

Innovations in East and West Africa

Transforming agriculture through collaboration



Implemented by

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WE4F

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WE4F



INTRODUCTION

Dear readers,

As you hold this booklet in your hands, it is likely that you are interested in addressing today's global challenges in our rapidly changing world. Food insecurity, climate issues, water scarcity, and energy demands are just a few of the pressing concerns we face. Did you know that approximately 30% of global energy usage, 28% of greenhouse gas emissions, and a significant 70% of freshwater consumption are linked to food production? With the world's population expected to grow, the demand for food could rise by up to 60% by 2050, putting additional strain on energy and water resources crucial for agriculture.

Addressing these challenges and driving sustainable transformation in agriculture and global food systems, while enhancing the livelihoods of smallholder farmers and mitigating climate change impacts, requires innovative approaches and solutions. This is why we, the international initiative Water and Energy for Food (WE4F) through the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), are excited to share this compendium packed with innovative ideas and technologies, fruitful partnerships, and inspiring stories from the Water Energy Food (WEF) Nexus in East and West Africa. Together, we aim to promote more sustainable food systems locally, regionally, and globally.

WE4F is a joint international initiative funded by the German Federal Ministry for Economic Cooperation and Development (BMZ), the European Union (EU), the Ministry of Foreign Affairs of the Government of the Netherlands, the Norwegian Agency for Development Cooperation (Norad), Sweden through the Swedish International Development Cooperation Agency (Sida), and the U.S. Agency for International Development (USAID). In the spirit of Team Europe, the initiative is dedicated to fostering the development and scaling up of climate-friendly, energy-efficient, and water-saving technologies and innovative solutions in the agricultural sector across Africa and Asia, with a primary focus on collaboration with the local private sector. Using a nexus approach, the initiative aims to break down silos to promote integrated solutions and increase synergies for greater impact and sustainability.

But what exactly does this collaboration entail? As co-implementers, USAID and GIZ operate through five

Regional Innovation Hubs (RIHs), spanning 53 countries across Africa and Asia. Located in West, East, Southern, Central and North Africa, the Middle East, and South and Southeast Asia, the RIHs work directly with the local private sector and are crucial for providing financial support, technical assistance, capacity development and investment opportunities to innovative companies offering WEF Nexus solutions.

This compendium highlights the collaborative efforts and achievements of WE4F and its partners across 15 African countries. From solar-powered irrigation systems and cold storage solutions to organic fertilisers, energy-efficient food processing, and digital credits, WE4F partners from the local private and finance sectors, research institutions, and governmental organisations have been driving groundbreaking WEF Nexus solutions. These solutions empower smallholder farmers by facilitating access to essential inputs, finance, technology, and markets.

To date, the initiative's support and scaling of nexus solutions in Africa and Asia has impacted 3.6 million end-users and helped them grow 6.8 million tonnes of food, save 1.2 billion kilowatt-hours of energy, reduce water consumption by 10.8 billion litres, and prevent 1.5 million tonnes of CO₂.

While the initiative has laid the groundwork for supporting innovative ideas and solutions, the journey is far from over. Our partners have already achieved significant impact over the past four years, whether by empowering individual smallholders, transforming entire communities, influencing policies, boosting economies, or advancing scientific knowledge. We are confident in their potential to continue disseminating their work and catalysing change in agriculture and food systems at local, regional, and global scales.

We express our gratitude to all the innovative enterprises and partners featured in this compendium for their trust, dedication, and collaborative efforts.

On that note, please join us now on a journey through the transformative power of collaboration, innovation, and sustainability as we showcase the remarkable achievements of WE4F and its partners across the following pages!

ABOUT THIS COMPENDIUM

WE4F via its Regional Innovation Hubs (RIH), has successfully worked with many innovative enterprises in West and East Africa on the Nexus of Water, Energy, and Food. The common goal: to produce more food with fewer resources, transforming agriculture and food systems, and to improve food security. The wealth of knowledge and experience is something that we want to bundle and preserve for future programmes, partners, and international initiatives. Therefore, the compendium highlights innovative Nexus solutions developed by creative minds. It is a testament to the collaborative efforts between the programme, local enterprises, global, regional and national institutions and end-users, aiming to enhance the livelihoods of smallholder farmers, mitigate climate change impacts, overcome silos and sustainably achieve food security on a national, regional, and global scale.

The compendium includes an overview of the GIZ project's (map), a list of innovative partners who have worked with WE4F, and a detailed description for each innovator working in one of seven pivotal topics:

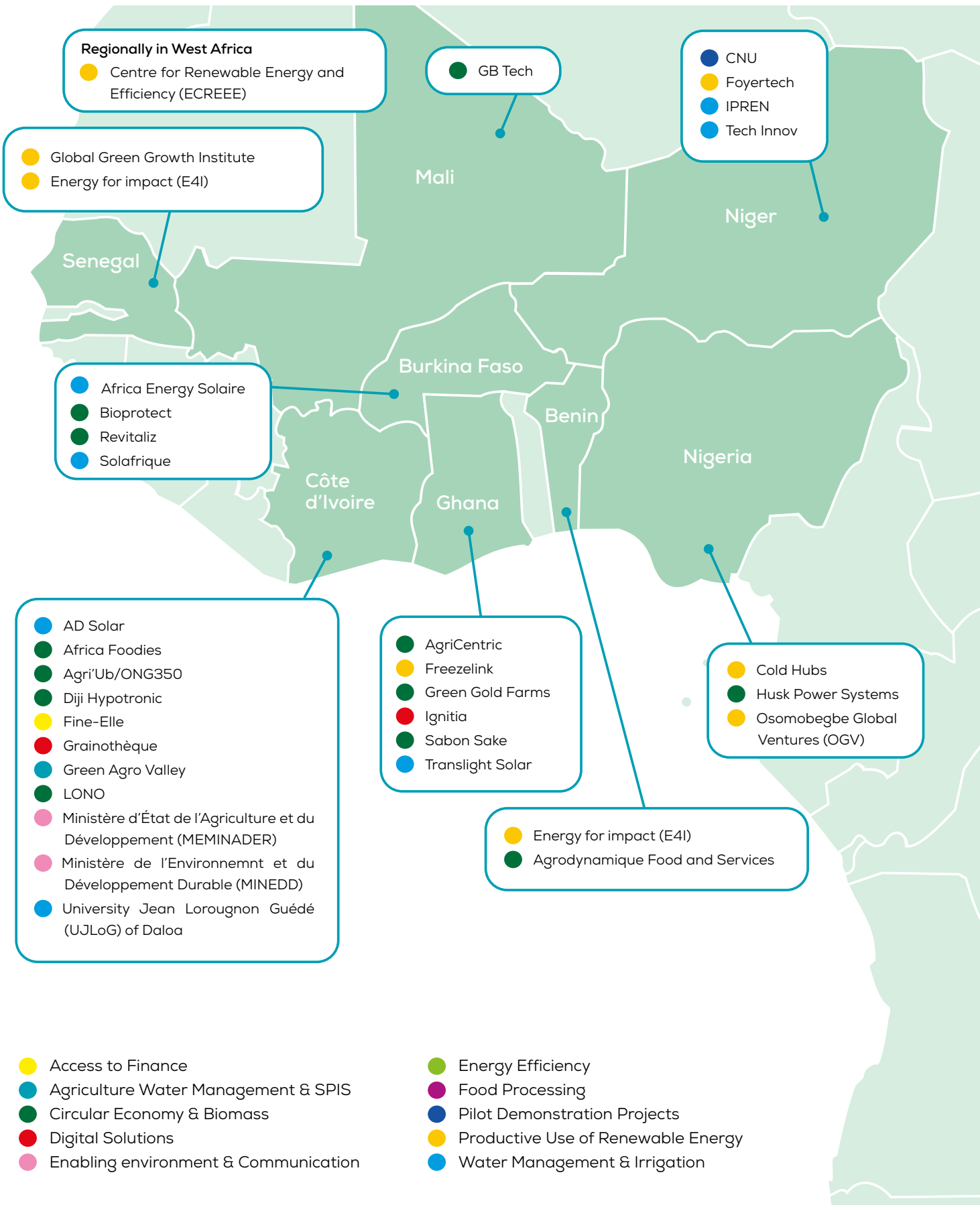
- Helping businesses grow
- Improving access to finance for smallholder farmers
- Optimizing resource use efficiency in agricultural value chains
- Promoting a circular economy
- Adapting to climate change
- Empowering women
- Creating an enabling environment across sectors

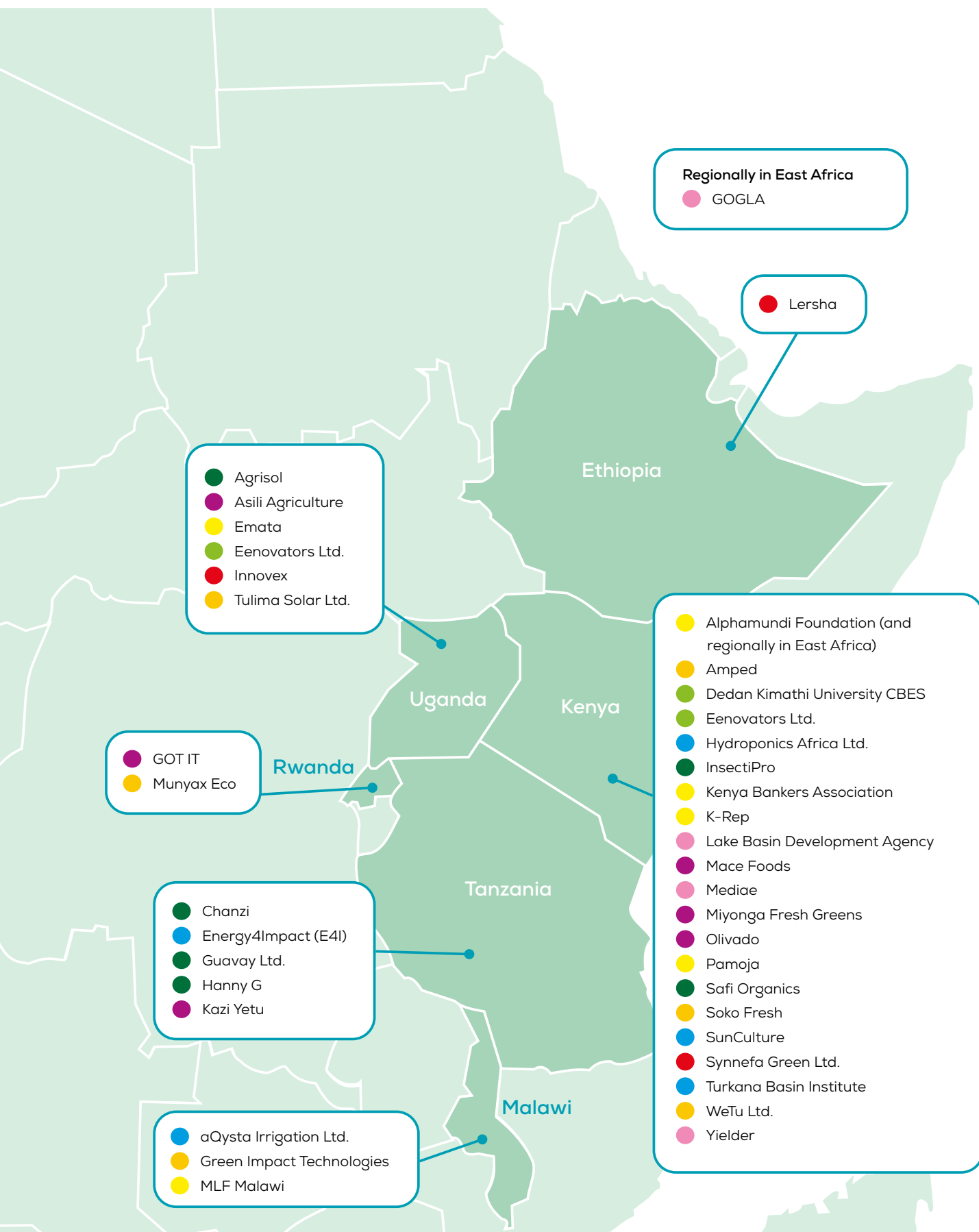
These partners have not only catalysed change and impact in their immediate environments but have also set a precedent for future innovation.

As we continue to support groundbreaking solutions and advance the implementation of the Water-Energy-Food Nexus, we invite you to delve into the inspiring stories, achievements, and the transformative power of the partnerships and success stories presented in this compendium. It serves as a roadmap for future cross-regional collaborations and joint efforts in the WEF Nexus. Together, we can continue to foster a more resilient, sustainable, and forward-thinking world.



MAP OF WE4F ACTIVITIES AND PARTNERSHIPS





Regionally in East Africa
 ● GOGLA

● Lersha

● Agrisol
 ● Asili Agriculture
 ● Emata
 ● Eenovators Ltd.
 ● Innovex
 ● Tulima Solar Ltd.

● GOT IT
 ● Munyax Eco

● Chanzi
 ● Energy4Impact (E4I)
 ● Guavay Ltd.
 ● Hanny G
 ● Kazi Yetu

● aQysta Irrigation Ltd.
 ● Green Impact Technologies
 ● MLF Malawi

● Alphamundi Foundation (and regionally in East Africa)
 ● Amped
 ● Dedan Kimathi University CBES
 ● Eenovators Ltd.
 ● Hydroponics Africa Ltd.
 ● InsectiPro
 ● Kenya Bankers Association
 ● K-Rep
 ● Lake Basin Development Agency
 ● Mace Foods
 ● Mediae
 ● Miyonga Fresh Greens
 ● Olivado
 ● Pamoja
 ● Safi Organics
 ● Soko Fresh
 ● SunCulture
 ● Synnefa Green Ltd.
 ● Turkana Basin Institute
 ● WeTu Ltd.
 ● Yielder

IMPACT BY EAST AND WEST AFRICA HUBS

The impact of two of the five Regional Innovation Hubs, **East** and **West Africa**



670.000+ tons

Food produced as a result of WE4F innovations

43+ Innovators

Scaling ground-breaking water-energy-food innovations to impact food security, gender and poverty reduction in an environmentally sustainable way



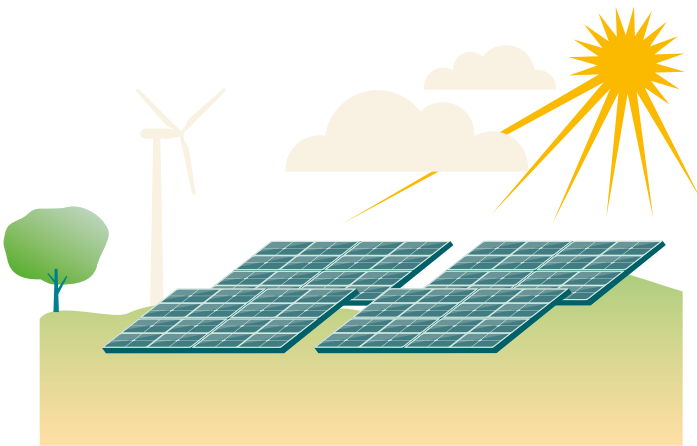
328,900+
smallholder farmers

have introduced climate-friendly, energy and/or water-efficient innovations



88.900+ tons

Food processed as a result of WE4F innovations



52 million+ kWh

Energy saved in the food value chains as a result of the use of WE4F innovations



14.3 million+ USD

External investment mobilized by WE4F innovators



5.3 billion+ litres

water consumption reduction in the food value chain as a result of WE4F innovations





**INNOVATORS
AND PARTNERS**



**ACCESS
TO FINANCE**

INTRODUCTION

The agricultural sector is seen as a highly risky venture by financial institutions (FI), and most do not offer products designed to meet the needs of smallholder farmers and MSMEs in rural regions. Without capital to invest in their farming, smallholder farmers are often stuck in the same cycle of poverty for generations. Lacking a financial buffer, they are particularly vulnerable to external shocks, such as inflation, rising fuel costs, or climate risks. Local government typically don't provide sufficient support for smallholder farmers to access finance. Banks and commercial MFIs do not serve the rural poor as it is expensive to provide small loans to communities, who need extensive training and support to succeed.

