



## **Webinar Proceedings:**

**SCALING-UP COMMERCIALIZATION OF LOW-COST SOLAR DRYERS WEBINAR  
HELD ON THE 31<sup>ST</sup> MARCH 2022**

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## LIST OF ACRONYMS

ACTS	African Centre for Technology Studies
UNEP	United Nations Environment Programme
IFT	Institute of Food Technologists
KIRDI	Kenya Industrial Research Development institute
EBAFOSA	Ecosystems Based Adaptation for Food Security Assembly

## Executive Summary

On March 31, 2022, the "Scaling-Up Commercialization of Low-Cost Solar Dryers" webinar was conducted to facilitate a dialogue among various agri-food stakeholders across Kenya. The webinar aimed to achieve the following objectives: i) Share the findings and experiences related to climate-action solutions for low-cost solar drying technology, building on the EBAFOSA project. ii) Understand the market and feasibility of solar dryer technology and business models in Kenya's dry food markets. iii) Identify ongoing relevant work in Kenya by different actors to support the scaling-up of the solar drying project. iv) Identify potential partners for collaboration in the project implementation.

A total of 76 participants from different sectors such as government, financial institutions, learning institutions, NGOs, donor organizations, and farmers attended the webinar from various parts of the country (see Annex 1 and 2). The presentations were made by different players in the solar drying value chain, including KIRDI (Hybrid Solar Dryer Fabrication), Ebagropamoja (Fabrication of Low-Cost Solar Dryers and Drying as a Service Experiences), Agricycle Global (Agricycle Experiences in Promoting Solar Dryers in Kenya), and ACTS (Scaling-Up Solar Drying to Reduce Post-Harvest Losses in Kenya and Call for Partnership).

During the webinar, participants engaged in discussions using chat boxes, and several recommendations were put forth as follows:

- The need to establish a sustainable financing mechanism to support the adoption of solar drying technology by small-scale farmers.
- The importance of establishing appropriate policies and regulations to promote the adoption of solar drying technology.
- The need to enhance farmers' knowledge and skills on the use of solar drying technology through training and capacity building initiatives.
- The importance of involving private sector players to support the scaling-up of the solar drying project.

## Opening Remarks

### **Dr Catherine Kilelu, Head, Agriculture Food and Nutrition Programme (AFNS) (ACTS)**

Dr. Catherine Kilelu, the Programme Head of Agriculture Food and Nutrition at the African Center for Technology Studies, commenced the webinar by expressing her gratitude towards the project funders, the Institute of Food Technologists (IFT), project partners (KIRDI, UNEP, EBAGROPAMOJA), and all the participants for their valuable time and contributions. She provided an overview of the webinar's objectives, which included an assessment of the market and feasibility of solar dryer technology and related business models in the dried food markets of Kenya, as well as identification of ongoing initiatives that could support the scaling-up of solar drying projects in Kenya.

## Welcome Remarks

### **Prof. Tom Ogada, Executive Director, African Centre for Technology Studies (ACTS)**

The Executive Director of the African Centre for Technology Studies (ACTS) expressed gratitude to the IFT partners and participants for attending. Professor Tom Ogada provided a brief history of ACTS, a leading research think tank founded in 1988, whose mission is to help African countries and institutions leverage Science, Technology, and Innovation to achieve Sustainable Development Goals (SDGs). The organization's sixth strategic plan centers on five programs, including Agriculture Food Security and Nutrition, Climate Resilience Economics, Science, Technology, Innovation, Knowledge and Society, Digital Economy, and Gender, Youth and Inclusive Development. The gender program's focus is policy, research, and knowledge and technology brokerage.

Prof. Ogada highlighted the significance of disseminating research findings and innovative technologies to the public, which contributes to national development and increases their adoption. The ACTS Governing Council has assigned the AFNS Program the task of achieving this objective over the next five years. The program aims to identify, deploy, and support the uptake of at least five agri-technologies at scale to achieve SDGs. For the first three years, the Program will concentrate on solar dryers and a community cooling hub driven by renewable energy.

Prof. Ogada also emphasized the need to move away from traditional methods of technology deployment and adopt new business models and approaches. This shift ensures technology transfer generates jobs, enhances income opportunities for beneficiaries, and guarantees technology sustainability and longevity. ACTS seeks potential partners to support the implementation of the "Scaling-Up low-cost solar dryers Project," whose target is to deploy 50 to 100 solar drying units, support youth-led SMEs to deploy more affordable solar dryers, and expand the market for "pay as you dry" services across various agri-value chains in Kenya.

Therefore, Prof Ogada announced that through the webinar, ACTS aims to explore partnerships, understand business models used by different players, share experiences, success factors, challenges, and possible solutions for solar drying technology transfer, and mobilize and engage women and youth in various business activities.

## **Dr Richard Munang, Acting Deputy Director, United Nations Environment Programme (UNEP)**

Dr Richard Munang expressed his admiration for the African Centre for Technology Studies (ACTS) and their involvement in the "Scaling-Up low-cost solar dryers Initiative", while thanking the participants for attending the webinar. He began by sharing an African proverb that emphasizes the power of unity.

Dr Munang emphasized the importance of the initiative to commercialize low-cost solar dryers in Kenya. He highlighted the significant market opportunity that exists, estimated to be worth 50 billion Kenyan shillings annually, due to post-harvest losses. He stressed the need for risk control at the outset, as well as the incorporation of experiences and lessons learned from partners. The webinar aims to learn from participants on valuable solar dryer acquisition financing approaches beyond Pay as You Go, to improve the performance and affordability of existing dryers such as those from KIRDI and Ebagropamoja.

He emphasized the value of beneficiary engagement, particularly among organized groups, to diversify risk and lower financial risk. He discussed the need for stakeholders to think of insurance coverage, particularly to cover the market risk, as producers need to be cushioned against such risks. He also discussed the importance of public-private partnerships in transferring technologies among community members and building ownership of technologies. He highlighted the importance of data generated from the initiative, which will be crucial in informing policy across the world. The deployment of solar dryers will provide data for developing a solar dryer standard in Kenya.

