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GRÜNE BÜRGERENERGIE (GREEN PEOPLE'S ENERGY)
RESULTS CASE STUDY

Increasing Crop Yields in Rural Ethiopia

Piloting Solar Cooling for Horticultural Cooperatives

Country	Ethiopia
Implementer	GBE
Target groups	Agricultural cooperatives
Other stakeholders	Ministry of Water and Energy, Ministry of Agriculture, regional energy and agricultural bureaus, regional cooperative bureaus, Strengthening Rural Value Chains project, Building an Avocado and Sesame Value Chain in Ethiopia project
Project duration	12/2019 – 09/2023

PROJECT APPROACH

The majority of Ethiopia's population depends on agriculture for their income and livelihood. However, the huge potential in the agricultural sector in general and in horticulture (fruit and vegetables) in particular is hampered by average post-harvest losses of up to 25 %. Smallholder farmers face the challenge of post-harvest losses due to a lack of access to appropriate cooling technologies. The areas where horticultural products are cultivated have no or limited access to grid electricity to power cooling systems.

To bridge this gap, Green People's Energy (Grüne Bürgerenergie, GBE) is improving the conditions for a decentralised energy supply through solar cooling. GBE is therefore implementing a scalable pilot project for solar cooling technology in close cooperation with two other BMZ-funded projects: Sustainable Rural

Value Chain (SRVC) and Building an Avocado and Sesame Value Chain in Ethiopia (develoPPP). The aim is to test modern solar-powered cooling systems in horticultural cooperatives in rural Ethiopia.

The SRVC component „Improving access to inputs, advisory services, and markets" selects partner cooperatives that specialise in horticultural production and have at least 200 member farmers. Their perishable horticultural goods (such as avocados) usually require refrigeration before they can be sold at the market or transported to processing facilities. The project approach consists of installing solar-powered cooling containers on the premises of selected cooperatives.

The installed solar cooling containers use PV panels as an electricity source. The pilot project adopts an innovative thermal energy storage technology to reduce the usual investment costs for batteries and their respective environmental impacts after usage. The generated solar energy can amount to a total of 4.55 kW per container and is used firstly to cool the goods during the day and secondly to cool down an additional water stock to freezing temperature. The produced ice allows for night-time cooling. The cooling temperature is set between 4 and 15 degrees Celsius. The cooling system therefore only requires a small battery to power the air circulation and the control units.

Picture 1: Solar panels powering the solar container

The containers and a set of spare parts and tools for each container are procured and paid for by GBE while the selected horticultural cooperatives contribute for example by providing land and installing fencing. Training in operation and maintenance is also part of the project approach and the cooperatives are developing financial models to cover operation and periodical maintenance of the cooling systems.

METHODOLOGY OF DATA COLLECTION

Data for this case study report was collected through a review of project documents, six qualitative interviews with representatives of the Ministry of Water and Energy, the Ministry of Agriculture, two solar companies, representatives of GIZ, Sidama Regional Energy Bureau, Sidama Regional Cooperative Bureau, and two focus group discussions at the following cooperatives: Taramesa Akababi Fruit and Vegetable Producers Primary Cooperative and Danchuma Fruits and Vegetables Producers Primary Cooperative. The case study was conducted between May 2023 and July 2023. At that time, some project activities were still ongoing. Accordingly, the effects captured are not exhaustive.

KEY FINDINGS

Project Achievements

The project has installed six solar-powered refrigerated containers, each 20 feet (approx. six meters) in size, at the selected partner cooperatives of the two BMZ-funded partner projects. All six cooling systems are operational, benefitting more than 1,400 farmers directly and indirectly.

The solar cooling system is covered by a 12-month warranty from the supplier. For any more complex troubleshooting and regular maintenance, the project and the system supplier have provided in-depth technical training to a pool of five local companies that specialise in cooling systems. A complete set of spare parts (controllers, condensers and regulators for all six systems) is available for any repairs and maintenance.

Moreover, the supplier has trained three representatives from each of the beneficiary cooperatives as well as one representative from the Regional Energy Office in the management of the solar cooling systems and the simple servicing and troubleshooting of the systems. During the training on the cooling system, the trainees were able to experience how the system reacts and what settings are available for different situations such as selecting the cooling temperature depending on the needs of the stored products. A manual with instructions was also given to the beneficiary cooperatives.

Intermediate Impact

The solar cooling systems have only recently been introduced and smallholder cooperatives have been using them since March 2023. Farmers are now able to access and maintain this climate-friendly technology and preserve vegetables and fruits such as tomatoes and avocados in the cooling system for periods of 24 to 48 hours.

Picture 2: Solar-powered Cooling Container

Picture 3: Inside the Cooling Container

While the impact is not yet evident due to the short period of use, solar cooling technology has the potential to reduce post-harvest losses by increasing the storage time and shelf-life of perishable fruits and vegetables products which ultimately increases the income and negotiation power of the producers in the market. One cooperative member stated that they "used the solar cooling container for tomato recently, and it showed promising results".

