



Establishing Local Power Markets and Enabling Financial Access to Solar Photovoltaic Technologies: Experiences in Rural Tanzania

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Abstract

Energy inclusion is a major concern in Tanzania, where rural areas are widely lacking access to both power networks and off-grid systems. Different barriers are slowing the achievement of Sustainable Development Goal 7: universal electrification in the country raises concerns in delays and equity. Financial exclusion adds to the complexity of adopting appropriate technological solutions, particularly for rural communities. Solar photovoltaic solutions represent an opportunity to increase energy access and enable growth. The introduction of new technological products requires to establish local power

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markets, including demand, financial resources and providers, supply mechanisms and after-sale services. The financing of renewable energy solutions for rural households partially relies on microfinance institutions and community financial groups. Technology suppliers are also providing financial services to expand access to solar and photovoltaic products, applying models mostly enabled by mobile payment systems. The paper assesses the effects of an initiative implemented in Malinyi and Kilombero districts to support the establishment of local solar power markets. The involvement of Village Community Banks to engage communities and develop sustainable financial schemes is evaluated, together with the complexity of combining awareness raising on technological solutions and financial education. Results of the implementation are presented and discussed evaluating the different ingredients of the established markets.

Keywords

Financial education · Access to Finance · Renewable energy (Renewables) · Photovoltaic · Rural areas (Rural)

1 Introduction

This paper sums up the experience acquired within project “Solar Finance 4 All” (SF4A), implemented between January 2018 and April 2020 by Associazione Microfinanza e Sviluppo ONLUS (AMS) in partnership with Tanzania Renewable Energy Association (TAREA), Associazione Mazingira ODV, NADIR Onlus and MUSE—Museum of Science. The project has been financed by the Autonomous Province of Trento, in Italy. Main objective of the initiative was to establish a functional market of renewable energy technologies, including:

- Demand for Solar and Photovoltaic Technologies (SPTs).
- Financial services for ensuring access to SPTs.
- Supply mechanisms of good quality, fairly priced SPTs.
- Affordable installation and maintenance services.

SF4A contributed to the creation of a demand for SPTs, despite the efforts were hindered by the expansion of the national grid. Interest in SPTs and capacity to compare different technologies was built towards financial service providers rather than community members. The provision of SPTs through Village

Community Banks (VICOBAs) allowed to positively combine financial education and access to energy, reaching a wide population through these community-based financial providers.

The financing of solar lanterns gave positive results, with a high satisfaction and repayment rate. The external financial support provided by project partners to kick-start the provision of SPTs was fully re-collected and made available for future financing cycles. SF4A positively supported the establishment and growth of local installation and maintenance services ensuring the presence of local technicians, indispensable component for the completion of a viable market.

This paper starts with an introduction on access to energy and its linkage with financial inclusion, also assessing the presence of inclusive and community-based financial service providers. The activities implemented within the SF4A project, and the data collection methodology are presented. Results are discussed analysing the four components identified for the establishment of local markets for SPTs.

1.1 Access to Energy in Rural Tanzania

According to the World Bank and the Tanzanian Rural Energy Agency, access to electricity deeply divides urban and rural citizens in Tanzania, with 66% of inhabitants living outside cities, where energy is available to only 24 % of the population (REA, 2020; World Bank, 2018). The country is far from achieving universal electrification by 2030, priority highlighted by Sustainable Development Goal (SDG) 7. The Government of Tanzania is currently implementing a national energy policy, the National Rural Electrification Program (2013–2022), whose goal is to increase the country's overall electricity access of the population from 36% in 2014 to 50% by 2025 and to at least 75% by 2033 (IED, 2018).

The program, led by the Ministry of Energy and the Rural Electrification Agency includes both on-grid and off-grid solutions and has four priorities; (i) the connection of new customers to the grid in already electrified settlements; (ii) new connections to the grid; (iii) electrification through off- grid investments; and (iv) the development of distributed technologies, in particular off-grid solar and other renewable technologies (IED, 2018).