He ended his remarks with another African proverb, underscoring the importance of working together to seize greater opportunities.

## **Presentations**

### **A. Fabrication of low-cost solar drying technology enterprises and “drying as a service”- The EbaGroPamoja journey - Steffi Maingi – Director, EbagroPamoja**

The presentation centred on the experiences of EbagroPamoja in fabricating low-cost solar dryers and facilitating the "drying as a service" business model in Kenya. EbagroPamoja is a Nairobi-based youth-led enterprise with a focus on developing solutions to benefit youth and communities.

#### **EbaGroPamoja Approach**

During the presentation, EbagroPamoja shared their experiences in the fabrication of low-cost solar dryers and the facilitation of the "drying as service" business model in Kenya. The organization, which is youth-led and based in Nairobi, focuses on developing solutions to help youths and communities. EbagroPamoja's approaches can be broadly categorized into three key areas aimed at driving the uptake of this climate action solution:

- **Technical performance and affordability:** This area focuses on protecting dried products from contamination, ensuring the appropriate moisture content of dehydrated food products, ensuring effective performance of drying in unfavourable conditions such as rainy and cold weather, and producing affordable dryers that can be locally made.

- **Deployment structure:** This area emphasizes the need to establish a deployment structure that ensures accountability and traceability while documenting community impact. This involves identifying safe sites for deployment, expanding community uptake, securing the dryers on sites, and collecting up-to-date data on performance.
- **Market forces:** This area focuses on increasing community accessibility and ensuring affordability of the dryers to generate income that demonstrates the financial viability of the dryer. It also aims to overcome the donor mentality whereby the community uses EBAGROPAMOJA as a donor.

The experiences and lessons learned by EbagroPamoja informs the project's technical performance needs. Building a team to develop a dry prototype, testing the prototype for performance, identifying cheap quality material sources, and expanding production of tested and approved prototypes through EBAFOSA will be a key solution.

EbagroPamoja received training on the design of affordable solar dryers from the Uganda labour force, which supplemented their own research. The organization mobilized willing youths with backgrounds in woodwork, metalwork, and masonry to refine the ideas and develop the prototype. The main objective of the training was to equip youths with skills and opportunities to offer productive climate action solutions to the community. Through this initiative, EbagroPamoja developed and tested the first prototype, which was deployed to Kirinyaga. As the need for seasoned dryers emerged, the organization developed backup heaters fueled by briquettes.

### **Strengths of EbagroPamoja Dryers**

One of the key strengths of EbagroPamoja's solar dryers is their simple design, which enables artisans to build them affordably using locally available materials. Another strength is their flexibility and portability, as they are able to effectively dehydrate various types of food, including high moisture retention foods like cassava, to below the 10% moisture content threshold. As a result, the solar dryers are able to achieve the required moisture levels faster compared to traditional open sun drying, while also preventing physical contamination of the food, giving them a competitive edge.

**Lessons Learned:** The most critical lesson learned from EbagroPamoja's experiences is the importance of developing effective and affordable solar dryers that can be built by local youth, while ensuring high-level performance that surpasses traditional open sun drying methods commonly used in the target communities.

### **Structure of Solar Dryers Deployment**

The deployment strategy for the solar dryers involved identifying accountable beneficiaries who would host and protect the dryers while collecting data on their impact. To achieve this, existing community groups engaged in farming but struggling with post-harvest losses were targeted. The advantage of working with these groups is that they are already accountable to each other and are more likely to protect and take care of the dryers. Additionally, they volunteered to provide sites for installation and collect data on dryer performance.

The community groups were mobilized as a collective rather than individuals, following the existing structure of low-risk high impact actions to ensure traceability and accountability. The groups were



required to demonstrate the impacts recorded, including the number of beneficiaries, reduction in post-harvest losses in terms of both weight and monetary value, increased savings in their respective cooperatives, and market opportunities for the dried products.

To further enhance the engagement process, solar drying centers were centralized for shared service by the groups rather than distributing dryers to individuals. The youth were specifically trained to engage in product development under EbagroPamoja. The organization offered a structure of engagement for both the youth and women cooperatives and community groups. Direct engagement increases ownership of the solutions offered, while also involving beneficiaries in taking up and paying for the solar dryers through market forces.

Initially, a pay-as-you-go model was intended, where the use of solar dryers would attract a small service fee. The solar dryers were to be taken up by groups of agri-value chain actors forming local solar dryer Chamas, saving benefits of using the dryers jointly, and using the savings to pay the service fee. This centralized all records, making it easy to capture the financial and market impact of the solar dryer uptake. However, significant compromises and improvisations were required to achieve this, and engagement with the beneficiaries was not linear.

### **Issues in the Structure of Solar Dryers Deployment**

- i. One major challenge faced during the deployment of solar dryers was that most group members already had their own Chamas and were hesitant to enter into financial commitments with each other.
- ii. Trust issues were also a problem as some beneficiaries were not willing to save money together, which is crucial for the successful implementation and sustainability of the solar dryer project.
- iii. Another obstacle was the reluctance of some beneficiaries to pay the service fee. Some beneficiaries believed that EbagroPamoja was a donor and expected the solar dryers to be distributed free of charge, as is often the case with donor-funded projects

### **Strengths in the Structure of Deployment**

One of the key strengths of the solar dryer deployment structure is the provision of the dryers as a shared service for use by groups rather than individuals. This approach not only reduces the cost of deploying the dryers, but also increases community ownership and ensures better utilization of resources.

Another strength is the ability of Agri-value chain actors to save any proceeds from the use of the dryers by reducing post-harvest losses in their preferred location. The solar dryer services are provided free of charge to established farmer groups, who are then responsible for maintaining and repairing the dryers to ensure their continuous operation.