It is for these reasons that WE4F partnered with microfinance institutions (MFIs) and local private sector to develop innovative financing mechanisms for small-holder farmers. This includes individual loan products for climate-friendly and resource efficient technologies as well as Pay-As-You-Go/ Grow models and energy performance contracts.

By accessing finance, smallholder farmers can invest in innovative technologies and practices that increase agricultural productivity, lead to more sustainable use of natural resources, and improve the livelihoods of farmers and their families.





ENERGY FOR IMPACT (E4I)

The power of the private sector: How solar irrigation is empowering farmers in Tanzania

If you combine improved access to small-scale solar irrigation with modern agricultural technologies and successful partnerships with the private sector, you have a recipe for change of Tanzania's agricultural sector. The WE4F East Africa Hub and Energy for Impact (E4I) teamed up in a project to support smallholder farmers in rural Tanzania to boost their food production and incomes by leveraging the private sector.

Background

Agriculture is a key sector in Tanzania, accounting for almost 29% of the country's GDP and about 80% of Tanzanians are working in the sector. Solar-powered irrigation systems (SPIS) have become a key technology for many smallholders in rural areas due to their low operating costs. WE4F and E4I have partnered in Tanzania to help create awareness and improve the uptake of SPIS solutions, ultimately empowering farmers to produce food efficiently – regardless of the weather.

Project in a nutshell

The project was implemented in three regions of Tanzania- Mara, Simiyu and Mwanza. These regions have been purposefully selected for project implementation because they are among the regions most affected by increasing temperatures and drought frequency, as well as shifting rainfall patterns. Activities included:

- 1) **Creating awareness** of benefits of small-scale solar irrigation systems in rural Tanzania.
- 2) **Linking farmers to local financial institutions and solar equipment suppliers** to increase the uptake of solar irrigation in rural areas.
- 3) Offering comprehensive **agricultural extension services** to farmers, disseminating information on farm technologies, support rural adult learning and assist farmers in developing their farm technical and managerial skills.
- 4) Documenting experiences and lessons learnt to help develop **policy briefs** for decision-makers, project developers, funding agencies and the private sector.

By connecting rural farmers with irrigation companies in Tanzania helps both sides benefit. Solar irrigation companies can sell their products, while farmers learn how to effectively boost production and adapting to the changing climatic and environmental conditions.

Challenges & learnings during the implementation

Affordability of pumps remained a key challenge. During the implementation of the project, the price of solar irrigation equipment rapidly increased by up to 90% due to increased logistical costs stemming from the Covid-19 pandemic and rising fuel costs. This meant that many interested farmers were unable to purchase pumps at the time. E4I enabled farmers to acquire the equipment using Pay-As-You-Grow method, repaying in instalments over several months and aligned to harvesting periods. E4I also worked with local finance institutions to develop specific loan products for solar irrigation equipment. This resulted in 76 pumps sold to smallholder farmers in the first year of making these two financing models available.

Lack of awareness of solar irrigation technology among farmers was another key challenge. Extension services are limited and there was a serious lack of training for farmers. E4I worked to increase aware-

ness through various communication measures, such as radio shows and roadshows, as well hands-on farmer trainings.

Participation rates of women in the trainings and financing schemes was low throughout the project. Only 9% of those who acquired a solar irrigation system were women. However, women were often involved in decision making, especially in acquisition of pumps and marketing of agricultural produce.

Looking forward

The project demonstrated to small-scale farmers that solar irrigation technologies are a viable option for farmers to adapt to climate change. By linking farmers, solar irrigation technology providers and financiers, they can work together to increase the uptake of solar irrigation by providing information and finance to small-holders. However, affordability remains a key challenge that can only be resolved by economy of scale. This can only be achieved together.

Awareness creation - highlights

- 87 roadshows covering 87 villages in 16 districts in 3 regions.
- 3,100 information pamphlets produced and distributed in different project areas.
- 20-minute explanatory video on the use and advantages of solar irrigation systems.
- 6 radio shows produced and aired in 5 regions -Mwanza, Mara, Simiyu, Shinyanga and Geita.
- 4 project articles produced and published.

Facts

- Agriculture in Tanzania accounts for almost 29% of the country's GDP.
- Declining costs in solar panel prices and new financial models have made solar-powered water pumps more accessible and affordable to rural farmers.
- Scaling the use of solar water pumps can contribute to many of the Sustainable Development Goals.

Agricultural Finance	76 irrigation equipments sold to smallholder farmers through credit from solar irrigation suppliers and local financial institutions and 3 solar irrigation equipment companies supported with promotion activities to access farmers
Capacity Development	327 farmers trained and supported to improve their farming practices and business management
Awareness raising	4,936 farmers reached by the project's awareness raising activities
Policy	2 policy briefs prepared and shared with policy and decision makers for call for action to support solar irrigation in Tanzania
Demonstration Sites	8 demonstration sites have been set up to conduct on-site training, demonstrations and awareness raising.



MLF MALAWI

ESG compliant finance

The partnership between the WE4F East Africa Hub and the Microloan Foundation Malawi (MLF Malawi) seeks to promote access to environmental, social and governance (ESG)-compliant finance for smallholder farmers and micro, small and medium enterprises (MSMEs) in rural and peri-urban communities in Malawi. In addition, the project aims to increase MLF's efficiency and establish better customer contact.

Background

The agricultural sector in Malawi accounts for 30 % of GDP engaging 80% of the population, mostly in subsistence farming. However, many smallholder farmers are faced with climate shocks, limited access to suitable financial services, and inadequate agricultural practices. MLF Malawi, founded in 2002, is one of the leading social microfinance institutions, providing financial services including credit, financial literacy training, and business training to bottom of the pyramid clients in rural and peri-urban areas of Malawi. MLF serves approximately 30,000 customers across 20 branches across the country, the majority of whom are female smallholder farmers and Micro, Small and Medium Enterprises (MSMEs). MLF Malawi recognizes the need to invest and future proof the support system for entrepreneurs to ensure that rural businesses in the agricultural sector in Malawi are working towards environmentally and socially sustainable practices.

Project in a nutshell

MLF Malawi partnered with WE4F to increase **access to Environmental, Social and Governance (ESG)-compliant finance for smallholder farmers and MSMEs** in rural and peri-urban communities in Malawi, the first of its kind in Malawi. In particular, the project aimed to:

- a) Develop needs-based individual loan products, which consider the environmental and social impact associated with potential business activities proposed for financing or being financed.
- b) Strengthen the internal capacity and adapting procedures of MLF Malawi to identify, evaluate and manage environmental and social risks for both the institution and smallholder farmers and MSMEs.
- c) Increase the overall efficiency of MLF Malawi and increase outreach to clients (male and female) by delivering the individual loan product digitally via mobile money.
- d) Provide training on financial literacy, business, and ESG compliance, and conservation farming to clients.

By connecting rural farmers with irrigation companies in Tanzania helps both sides benefit. Solar irrigation companies can sell their products, while farmers learn how to effectively boost production and adapting to the changing climatic and environmental conditions.

Facts

- According to Finscope, most women in business own micro-enterprises (**84%**) and only **15%** are in the SME sector.
- MLF Malawi operates in 22 branches and 13 satellite locations across Malawi. Currently, **100%** of MLF's clients are women and **90%** of them are smallholder farmers.
- Market research has shown the clear demand for an individual lending product. The growing number of high-performing businesses opens the opportunity for a profitable and scalable rural agricultural loan portfolio.
- Currently, **15%** of loans are repaid via mobile money, increasing overall efficiency for MLF Malawi and simplifying the processes for its clients.

Gender policy

- Mission of MLF Malawi: Provide poorest women in Malawi with tools & skills to work their way out of poverty

- 100% of Agribusiness & MSME clients are women, mostly in rural & peri-urban areas.
- Solidarity groups formed to offer microcredits to women.
- Gender Strategy planned to assess impact of including men and individual loans for growing female smallholder farmers and businesses.

What has been achieved so far?

WE4F and MLF Malawi Ltd started working together in April 2022, combining MLF Malawi's local knowledge and expertise in providing pro-poor financial services for women with the know-how of experts in ESG frameworks and digital SME product development. As a first milestone, market research was conducted with 300 clients and 20 non-clients to improve market knowledge of growth-oriented agricultural businesses and identify potential ESG risks. The research identified four bankable ESG-compliant investment opportunities, namely individual loans for solar irrigation, solar fridges, biogas systems, and stress-tolerant maize crops. To this end, MLF Malawi signed partnership agreements with several technology suppliers. As a next step, the loan products were tested through digital channels with existing and new clients. Following the pilot stage, all ESG loan products will be offered across all of MLF Malawi's branches, reaching at least 5,000 clients in the first year.

At the same time, training for smallholder farmers and MSMEs took place to improve their knowledge of environmentally and socially sustainable agricultural business practices.

After an assessment of MLF Malawi's internal structures, an ESG framework for the institution was developed and integrated into MLF Malawi's operating procedures. A particular focus was put on governance issues. This also included the development of a gender strategy to assess impact and risk of including men in portfolio is developed and implemented.

Both processes seek to prepare MLF Malawi staff and clients on key aspects for ESG-compliant products.

Capacity Development	30 HQ and pilot branch staff from MLF Malawi trained and selection coached on ESG compliance and individual loan products.
Food Security	Smallholder farmers and MSME trained to manage environmental and social impact of their businesses and improve farming practices as they access loans to make investments in their own food security and livelihoods.
Access to Finance	<ul style="list-style-type: none"> • ESG Framework and implementation strategy developed • Gender strategy to assess impact and risk of including men in portfolio is developed and implemented • Digital ESG-compliant individual loan product (secured and unsecured) tested with 50 smallholder farmers and microentrepreneurs with growth ambitions.



K-REP

Promoting financing for solar for productive use technologies

K-Rep aims at providing financing to smallholder farmers and small and micro-entrepreneurs in rural areas to acquire productive use of renewable energy technologies (PUE). Through its partnership with WE4F, K-Rep is able offer an affordable and customer centric solution. The clients benefit from improved access to information about solar irrigation and financial literacy.

Target customers

K-Rep's main customer segment are smallholder farmers, dairy farmers and youth operating micro and small enterprises that may require solar powered equipment and devices. Farmers organized in groups are affiliated to Financial Services Associations (FSA) through which they can access K-Rep's services and loans. The group lending model attracts more women than men to take up agricultural and clean energy loans. K-Rep places special efforts in ensuring that women participate in all training, promotion and awareness raising activities to contribute to women empowerment.

Business model to provide finance

WE4F and K-rep Fedha Services partnered in 2022 to make PUE technologies more affordable for smallholder farmers. As part of this, they implemented:

- 1) Awareness creation, promotional events, and end-user education on solar for productive use technologies.
- 2) Expansion and enhancement of promotion and distribution channels of Financial Services Associations (FSA) to provide consumer credit services earmarked for solar for productive use technologies.
- 3) Development of scalable business cases for financing Solar for Productive Use Technologies by Financial Services Associations (FSAs).

K-Rep makes direct sales through FSAs. FSAs are rural member based financial institutions. Credit to members is accessed and administered using the group methodology where members are self-selecting mainly based on familiarity and proximity of residence. Group guarantee and social pressure therefore form the first level of loan approval and guarantee. Prior to accessing credit, new group members are taken through financial literacy sessions by loans clerks for a period of 4 to 8 weeks and upon fulfilling pre-requisites at group level, a loan application need to be approved by group leadership and the FSA manager. Capital for financing credit comes from a pool of share capital contributed by the members, member mandatory and voluntary savings.

Distribution channels

K-Rep reaches farmers and micro and small enterprises through Financial Services Associations (FSA). The FSAs organize information sessions in their different branches for their members on credit services offered. K-Reps signs agreements with reliable and affordable distributors of PUE technologies with clear terms and conditions on quality, warranty and aftersales service and sets up demonstration sites where group members learn about solar PUE technologies.

Repayments

In addition to K-Rep's existing credit guidelines that govern the monitoring and the follow-up of disbursed loans, the monthly group meetings serve to facilitate the loan repayments.

Terms and conditions

K-Rep assesses the need and capacity to pay for the loan for acquisition of solar irrigation systems for each individual customer irrespective of whether they are in a lending group set-up. The main criterion is that the farmer is already engaged in farming and that the use of solar irrigation will boost the productivity and cost efficiency of the existing farm. Once acquired, K-Rep considers the solar irrigation equipment as collateral for the loan. K-Rep's loan interest rate is 1.5% per month with a loan repayment period of up to a maximum of 18 months.



Value-added services

K-Rep offers various value-added services to its farmers and micro and small enterprises in form of trainings on general solar powered solutions, financial management and investments. New farmers acquire co-ownership of the FSA through a membership. To solve market access challenges establishing a market linkage platform to link buyers and off takers of horticultural and dairy produce with smallholder farmers who have bought solar PU products on credit from FSAs.

Value proposition

K-Rep's partnership model with solar irrigation suppliers helps to stimulate demand for financing for solar PUE technologies and establish a business model that is scalable and commercially viable. It addresses both the information and affordability challenge of PUE technologies. Customers can acquire quality and appropriate solar pumps at more affordable prices. Unlike diesel powered water pumps, which have high operations and maintenance costs, the use of solar powered water pumps reduces farming overheads and increases productivity for the farmers. K-Rep allows the customer to purchase the solar irrigation systems as an asset to be used as collateral for subsequent loans with the FSAs.