Tanzania's central grid, managed by the state public utility TANESCO, is responsible for 98% of electricity supply, counting on Independent Power Producers (IPP) and Emergency Power Producers (EPP) to provide 26% and 13% of the demand. Independent producers with a capacity inferior to 10 MW account for 2% of total capacity (WFC, 2017). The dependency from hydroelectric

systems, which supplied up to 80% of electricity needs, was hindered in recent years due to extensive droughts. This forced TANESCO to use significant load shedding, thermal power plant for base load, and hire emergency power installations, at a relevant financial cost. Hence, the energy security of the country fell, making Tanzania dependent on imported fossil fuels for its electricity (AFDB, 2015; MoEE, 2016).

This represents a heavy burden for the country's socio-economic development and energy plans. An increasing dependence on fossil sources is causing fuel price shocks, inflation and it is hindering government efforts to expand energy access due to the scarcity of financial resources. In addition, the nearly 1 million tons of charcoal consumed each year produces over 20 million tons a year in CO₂ emissions and requires an estimated 30 million cubic meters of wood, with annual average loss in forest cover at 100,000–125,000 hectares (AFDB, 2015). This energy supply and end use structure reflects Tanzania's low level of development and contributes to the intensification and perpetuation of poverty (WFC, 2017). Worldwide, electricity provision in rural areas no longer relies only on centralized grid expansion, but also on off-grid and mini-grid systems, differing both physically and institutionally in electricity delivery. In 2019, the share of Tanzanians connected to off-grid solar supply was 2% (IEA, 2019).

1.2 Energy Inclusion and Financial Inclusion Barriers

Energy inclusion in rural Tanzania is threatened by different factors including lack of access to human capital, difficulties in planning and donor dependency, low rural markets and little appeal from private sector, and finally more straightforward technical matters such as difficulties with installing electric equipment in traditional buildings (Ahlborg & Hammar, 2014). A dearth of investment is linked to the existence of excessive negative financial uncertainties or risks related to electricity infrastructures (Gregory & Sovacool, 2019), being a concurrent cause to the high exclusion rate. SDG 7 promotes access to “affordable, reliable, sustainable, modern energy” (UNDESA, 2020) but makes no attempt to track the mentioned descriptors (Moss, 2019). The existing different energy delivery systems in Tanzania raise, indeed, equity and justice concerns around how they are implemented. Electricity costs can be differently reasonable for consumers when access is provided by various technologies operated under different business models (Menghwani et al., 2020). Available data reveals that poor citizens spend up to 35% of their household income on energy while the better-off spend only 14%; even those connected to the grid opt for burning cheaper biomass to avoid

paying high electricity prices (WFC, 2017). Renewable energy solutions, and particularly SPTs, are perceived as an effective way to overcome domestic energy poverty in rural areas (Zubi et al., 2019), though financial access and effective convenience must be assessed depending on final users, technology, maturity of local SPTs markets.

According to the nationally representative survey “FinScope Tanzania 2017”, 65% of the adult population (over 16 years old) has access to either formal or informal financial services. The 14% growth of formally included people from 2013 mostly is related to transitioning from informal ones. The number of Tanzanians not having access to financial services, being formal or not, remained constant around 28% between 2013 and 2017. Rural communities are the most affected with excluded being 79% of the population (Elvis et al., 2017). The most financially excluded come from the two poorest quintiles of the population and are from rural Tanzania, where proximity to financial services is lower. They are also more likely to be people with no formal education, women, farmers, young people, and dependants (Andrew, 2013; Elvis et al., 2017; Lotto, 2018).

1.3 Tanzanian Microfinance and VICOBA

The Tanzanian microfinance sector services a large portion of the population who would not have access to credit and finance otherwise (Rabodiba, 2019), possibly due to inefficient incomes or unawareness (Elvis et al., 2017). With the aim of enhancing economic growth and accelerating poverty reduction, the Tanzanian Ministry of Finance and Planning (MoFP) enacted a Microfinance Act, executing the 2017 National Microfinance Policy (MoFP, 2017). The Act licenses, regulates, monitors, and supervises microfinance institutions, structuring their businesses into four tiers that reflect size, function, and potential for development:

1. Deposit-taking institutions (e.g., banks).
2. Non-deposit-taking institutions (e.g., credit providers).
3. Saving and Credit Cooperatives (SACCOs).
4. Community financial groups.