To cover maintenance and repair costs, a service charge is paid directly to a designated individual within the community. This approach not only ensures that the dryers remain operational, but also empowers individuals within the community by creating employment opportunities.

Finally, the community leader is responsible for reporting on the usage of the dryers, including financial data on the benefits to the community and potential market opportunities for the dried products. This

reporting system ensures transparency and accountability within the community and helps to drive further adoption of the solar dryers.

## **The market for Dried Food Products**

The market for dried food products has shown promising growth, with a high demand for solar dryers among the community groups. The solar drying centres are utilized by the groups at their convenience, and the dried products are either sold in the market or consumed domestically. It is noteworthy that the responsibility of finding a market for their products lies with the groups themselves.

Moreover, the consistent use of solar dryers by the farmers indicates an increasing demand for dried products. This is a positive sign for the sustainability of the solar dryer project and its potential to create a new market for dried food products. As the project continues to gain momentum, it is expected that more opportunities for market expansion will arise, resulting in increased incomes for the community groups.

### **Case of Khaki Women Group in Kirinyaga**

The Khaki Women's Group comprises of 60 women, with each representing a household. Previously, they experienced a post-harvest loss of 100 kg of vegetables per harvest, which resulted in a loss of approximately KES 2,000 per harvest and KES 12,000 annually. However, since the establishment of a solar drying center, this loss has been reversed, resulting in an increase in annual earnings by KES 12,000 and saving them from incurring any further losses due to post-harvest losses.

The women's income has increased by 100% since they are no longer experiencing any harvest spoilage and can sell their products instead of consuming them at home. By efficiently drying their main value chain, which is greens, they have even increased their income. For instance, they can now sell fresh greens for KES 20 per kilo, and when dried, they sell them for KES 50 per kilo. This means that they are now able to make a profit of KES 30 for every batch of greens they dry. Therefore, in addition to reversing their post-harvest losses, the solar drying center has also enabled them to increase their income.

## **B. Scaling-up solar drying to reduce post-harvest losses in Kenya and Call for Partnership- Dr. Catherine Kilelu, Director, Agri, Food & Nutrition Security Programme- ACTS**

The presentation was centred around the solar drying technology scaling initiative by the Consortium (ACTS, KIRDI, and UNEP) aimed at reducing post-harvest losses in Kenya. It outlined the project's key objective of transitioning from the traditional approach of deploying solar drying to establishing solar drying enterprises.

### **Scaling up Solar dryers Project Overview**

The project's main goal is to reduce post-harvest losses in Africa and Kenya, where approximately 240 million Africans are undernourished, and the current season of drought will leave around 3.5 million Kenyans hungry. The project aims to provide sustainable solutions to address the challenge of food and nutrition security, while also promoting climate action by reducing greenhouse gas emissions associated with post-harvest losses. The use of solar drying technology is an eco-friendly solution that ACTS is

promoting, and the project seeks to engage young people in these solutions, as they are bright and innovative. By making the project inclusive, it will help ensure that everyone has access to healthy and nutritious food while mitigating the effects of climate change.

The key question is how we can improve upon existing experiences and technologies in reducing post-harvest losses. Steffi's shared experience provides a good overview of a multifaceted approach that includes not only deploying technology but also engaging young people as fabricators and establishing community groups to run the technology using a drying-as-a-service approach. The model has shown efficiency and presents a huge opportunity for scaling up. However, questions remain about the technology's efficiency and the quality of dried products. Additionally, the challenge of losing 500 million US dollars per year must be addressed.

Solar dryers can be part of the solution, and we need to understand the challenges of solar drying and seasonality. When solid drying may not be optimal, we must integrate new elements to optimize drying processes. ACTS aims to grow the market of drying as a service while also promoting the consumption of solar-dried products to address nutritional and consumption gaps across our communities. This can create opportunities for entrepreneurship and job creation, benefiting small and medium enterprises, young people, and women in agro-processing.

The project motivation is to be part of the solutions for reducing the post-harvest losses that the continent, as well as the country, is experiencing. These losses are connected to the challenge of food and nutrition security in the continent where the latest data shows that approximately 240 million Africans are undernourished. In Kenya, the current season of drought will result in about 3.5 million Kenyans being hungry. Hence, a need to ensure people do not become food insecure while ensuring access to healthy and nutritious food as well as ensuring climate action.

Post-harvest losses are also a contributing factor to greenhouse gas emissions. Therefore, addressing PHL will be contributing to actions toward reducing the problem of climate change. Therefore, ACTS is trying to deal with PHL issues sustainably since solar drying is a sustainable technology. We are also trying to make it inclusive, where we trying to engage young people in the solar dryer solutions as they are intelligent.

Therefore, the question is how we can improve on some of the experiences and the technologies that are out there. Building on the experience that Steffi has shared gives a good overview of including more than a kind of technology that they have deployed while working with the young people as fabricators of the technology. They have also been trying to establish community groups to run this technology where they collectively access the dryers through a drying as a service approach. There is a huge opportunity, and we can build on these experiences and see how we can scale up the model, which is efficient. There are questions around the efficiency of this technology and the quality of the dried products but importantly how can we close this gap of losing money in dollars, its 500 million US dollars per year?

How solar dryers can be part of the solution and is to be done now is try to understand the challenges of solar drying and seasonality and when solid drying might not be optimal, how can we integrate new elements. ACTS want to grow the market of drying as a service but also grow the market for solar dried products so that we can leverage dried products to address the nutritional gaps and consumption gaps across our communities. Therefore, we can expand entrepreneurship and job opportunities for many different people small and medium enterprises, young people, and women in agro-processing.



ACTS is building on Ebagropamoja's solutions, and they have also collaborated with KIRDI who are working a lot on different models of solar drying technology and the idea is to use those technologies that are already available in the market. We will fabricate low-cost dryers by working with young people who will be trained to do the fabrication to meet the specifications, and then start to scale the kinds of products that can be dried. For the last two months, we have been trying to understand the type of dryer that is already on the market, the capacities of the dryers, and their efficiency as these technologies for drying food. So far, we have seen improvement in drying from eight hours and some cases to, two to three hours. Therefore, the question is how we can improve the quality of our product because there are many great products in the market but we are not sure about the quality of the products.