Traction and impact

K-Rep in partnership with the leading service provider for solar PUE technologies in their operating regions were able to train and provide live demonstration for 461 farmers. Well attended awareness and training activities have generated a lot of interests. K-Rep plans to disburse the loans and solar equipment after the rainy season.

Scalability

K-Rep's model is easily scalable in other counties and countries where farmers and micro and small enterprises experience the similar challenges. Currently the pilot runs with 5 FSAs under K-Rep networks. The product is anticipated to be rolled out to all 36 FSA in various counties, leveraging on the lessons learnt from the pilot.

COMPANY DESCRIPTION

K-Rep Fedha Services Limited (KFS), registered under the Kenya's Companies Act as a Limited liability Company, was established by K-Rep Development Agency (KDA) in 2005 as a specialist Management Company for Financial Services Associations (FSA) to provide backstopping and oversight. FSAs who K-rep works with are rural community member based financial institutions offering financial services with the main aim of improving the lives and livelihoods of the people in the communities that they serve. There are 36 FSAs under KFS network with the oldest being in existence for around 20 years and the youngest for 5 years, with over 330,000 members spread across 9 counties in Kenya.





PAMOJA DIGITAL

Pamoja's digital loan for solar productive use technologies

Pamoja Digital offers a 100% digitally anchored loan product for solar productive use (PUE) technologies. Pamoja Digital has partnered with WE4F to provide a financial product adapted to the needs of smallholder farmers. They use a USSD platform and App that eases the customer's access to financial services and allows for user friendly customer onboarding, loan applications, repayment, marketing, and educational content delivery.

Target customers

Pamoja Digital's offering is addressed to smallholder farmers and entrepreneurs in rural areas, most of whom run informal businesses. Both individuals and organized groups of farmers and farmer cooperatives are eligible for a loan product. By the nature of its lending model and products marketed, women and youth form a majority of the client portfolio. Pamoja Digital places special efforts in ensuring that women participate in all promotion and training activities and that the financial products introduced contribute to women empowerment.

Business model to provide finance

WE4F and Pamoja Digital Financing Company Limited partnered up to improve the accessibility of financial services for smallholder farmers, which, in turn, improves the affordability of PUE technologies. This includes awareness creation and farmer trainings on the use of solar technologies for productive use; the expansion of distribution channels for micro finance credit services; and the development of loan products for smallholder farmers, wanting to acquire solar technologies.

Digital lending business: To alleviate challenges and high cost of operations in remote areas, Pamoja Digital uses mobile technology to provide loans for PUE to its customers. It has partnered with a technology supplier providing a platform for the loan management system. Through another partnership it has developed and rolled out a USSD platform and a Pamoja App that allows for new customers registration, loan application, training materials and a diagnosis of the PUE appliances.

Distribution channels

Pamoja Digital has invested in expanding its branch network to reach more farmers in remote areas. Together with Solar Water Pump distributors it sets up demo sites, curates educational content for farmers and conducts field days to demonstrate the functionality and elaborate on the benefits of solar PUE technologies. In addition, Pamoja Digital grows its rural customer base through an incentive scheme that rewards clients for referrals and clean energy products demonstrations to their peers and communities. Pamoja Digital uses its USSD platform and an App to increase PUE adoption by farmers in rural areas. Rural farmers can self-register, review the variety of Pamoja PUE products offered by different suppliers, and initiate a loan application process from the comfort of their homes.

Repayments

Pamoja Digital uses multiple ways to ensure loan repayment. For that purpose, continuous training and weekly group meetings are organized. Reminders are also sent via SMS. For a group lending loan, Pamoja Digital demands co-guarantee of the group members. Repayments on individual loans are collected through farm visits by loan officers.

Terms and conditions

Pamoja Digital combines touch and technology to conduct credit appraisal and to manage the credit cycle through the 5C's (Capacity, Capital, Collateral, Conditions, Character) of Credit and CAMPARI model. The credit cycle management includes farmer trainings upon disbursement of the loan, loan repayment, farm visits by the loan officers, and the repayment to the suppliers. Pamoja Digital uses chattel mortgage such as the solar powered water pump as a collateral. The interest rate of the loan product is 20% with a payback period of 3 to 9 months.

Value-added services

Pamoja Digital makes Solar PUE technologies affordable and accessible to small holder farmers by linking them up with suppliers with quality products and over one-year warranty. Pamoja Digital addresses the lack of information on solar PUE technologies of its customers by partnering with solar PUE technology providers and technicians to conduct farmer trainings and deploy demo fields on farms to promote the farmer's user experience. The trainings include a financial literacy component as well. In addition, Pamoja Digital constantly sources for off takers to link farmers to markets.



Value proposition

Pamoja's combined value proposition of energy for productive use technology + financing + digital services including training is an innovative, unique and customer centred solution in the market. The use of solar irrigation, for instance, not only reduces significantly overall production and operating costs by 40% compared to the conventional farming model with petrol powered pumps, but also contributes to a reduction in environmental pollution and of CO2 emissions. Farmers benefit as well from consistent supply of water during the dry seasons.

Traction and impact

Pamoja's digital loan product for solar PUE technologies has so far benefited 237 farmers, of whom 75% are women and 25% men. As a result of the various outreach and awareness raising campaigns such as farmer group trainings and demonstration fields, Pamoja Digital has experienced a steady increase in loan uptake. 7 direct jobs (loan officers + trainers) and 4 indirect jobs (solar water pump technicians) were created. Smallholder farmers and entrepreneurs benefit from reduced production costs of over 40%, leading to an increase in household income. Due to the constant supply of water during the crop cycle, farmers have reported a 15% increase in yields. The IT platform upgrade, including the Pamoja App and USSD code, has significantly boosted customer loan repayments, facilitated farmer training access, and streamlined onboarding for new farmers directly from their farms. Additionally, farmers can now apply for SWP loans without visiting Pamoja offices, allowing them to prioritize their farm work.

Scalability

Pamoja Digital's PUE technology financing model has attracted interested and demand by farmer cooperatives in dairy, crop and green house farming. It is replicable in other countries in East Africa with similar climatic conditions and comparable agriculture cycles, needs and challenges.

COMPANY DESCRIPTION

Pamoja Digital Financing Company Limited is a credit only microfinance institution incorporated in January 2019 with 3 years in operation and provides financial services to rural small holder farmers and entrepreneurs organized in groups of between 5 and 30 through provision of affordable, flexible, innovative and customer oriented financial services. Pamoja Digital has operations in 5 counties and branches in Makutano, Chwele, Kabsabet, Ruiru and Embu. Pamoja Digital's credit services are invested in agricultural value chains for purchase of farm inputs, farm equipment and clean energy products while rural business enterprises for working capital and purchase of equipment. To alleviate challenges and high cost of operations in remote areas, Pamoja Digital Business Model is 100% anchored on mobile technology utilizing android devices for client recruitment and digital wallets such as MPESA for loan disbursement and repayment. Pamoja Digital has an in-house custom credit scoring system which profiles new clients into risk buckets for ease of credit decisions. Pamoja's mission is to enhance the livelihoods of small holder farmers and entrepreneurs by providing innovative and efficient customer oriented financial solutions in the market.





TULIMA SOLAR

Pay-As-You-Go financing by Tulima Solar

Tulima Solar provides productive-use solar irrigation solutions in East Africa. It is combining technology with financing. The company offers both pumping technologies as well as finance. Tulima deploys a Pay-As-You-Go (PAYG) platform that allows it to communicate with customers to provide optimal services as well as follow up on payments.

Target customers

Tulima Solar's offer addresses smallholder farmers' needs by providing accessibility to solar equipment. The key segments are loosely-market affiliated farmers who sell intermittently, often at farm gate, and rarely have access to irrigation technology; market-integrated farmers who are more experienced in using irrigation technology and have consistent markets where they sell; and commercial farmers who invest in seeds, irrigation and best practices to sell to pre-arranged buyers and/or off-takers. Historically, the profile customer has been male and over 40 years old. Through the support from WE4F, Tulima targeted especially younger and female farmers to increase the market size and inclusivity.

Business model to provide finance

One-Stop-Shop Model: Tulima Solar offers multiple services to its customers. This includes the solar pumps, after-sales services and loans.

Distribution channels

Tulima Solar's go-to-market model is centred around partnerships with key value chain players having signed distribution MOUs with 26 of them. They include cooperatives, development partners, financial institutions, equipment manufacturers and seed suppliers. Tulima Solar collaborates with these partners in activation and training events, generating sales leads, and supporting clients with complementary services after they adopt the systems. Tulima leverages its partner networks to service its clients in parts where the company doesn't have a presence.

Repayments

Farmers do a downpayment of 25% of the pump's value upon picking the asset. The balance is paid in monthly instalments. A typical loan cycle goes up to 22 months. Usually, Tulima Solar's margin is embedded into the product price and the monthly breakdowns include the cost of financing. Farmers pay different rates depending on the cost of the pump that meets their needs. Tulima Solar offers 15 different types of solar pumps. Farmers select their preferred payment plan ranging from 3, 6, 12, 18 and 22 months depending on the type of pump they acquire. Tulima's control box (PAYG Bridge) integrates with pumps and automatically shuts them off when a client is late on repayments. Via a GSM feature, they also get information on the usage of the pumps. The solar pump then becomes the only collateral held by the farmer for the loan facility.

Terms and conditions

Tulima Solar receives farmers' requests for solar irrigation equipment directly and through its regional partners. After a careful assessment process that evaluates farmers' water needs, experience, and sources of income, provides financing for the solar equipment to farmers. They have a standardized application and professional underwriters on staff. Tulima Solar's pumps vary in pricing depending on model but range on average between \$250-\$500 a pump.

Value-added services

Tulima Solar has developed on demand complementary products such as drip irrigation, sprinkler and tanks, as well as agronomic advice, quality farm inputs like quality seeds and market linkages for farmer produce through its partners to enable farmer success.

Value proposition

Tulima Solar's PAYG financing acts as the only collateral required to purchase a pump from Tulima Solar as opposed to FIs that usually require higher value collateral such as land in such cases, thereby opening access and affordability of critical farm irrigation assets by smallholder farmers. The value proposition of energy + financing + equipment + service is an interconnected solution that is currently unavailable for income-generating equipment within the East Africa region, making it both unique and highly competitive.

Traction and impact

Below is Tulima Solar's traction as of Dec 2022.

Loan disbursements	UGX 775 million
Signed partners	26
Tulima Solar clients live on lending	402 (including paid off) and 106 (in repayment only)
N# of smallholder farmers reached	457

Scalability

Tulima Solar's irrigation financing model has already been replicated in the dairy and fish value chains in Uganda accelerating access to smallholder farmers to acquire freezers, milk chillers, solar fridges, and fishing lights. The model is easily replicable and scalable across the region as smallholder farmer challenges in Uganda cut across the East Africa region.

COMPANY DESCRIPTION

Tulima Solar is a leading productivity-enhancing agricultural equipment provider in East Africa that focuses on smallholder farmers with 0.5 to 20 acres in the horticultural and animal husbandry (livestock) sectors. The company provides access to affordable and modern farm equipment by financing farmers to acquire solar-powered water pumps for irrigation, enabling them to improve farm production. For smallholder farmers in Uganda, irrigation has provided a means of subsistence and economic opportunity in the form of small-scale farming operations. Tulima Solar has been operational in Uganda since 2019 and is on a mission to enable rural prosperity through financed productive equipment access.



AQYSTA

Farmer incubator model

aQysta produces and sells hydro-powered pumps for irrigation. Its Barsha pumps use the current of rivers to pump water without further operational costs for the farmer. To ensure farmers can access and use the pump despite the high initial investment costs, aQysta has adopted the GROWN farm incubator training model in Malawi.

About the grown farm incubator training model

The GROWN Farm Incubator Training model was designed by aQysta to address the challenge of access by smallholder farmers. Through the model, the company provides the pumps, farm inputs and a pre-payment to farmers.

This allows farmers to access quality farm inputs and water throughout the year for continuous crop production and to meet their basic needs during planting period. Smallholder farmers and aQysta enter into a contract where the cost of the inputs, the pump and the pre-payments are recovered from the sale of the produce.

Proceeds are shared on a 40-60 revenue share basis between aQysta and the farmer. Farmers are provided with a detailed breakdown of the costs involved for inputs and assets.

Upon harvests, aQysta deducts part or the whole of what is owed to them by the farmer in line with the agreement between aQysta and smallholder farmers.

About the centralized incubation model

Under the centralized incubation model, aQysta has since dropped pre-payments to farmers as they have built trust with farmers to adopt the pay per kilo model through which aQysta's farmers are incentivized to produce more and thus earn more from the sale of their produce.

Low or failed farmer harvests negatively affect aQysta's payments to farmers since low farm yields result in reduced payments to farmers, but also means that aQysta must wait for the next season to recoup part or whole cost of inputs to farmers.

While aQysta guarantees the farmer with market for their produce, the company will not purchase poor quality produce as aQysta will not be able to sell the produce to end markets hence no incentive to pay the farmer.

The farmer receives no payment from aQysta in case of poor harvest or calamities such as cyclones. The centralized farm incubator model also works as a safety net for aQysta as it ensures the company has control on certain risks as side selling from farmers looking to make a quick buck.

Distribution channels

Sales of Service (hardware + service) to farmers: In the farm incubator model, Barsha pumps, along with additional services of agriculture extension and market linkage are sold to farmers as a service. Farmers pay using a percentage of harvest revenue.

Repayments

Profits from the sale of the products are shared between aQysta and the farmer on a 40-60% revenue share basis. For the aQysta's farmers who receive a monthly allowance in the form of pre-payments, these are eventually deducted from the profit after the harvest and sale of produce.

Terms and conditions

Farmers pay for the service as a proportion of the harvest. Specific crops are selected for which market partnerships are secured and seed, training, and working capital financing are provided to farmers. To mitigate financial risk, farmers in the farm incubator model sign an agreement stating that the hardware can be moved, or the farm management can be transferred to another farmer if there is a case of negligence.

Business model to provide finance

aQysta's main customer segment is smallholder farmers who lack resources to purchase farm inputs and assets upfront. Most of the end users of the pumps and farm incubator services are youth below 35 years of age.

Target customers

One-Stop-Shop Model the GROWN Farm Incubator, providing the assets and farm inputs and market linkage for the produce. aQysta has a 40:60 revenue-sharing model with the smallholder farmers as part of the recovery of the cost of the inputs.