The fourth level includes Village Community Banks (VICOBA), small member-based groups mobilizing financial resources by saving and giving out loans among people within groups. Services are generally provided without any collateral, using joint liability and referees within the institution (Ahlén, 2012). VICOBA proved a success in empowering community members over the years

(Bakari et al., 2014; Nkyabonaki, 2017), partially contributing to poverty reduction (Ahlén, 2012). They differ in interest rates and repayment schedules, on a three to six months base.

According to Begasha, the main difference between the VICOBA model and the well-known Grameen model is the usage of the interest rate, which is not collected to cover lenders' operational costs while it is used to increase the capital collected, with the aim of providing bigger loans (Begasha, 2011). At the end of the cycle the interest rate is usually divided between the members together with savings sharing with them the increase of capital. VICOBA's differ from minimum and maximum amount of savings and loans, how loans can be linked to shares and how often group members divide the money among participants (Ahlén, 2012).

1.4 Financing SPTs in Rural Tanzania

Energy financing by financial institutions towards Micro, Small, Medium Enterprises was a sector at infancy before this decade, with most of the end user finance in the energy sector being for solar lanterns (SLs) or solar home systems (SHS), generally for domestic use (Kariuki & Rai, 2010). In Tanzania, Renewable technologies suppliers themselves offer targeted financial services to expand access to SPTs, hindered in the past by high costs of technologies combined with low purchasing power (Kassenga, 2008). An example is the Pay as You Go (PAYG) model, where an energy service provider rents or sells SPTs in exchange for regular payments through mobile payment systems; in cases of non-payment, the service provider can remotely disconnect the service (IRENA, 2020). Several positive aspects enabled the expansion of the sector, including consumer awareness of PAYG models (IRENA, 2020), remote monitoring and control (Mazzoni, 2019), and eased incremental repayments allowing access for poor households (USAID, 2017). Nonetheless, negative factors must be considered. There is a wide range of standardised products and solutions (Energypedia, 2016), possibly not covering tailored needs and making SPTs only complementary to other energy sources (Collings & Munyehirwe, 2016). Customers lack education about the capabilities of the products (Collings & Munyehirwe, 2016), and technical faults are often untackled due to distances or absence of technicians, due to the highly sales-oriented model adopted by PAYG companies (Naqvi & Bhatt, 2019).

To increase their profit, suppliers often deliver inappropriate low-quality products at a high service cost, aiming to expand their sales at the expense of clients. (Naqvi & Bhatt, 2019). Finally, as mentioned by D. Waldron and A.M. Sinderen, the rapid emergence of remote lockout technology in lending raises important

difficult questions (Waldron & Swinderen, 2018): When is it appropriate to disable a financed asset? What balance must be struck between borrowers' dignity and lenders' need for security?

2 Intervention Methodology and Implementation

Seen the need for improving energy inclusion in rural Tanzania, combined with the necessity to fund access to energy solutions, the intervention implemented by AMS contributed to the establishment of the different ingredients that ground solar power markets in villages, directly working in rural areas in Malinyi and Kilombero districts, Morogoro Region. The envisioned methodology grounds on combining social, technological, and financial aspects to generate a viable system of demand and provision of SPTs as well as technicians and financial providers.

2.1 Project Stakeholders

Through participatory initiatives, SF4A engaged the different stakeholders, assessing their diverse needs related to their status and interests. The target local community, residing in the eight villages of Misegesi, Kipingo, Lugala, Igawa, Mang'ula A e B, Mwaya e Mgudeni, has been involved together with local authorities, public and private institutions, and associations active in the area. A group of 36 VICOBAs has been selected as local financial provider, the local partner TAREA has been involved in the process acting as a supply chain linkage together with local retailers. In Kilombero, 7 technicians have joined the initiative and 5 had been previously involved in Malinyi.