Additionally, for the issue of willingness for people to pay for the service, not every farmer has the ability to buy a solar dryer. Therefore, how can we use the dryers collectively or build a business case around a cooperative or women's group owned dryers hence those are the things that we want to scale and that's where we are now seeking how to collaborate with others. This initiative launched needs to improve the Climate Action enterprises.

ACTS is trying to understand; what are some of the price points around that you know, what is the optimum capacity for the dryers, what are the margins for people who are in that business of fabrication? In addition, what are the margins for people who are drying products? For instance, when somebody brings 20 kilos of mangoes to dry, what is the cost you will be offering that service? What would you be charging them? How do we arrive at some of these unit costs for us to better understand these businesses? Therefore, these are some of the things that we are also doing ourselves. The organization is trying to understand the kind of return on investment for this technology at the dryer fabrication level. Also at the drying centre particularly for the drying as a service, what is your investment? So that when we are saying people can get into this business, you know, we can really provide kind of enough information for them to consider when you are thinking about the business.

There is a great global demand for dried fruits and vegetables, and foods and much is not known about the market. There are some studies for instance from the University of Nairobi are here, particularly on the consumer dimension and the market is growing. MSMEs are already doing this since you can see products in the market. However, there is little understanding of what this market looks like and where to position itself. Therefore, we are going to start to really understand and inform businesses as they develop products and work on packaging, and quality and identify the target customer.

We are looking at a niche market, or for consumers who will not begin to pick up and take up these great products. Therefore, this is where ACTS is looking for partnerships that are we're looking to engage with fabricators, financial institutions, research institutions, the county governments, run partnerships, public-private partnerships, and of course, the SMEs themselves who are interested in acquiring solar dryers. So that's what this project is embedded in. I want to welcome people to contact us.

### C. Solar drying technology development and deployment- Experiences of KIRDI - Dr. Fredrick Ogutu, *Research Scientist, KIRDI*

The presentation mainly focused on the solar dryers being fabricated by KIRDI, with a particular emphasis on their design and technical support for installation. The design of solar dryers was optimized for maximum efficiency.

The presentation covered the different types of solar dryers, including direct and indirect dryers. Direct drying involves exposing the substance to be dehydrated directly to sunlight using a solar box dryer. The dryer has a black absorbing surface that collects sunlight and converts it into heat, which is used to dry the substance placed directly on the surface.

The presentation also discussed the costs associated with solar dryers, including the design, fabrication, and installation. KIRDI is committed to providing affordable solar dryers to farmers, especially small-scale farmers, to reduce post-harvest losses and increase their income.

**Types of solar dryer** discussed in the presentation include.

Indirect drying, which involves using a solar cabinet dryer (figure 2). Unlike direct drying, the substance to be dried is not placed directly on the black absorbing surface but is instead heated indirectly. In the solar cabinet dryer, the black surface heats incoming air, which is then passed over the substance to be dried. As the heated air passes over the substance, it takes moisture with it, which is then removed from the dryer through a chimney. This process allows for a more controlled and gentle drying of the substance, resulting in a higher quality product.

The presentation also covered different types of hybrid solar dryers (figure 3), including the hybrid solar biomass dryer, hybrid solar biogas dryer, and hybrid solar electric dryer. The hybrid greenhouse type dryer discussed in the presentation works on a mixed mode, which involves direct exposure of the product to sunlight and drying through direct hot air. The dryer's floor is painted black to convert solar radiation to heat and dry the products, while direct heat is absorbed through a transparent sheet to enhance double heating. The dryer also has a biomass part that is engaged when solar radiation is low. In this case, the biomass chamber is connected to the heat exchanger



Figure 1: Solar box dryer



Figure 2: Solar box dryer



Figure 3: Hybrid solar biomass solar dryer

works on a mixed mode, which involves direct exposure of the product to sunlight and drying through direct hot air. The dryer's floor is painted black to convert solar radiation to heat and dry the products, while direct heat is absorbed through a transparent sheet to enhance double heating. The dryer also has a biomass part that is engaged when solar radiation is low. In this case, the biomass chamber is connected to the heat exchanger



to produce gas that passes through the heat exchanger. The air then gets heated through conduction and convection and is channelled through a pipe. The heated air passes through perforated pipes under the drying trays and exits through the top of the dryer. Additionally, fans are installed to assist the ventilators in removing the required air.

Key components of the solar dryers fabricated by KIRDI include a solar collector with an absorber plate, a drying chamber for heated air circulation and humidity control, an exhaust for natural or forced ventilation, and an air inlet for natural or forced ventilation. These components ensure efficient and effective drying of products using solar energy.

KIRDI has developed and installed various solar dryers in different locations. For instance, a solar dryer with a capacity of 90kgs has been installed in Kisumu and is used by SMEs who are charged two shillings. The drying time for maize and cassava has improved, taking about six to seven hours, while fish takes 10 hours to dry. Additionally, KIRDI has designed dryers for other products such as meat, which has been installed in the northern part of the region for pastoralists working on camel meat production. This dryer has a capacity of 1000kgs per batch for drying meat, which is dried, packaged, and exported to the UK, generating business for the community.

KIRDI has installed solar dryers in four regions, namely Kisumu County, Garissa County (funded by NRF), Kisii County, and Migori County (funded by the EU and Migori County Government). The dryers have different capacities and fabrication prices, including 90kgs (ranging between 250,000 -300,000 KSH), 400-500kgs (ranging between 750,000-800,000 KSH), and 1000kgs (costing KSH 1.6 million).

Figure 5 shows the solar drying system in Migori and Kisii.