Value proposition

The partnership with smallholder farmers provides an opportunity to profitable and ecologically sustainable agriculture, from supplying water for irrigation to market linkages. The GROWN model also provides pay-after-harvest financing for inputs, technologies, and services.

Traction and impact

- aQysta's GROWN farm model has so far over 1800 beneficiaries.
- 200 smallholder farmers have increased farming income by 300% to date, as reported by aQysta through surveys conducted for their beneficiaries.
- Over 1800 indirect beneficiaries impacted through the GROWN model.

Scalability

aQysta's model is replicable in other countries seeing that the challenges aQysta is solving in Malawi cut across the continent for smallholders. aQysta receives applications from farmers monthly to join their GROWN financing model, a testament to aQysta's model potential to scale and replicate into other countries within the region.

COMPANY DESCRIPTION

aQysta Irrigation was incorporated in Malawi in 2018. The company provides pumps to smallholder farmers as well as agriculture extension service, critical agro-inputs, and market access for harvest. aQysta's model enables end-users to pay for the product and service as a percentage of the harvest, in proportion to the value created by the technology and service (GROWN Farm Incubator). aQysta aims to empower 1 million farmers with better access to markets, capital, knowledge, farming inputs and renewable energy technologies by 2030.



EMATA

Digital agriculture loans

Emata provides affordable digital loans to farmers. Emata lends to farmers at only 3% per month interest rate.

Financial product

Agriculture is classified as a high-risk sector, especially for access to financing. Emata has developed a solution for affordable and accessible credit for smallholder farmers in Uganda. Emata has developed an innovative digital agriculture financing model where they partner with cooperatives and aggregators. Emata is granted free access to the company's MIS (Management Information System) which they use to develop credit scores for the individual farmers. Emata uses big data to create data-driven alternative credit scoring to offer digital loans to rural smallholder farmers. The farmers' data is used to make lending decisions, and in the process, Emata earns interest revenue by lending to farmers at a 3% per month rate. The high level of digitization enables Emata to make lending decisions more efficiently than most of the traditional lenders.

Target customers

Emata finances farmers affiliated with its B2B partners (Cooperatives and aggregators). Under the B2B model, the company partners with middlemen in the value chain such as cooperatives in dairy, aggregators in oilseeds or large off-takers in coffee. Under the B2C, Emata finances the full range of farmers: smallholders (60%), 'missing middle' (30%), and professional farmers (10%).

Distribution channels

Emata organizes farmer info sessions where they provide detailed information on the credit facilities they offer and their partnership with the cooperatives and the aggregators. Farmers are informed and updated on their loan limits, repayments and deliveries via SMS. They also use their phones to apply for subsequent loans, while those who have no phone can apply through the Emata partners.

Repayments

Data that Emata aggregates from its partners is used as Emata's collateral for the loans offered to member farmers in line with a farmer's milk or other crop delivery to the cooperative. A percentage of farmers' earnings are then deducted on a monthly or quarterly basis depending on the agreement in place between Emata and the cooperatives. The cooperatives guarantee farmer payments to Emata's loans to smallholders.

Terms and conditions

Emata's digital platform relies on high-tech algorithms that convert data collected into credit limits tailored to each individual farmer. Emata also has an alternative credit scoring algorithm that leverages machine learning and clustering analysis. Digital loans are available only to active member farmers registered through partner cooperatives. Emata's interest rate is 3% per month with no (upfront) fees and a loan repayment period that can go over 6 months. Access to the Emata loans does not require collateral. This business model empowers Emata's partners to reward the loyalty of their farmers with access to loans at Emata's affordable rates. The more a farmer delivers, the higher their loan limit.

Value-added services

Emata's impact team regularly calls and visits B2B partners. Through the cooperatives, Emata provides additional services to smallholders in the form of extension services through a network of outsourced and in-house agronomists. Farmers also reach out to Emata through their service number, and plans are underway to launch a toll-free version of this number.

Value proposition

Emata's digital agriculture loans provide an innovative combination of financial technology with physical touch, by combining technology and partnership to deliver digital loans in a low-tech setting. Agriculture middlemen are provided with a software to help them digitize and better run their operations converting data collected into tailored credit limits to individual farmers and provision of digital loans that farmers request via their user-friendly WhatsApp bot.

Rather than charging high prices for software, Emata's loans create additional value beyond the loans by strengthening agricultural value chains, nurturing accounting skills in the agricultural sector, and reducing B2B side-selling which happens when farmers urgently need loans and as a result end up selling (part of) their produce to the moneylender - rather than to their cooperative or aggregator. Farmers often sell their produce to the moneylenders at prices well below market value.

Scalability

Since launching the digital financing model to farmers in 2021, Emata has scaled into four value chains (dairy, oilseeds, coffee and maize) and has signed over ninety farmer cooperatives as partners with an aggregated base of over forty thousand farmers. Emata has also introduced loans to farmers who lack the opportunity credit can offer in helping them run and invest in their farms. Emata's digital platform is designed for scale - the strong tech and data science team automated Emata's entire process which is easily scalable into other value chains across Uganda and to new regions/countries within Africa and beyond.

COMPANY DESCRIPTION

Emata was founded in 2020 to provide simple, available, and affordable farmer financing in East Africa. This was because of the founders' frustration that African Banks were not using technology and big data efficiently to bring financing to farmers. Emata partners with cooperatives and aggregators then use their data to conduct AI-powered alternative credit scoring. These scores inform the qualification of farmers to access digital, affordable loans which in turn enables the farmers turn their farms into businesses. It allows the farmers to use the power of loans to invest in the productivity of their farms. Emata has been in operation in Uganda for the last 3 years.



Empowering farmers in Uganda: George Mbanju's powerful transformation

George Mbanju, a dedicated member of the Kinyogoga Dairy Cooperative, resides in Kinyogoga, a rural area of Uganda with his wife and 12 children. Together they maintain a herd of 80 cows on his 200-acre piece of land, which is above the rural Ugandan average of 100 acres per farmer. George faced numerous challenges in his farming enterprise before the intervention by Emata, an innovative enterprise supported by the WE4F Hub in East Africa. Farmers, like George, that live in the region must endure harsh climatic conditions leading to drought, which severely limits milk production and financial stability.

Dairy farmers in Uganda lack cooling facilities

After the Government of Uganda abolished the transportation of unrefrigerated milk, it became difficult to transport milk to Kampala as many farmers used open trucks for collection and transportation. The East Africa Dairy Development Project stepped in to mobilize farmers, encouraging them to form cooperatives and providing them with loans to purchase chilling machines. This enabled the Kinyogoga cooperative to install chilling facilities and secure contracts with milk processing companies. While this one challenge was tackled, farmers also struggled with low milk volume due to drought,

which severely limited milk production and financial stability for farmers. The lack of income meant they could not afford to purchase cow feeds, resulting in cows having to graze free range. On top of this development, unreliable weather conditions began to negatively impact overall milk production. To make ends meet, farmers resorted to leasing out their land and investing in equipment for long-distance milk transportation, such as motorbikes. Additionally, the cooperative provided soft loans to farmers, which however, came at a cost.

How Emata brought change into George's farming

The partnership between Kinyogoga Dairy Cooperative and Emata began in 2020, bringing transformative changes to George's farming enterprise. Emata provided extensive support and training to cooperative leadership, guiding them through the loan application process. They also introduced a management information system (MIS) that digitized customer information and loan management. In turn, the cooperative staff worked closely with farmers, assisting them in the loan application process and ensuring smooth access to funds. They started off with a loan period of 1-6 months, which has now been extended to 9-12 months.

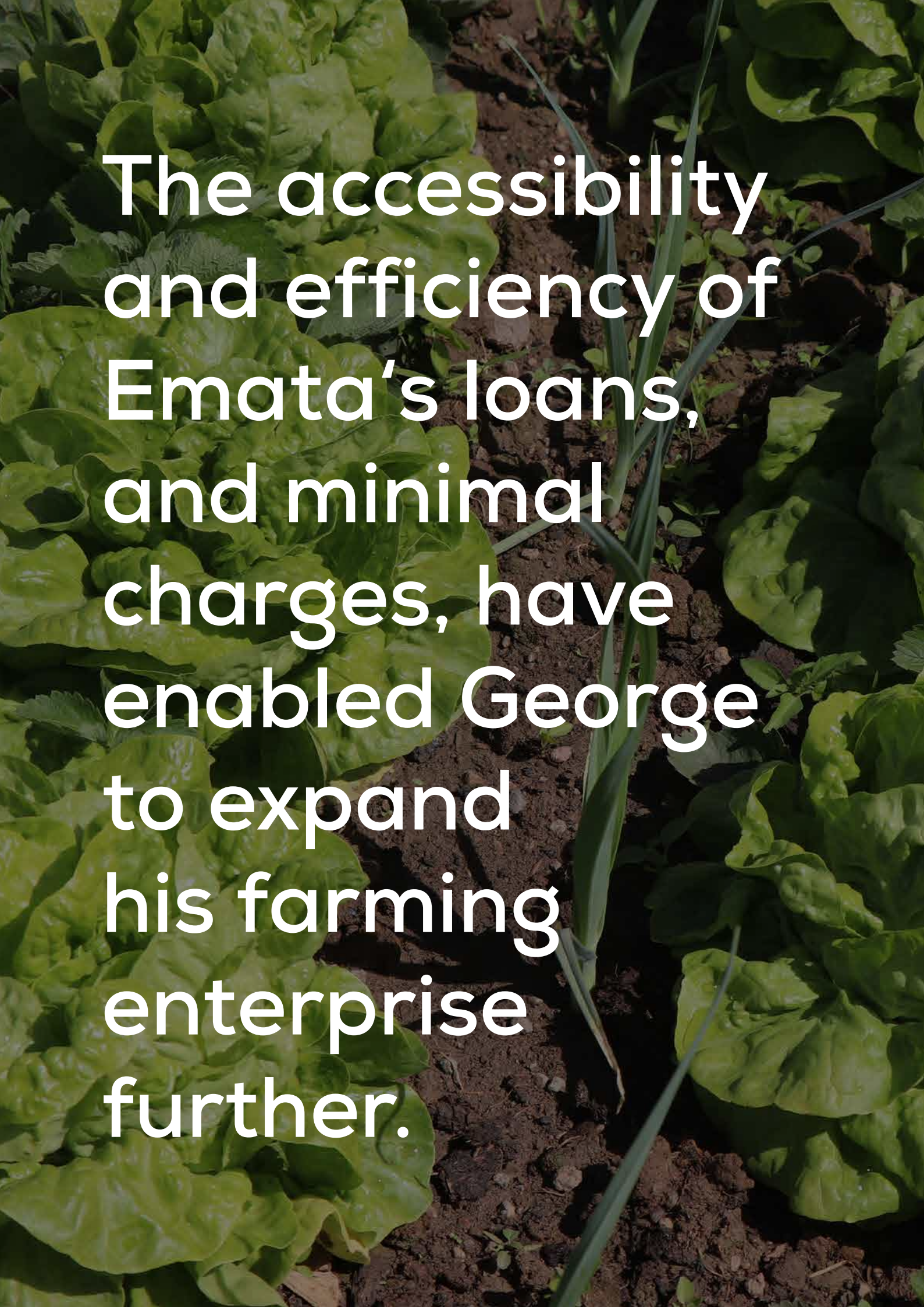


George's farming business changed significantly with the implementation of Emata's MIS database. The accurate tracking of milk deliveries under individual farmers' names improved creditworthiness assessment and assignment of loan limits. Additionally, Emata's loans are easily accessible, approved within a week, and disbursed to farmers with only a 4% monthly interest rate and no additional charges. The accessibility and efficiency of Emata's loans, and minimal charges, have enabled George to expand his farming enterprise further. George successfully borrowed and repaid three loans from Emata, amounting to UGX 1,000,000 (~\$260 USD), UGX 2,500,000 (~\$655 USD), and UGX 1,700,000 (~\$450 USD), respectively. He utilized these funds to purchase animal feed during the dry season and acquire additional cows for crossbreeding, resulting in the improved quality of his herd. Now George delivers 30–40 liters of milk per day to the cooperative, a significant increase from the initial 20 liters. He plans to continue investing in more and better breeds of cows to enhance milk production. George also aims to construct a store for animal feed preservation, ensuring a consistent and sustainable supply for his livestock.

One of many success stories thanks to Emata

The partnership between Emata and Kinyogoga Cooperative exemplifies the positive changes that can be achieved when innovative solutions are combined with targeted support. The impact of Emata's partnership with the Kinyogoga Dairy Cooperative extends beyond George. As of May 2023, Emata has already issued 50 loans to farmers from the cooperative, with 38 loans being fully paid and 12 still active. These loans empowered smallholder farmers to overcome financial constraints, improve their farming practices, and enhance their livelihoods.

George Mbanju's transformation exemplifies the positive outcomes achieved through supporting innovative enterprises throughout WE4F. It serves as an inspiring story of how strategic interventions and access to financial resources can create a ripple effect of improved incomes, increased production, and enhanced living conditions benefiting an entire community and contributing to the socioeconomic development of Uganda.



The accessibility and efficiency of Emata's loans, and minimal charges, have enabled George to expand his farming enterprise further.



ESCO

The ESCO Model

An Energy Service Company (ESCO) implements customized energy service packages through performance-based contracting. It includes planning, financing, building, operating, and maintaining energy projects for clients. How this is done depends on who assumes financial and technical risks of implementation.

What is an ESCO model for energy efficiency?

An ESCO undertakes energy audits and on which the design, financing, development and building of energy conservation projects is based. The underlying assumption of any ESCO models is that costs are recovered through actual energy savings. Reducing energy consumption means reducing energy cost and carbon emissions.

How does it work?

ESCOs usually do the following when offering their services:

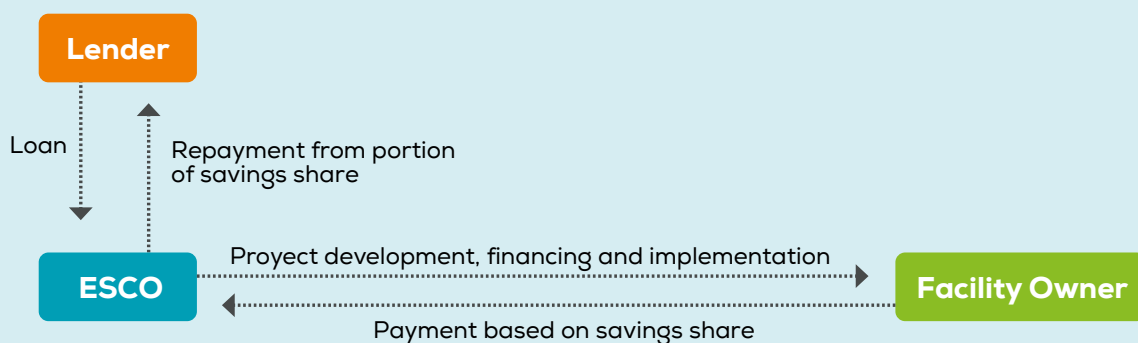
- a) Assessment of client's site to determine the energy 'footprint', potential energy cost and carbon savings,
- b) Recommendations on the measures to achieve such savings,
- c) Implementation of the recommendations in the client's site through identified projects,
- d) Offering contractor support and financial options to implement the projects
- e) Using the expected energy savings to obtain financing for the project.