2.2 Theory of Change

SF4A combines the socio-cultural factors related to the demand of SPTs, depending on financial capabilities, understanding of solar and photovoltaic solutions as well as community engagement that ground the market of these products. The aim was to establish a viable network of stakeholders composing a solar market, able to identify, purchase, sell, finance, install and maintain SPTs in rural areas. The expected impact of the initiative was the enhancement of the economic, social, and environmental capital of the area, contributing to the sustainable development of the region. To achieve this, SF4A provided training and technical

assistance together with capital, while working with the different stakeholders to approach the achievement of the expected long-term result. The envisioned theory of change highlights the process that leads from target stakeholders to direct outputs of the activities conducted and to the outcomes in the short and medium term, potential indicators of the contribution to the expected long-term impact, see also Table 1. Hence, the intervention methodology implies the development of four complementary components functional to the creation of a sustainable enduring mechanism. The components, highlighted in Table 1, include:

- Awareness raising on SPTs, communities and local authorities engagement.
- Financial education, at family and financial provider level (prioritization of savings principles).
- Innovative financial mechanisms for SPTs: rotative funds.
- After-sale services for SPTs.

Table 1 Theory of change: expected outputs (OPs) and outcomes (OCs) of SF4A project activities in Malinyi and Kilombero, disaggregated by type of activity and targeted group. (Source Authors' elaboration)

Target	Activities	Outputs	Short Term OCs	Medium Term OCs
Local community	Awareness raising	Community aware of benefits of SPTs and difference between good/bad quality SPTs	Community understanding and demanding SPTs	Established demand for SPT products and services
VICOBAs' members	Financial Education	Usage of Savings notebooks, provision, and reimbursement of solar lanterns	First financial service piloted	Financial services for SPTs made available
VICOBAs, TAREA, retailers	Technical Assistance	Selection, purchase, seed funding of good quality SPTs	Supply channel of good quality SPTs piloted	Access to good quality SPTs through local retailers
Local Technicians	Technical Assistance	Development of local technicians' skills and incorporation of a cooperative	Piloting of services for SPTs' adopters	Affordable installation/maintenance services available

2.3 Data Collection Methodology

Through qualitative semi-structured questionnaires and quantitative data collection tools, baseline data for the intervention were collected. Surveys were conducted in Swahili language by local trained operators. With the aim of understanding the stakeholder's status and developing tailored initiatives, the baseline provided data for tracking the achievement of expected outcomes and behavioural changes. Monitoring indicators and research questions were, though, not as structured and organized in the initial phase compared to the final evaluation, due to the inability to foresee project variations, unexpected changes in the environment as well as varied priorities and updated expectations. The initial assessment conducted focused on:

- Appraising access to energy sources and SPTs.
- Evaluating local financial behaviours, family budgets, in particular on energy-related expenditures.
- Understanding the functioning of local financial providers, in particular VICO-BAs.

The final evaluation of the initiative assessed the appreciation, usage of SPTs and related services, local community members' progress and the enhancement of the local solar market. The evaluation also included a final survey with 199 qualitative interviews conducted towards VICOBA's leaders, their members who did and did not purchase SPTs, community members not joining VICOBA's. Six evaluation sections were included in the questionnaire to evaluate:

- Respondents' situation (e.g., poverty level, work).
- Knowledge of and access to SPTs.
- Appreciation of financing method and usage of SPTs.
- Access to and usage of financial services.
- Family budget management (for trained people).
- Activities and performance of VICOBA's (for leaders).

The Poverty Probability Index analysis of project beneficiaries highlighted that the poverty rate of the target community is in line with rural Tanzania levels, and that the financial situation of VICOBA's members is comparable to the one of non-members. Working with such local financial providers is therefore an effective way to target a population representative of the reference community, and a way to achieve multiplier effects.

2.4 Activities Implemented and Financial Scheme Established

The SF4A project has been implemented over a period of two years, started in February 2018. Initiatives realized through SF4A, apart from coordination and management related activities, include:

- 2 awareness events on SPTs (600+ participants).
- 3 demonstrative installations of photovoltaic systems.
- 4 demonstrative provisions of photovoltaic systems to local entrepreneurs for productive activities.
- 36 VICOBAAs identified, 2 financial education cycles provided to 3 leaders of each, financial education sessions provided to members.
- 1 rotative fund for SPTs financing established.
- 30 VICOBAAs involved in SPTs financing.
- 7 technicians trained and supported in incorporating a viable service cooperative.
- 1 training program for SPTs retailers.