Figure 4: Solar drying system in Migori and Kisii

#### **D. Agricycle’s experience in promoting solar dryers in Kenya - Patrick Nderitu, *Director, Agricycle Global***

The presentation focused on the organization’s experience in agricycle’s experiences in the promotion of solar dryers to smallholder farmers, women and youth across different value chains such as fruits among others.

#### **Agricycle’s Approach to promoting solar dryers in Kenya**

Agricycle is a social enterprise that promotes solar dryers to smallholder farmers, women, and youth across different agricultural value chains such as fruits. The organization takes a market-oriented approach to solar drying and aims to support smallholders in processing their products and taking them to markets. Agricycle acknowledges that smallholder farmers produce a significant amount of food, but a considerable percentage goes to waste due to limited processing and market access. Therefore, they work with smallholder farmers, women, and youth in areas where there is excess production of certain products of interest to them. They organize them into production groups, and they work with them in a distributed

network, which allows them to buy resources from different regions of East Africa and distribute benefits widely to smallholder suppliers.

To ensure consistency in the supply of farm products, they get it from different regions. For example, they get many dried mangoes from Uganda when the mango season in Kenya ends, and they start getting them from other regions where the season starts. Technology is considered essential, where micro processing such as drying is critical to preserving the products. Therefore, Agricycle invested in a solar dryer, where they have three brands they are selling globally.

- **Jelly:** It is one of their solar dryers that is utilized for dried mangoes, dried fruits, and dried pineapples, and they also found others who are interested in other dried products like bananas.
- **Feel Better:** It is a product designed to be affordable and nutritional ingredients like gluten-free flowers sold in bulk to ingredients manufacturers in the USA and Europe. Agricycle's dehydrators are portable and innovative enough to meet the needs of the target population.

The organization is working with women, who do not own land, and one of the significant challenges in setting up big dehydrators is land ownership. Therefore, they invest in solar dryers that are food safe, portable, and easy to disassemble, making them affordable and accessible to the youth. The capacity of one unit is five kgs, with a power output of approximately two to three batches a week. The dryer is usable individually, but farmers are encouraged to come together to be able to afford a number of units. The organization provides them with training, and they monitor the farmers' production.

They have different financing options for the women and youth groups, such as allowing them to get the solar dryers for a small fee and pay the rest as they supply the products. Agricycle's approach to solar drying focuses on the market, supports smallholders, and empowers women and youth in the agricultural sector.

## Questions and Discussions

This session provided an opportunity for presenters to respond to questions and comments from participants on solar dryers and the solar drying value chain. This was also an opportunity for participants to contribute to issues on solar drying. The questions are outlined below:

1. **Question** “Are there any developments with regards to the mechanical development of dryers? And lastly, I work for a social enterprise known as village industrial power and we manufacture mechanical dryers. We found that once we sold them to our farmers, they had a challenge accessing markets for their dried produce, especially dried mango. I wanted to know what others are doing about that. It seems like getting markets for dried produce, may not be a walk in the park for most. “

**Answer: Patrick Nderitu:** “The biggest issue in most cases is not demand but awareness of where the market of dried mangoes/products is at the moment. I would be willing to negotiate and help various farmers access the market”

2. **Question** “Could we get more input on the insurance from Dr Munang?”

**Answer: Dr Munang:** “Agro insurance is an important aspect to be considered by farmers in the production line and individuals venturing into drying. This will ensure a sense of protection from any losses that the farmer might incur during production or when one lacks a market for their dried products thus ensuring sustainability. There are several companies in Kenya that offer agro insurance e.g., Jubilee insurance etc. “

3. **Dr Catherine Kilelu:** “What do we know about consumer trends? What is driving the market development, especially domestic and how to scale up solar drying in Kenya?”

**Jackis Auka:** “To scale drying in Kenya the following should be considered

- i. Make solar dryers that can dry smaller quantities and make them efficient and cheap.
- ii. Establish shorter drying periods
- iii. Link the producers with the market for dried products
- iv. Create awareness of markets for dried products
- v. Civic education on dried products to the general public
- vi. Enhance public/private partnership “

4. **Question** “What is the maximum temperature when using the heating system and how does the heating system guarantee food safety since the burning briquettes emit fumes into the food chamber?”

**Answer : Jackis Auka:** “Briquettes are smokeless thus there are no dangers of food contamination with smoke. And in terms of temperatures, at the moment, I'm not really sure because we usually have meters that measure the temperatures, but the temperatures are usually two or three times higher than the temperatures outside.”

**Dr. Richard Munang- UNEP:** “To prevent smoking, first off, the heating chamber is only activated once the fuel briquettes are fully lit such that they no longer smoke. The jiko that generates the heat is first lighted fully before it is engaged to preheat air, Second, the heater chamber has a chimney to exhaust & also fresh air inlet to maintain the briquettes lighted such they do not quench & start smoking. On maximum temp of backup heater, the backup heater is fired by jiko fuelled by briquettes. The typical temp of a fully lighted jiko is 260 - 370centigrade heat control is achieved through air control. Reducing the amount of air getting into the dryer reduces flame. The heater chamber has a mechanism for controlling air going into the fire. The produce that is drying is constantly monitored for moisture content and immediately the threshold is reached, the heater is removed and the produce unloaded from the dryer.”

5. **Question** “What are the effects of subjecting food to direct sunlight?”

**Answer: Joshua Ombaka – ACTS:** “Of course, the question revolves around where it is direct (active) or indirect (passive). But you need also to be certain if you have sufficient insolation for you must know that you are possibly competing against time too. The critical point for moisture must be attained within recommended times to avoid microbial spoilage.”

**Fred Ogutu:** “The transparent paper filters out UV hence there is no photo degradation of products in the transparent driers.”