The assumption is that the energy savings made on the client's site should reduce their energy bill enough, to cover any repayments to lenders. In some cases, the client obtains a bank loan or uses their own equity to pay contractually determined fees to the ESCO and the bank, and keeps the difference.

How do ESCO models address market barriers?

- 1) Efficient equipment and facility modernization, external financing mobilization, installation simplified turnkey arrangements, hence solving the challenge of small project size, which make commercial financing difficult,
- 2) Commercial financing mobilization with loan repayments made from project cost savings, providing positive cash flow throughout the project in addition to solving the puzzle of business models to lenders. Bigger project "ticket size" through aggregation of similar projects for smaller facilities to increase and facilitate financing to create interest or motivation among energy users.
- 3) Use of performance-based contracts, that clearly define project benefits & costs and demonstrate low risks of projects already implemented. ESCOs also conduct formal measurement and verification to address inadequate information and technical expertise.
- 4) Reduction of project development and transaction costs through Provision of technical skills and expertise to identify, assess, and implement projects.
- 5) Utilize standard, streamlined tools for energy auditing, option identification and assessment, and standardized energy services agreements.
- 6) Demonstrating the success of business models and increased credibility of performance contracting in dealing with limited internal capital for investments.

Overview of the basic ESCO model



Typical models for ESCOs

Guaranteed savings model: The ESCO takes on the technical risk and guarantees certain savings on the client's energy bill. The client obtains a bank loan, or uses their own equity, to pay contractually determined fees to the ESCO and the bank and keeps the difference.

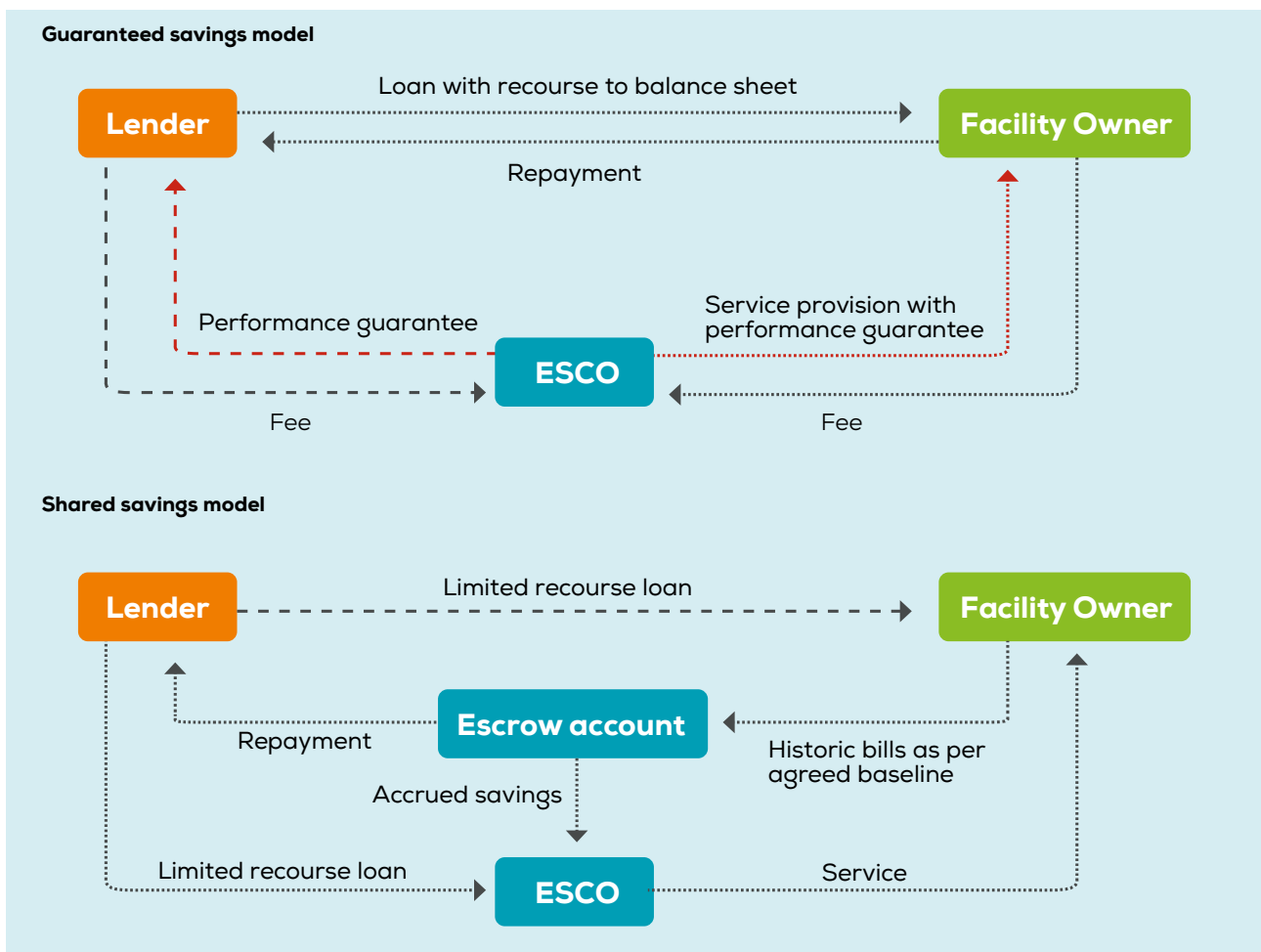
Shared savings model: The ESCO provides financing, undertakes project development with the energy savings being shared between the ESCO and the client over the contract period. A separate escrow account under the contract might be created into which the owner pays up all accrued savings and all repayments of finance. Third parties, who may have lent to the ESCO, would normally have the first access to this account. The ESCO thus assumes both the technical and the credit risk of the client, which relieves the client the need for upfront capital costs. With ongoing payments to the ESCO based on the savings obtained, the project would therefore be off-balance sheet.

Energy savings insurance and credit risk guarantee: To mitigate risk inherent in an energy efficiency project, certain financial institutions, private companies, and insurance companies cover the uncertainty associated with the performance of efficiency measures. Such

uncertainties present risks that hinder third-party energy efficiency financing. This has resulted in energy savings insurance (ESI). ESI is particularly useful for ESCOs or smaller enterprises with poor credit or who lack the means to secure third party financing. There are two types of ESI:

Technical risk insurance: In the event that energy savings are not achieved, the insurance provider covers for the ESCO or technology provider assuming the technical risk associated with efficiency projects. **Credit risk insurance:** Under this package, the insurance provider assumes the credit risk of a project, thereby ensuring that repayments owing to the ESCO continue to be made, in case of customer default.

Super ESCOs: Entities established by a Government or through public-private partnership that function as intermediaries between the Government, facility owners and ESCOs. They coordinate the large-scale energy efficiency project implementation to achieve a scale capable of taking on multiple Energy Performance Contracts and gaining access to competitive lending terms from financial institutions. They also benefit from risk diversification, capacity building and streamlining for other ESCO players in terms of procurement.





**HELPING
BUSINESSES GROW**

INTRODUCTION

One of the main objectives of the Water and Energy for Food (WE4F) initiative is to help businesses grow. By supporting innovative Small and Medium-Sized Enterprises (SMEs) to refine their business models, develop their client base, increase profits, expand to new markets, and leverage new investments, they are more likely to reach more people with their innovations, and to positively impact local economies and environments. Only businesses that are financially viable in the long run can ensure that they do their part to make this world a more sustainable place to live.

Moreover, SMEs in emerging markets tend to have insufficient access to finance. Entrepreneurs seeking finance in these markets are often perceived as too risky for traditional loans by commercial banks, and yet they are too large for the growing number of microfinance programmes. This gap in financing leads to what has increasingly been referred to as the missing middle.

WE4F seeks to support SMEs by providing investment advice, by matching SMEs with potential investors, and by offering seed funding. Ultimately, this should help them to leverage additional investment and to reduce the funding gap that prevents them to innovate, diversify and grow.

A special thank you goes to NIRAS, Intellectap, Alphamundi Foundation and GFA in supporting the endeavours of the WE4F Hubs in East and West Africa, implemented by GIZ. WE4F and its partners have worked tirelessly to provide business and investment advisory services and to build a strong network of like-minded change makers.





WETU

Cooling off with the sun - A smart-food cold chain on Kenya's Lake Victoria shores

An effective cold chain can unlock the competitiveness of small-holder farmers, small traders and other value chain actors. Water and Energy for Food in East Africa and We! Hub Victoria Ltd (WeTu) are working together to use innovative solar-powered cooling technologies and demand-oriented business models to bring cooling solutions to the shores of Lake Victoria in Kenya.

Background

Fisheries and horticulture play a key role for food security, income and employment around Lake Victoria – locally known as Nam Lolwe. It is estimated that the region contributes over 80% of the country's fish production per year. Lake Victoria also offers significant potential for small-scale irrigation.

Nevertheless, post-harvest loss and food waste among smallholders and fisherfolk is estimated at 30-40%, mainly during handling and storage of food.

Water and Energy for Food in East Africa and We! Hub Victoria Ltd (WeTu) are piloting an integrated solar cooling solution at the shores of the Lake Victoria to come up with market-driven solutions. WeTu's ability to maintain and strengthen its role in delivering clean energy solutions, better mobility and creating business opportunities for rural communi-

ties in this region aligns well with WE4F's strategic goal of improving livelihoods of smallholder farmers through greater agricultural productivity and more sustainable practices of natural resource use.

Project description

The project seeks to support smallholder farmers and fisherfolk in Western Kenya to access cooling technologies for improved food chains. Coupled with an e-mobility concept, the partnership will offer support to value chain actors by:

- 1) Demonstrating the feasibility and technical viability of an **off-grid solar powered food cold chain**. This is expected to boost incomes by reducing post-harvest losses associated with lack of an efficient cold chain, especially in resource-constrained rural areas.
- 2) Designing and testing a sustainable **business model in the cold value chain** that is socially responsible and addresses the needs of smallholders, traders and other value chain actors.
- 3) Conducting effective skill transfer on business development to expand income opportunities for smallholders, traders and other value chain actors.

Anticipated impact

Given that solar-powered cooling and cold storage solutions are still highly underdeveloped in most parts of western Kenya. There still is great potential to create business opportunities in a) providing cooling services and b) using these solutions in the fishing and horticulture sectors. Ultimately, this will contribute to improved incomes and livelihoods owing to rapid access to lucrative markets, and longer shelf lives of perishable produce.

What has been achieved so far?

- A solar icemaker has been procured and is currently being shipped to the installation site.

- WE4F is working with a team of co-designers to work on a community-focused, collaborative process to develop business cases for the solar icemaker. "Co-design" refers to a participatory approach to designing solutions, in which community members are collaborators.

Looking forward

- 1) The project partners will further develop the different energy services provided by WeTu, such as cooling solutions combined with water provision and e-mobility.
- 2) Combining these services with a tailored business model will create opportunities for WeTu as well as the fishing and agricultural producers around the lake, especially women and youth.
- 3) Business development services through short term trainings will primarily support the pool of micro-businesses that are run by women and youth in the area.
- 4) Documentation of project impact will contribute to knowledge management that can be shared and upscaled in other similar contexts to further improve livelihoods.

Facts

- Lake Victoria contributes **80%** of Kenya's inland fishery.
- **30-40%** of food produced in Kenya is lost post-harvest.

Targets at a glance

- A fully functional off-grid solar cooling system installed for fish and horticulture preservation.
- A sustainable business model for the provision of on-demand cooling services developed, viability documented and implemented.
- Information and training materials for the solutions developed and being used by customers.
- Business opportunities along the cold chain are identified, documented and implemented with the local communities.

End Users	People in a rural area who have increased their income because of GIZ's contribution. Smallholder farmers and other end-users using energy or water efficient WE4F innovations in their activities.
Capacity Development	Multipliers that are informed about potentials of climate friendly, energy and/or water efficient innovations.
Business Model	Sustainable business models for the marketing of climate-friendly, energy and/or water efficient innovations have been developed by new or already established innovators.
Demo Measures	Solar icemakers show WeTu customers the potential of climate-friendly, energy and/or water efficient innovations to increase productivity and income.

Hydro-powered pump - water pumping without fuel, electricity or emissions

What is a hydro-powered irrigation?

Water that is in motion, for example in rivers, streams or canals, contains energy that can be transformed for other usages. The water wheel pump is a hydro-powered pump. It incorporates a pipe wrapped around a horizontal axle, generating a spiral tube that is fastened to a water wheel. Flowing water causes the wheel to spin, forcing water into the inlet of the tube with each rotation. This results in pressure required for pushing the water to the outlet. The water is delivered directly to the field, or first into a storage tank, from where it is distributed.

What are the main features?

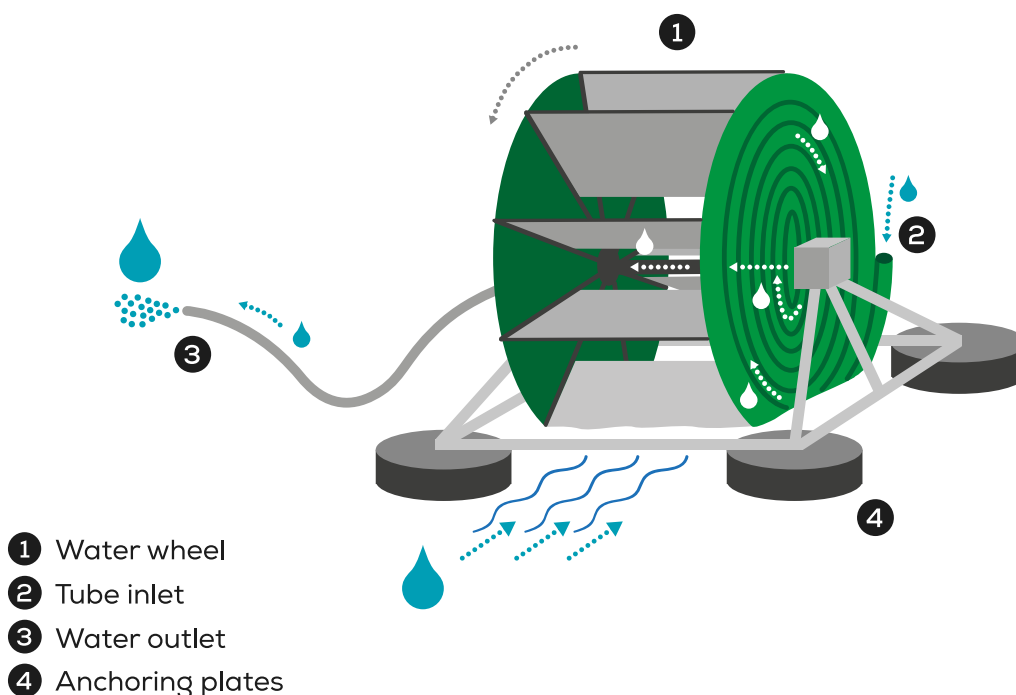
The hydro-powered pump does not need any fuel or electricity, presenting a climate-friendly way of pumping water. In comparison to solar powered pumps, the hydro powered pump can work all through the day. The system installed by WE4F pumps 20 to 40 m³ per day to an elevation of up to 20 m or a distance of 1 km. The performance of the pump depends on the characteristics of the water source, the higher the flow rate, the higher is the amount of pumped water.

