewable Energy Efficiency Alliance (UNREEA) to demand for more funding and prioritization of the Renewable Energy technologies in Uganda.

The potentials for scaling up of RE technologies

i) The will of people to take up technology is high, especially due to the low electricity distribution and coverage across the country, coupled with high power tariffs. Hence RE is a good driver to have alternative sources of fuel.

ii) The availability of NGOs and development partners supporting the RE development provides opportunity for scaling up.

iii) The recent RE Government policy which supports the use of RE technologies. Under the policy, farmers will be given RE technologies on loan under the UGIFT project. Any farmer who wants a solar irrigation system will pay 25% of the loan while Government will pay the remaining 75% and vice versa if one wants a fuel powered irrigation system. This was put in place to encourage the use of renewable energy in agriculture.

iv) The availability of RE policy that can be used to promote renewable energy use and enforcement. The policy goal is to increase the use of modern renewable energy, from the current 4% to 61% of the total energy consumption. This is a step closer towards making a modern renewable energy a substantial part of the national energy consumption.

v) Availability of media to support the information dissemination. This is will enable easy and fast information flow about the different RE technologies available as well as marketing the RE technologies.

vi) Availability of raw materials to be used in the production of most RE technologies. Most of the RE technologies require locally available materials such as animal waste for biogas, and plant residues for briquettes.

vii) Framer organization: The District and development partners have organized farmers into groups and cooperatives which will help to disseminate the use RE in agriculture. Since most of the RE technologies require high capital, the local authorities have used the strategy of supporting farmers to work and save as groups so that they are able to purchase the RE machinery.

viii) Government will to partner and collaborate with other partners to facilitate the adoption of the RE technologies. The government has clearly laid out its plans through the National Development Plan 3 to foster more partnerships and collaborations to support upscaling RE technologies.

Conclusion

There is a lot of potential for the Renewable Energy technologies in Uganda and all this requires combined efforts from everyone, including citizen scientists, the duty bearers and other development partners, as we are all affected by the effects of climate change.
The government should enhance its collaboration with the different CSIs like ARUWE so as to bench mark, support and participate in the activities being carried by the CSIs, to create more awareness about the Renewable Energy technologies but also use this strategy to gain public trust.

Uganda is at an advantage, because there is a conducive environment and the will of the population to promote and upscale these technologies, considering that already there are various positive impacts being reported by those that have already adopted it.

Attachments

https://drive.google.com/drive/folders/1GCpaX62f0ZzInjc91807ZajGwcJq5_kS?usp=share_link