**Dr. Richard Munang- UNEP:** “The key here is to understand we are talking about optimising solar dryers. On bleaching, UV material filters out some of the destructive suns. The idea is to monitor the food to ensure it does not over-dry constantly. Another aspect is affordability, solar dryers are made simple for purposes of affordability. But once you make backup heating (briquettes/biogas) as the primary heat source, it no longer is a solar dryer. We cannot solely present biogas or briquettes alone to heat the air. What we must understand is that these other sources are for backup. The primary is solar radiation. The "dark drying" to prevent bleaching is something else, shifting the discussion away from the core, which is solar hence, we must not focus on backup alone. “

6. **Question** “what is the cost of operating, the volume and time frame for drying a particular product?”

**Answer: Steffi Maingi:** “There is no cost of operating because the youth groups undertake the operations whereby, they will just have their produce from the farm and directly bring it to the solar drain centre. In regard to the time frame depending on how hot or the temperatures, cassava has dried in eight hours, millet and sorghum have dried within two hours, and groundnuts in two to three hours. Bananas will do up to 10 hours.”

7. **Prof Tom Ogada:** “How do we collaborate or recalibrate the Pay as You Go approach to make it more of a sustainable business model?”

**Steffi Maingi:** “The Pay as You Go model sustainability is based on economies of scale. Thus, the more people engaged, the better.”

8. **Question** “Has anyone tried to dry tomatoes successfully?”

**Answer: Fred Ogutu:** “KIRDI has dried tomatoes and it works well, though due to high water content salting is required during preparation.”

## Closing remarks by Dr Kilelu.

Dr. Kilelu encouraged stakeholders who were interested in collaboration to stay engaged and connected. She acknowledged that many people had expressed a desire to work with ACTS and assured them that follow-up would be done. She emphasized the importance of building on existing initiatives rather than starting from scratch and encouraged participants to share their experiences and information through the questionnaire that was distributed. This would help to understand what other stakeholders are doing and allow for collaboration and sharing of best practices.

In closing the meeting, Dr. Kilelu announced that more sessions would be organized in a variety of topics, such as technology, drying as a service, and market aspects of great products. She encouraged participants to attend these sessions and continue to engage with ACTS.

## Annex 1: The geographical Location of Participants



## Annex 2: List of Participants

First name	Last name	Name of your organization/business	Location of your organisation/business (Country and City)	Type of organisation
Kevin	Korir	Farmer	Nairobi	Cooperative and Farmers Association/ groups
William	Gitau	Healthy Living Tech-Agri Campaign	Lari subcounty	Cooperative and Farmers Association/ groups
Kennedy	Munyoki	Mbitini Farmers Horticulture Cooperative Society	Kitui County Kenya	Cooperative and Farmers Association/ groups
Anthony	Kioko	Cereal Growers Association	Kenya	Cooperative and Farmers Association/ groups
Violet	Nyando	Cereal Growers Association	Kenya, Nairobi	Cooperative and Farmers Association/ groups
Gabriel	Litunya AKali	GAPEPHI FARM VENTURES	KENYA -KAKAMEGA	Cooperative and Farmers Association/ groups
Zacheaus	Kosgei	Techgaa youth	Kenya and Eldoret	Cooperative and Farmers Association/ groups
Rodgers	Wakhungira	N	Kenya	Cooperative and Farmers Association/ groups
Joseph	Odwaro	Cga	Homa Bay farmers organisation	Cooperative and Farmers Association/ groups
Samuel	Odhiambo	Future Makers Self Help Group	Kenya (Siaya county)	Cooperative and Farmers Association/ groups
Hellen	Keti	ABOSI TOPHILL FARMERS COOPERATIVE SOCIETY	Kenya, Ndanai	Cooperative and Farmers Association/ groups
Tobias	Bodi	Mama Euphy enterprise	Kenya homabey	Cooperative and Farmers Association/ groups
Christerpell	Mose	Nyakwerigeria Disabled SHG	Kenya, Kisii, Nairobi	Cooperative and Farmers Association/ groups
Anthony	KIOKO	Cereal Growers Association	Nairobi, Kenya	Cooperative and Farmers Association/ groups
Dr. Temi	Mutia	Mwingi Horticulture Co-operative Society Ltd.	Kitui County	Cooperative and Farmers Association/ groups
Edda	Lujesi	MAENDELEO ya wanawake	Vihiga	Cooperative and Farmers Association/ groups
Cyprian	Kaliunga	Don Bosco cbo	Meru	Cooperative and Farmers Association/ groups
Sarah	Cheruiyot	Testai horticulture organization	Kenya , Bomet	Cooperative and Farmers Association/ groups
Richard	Langat	Testai horticulture organization	Kenya, Bomet	Cooperative and Farmers Association/ groups
Rebecca	Kadzokenga	Furunzi farm	Malindi	Cooperative and Farmers Association/ groups
Cyprian	Kaliunga	Don Bosco CBO	Kenya - Meru	Cooperative and Farmers Association/ groups
Sammy	Karisa	Posho mill	Misufini town	Cooperative and Farmers Association/ groups
Tonny	Muema	Kcic	Kilifi	Cooperative and Farmers Association/ groups