Farmers expect to be able to negotiate higher prices for their produce, for example in the avocado processing industry, due to increased product quality. It is anticipated that the cooperative members will be able to increase their income due to a decrease in losses and improved bargaining power. Average annual post-harvest losses in Ethiopia are at 25 % for all crops, while it is at more than 32 % for fruit and vegetables, indicating a huge potential for post-harvest loss reduction. The productive use of energy could thus change the lives of people as well as small businesses in the rural target areas in Ethiopia.

Climate Impacts

Following the calculation methodology of the United Nations Framework Convention on Climate Change (UNFCCC), the installations described above are estimated to mitigate 40 t CO_2e/a in the year of installation by avoiding the use of fossil fuels.

This is roughly equivalent to the annual CO_2 emissions of more than 28 medium-sized cars in Germany.

Challenges in Project Implementation

The implementation of the project has faced several challenges, which the project addressed adequately to achieve the project goals.

First, the partner cooperatives welcomed the project and it became apparent that their demand for cooling goes beyond the scope of the pilot project. The focus of the pilot project is to demonstrate the feasibility of the technology rather than covering the end-users' full demand. The pilot project could be scaled up by the beneficiary cooperatives and the institutional partners.

Second, the implementation of project activities was delayed due to the Covid-19 pandemic and the resulting lockdown as well as postponement of the coordination meetings, travel restrictions and interruption in the international supply chain.

Third, it was not possible to find Ethiopian suppliers for the applied cooling solutions and therefore, the project had to import solar cooling systems. This also contributed to the delay in project implementation, as import processes need time.

Lessons Learned

The internal cooperation with the two aforementioned BMZ-funded agricultural projects has contributed a lot to the successful implementation of the project. Through these synergies, the cooperatives and institutional partners were efficiently identified and selected for the pilot. Moreover, this cooperation increased the implementation efficiency by identifying entry points for the cooperatives and generally reduced transaction costs and time for the implementation.

The engagement of the Regional Cooperatives Bureaus also contributed to the project outcomes. They contributed by allocating land for the concrete foundations for the solar cooling containers. Moreover, their own commitment (e.g. through resource allocation) enhanced the cooperatives' ownership of the project results. This facilitated their sense of responsibility for the operation and maintenance of the cooling systems.

In addition, the almost battery-free solar cooling technology is opportune as it reduces initial and operational investment capital and avoids the environmental impacts of battery usage. Therefore, this technology is adapted to the off-grid cooling needs in rural areas.

As there were no locally produced solar cooling systems available, the project had to start from scratch with its pilot to demonstrate the technical feasibility and potential of solar cooling in Ethiopia. The installed solar cooling systems are high-end technologies, though designed to be easy to use and practically fail-safe if handled and maintained properly. For up-scaling, however, partners might want to look into less high-end solar cooling systems that on the one hand may be less efficient but on the other hand can be easier reproduced and maintained locally.

Sustainability of the Intervention

The project has trained representatives of the Regional Energy Bureaus and members from the cooperatives on the operation and simple servicing of the solar containers, which ensures the system's maintenance at the cooperative level. Moreover, the agricultural projects of GIZ, the Regional Energy Bureaus, the Regional Cooperatives Bureaus and the Woreda Energy Offices are all strongly committed to supporting the cooperatives in sustainably using the solar cooling containers. They are accompanying the cooperatives in preparing monthly reporting on the operations of the solar cooling containers. In addition, service companies have been selected and trained by GBE and its partners. They will enter into an agreement with the cooperatives and are expected to ensure the sustained functioning of the solar cooling systems after the warranty period has ended.

Moreover, the cooperatives will consider using the solar cooling systems for rental purposes. Members of the cooperatives state that there is potential demand from milk producers. The systems might be used by members and non-members of the cooperatives against a fee. GIZ projects and regional government partners will assist the beneficiary cooperatives in designing and developing a business plan for the rental of the cooling systems. In the end, cooperatives could rent out the systems to any other farmer or farmer group during the off-season or when their own production is low based on the agreed storage unit rates. By doing so, the usage of the cooling system could be enhanced even during low season and additional income could be generated for ensuring the service and maintenance of the systems.

CONCLUSION AND OUTLOOK

The project has achieved its goals and brought a new technology for cooling to cooperatives, being based on the use of solar energy and environmentally friendly refrigerants. The strong commitments of the piloting cooperatives and the partner institutions, and the training of experts from the cooperatives are key factors and will ensure the continuation of the project.

The example of solar cooling for the preservation of fruits and vegetables is pertinent and could serve as a model for further scale-up as well as more deployment of solar energy for other productive uses. The Ministry of Water and Energy, as well as the Ministry of Agriculture are interested in scaling up the solar cooling technology.

Nevertheless, several institutional partners reported that the necessity to import the solar cooling systems and the lack of local supply of spare parts is an issue that might compromise the upscaling of the solar cooling systems. Future projects could try to address this challenge by supporting local suppliers in manufacturing locally similar solutions. Furthermore, it might be useful to facilitate networking between cooperatives and suppliers to bring the supply- and demand-side together for further market development.

MORE INFORMATION

Energypedia:
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