The provision of technical assistance allowed the establishment of a rotative mechanism for SPTs supplies and delivery, kick-started along with a seed financial injection. The mechanism allows TAREA, Tanzanian non-profit promoter of renewable energies, to negotiate large quantities of high quality SPTs under favourable market conditions. SPTs are then provided to VICOBAAs, depending on orders placed by their members. VICOBAAs provide the reserved SPTs, managing the monthly recollection of expenditures and withholding a quota as expenditures cover, revenue source and first year guarantee. VICOBAAs then refund TAREA of both purchasing and transportation costs. The process allows the supply of selected SPTs with an advantageous quality- price rate. Once expenditures are covered, collected funds can be reallocated to new financing cycles. VICOBAAs' margins can be redistributed either as services or as shared profit between all contributors at the closure of the saving scheme cycle. Through a participatory methodology, SF4A worked together with VICOBAAs' representatives and TAREA on the definition of appropriate prices related to the adoption of SPTs, being solar lamps or solar home systems (including photovoltaic panels, batteries, basic home grids). Technologies, costs, delivery, reimbursement rules and profit share were discussed and agreed by and with them.

3 Results

Outputs and outcomes of the initiative are presented and discussed according to the adopted theory of change, to assess the progress towards expected results and to evaluate unforeseen effects and findings. Four results sections follow.

3.1 SPTs Awareness

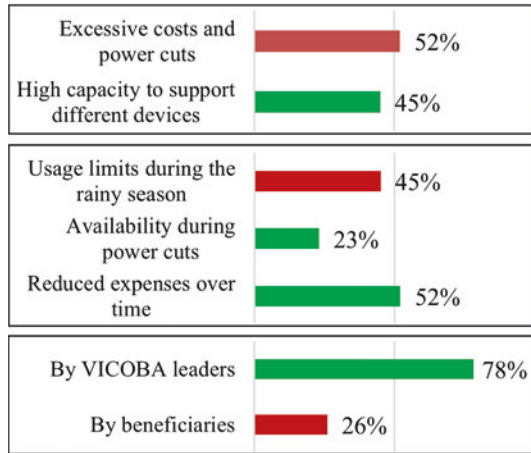
The engagement of community leaders of public and private institutions at Village, Ward, District level successfully matched the participation of residents, both involved in awareness initiatives and SPTs' demonstrative installations, in both community spaces as well as private enterprises. Installations benefited more than 3 buildings with 1000+beneficiaries and 4 small entrepreneurial activities. The interest in SPTs was limited due to a direct competition with the expansion of the TANESCO grid, preferred by 45% of respondents. Connecting to the grid is positively perceived because of being powerful enough to support different devices (45%), while it is dispraised for being too expensive or subject to power cuts (53%). More than half of the respondents' value SPTs as less expensive because of only being tied to an initial investment (52%) and for being available even in case of power-cuts (23%). 45% of respondents, though, fear usage issues during the rainy season. When assessing the differences between analogous SPTs, 26% of interviewees highlight huge differences, while 33% notice only slight dissimilarities. Results are presented in Fig. 1.

The goal of building the capacity to evaluate SPTs depending on their quality was not reached as hoped. 74% of the sample stated they are not able to identify good and bad solar. Although, the result was achieved with suppliers and local technicians, and only 22% of VICOBA's leaders state that no differences can be noticed between similar technologies, suggesting that financial providers can guide the adoption of selected solar and photovoltaic products.

3.2 Community Members' Financial Education and Engagement

SF4A invested in enhancing financial capabilities of both VICOBA's leaders and members, with a particular focus on enhancing effective resources management to increase access to and usage of sustainable energy sources. Training has been

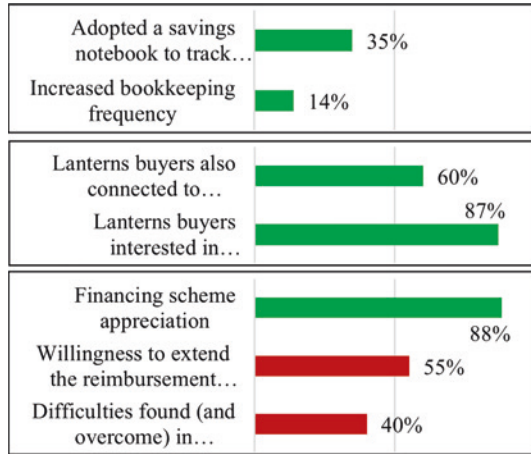
Fig. 1 Evaluation of SF4A awareness project components (positive in green, negative in red). (a)—Appreciation of TANESCO National Grid. (b)—Appreciation of SPTs. (c)—Capacity to compare different SPTs and assess their quality. (Source: Authors' elaboration)