Marrietta	Gonna	Ukulima Bora Dairy Farmer's Co op society	Kenya, Kilifi County	Cooperative and Farmers Association/ groups
Hassan	Kazungu	Glorious	Malindi	Cooperative and Farmers Association/ groups
Nahshon	Moturi	United Multipurpose Co-op Society Ltd	Kenya, Kisii	Cooperative and Farmers Association/ groups
Kennedy	Osingo	Akuno Farm	Kenya/ Kisumu	Food Processors/Value addition MSME
Dominic	Maturu	Boitangare banana growers.	Kenya-Nairobi	Food Processors/Value addition MSME
Jeremiah	Opiyo	Kaugege Bmu	Kenya Mbita	Food Processors/Value addition MSME
Jeremiah	Opiyo	Bmu	Homa bay Mbita	Food Processors/Value addition MSME
Pauline	Okubasu	Azaavi Foods	Kenya, Machakos	Food Processors/Value addition MSME
PATRICK	Muchoki	africa natural products ltd(agritech)	parklands park place business center 1st floor	Food Processors/Value addition MSME
Patrick	Nderitu	Agricycle Global	Kenya Nairobi	Food Processors/Value addition MSME
James	Nyamai	BioAfriq Energy Limited	Machakos	Food Processors/Value addition MSME
Omar	Abdosalam	Osprey grain industry	Kenya,kosumu	Food Processors/Value addition MSME
Carol	Kimetto	Lilo Pure Foods Limited	Homabay, Kenya	Food Processors/Value addition MSME
Priska osebe	Moranga	Primoza Enterprises	Kisii county	Food Processors/Value addition MSME
Priska osebe	Moranga	Primoza Enterprises	Kisii county	Food Processors/Value addition MSME
Faith	Okong'o	Desiccated Sweetness	Nyamira	Food Processors/Value addition MSME
Charles	Kariuki	Village Industrial Power (VIP) Kenya Ltd.	Wote, Makueni	Food Processors/Value addition MSME
Samson	Okal	Jiranisam Enterprise	Kenya,Kisumu	Food Processors/Value addition MSME
Lilian	Kanoti	Lijam Eco-stimulus	Oyugis, Homabay county	Food Processors/Value addition MSME
KATHLEAN	RIZIKI	SHAJU WOMEN ENTERPRISE	KISII	Food Processors/Value addition MSME
Omar	Abdosalam	Osprey grain industry	Kenya, kisumu	Food Processors/Value addition MSME
Hildah	Nyasimi	Jayleen foods	Kenya_kisii	Food Processors/Value addition MSME
Hazel	Awino	Agri Innovation Hub Kenya	Narok	Food Processors/Value addition MSME
Dima	Abae	DMAZ PORK CENTER	Tana River	Food Processors/Value addition MSME
Maimuna	Abdurahim	ALMA ORGANIC	KILIFI	Food Processors/Value addition MSME

Samwel	Mwangala	Kijani Smile limited company	Kilifi	Food Processors/Value addition MSME
Amos	Obaga	Delight Grocers	Kenya - Mombasa	Food Processors/Value addition MSME
Dorcas	Asianut	Clazee Enterprise	Eldoret	Food Processors/Value addition MSME
Nesphory	Mwambai	Organic ilemba	Taita Taveta, Kenya	Food Processors/Value addition MSME
Roberto	Mwashashu	Mariah Dairy	Taveta, Taita Taveta County	Food Processors/Value addition MSME
Marrietta	Gonna	Ukulima Bora Dairy Farmer's Co op Society	Kenya Kilifi county	Food Processors/Value addition MSME
Martha	Kathure	JOMA JUNIOR EDUCATIONAL CENTRE	Kenya, meru	Food Processors/Value addition MSME
Samson	Maobe	Kisii University	Kenya	Learning and research institution
Martha K.	Nyang'au	Kisii University	Kenya	Learning and research institution
Ongaro	Paul	University of Nairobi	Nairobi	Learning and research institution
Stephen	Wanjiru	Lukenya University	Mtito Andei, Kenya	Learning and research institution
Justus	Kimolo	Lukenya university	Athiriver	Learning and research institution
Vincent	Otsieno	University of Nairobi	Nairobi	Learning and research institution
Vincent	Sudoj	University of Eldoret	Eldoret	Learning and research institution
JANE	AMBUKO	University of Nairobi	KENYA/NAIROBI	Learning and research institution
Daniel	Muinde	ACTS	Nairobi	Learning and research institution
Fiona	M	African Centre for Technology Studies ACTS	Nairobi	Learning and research institution
Kenneth	Werimo	Kenya Marine and Fisheries Research Institute	Kenya,Sangoro Station	Learning and research institution
Grace	Werikhe	Food Security center, University of Nairobi	Kenya	Learning and research institution
Justus	Kimolo	LUKENYA UNIVERSITY	ATHIRIVER	Learning and research institution
Jackis	Aukah	KIRDI	KISUMU- KENYA	Learning and research institution
Joshua	Owade	ACTS	Nairobi	Learning and research institution
Judith	Okoth	Jomo Kenyatta University of Agriculture and Technology	Nairobi	Learning and research institution
Joel K.	Tonui	University of Eldoret	Eldoret	Learning and research institution
Mohamed	Amin	Consultant	Somalia	Micro Finance Institutions (MFI)

Alex	Kiragu	Faulu Microfinance Bank	Kenya	Micro Finance Institutions (MFI)
Vis	Omondi	Bk	Mtwapa	Micro Finance Institutions (MFI)
Nasirembe	Wanjala	KALRO	Machakos, Jatumani	National and County Governments departments
Nasirembe	Wanjala	KALRO	Machakos Katumani	National and County Governments departments
James	Oyesola	Ministry of Agriculture/ EBAFOSA Nigeria	Nigeria	National and County Governments departments
George	Okoth	Directorate of Fisheries	Homa Bay, Kenya	National and County Governments departments
MUTUKU	FRANCIS	Ministry of Trade Cooperatives and Investment	Kitui	National and County Governments departments
Aatos	Mogoi	Youth Enterprise Development Fund	Kisii	National and County Governments departments
Winstone	Nyaguti	KIRDI	Nairobi	National and County Governments departments
Samwel	Owigo	County Government of Homa-Bay	Homa-Bay	National and County Governments departments
Jeritah	Kerubo	Fisheries	Kisii	National and County Governments departments
Fred	Karanja	DoA	HQ	National and County Governments departments
Ruth	Ndegwa	Kenya Climate Innovation Center	Kenya, Nairobi	Non-profit or Donor organizations
Charles	Tonui	African Centre for Technology Studies	Kenya, Nairobi	Non-profit or Donor organizations
Flora	Ajwera	GIZ	Kenya, Kisumu	Non-profit or Donor organizations
Jonathan	Omollo	Fsc /mobile agrovert	Homabay/suba south	Non-profit or Donor organizations
Mary	Imana	NETFUND	Nairobi	Non-profit or Donor organizations
Duncan	Morinke	NATIONAL ENVIRONMENT TRUST FUND	Nairobi	Non-profit or Donor organizations
Fredrick	Ochieng	Biovision Africa Trust	Nairobi	Non-profit or Donor organizations
Erick	Otieno	KCIC	Kenya	Non-profit or Donor organizations
Elizaphan	Ogechi	Nguzo Africa	Narok	Non-profit or Donor organizations
Mary	Mutemi	Green Africa Foundation	Nairobi	Non-profit or Donor organizations
Priscila	Muindi	Kenya Climate Innovation Center	Nairobi	Non-profit or Donor organizations
Josephat	Okemwa	ACTS	Nairobi	Non-profit or Donor organizations
ASENATH	OLOO	MAENDELEO YA WANAWAKE	MIGORI COUNTY NYATIKE SUB COUNTY	Non-profit or Donor organizations