What are common uses?

Hydro-powered pumps are used for the irrigation of crops. Under irrigation, crops can get the ideal amount of water for higher yields and increased income for the farmers. The pump can mitigate the effects of climate change and unpredictable rainfalls, as long as a water source with sufficient flowrate and volume is accessible.

Market development

Hydro-powered pumps, such as water wheel pumps or hydraulic ram pumps are based on long-known mechanic principles, but are mostly produced in an artisanal way. Only a few manufacturers provide their systems for a larger market. The technology is very sturdy and only consists of mechanical components that are easy to maintain, giving it a high potential for users in rural regions with access to streams or rivers.



Solar powered flake ice machine - cooling agricultural value chains as a business

What is a solar powered flake ice machine?

There is significant food loss in East Africa due to interrupted or non-existent cold chains safely store and aggregate agricultural produce. Ice machines are typically powered by either diesel generators or the grid, thus generating high running energy costs and emissions. The solar ice machine uses a photovoltaic system integrated with a conventional ice maker, making it cheaper and more climate-friendly to produce ice.

What are the main features?

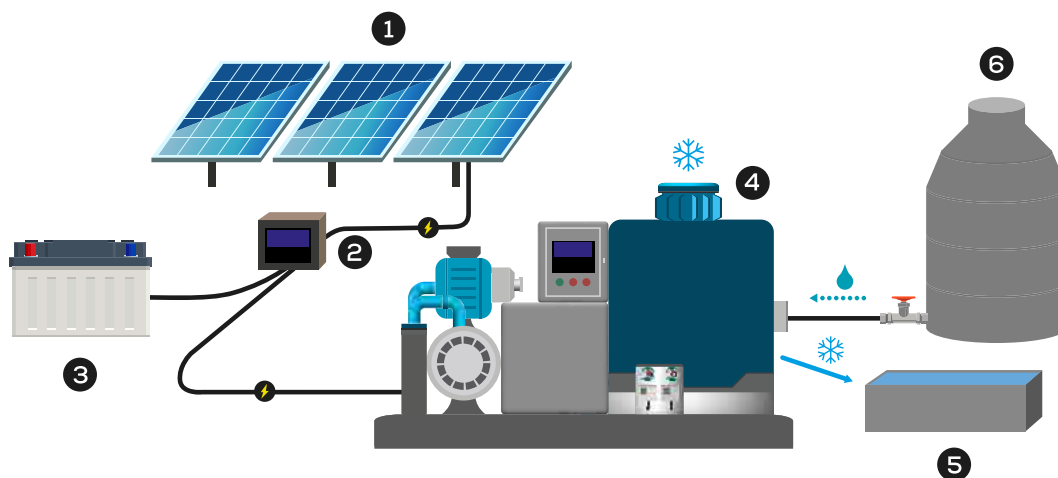
A flake ice machine yields consistently sized ice that is easy to pack, ensuring even and consistent cooling. The flake ice thickness is around 1.5~2.2 mm. The ice making machine has total power consumption of 22.75 kW and can produce up to 5 tons of ice in 24 hours. The system is powered by a 30 kWp solar generator coupled to a battery bank and 3-phase inverter. Optimal insulation helps to keep the ice cold for a long time.

What are common uses?

Flake ice is mostly used for the preservation of fish but can also help to cool other meat types and horticultural products. It can be transported, e.g. on fishing boats, so that the product can be cooled instantly and during transit to markets. With the dimensions of the ice flakes, the surface area in contact with the product is high, supporting a quick and uniform cooling. As the flake ice melts, it helps to moisten the product, keeping its quality high.

Market development

The production and sale of flake ice is a profitable business in regions where demand from, e.g. fisher communities, is high. Different sizes of conventional flake ice machines exist in the market, designed to be powered with electricity from the grid. Solarizing these conventional machines requires the introduction of inverters and batteries, resulting in large initial investment cost. However, payback periods can be short due to the low running costs. A number of companies are slowly getting into the market with specialised ice machines that are designed for the use with photovoltaics.



- 1 Solar generator
- 2 Controller & inverter
- 3 Battery bank
- 4 Flake ice machine
- 5 Flake ice
- 6 Water tank



GUAVAY COMPANY LIMITED

Blending mineral and organic fertilizer

Unlike many generic brands in the market, Guavay Organic fertilizers are designed for specific crops and soil types. The fertilizers are rich in nutrients specific to the crops the fertilizer is used on.

The ability to undertake soil analysis and produce fertilizer with the correct nutrient levels for the soil sets the Hakika fertilizer apart from the chemical-based fertilizers in the market.

Key partners

Guavay produces organic fertilizer under the brand "Hakika". Guavays main partners are the distribution partners, agrovets, end-to-end stores for farmers that sell seeds, fertilizer, animal feeds and veterinary supplies. For long-term customers with an established credit history, Guavay extends a 50% credit to the agrovets to sell more fertilizer.

The balance is paid after the sale of the fertiliser. Guavay has also partnered with the University of Dar es Salaam and Makerere University for the Research and Development of their products. Guavay also partners with the city authority to collect urban organic waste.

Key resources

Guavay was set up in 2014 as the 1st company in Tanzania to produce, market and distribute crop-specific organic and mineral-organic fertilizers. The company is the brainchild of three partners who developed the product as a result of a university project funded and supported by Makerere University. Trading under the brand name "Hakika", the company produces crop-specific organic fertilizers to enable certified and non-certified farmers to grow high-value crops (avocados, rice and onions) for export. The main resources for production are organic waste collected from farmers, limestone, and organic rock phosphate.

Target customers

Guavay work both with B2B and B2C customer segments. For B2C segment, the company supplies directly to large-scale farmers, developing customised fertilizer products for specific soil types and crops grown on these farms. The B2B model targets agrovets in Tanzania. Guavay produces specially curated fertilizers targeted for specific crops. Guavay sells Hakika Onions, Hakika Rice and Hakika Avocado to agrovets, who resell to small-scale farmers in Tanzania.ors

Distribution channels

Guavay distributes directly to large-scale farms as well as through agrovets, who resell fertilizer to small-holder farmers. Guavay also sells through farmer cooperatives, farmer groups and farmer associations. For groups/ cooperatives or associations that have more than 200 farmers a 5% discount on purchase is extended for bulk purchases.

Revenue streams

The main revenue model for Guavay is the sale of Hakika fertilizer in Tanzania and a growing export market. Guavay advises farmers to conduct soil analysis as pre-sales support at a minimal cost.

Hakika fertilizer has so far been sold to about 50,000 smallholder farmers.

What sets this business model apart from its competitors?

Guavay is the 1st company in Tanzania that produces, markets, and distributes crop-specific organic and blended fertilizers. Some of their fertilizer formulas are trademarked, making them unique products on the Tanzanian markets.

Guavay has worked with WE4F to revise their strategic business plan, pitch to investors, and help with deal-making processes. During this time, Guavay was able to set up new production sites, expand its customer range and has proven to be a profitable company.

Impact

Hakika fertilizer has so far been sold to about 50,000 smallholder farmers. The use of Hakika fertilizer increases the yield of the farmers by about 25% above those using chemical fertilizer. The quality of soil is improved using Hakika fertilizer as they are specially formulated for specific crops and soil types. Due to the soil testing Guavay offers there is minimal use of generic nutrients therefore preserving soil quality. Guavay's fertilizer contains more than 25% organic matter, increasing the water holding capacity of soil.





INNOVEX

Going international - Solutions for solar applications across East Africa

Innovex was founded in 2015 as a Ugandan company with the aim to develop IT systems, connected devices as well as web and wireless communication technologies. Their first prominent product was “REMOT”, a cloud-based platform that is connected to solar applications to remotely control and monitor them. The matching hardware component DAVIX is also produced by Innovex. It is connected to the solar system, collects data and transmits them via GSM to the cloud-based platform for further analysis and visualization.

Key partners

Innovex works with a number of partners to operate and scale their business. Partnerships with CLASP (solar cold chains), Epicentre Africa (solar water pumps) and AgSol (solar milling) supported the piloting of the REMOT platform for different appliances. Since the platform bases on the transmission of real-time data from the appliance into the cloud, Innovex has partnered up with leading GSM operators in East Africa, such as Safaricom, Airtel and MTN. Partnerships with Efficiency for Access, Innovate UK or the Government of Uganda helped to further upgrade and scale up the hardware and software developed by Innovex.

Innovex has been keen to expand its operations to other countries and to widen its market reach internationally.

Target customers

Innovex offers different services to address a broader B2B market. With its REMOT technology the company targets organizations and other businesses who have an interest in remotely monitoring their solar appliances. These are for example businesses distributing solar-powered water pumps, maize-mills or cold chains.

Innovex has also the equipment and capacities for the local manufacturing or repair of electronic products. The company also offers engineering services for organizations and businesses to support them in product design and development, including hardware and software products.

Revenue streams

Innovex generates income from the following services:

- Remot software and hardware to remotely monitor solar appliances.
- Manufacturing of electronics and repairs for third parties.
- Engineering services & product development.

Whilst working with WE4F, Innovex has managed to expand its operations to Kenya, Tanzania and India for a variety of solar applications. This helps Innovex to reach a greater market to sell products "made in Uganda".

Value proposition

Innovex's remote monitoring system allows companies, organisations but also end-users to access system performance data from the distance. The universal datalogger DAVIX can be connected to any component-based solar system and sends the data to the cloud-based platform. The combination of proprietary hardware solution and cloud-based software enables a variety of use-cases. This includes Pay as You Go mobile money integration, where the system can be switched on/off from the distance. The platform also features customer records management to handle larger volumes of systems. Also, the management and maintenance of solar systems in rural environments is improved. The system performance can easily be monitored. In case of equipment failure, a physical diagnosis is often not required as the parameters can be accessed remotely, this increases the efficiency for system repairs.

Impact

The usage of Innovex's solution increases the uptake of solar-powered technologies, especially in agricultural contexts, by making financing and centralized management possible. The use of these technologies leads to:

- Increased Productivity: smallholder farmers have a reliable water supply for agricultural production (higher yields and minimized losses).
- Job creation through a multiplier effect (empowered businesses, more value chains).
- Improved Livelihoods/ income: better yields leads to increase income, which can be reinvested and improve their standard of living.
- Thousands of units have already been installed across Uganda, Kenya, Tanzania and Somalia, often creating unique use-cases for solar powered appliances.



GREEN IMPACT TECHNOLOGIES

The one-stop-shop for climate-smart technologies for smallholder farmers

Green Impact Technologies (GIT) was established in 2018 to accelerate access to alternative energy technologies of low-income communities in sub-Saharan Africa countries. Located in Lilongwe, Malawi, it operates in a country that is heavily reliant on agricultural production. GIT provides innovative technologies that are used by smallholder farmers. This includes biodigesters for biogas and bioslurry production, Pay-As-You-Go, solar water pumps and much more.

Key partners

Green Impact Technologies is supported through its partnerships with various stakeholders in the sector. The Malawi University of Science and Technology works with GIT on technical level, e.g. on the topic of biogas. The company has partnerships with different funds and organisations that are invested, such as Unido, AfDB, USAID, IFAD and the Malawi Off-Grid Market Development fund. To further market their products, GIT is in cooperates with MAEVE, a local NGO that promotes the use of fuel efficient technologies. GIT also works with a number of international suppliers of solar applications, such as BioLite (solar lighting), or Futurepump (solar water pumping).

Target customers

GIT targets the B2C market. The company provides a wide range of technologies to smallholder farmers, linked with an adequate financing scheme to make them accessible. This includes solar home systems, solar fridges or solar water pumps. The company also produces and sells a bio-slurry based soil amendment product. GIT also provides their customers with extension services and access to market.

Revenue streams

Together with WE4F, Green Impact Technologies has refined its business model, developing a catalogue of services and products that the company can offer to its customers, including:

- Productive use of renewable energy technologies, such as solar pumps and fridges.
- Biodigesters, biogas and organic fertilizer.
- Support to other SMEs through mentorship, resources and infrastructure.

Since purchasing power of farmers is limited in Malawi, GIT has tested different financing schemes for accessing renewable energy technologies and inputs. These include Pay-As-You-Farm for solar pumps, which includes extension and marketing services for farmers that otherwise struggle to sell their products.

Value proposition:

Green Impact Technologies provides farmers with a wide range of services and farm inputs, to increase their agricultural production. Compared to other companies in Malawi, GIT provides flexible financing models such as Pay-As-You-Go or monthly repayments to make their systems accessible for smallholder farmers. By doing this, they are able to overcome one of the trickiest barriers to uptake of technologies: affordability. The company also combines sales with farmer trainings and supports in collection and distribution of farm products to different wholesalers in Malawi.

Impact

Green Impact Technologies has pushed solar fridges into the Malawian market, helping consumers to store perishable products for a longer time and reducing the spoilage of food. The provision of solar water pumps to farmers increases yields and makes farmers more resilient towards droughts. The organic fertilizer supplied by GIT helps to restore replenished soils and increases soil fertility and yields. During the partnership, GIT reached over 5,000 smallholder farmers, created 7 permanent jobs and increased profits by 50 %. The company could also secure a number of investments (grants and debt) to further scale up operation and increase their impact.