delivered to financial institutions' leaders (presidents, secretaries, treasurers of 36 VICOBA) who then trained their participants (for a total of over 700 associates). 100% of committee members positively evaluated the benefits of the training. The percentage falls to 66% within members, denoting that VICOBA's leaders are a good information channel though their capacity to transfer knowledge can be improved. Financial education on family budget management and savings generation helped 80% of participants in changing their behaviours, starting to track expenditures (39%), or increasing their bookkeeping frequency 14%. Indirectly, training success can be evaluated through the adoption of the tool provided for basic accounting; the tailored saving notebook developed has been tested by 80% of trainees and permanently adopted by 35%, apparently a limited result but a significant fraction basing on similar experiences. The practical saving exercises conducted, which were positively valued by 36% of interviewees, and the assessment of energy related expenditures were strongly correlated within the training on SPTs. Results are presented in Fig. 2.

553 people decided to purchase a SL (going beyond the initial objective of 400 adopters). Out of the surveyed members who got a lantern, 80% appreciate the product, mostly because of its light quality, portability, fair price. SLs were mostly acquired by members who already had access to the hydroelectric grid (60%), highlighting the benefits of blended solutions in relation with grid-related problems. Negative feedback registered highlights that SLs were not able to illuminate the entire household and that some VICOBA's members would have pre-

Fig. 2 Evaluation of SF4A financial inclusion for energy access project components (positive in green, negative in red). (a)—Behavioural change in household budget management. (b)—Blended solutions usage and interest. (c)—Financing schemes benefits and limits. (Source Authors' elaboration)



ferred to directly adopt a higher scale SHS. In fact, 87% of buyers declared to be interested in purchasing a SHS for their home, mentioning difficulties in both identifying products (44%) and having the needed financial resources (43%). This result underlines the importance of the facilitation role guaranteed by local financial providers.

SLs were mostly used to illuminate the main room of the household (96%), to light the shelter close to their crops (83%), to allow kids studying when it gets dark (75%), to charge phones (76%), and to illuminate the workplace (11%). Most buyers appreciated the reimbursement scheme introduced by VICOBA (88%), defined beneficial but improvable by 9% of respondents and criticized by 3% only. The totality of SL purchasers who did not appreciate the product were though satisfied of the reimbursement scheme. Aspects that the community would improve include extending the reimbursement period (50%), reducing the final price (22%). While 60% of purchasers acquired the SL without problems, 40% have found (and overcome) some difficulties, mostly related to the duration of the repayment cycle.

3.3 SPTs Financing and Supply Chain

A demand for SPTs has been proven even in areas served by the national grid, as substitutes or complementary. SLs are not the only product requested, 83.7% of respondents are interested in SHSs, even if financial access is not possible for all. The final evaluation registered an increased demand, within VICOBA's members

and non-members who contacted project partners. The willingness of purchasing SLs in cash highlights a market for local retailers and technicians. SPTs availability has increased since the beginning of the implementation, and targeted trainings have been provided to local retailers, representing a strategic communication channel.

The financing scheme adopted for SLs has proven to be effective. The five financing cycles implemented closed with a 97.5% repayment rate, meaning that only 2.5% of purchasers were not able to reimburse the product. The rotative fund established is therefore a viable and well understood mechanism that partners can extend to future financing cycles in the long term. The scheme allowed a multiplier effect generating 1.73 the value of each Tanzanian Shilling invested. The counter-value was therefore made available for the beneficiary community, meaning that SLs have been provided for a value 1.73 times higher than the initial capital allocated.

Prior to the end of the initiative, the financial conditions for financing SHS were defined, a bank account was established for the capitalization of a fund and products have been presented to community members. VICOBA's financial stability and capitalization is still a restrictive factor, to be possibly partially mitigated through further education on savings generation. SHSs remain barely accessible for households, while representing a promising opportunity for entrepreneurial activities. The initiative registered an initial request of 39 SHSs, reasonably lower than the 553 SLs distributed.