Laban	Okeyo	County Government of Kisumu	Kenya, Kisumu City	Non-profit or Donor organizations
Pheles	Ngovo	ACTS	Nairobi	Non-profit or Donor organizations
Benson	Kimani	Kikozi Program Group (KPG)	Lamu County, Kenya	Non-profit or Donor organizations
Damaris	Ogonji	KCIC	Kenya	Non-profit or Donor organizations
Kariuki	Waweru	Ntashart Eco Green	Kenya, Kajiado West	Private sector and agriculture technologies
Macro Consultants	Consortium	Macro Consultants Consortium Ltd	Kenya	Private sector and agriculture technologies
Mary	Mutemi	Natural Resource Forum	Kenya, Nairobi	Private sector and agriculture technologies
Noel	Amoit	Kenya Climate Ventures	Nairobi, Kenya	Private sector and agriculture technologies
Wamae	Mwangi	Grekkon Limited	Nairobi	Private sector and agriculture technologies
Dancan	Ogola	Cereal growers association- CGA	Kenya	Private sector and agriculture technologies
Isaiah	Kipchirchir	Village Industrial Power Ltd	Kenya, Nairobi	Private sector and agriculture technologies
Isaiah	Muchilwa	Maridadi Farm Enterprises	Kenya, Kitale	Private sector and agriculture technologies
Evans	Mikera	Mevano Farms	Kenya, Kisumu	Private sector and agriculture technologies
Emmastella	Gakuo	Savanna Circuit Tech limited	Nairobi	Private sector and agriculture technologies
Percy	Lemtukei	Savanna Circuit Tech Limited	Nairobi	Private sector and agriculture technologies
Margaret	Kenda	Savanna Circuit Technologies Ltd	Nairobi	Private sector and agriculture technologies
Dominic	Wanjihia	Biogas International Ltd	Nairobi, Kenya	Private sector and agriculture technologies
Lewis	Ngugi	Biogas International Limited	Karen, Nairobi - Kenya	Private sector and agriculture technologies
Millicent	Okinyi	Reapline Farm Enterprises	Kenya /Migori	Private sector and agriculture technologies
Celina	Muriati	Cekare Farm	Meru county	Private sector and agriculture technologies
Felix	Njeru	N/A	Nairobi, Kenya	Private sector and agriculture technologies
Mercy	Njeru	Brands Company Limited	Embu Kenya	Private sector and agriculture technologies
Joe	Munene	Munene super fruits	Naromoru	Private sector and agriculture technologies
Caroline	Wanja	Betafut Investment Services	Lamu	Private sector and agriculture technologies
Caroline	Wanja	Betafut Investment Services	Kenya - Mombasa City.	Private sector and agriculture technologies



Charles	Masila	TM INVESTMENTS KENYA LIMITED	Mombasa	Private sector and agriculture technologies
Caroline	Wanja	Betafut Investment Services	Kenya - Mombasa city.	Private sector and agriculture technologies
Leah	Ndirangu	Lemmy jemmy enterprise	Kenya, MTWAPA	Private sector and agriculture technologies
Steffi	Maingi	EBAGROPAMOJA AFRICA	Nairobi	Women and Youth led groups working on distribution, fabricating solar dryer
Benard	Opondo	Millennium Media Services	Siaya	Women or Youth led groups
Gladys	Chesimett	Youth group	Nairobi	Women or Youth led groups
James	Obeto	Ndiru agroforestry group	Kenya- Homabay	Women or Youth led groups
Kamau	Wega	Wega Holdings Limited	Nyandarua	Women or Youth led groups
CHERUYOT.	RONO COSMAS.	CHEPKALWAL VISIONARY YOUTH GROUP	KENYA, BOMET COUNTY, NDANAI	Women or Youth led groups
Enid	Charana	Elite Youth Group	Kenya	Women or Youth led groups
Sarah	Onchangu	African Solutional Technology S.H.G	Kisii, Kenya	Women or Youth led groups
Jackline Moraa	Akunga	Akuja Apiculture Women Self Help Group	Kisii	Women or Youth led groups
Benjamin	Machuka	Jogre	Kidii, Kenya	Women or Youth led groups
Matara	Albert	Alma's pure honey enterprises	Nyamira county	Women or Youth led groups
Naftal	Nyangena	Nyabomoke Women Group	Kenya, Nairobi	Women or Youth led groups
Elizabeth	Ogutu	Margaret Baraka fish farming	Kenya /Mbita	Women or Youth led groups
Linnet	Arisa	Youth Enterprise Development Fund	Nairobi	Women or Youth led groups
Kevin	Andere	Kabodho vision 2030 Farmers Field School	Kisumu, Kenya	Women or Youth led groups
Mukune	Maroa	Osega women group poultry keeping	Bukira west	Women or Youth led groups
Josephine	Kibaru	Runyenje Ladies	Kenya; Embu County	Women or Youth led groups
Felix	Maingi	County Brave Limited	Kenya, Meru County	Women or Youth led groups
Meshack	Mutesa	Tijara farm	Kenya -Kilifi	Women or Youth led groups
Apolinary	Tulu	006 youth network	Taitaveta	Women or Youth led groups