GREEN AGRO SOLUTIONS PLC

Lersha's network of agricultural extension services

Green Agro Solution PLC is an Ethiopian company headquartered in Addis Ababa. It offers a wide range of farming information and services to improve farmers' decision making and farm operations. The company's main product is the digital agricultural platform Lersha. It combines a mobile application, call center and SMS services to provide farm inputs, mechanization services, extension knowledge and agro-advisory services. To bridge low literacy levels and limited access to smartphones, the company also works with a network of trained and certified Lersha Agents.

Key partners

Lersha has a vast network of partners, who are key for the operation of the business. Research partnerships with Ethiopian universities, the Ministry of Agriculture and different CGIAR institutions allow Lersha to provide reliable information to farmers. Different development agencies supported Lersha in the early operations and the scale-up of the company. Lersha is also collaborating with a number of financial institutions to provide farmers with credit to access farm inputs. Lersha's partnership with insurance companies supports farmers in getting insurance for their crops or livestock against weather risks. Also, the Lersha Agent system bases on the on-boarding of mostly unemployed agricultural graduates that get a commission for their services. They are treated and nurtured as entrepreneurs with the potential to grow into professional agricultural service providers in the future.

Target customers

The company mainly targets farmers as customers for their services. Lersha Agents reach out to farmers to register on the digital platform, from where they can access different farm inputs and other services. This includes smallholder farmers in rural Ethiopia with an average of less than one hectare, but also commercial farmers who request services specifically on the cotton and coffee value chains.

Lersha also works B2B with micro finance institutions, who are the major customer of farmer credit scoring that bases on Lersha information collected in the field.

Revenue streams

The main revenue comes from the commission on farm inputs or mechanization services that are ordered by the farmers via the Lersha platform. Lersha also provides a digital credit scoring to micro finance institutions who pay for this service before offering loans to farmers. GAS also operates a farm service center with 137 type of farm inputs available, as well as a tractor and combine harvester to provide mechanization services themselves. Whilst working with WE4F, Lersha has sought to expand its agent network to more rural areas and to Kenya in an effort to reach more smallholder farmers and supporting them with their advisory services.

Value proposition

Green Agro Solutions operates in a complicated environment where the private sector has a very limited role and a weak regulatory framework. Smallholder farmers, especially in rural areas, often lack access and timely delivery of genuine farm inputs such as fertilizers, seeds or pest control. Only 3.7 % of smallholder farmers have access to agricultural machinery and also the access to weather information, farm credits, insurance and advisory services is very limited. The Lersha platform brings together different market players on their platform, providing all services the farmers need. This includes agro-climate advisories, extension information, farm inputs and price information, access to credit, mechanization services, output market information, market linkages and insurance services. By operating a call center, SMS services as well as an agent system, Lersha is able to reach a wide range of farmers.

Impact

Lersha keeps on expanding its networks, both within Ethiopia, but also in neighboring countries. So far, the Lersha platform has 157,000 registered farmers who are using the platform. 1,490 Lersha Agents are active in the country, providing agricultural services and connecting new customers to the platform. 172 mechanization service providers have connected with the digital platform to offer their machines to interested farmers. When using the Lersha platform, farmers have better access to the various farm inputs and can improve their farm operations and income.



Lersha: Transforming lives through innovation

In the heart of Ethiopia's Oromia region, where smallholder farmers once faced numerous challenges accessing agricultural inputs and resources, two remarkable individuals emerged as agents of change. Abujaba and Bujusima found their purpose as Lersha agents, dedicated to uplifting their communities. Abujaba's journey began in 2011 when he graduated with a degree in water resource management. Unfortunately, he spent several years unemployed, struggling to make ends meet. His life took a significant turn when he joined Lersha as an agent four years ago. Armed with a mobile application, Abujaba embarked on a mission to revolutionize smallholder farming in his region. One of Abujaba's primary responsibilities as a Lersha agent was to register smallholder farmers. Over the years, he has tirelessly registered more than 10,600 farmers, granting them access to essential agricultural products and services right at their fingertips.

The impact of Lersha's innovation on the farmers under Abujaba's care has been profound. They can now access agricultural inputs from the comfort of their homes, eliminating the need for arduous journeys in search of resources. Production levels have soared, and the entire community is experiencing a positive transformation. Beyond the community's growth, Abujaba himself has reaped numerous benefits from his role as a Lersha agent. The training provided by Lersha improved his communication skills, allowing him to connect more effectively with his community members. The income he receives from being a Lersha

agent has transformed him into the breadwinner of his young family, offering them a brighter future.

In 2019, Bujusima graduated with a degree in hydraulic water resource management. Like Abujaba, she struggled to secure employment until she found herself talking with Lersha. As a field agent, Bujusima engaged with nearly 1,000 smallholder farmers, with over half of them actively benefiting from Lersha's services. Bujusima has witnessed the profound impact of Lersha on the lives of these farmers. In the past, they would blindly search for agricultural inputs, facing countless challenges. However, now, thanks to the Lersha app, they can easily access the resources they need to thrive in their farming endeavors.

For Bujusima, her journey with Lersha has been transformative as well. The training she received equipped her with valuable knowledge, and the income she earns as an agent has allowed her to sustain her livelihood. With a sense of purpose and financial stability, she is not only improving her own life but also contributing to the betterment of her community.

Abujaba's and Bujusima's stories represent the remarkable impact that individuals can have when they dedicate themselves to uplifting their communities. Through Lersha's innovative solutions and their unwavering commitment, smallholder farmers in Oromia are experiencing positive changes that are shaping the future of agriculture in the region.



Armed with
a mobile
application,
Abujaba
embarked on a
mission
to revolutionize
smallholder
farming in his
region.



**RESOURCE
USE EFFICIENCY**

INTRODUCTION

Agriculture places significant pressure on natural resources and the environment. At present, food production accounts for around 30 per cent of global energy consumption, 28 per cent of worldwide greenhouse gas emissions, and around 70 per cent of the world's freshwater resource uses. An increasing global population also means that the need for food continues to rise, putting further pressure on water, energy and land resources.

WE4F has partnered with innovative businesses, organisations, investors and finance institutions to promote more sustainable agricultural production and efficient use of natural resources. Ultimately, the objective is to produce more food with fewer inputs of energy and water.

Through the solarisation of technologies, farmers were able to transition away from fossil fuels and towards greener alternatives. Solar cooling solutions minimised post-harvest losses, reducing greenhouse gas emissions. Energy audits and modern monitoring technologies in food processing factories helped pinpoint areas for improvement to optimise the use of water, electricity, and firewood. Improved agricultural practices, too, can preserve and restore critical habitats, help protect watersheds, and improve soil health and water quality.





CBES

The making of climate-smart tea in Kenya

High energy costs, shortage of fuelwood, water scarcity and the need to reduce greenhouse gases have pushed Kenyan tea factories to rethink their production methods. Several of them have teamed up with the WE4F East Africa Regional Innovation Hub and Dedan Kimathi University to pilot an intelligent energy and water management system with the aim of making tea processing more climate-smart and resource-efficient.

Background

Kenya is currently ranked the third-largest producer and exporter of black tea in the world. Boasting of a production capacity of nearly 350,000 tons per year, this makes the tea industry one of the major contributors to national income and employment in the country. Nevertheless, climate change has started to negatively impact the Kenyan tea sector. Changing weather patterns affect the tea production process and increases the vulnerability of the tea sector's farmers, workers, and producers.

Improving energy efficiency can not only help in reducing greenhouse gas emissions but can also significantly lower operating costs during production and processing. In Kenya, where farmers are often part of cooperative-owned tea factories, saving on energy costs can directly lead to improved incomes.

By finding alternatives to fuelwood, the risk of deforestation and as a consequence, water scarcity and erosion, can be reduced.

Project description

The project aimed to reduce water and energy use during tea processing. It did so in two-ways: a) using an inexpensive, low cost storage solution to dry fuelwood efficiently, and b) by installing a smart metering system for water and energy and training staff to use the resulting data to make smarter resource use decisions.

- 1) **Seasoning Shed:** A seasoning shed was built to dry and store fuelwood at optimal moisture levels, increasing its firing efficiency in the factory boilers.
- 2) **Smart Metering and Assessment of Water Consumption:** A smart meter was installed to capture real time data on water and energy consumption.
- 3) **Capacity and Knowledge Management:** Trainings on the two technologies described above were provided to the factory managers and staff.

Challenges & learnings during the implementation

By integrating tunnel-type greenhouse seasoning sheds with smart metering technology, the pilot tea factory has experienced a reduction of energy and water consumption, resulting in lower production costs and improved profit margins. Measurements from wood samples taken from the innovative seasoning shed show a 35.7% higher calorific value than the typical values required by KTDA (14 MJ/kg).

Using the seasoning shed as an example, KTDA's Iriaini Tea factory used 35% less fuelwood, generated 35% less CO₂, and reduced the number of trees being cut down by the same percentage while maintaining the same tea production levels. The successful results

from the pilot greenhouse seasoning shed have generated significant interest from other tea factories, transforming it into a commercial product. In October 2023, the KTDA Kiru tea factory invested in its own seasoning shed.

Looking forward

- 1) DeCes is currently building a second seasoning shed at the KTDA Githambo Tea Factory with the same specifications as the one in Kiru (576 m² and 2000 m³ drying capacity).
- 2) As more and more tea factories want to replicate the seasoning shed, DeCes expects even more demand from factory side and a busy time ahead.

Facts

- Withering uses about **40%** of a factory's total electricity and over **50%** of thermal energy consumption.
- Kenya tea factories have established private wood fuel plantations but can still not meet the demand.
- Approximately **90%** of the total energy that goes into tea processing in a tea factory is thermal with the fuel of choice being fuel wood.

Optimized fuel wood drying

- The solar drier Installed at KTDA Iriaini Tea Factory is 32 m long, 16 m wide and 7 m high with a capacity to season approximately 1400 m³ of fuelwood per batch.
- Performance testing on sampled wood batches treated in the drier indicates that the use of this drier allows Iriaini Tea Factory to consume approximately 35% less fuel wood and enjoy associated cost savings on firewood and environmental benefits of 35% less CO₂ emissions.

Capacity Development	260 tea factory staff, engineers, and managers have been trained on the use and effects of the fuelwood dryer and IoT-enabled energy management system.
Climate Change	The measures helped Iriaini tea factory to use 2,313 m ³ less firewood. Together with other energy efficiency actions, a total of 3,720 tons of CO ₂ emissions have been abated.
Water saved	130,000 litres of water have been saved by improving the boiler combustion and reducing the overall operational hours, hence water usage.
Demo Measures	2 demo measures – fuelwood drier and IoT-enabled energy management system – have proven to factory managers and staff that they can contribute to cost savings as well reduced energy and water use and climate change mitigation.

Smart metering and process monitoring

Optimization of water and energy consumption in tea factories

What is smart metering and process monitoring (IOT)?

Smart metering helps to capture data on a real-time basis to document resource utilization at factory and process scale. Process monitoring on an Internet of Things (IoT) platform enables the monitoring, verification and optimization of efficient water and energy use. The integrated system is used in tea factories as well as other agro-processing facilities to improve resource use efficiencies.

What are the main features?

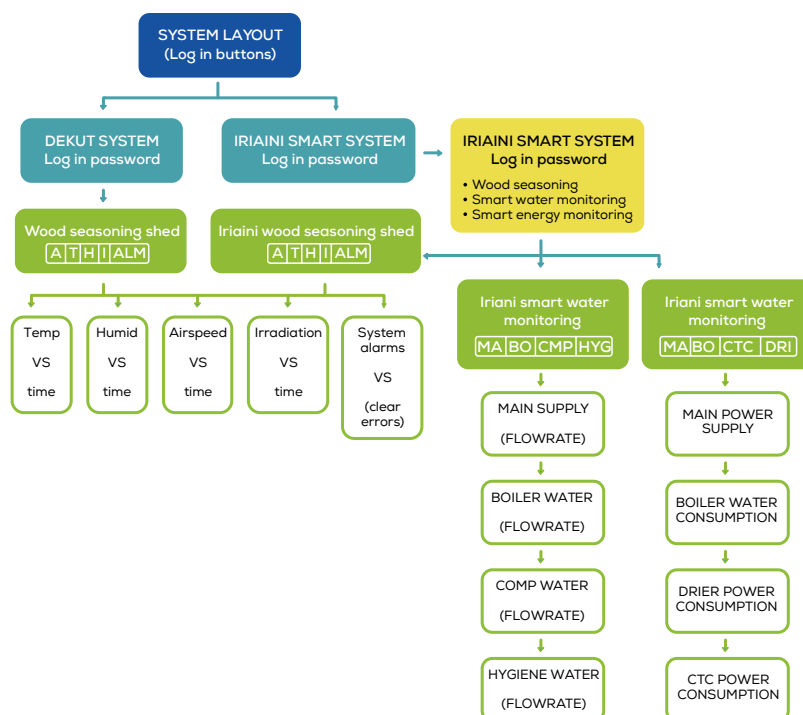
The IoT-based energy and water management system for factories helps to control different equipment wirelessly. Process data is collected by sensors and processed to regulate use by machinery. In tea factories, fans are controlled according to the humidity level in the withering house. Lamps are switched on/off based on light intensity. The water distribution is based on real-time demand. With learning capability through integration of Artificial intelligence (AI) the system will have both predictive and prescriptive capabilities.

What are common uses?

The IoT platform is the central data repository and decision-making engine and driver for wood seasoning shades and smart metering systems installed at tea factories. The system optimizes the water and energy-resource utilization efficiencies of different processes in tea production.

Market development

The Internet of Things is a field that has evolved due to the convergence of multiple technologies, including ubiquitous computing, commodity sensors, increasingly powerful embedded systems and machine learning. Developing customized IoT solutions for tea factories is expected to introduce technical, economical and environmental benefits to the overall production processes. In the tea factories, it has helped to save on costs and reduce the demand for fuel wood.



Wood seasoning shed

Energy efficiency for tea factories

What is a wood seasoning shed?

There is an inverse relationship between the moisture content of wood fuel and its calorific value. The higher the wood fuel moisture content, the lower the calorific value and vice versa. Low wood fuel calorific values translate to higher wood fuel consumption for the same level of output. A low-cost, high efficiency seasoning shed for drying fuelwood is critical in reducing the moisture content of wood before it is fed into boilers for thermal energy generation.

What are the main features?

The developed 1000 m³ capacity greenhouse tunnel type wood fuel seasoning shed is constructed of light gauge hollow tubes or lack pipe metal, heavy gauge and UV-treated polythene cover sheets. The seasoning shed is equipped with sensors to monitor environmental parameters such as humidity, wind and temperature. A digital wood moisture meter is provided to track wood seasoning progress. A special Android-based monitoring app is used to capture and track the drying process.