3.4 After Sale Services

Installation and maintenance services are available and fairly priced in the area. SF4A allowed the reinforcement of the existing cooperative of technicians AMBASE, established in Malinyi district, through a previous initiative by AMS also funded by the Autonomous Province of Trento. The cooperative is effective and growing, reaching a capital exceeding 4,000,000 Tanzanian Shillings over two years. The equivalent of 1,500 USD, around 300 USD for each of its five members, is a significant amount in a country in which the Gross National Income per capita was around 1,080 USD/year in 2019 (World Bank, 2019). In Kilombero district, 7 technicians were trained, resulting in the incorporation of ANGAZA cooperative, which opened a bank account and established its office. The cooperative became operational and positively concluded 6 interventions before the end of the initiative. Upon the 40 VICOBA's members who received services from the two cooperatives, over 80% of interviewees confirmed they

were satisfied with the interventions, the remaining ones affirmed it was at standard level and no one criticized their work.

3.5 Threats: Environmental Factors and Covid-19

External factors had an unforeseen effect on the initiative. Intense rainfall seasons posed an important threat, with Malinyi district remaining isolated for over three months in 2018 and 2020. A drought in 2019, as well as heavy precipitations in 2020 affected agricultural production, main source of income for most of the beneficiaries. Significantly reducing their saving capacity, economic investments were hindered. Though 41% of SL buyers stated they did not encounter any problem, the first distribution unrolled during the rainy season. Stakeholders therefore agreed to delay the repayment phase, avoiding late reimbursements or insolvency. The flexibility of the financial mechanisms is therefore capable to match the need to combine resources planning, climate hazards and related debts.

Environmental threats particularly affected the adoption of SHSs, for which interested buyers preferred to delay the acquisition. Losses, combined with unforeseen damage remediation expenditures, affected the purchase of SHSs, which had been planned at the end of the agricultural cycle in both early 2019 and early 2020. Adding to this, the COVID-19 Pandemic affected the adoption of energy systems. SHSs, in fact, had been selected based on their quality from European and Indian companies, while in any case most spare components are made in China, and were therefore not available on the market. The distribution has been interrupted and will be carried out with the support of TAREA when possible.

4 Conclusion

SPTs represent a valuable opportunity to diversify energy access in rural areas, both where villages are reached by electrical grids and in unconnected communities. Even with the positive results obtained with project SF4A, access to appropriate good quality technologies and products remains a barrier for rural communities.

The initiative highlighted, in fact, the potential of introducing small scale SLs able to provide a source of light or charge small appliances. SLs, though, cannot cover the needs of an entire household, and remain bounded to weather conditions and product reliability. The limited benefit of this device cannot sustain the

behavioural change possibly related to accessing electricity, and willingness to expand its usage for different uses. SHSs, on the other hand, are still too expensive, not allowing most community members to cover the initial sum needed for the investment. SHSs are more appropriate to cover growing electricity needs, however it would still bound households to the presence of the sun, in a country where the rainy season is yearly expected for three months.

The financing mechanism can be flexible enough to delay reimbursements in case of external threats, but it is unable to cover the diversified needs of community members with different financial resources and capabilities. VICOBAAs, in fact, proved to gather a wide range of adherents, including landowners, farmers, employees, entrepreneurs and more. Their diverse needs are not addressed with different financial products or conditions. The price of SPTs and the investment capacity leads to different levels of access, with only wealthier members reaching products able to guarantee a satisfactory energy access. VICOBAAs' growth capacity is bound to their functioning mechanisms, which limits a permanent capitalization of these financial institutions. Dividing shares between members at the end of every cycle means that VICOBAAs can generate value and growth but cannot stabilize and increase their resources ensuring longer term sustainability. A direct issue, for instance, is allowing large scale investments for the community, having portfolios unable to scale compared to amounts saved by the community. This means that future greater financial opportunities, and in this case large scale adoption of appropriate SPTs, can be difficult.

The value of this intervention remains relevant. Possible future initiatives must evaluate how to improve the defeat of both financial and technological barriers, possibly focusing on different solutions in terms of financial schemes and renewable energy sources, always considering how to assemble all collateral components of local power markets.

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