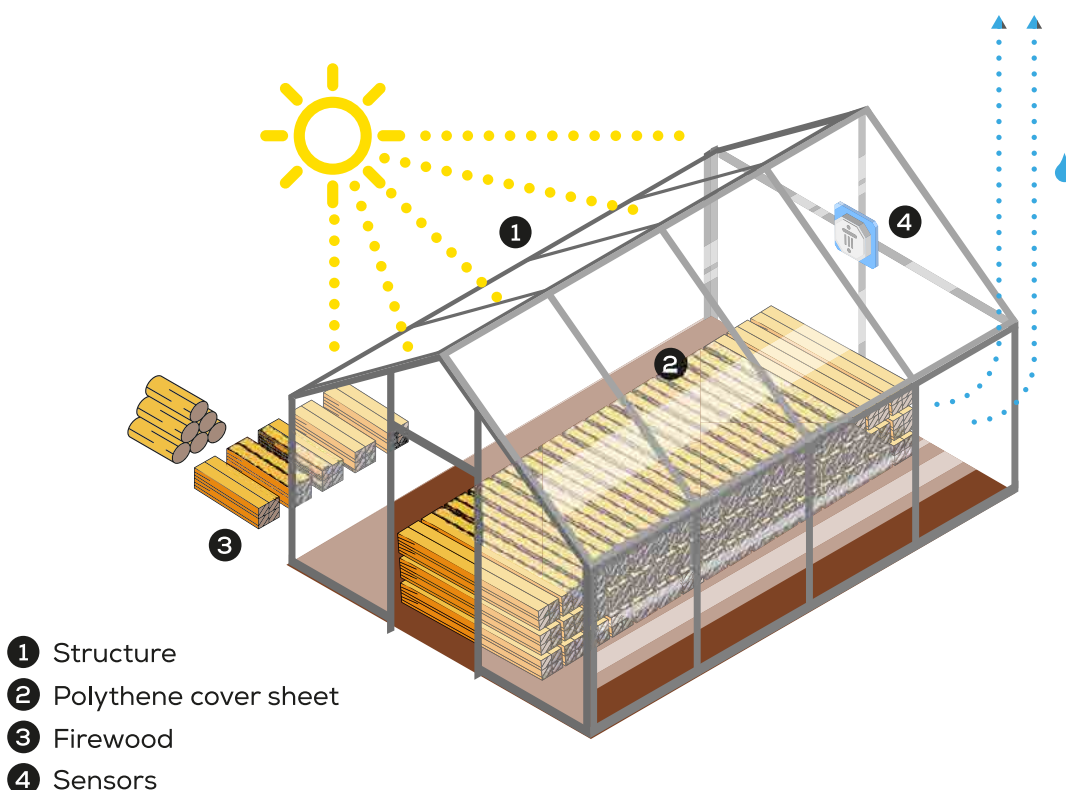
What are common uses?

The low-cost, high efficiency fuel wood seasoning shed provides a cheaper and effective alternative towards the improvement of fuelwood energy density and flammability. This leads to less fuelwood consumption, saving energy costs and reducing the number of trees cut down.

Market development

Wood seasoning sheds have been in existence for a long time and are commonly used in tea factories to reduce their biomass fuel consumption, water use for steam generation, deforestation and carbon emissions. However, most of them are expensive, ineffective and serve as wood storage instead of a dedicated dryer.

The commercial viability of this newly developed low cost, high efficiency fuel shed is high and can be easily adopted by tea factories that rely on the combustion of fuelwood. Once piloted, several other tea factories opted for similar fuelwood sheds.





MIYONGA

Saving fruits, saving resources

Miyonga processes fruits and vegetables that would otherwise be wasted, opening new markets for farmers. By using lower quality produce and implementing circular economy approach to food waste adds value where there was none before, creates new income opportunities and reduces the environmental impact of food loss.

Background

In Kenya, as in other regions of the world, farmers face high pre- and postharvest losses due to poor agricultural practices and challenges in finding markets for second grade fruit. The food losses also represent wasted water, land and energy resources that have gone into producing the food in the first place.

The Kenyan company Miyonga works in fruit processing together within a network of 2400 farmers. By investing into a mobile 40-foot container, that houses a fruit-dryer, Miyonga transforms second-grade fruit into products that can be sold on national and international markets.

Project in a nutshell

The project between WE4F and Miyonga achieved the following:

- 1) Piloting innovative climate-friendly processing equipment (solar mill, solar cold storage) that helps to add value to second grade fruit and reduce food waste.
- 2) Providing trainings for farmers in Good Agricultural Practices (GAP) and conservation farming to increase farm productivity and make farmers more resilient to the effects of climate change.
- 3) Supporting farmers in obtaining organic certification to enable them to access new markets and to allow Miyonga to have a traceable source of products for the own processing and sale.

Project outcomes

The development of training materials, followed by farmer training sessions on Good Agricultural Practices (GAP), conservation farming, and organic farming, has significantly supported the network from which Miyonga sources its products. Farmers learned best practices, particularly for the value chains that supply Miyonga with bananas, pineapples, and mangoes. Over 867 farmers received this training. Additionally, Miyonga factory workers were trained in proper produce handling during a food safety and compliance training session. These trainings helped Miyonga navigate the various regulations faced by exporting companies.

Miyonga operates through decentralized processing hubs located close to the farms. This approach has facilitated local value addition and created jobs, particularly for women and youths. The different technologies at these hubs are fully operational and have been used to process over 6.2 tons of mangoes, bananas, and pineapples.

Looking forward

- 1) With all training materials at hand, Miyonga wants to continue rolling out trainings, especially on organic agriculture. As a next step, the company seeks to get organic certification.
- 2) With additional funding the company plans to set up other processing hubs within the country to scale up production and increase the year-around availability of produce.

Facts

- **80%** of Kenya's live in rural areas and depend directly on agriculture for their livelihoods.
- **30%** of Kenya's income comes from agriculture, mainly smallholder.
- **14.5 million** Kenyans face food insecurity and poor nutrition each year.
- Only **16%** of agricultural products undergo further processing.

Trainings of farmers on GAP

- Good Agricultural Practices (GAP) cover a wide range of principles for farm production and post production to ultimately increase the quality and safety of produce.
- Miyonga GAP trainings focus on production of mango, pineapple and banana, the main products of the business.
- In a first step, Trainings of Trainers have been implemented for Miyonga staff and champion farmers. Once done, trainings were rolled out in a larger scale in 4 counties of Kenya: Tana River, Taita Taveta, Makueni and Kilifi.

Processing site	The main processing site in Taita Taveta has been made operational through a mobile dryer, solar cold room and a solar mill.
Capacity Development	867 smallholder farmers have been trained in good agricultural practices, conservation farming and organic agricultural practices. 34 factory workers have been trained in food safety and compliance.
Food processing	A total of 6.2 tons of mango, banana and pineapple and coconut have been processed into dried fruit and powders/flakes, proving the functionality of solar-powered equipments.

Solar powered mill

Giving second grade fruit another life

What is a solar mill?

In agricultural processing, mills are used to break a product into smaller pieces to allow for different uses. Solid materials such as grains or dried fruits can be processed into flour or powders. Conventional mills often operate with a diesel engine, that is inefficient, polluting and has high operational costs. Solar mills are powered by PV-panels and easy and cheap to operate, reliable, properly sized and environmentally friendly.

What are the main features?

The mill installed by WE4F is a hammer mill that crushes the product into smaller pieces by repeated blows of little hammers, until the wanted particle size is reached.

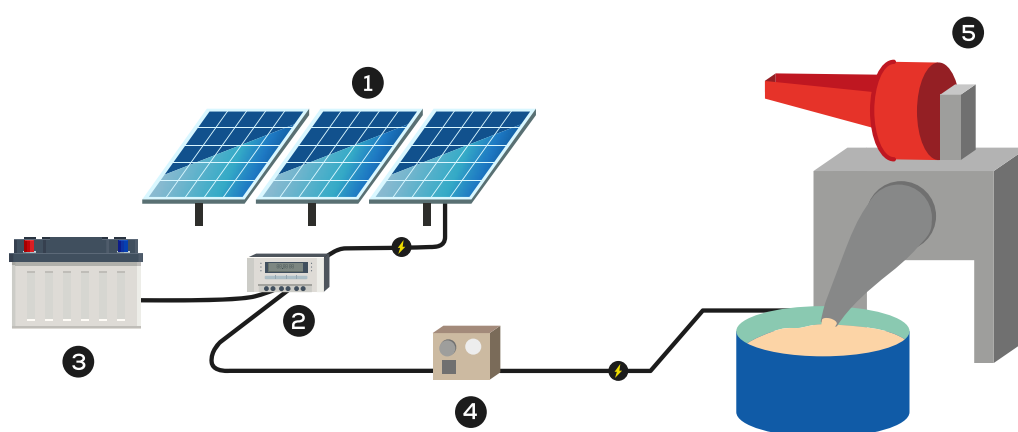
The mill is driven by an electric motor (brushless, 48 V, 1.3 kW), powered by solar energy (2 kWp). The system comprises a battery bank (800 Ah), that allows a continuous operation of the mill even under unfavourable weather conditions or during times after sunset. The mill can process up to 500 kg of product per day, and allows value addition to different types of product.

What are common uses?

WE4F's partner uses the mill to produce fruit powders from previously dried pineapple, banana and mango. The partner uses lower quality fruits that do not meet market expectations but still make for nutritious food powders. They can be used to prepare drinks or for cooking. Other usage of the mill is the production of flour from cassava, maize or other grains.

Market development

The market potential for solar milling in East Africa is high. However, manufacturers have to balance cost, throughput and efficiency to meet market needs. Reducing costs by increasing energy efficiency and consumer outreach and education can unlock higher demand. Used for processing of low value food crops (cassava, maize), solar milling does not have high value addition potential compared to other productive use appliances, as market fit and business case are challenging. There are only a few suppliers, including companies in Kenya and Europe.



- ① Solar generator
- ② Charge controller
- ③ Battery bank
- ④ Motor control
- ⑤ Milling unit



SOKOFRESH LIMITED

Post-harvest reduction: Cooling and aggregation model

SoKoFresh provides solar cooling solutions for the food and agriculture sector. Since its founding, the company has experimented with different business models. The initial idea of proving cooling as a service through Pay-As-You-Chill was not profitable in Kenya, so SokoFresh shifted its focus to a B2B model. It is now aggregating fruits, storing and selling them to retailers, such as Carrefour and Naivas supermarkets.

Key partners

SokoFresh was incorporated in 2019 as a cold storage solutions provider towards eliminating post-harvest food loss in smallholder farmer value chains. The company offers cold storage as a service, processing as a service and market linkage solutions. The key partners for SokoFresh are smallholder farmers, who sell the crops to SokoFresh and the retail stores, such as Carrefour or Naivas, that buy the produce to resell to the final consumer. SokoFresh through the incorporation of the cold storage into the value chain has managed increase the incomes of farmers through the reduction of post-harvest losses.

Key resources

SokoFresh piloted cooling as a service for two years but had to pivot the business to aggregate the produce from the farmers and preserve it in the SokoFresh cooling systems. The business model was pivoted to enhance the value for the smallholder farmers where SokoFresh aggregates and sells the product.

The cold storage units are the main resources for the SokoFresh business model. The units are used to store the produce and ensure they maintain the required quality before they are delivered to the main clients of SokoFresh hence reducing post-harvest losses. The company aggregates highly perishable goods like bananas.

Distribution channels

SokoFresh buys from contracted and non-contracted farmers, who meet the quality standards of products required by SokoFresh. The farmers are reached through agents or champion farmers, who point SokoFresh to the farmers that are producing the fruits. After inspection, SokoFresh collects the produce directly from the farms and stores in their cold rooms before transporting to the retail partners. SokoFresh has integrated an online platform that is used to record the produce purchased from the farmers, calculate and make payments instantly. SokoFresh is working on developing the online platform further to include trading functionality. Farmers will be able to trade their produce through the platform.

Revenue streams

SokoFresh main revenue is from selling of the fruits and vegetables to the B2B market. There are revenues that are drawn from the Pay as you Chill model but the company is slowly pivoting from that model. Having implemented the model for more than two years SokoFresh established some challenges that slowed down the uptake of the PAYC service. The smallholder farmers were not able to enjoy the economies of scale as they stored in very little quantities which in turn increased the final cost of the products. This became a deterrent for the smallholder farmers and the uptake of the cold storage service was underutilised. SokoFresh has however now integrated the cooling services to the market linkage and aggregation.

Value proposition

SokoFresh has developed a market linkage arm which is a digital innovation that guarantees farmers fair markets for all products stored with the company. One of the company's market guarantees is through their off-grid solar processing factory that can convert unsold produce to value-added products such as avocado oil, with profits from processing shared with

the farmer. SokoFresh offers Cold storage and Market Linkage services. SokoFresh focuses on delivering the benefits of solar technology to the most vulnerable by making it affordable, and accessible, with aligned incentives for the farmer with the adoption of cold storage, by guaranteeing access to markets through its digital market.

What sets this business model apart from its competitors?

- 1) SokoFresh offers competitive prices to the farmers. They ensure 1. to offer prices that are better than the prevailing market prices, usually being 10% to 20% higher.
- 2) SokoFresh offers agronomic support through partners such as the 2. cereal growers association, Farm to Market Alliance, FAO and the One Acre Fund to ensure the products are of the required standards by their buyers.
- 3) The company uses a digital platform where the quantity of 3. products is keyed in at the farm gate and payments are done instantly to the farmers.

Impact

With support of WE4F, SokoFresh has set up 6 cold storages under full-service model in Kiambu, Kirinyaga, Muranga, Garissa and Meru. Furthermore, there are 7 aggregation hubs in Tharaka Nithi, Makueni, Nakuru, Bomet, Nandi, Homabay, and Busia. These hubs have resulted in the recruitment of 10,000+ farmers onto the SokoFresh digital platform for the full-service model. In 2023, Sokofresh aggregated a total of 1,553 metric tons of fresh produce across Kenya.

SokoFresh has also leased out 9 units in different parts of the country, serving other organisations such as the One Acre Fund.

Solar cold room

Optimizing resource efficiency through cooling

What is a solar cold room?

Cold rooms are refrigerated spaces that provide chilled storage for large quantities of agricultural goods. A solar cold room is powered with electricity generated through photovoltaic panels. In a containerized solution, the room is housed in a modified standard overseas container (20-foot or 40-foot) making them mobile and robust for the installation and use outdoors.

What are the main features?

The containerized solar cold storage installed by WE4F is housed in a 20-foot container with PV-panels installed at the top. It has an inner storage volume of 21 m³ and a temperature range that can be set from 4 °C to 20 °C, depending on the product to be cooled. It consists of 7 kWp PV that powers the cooling system and distribution pumps. A thermal ice storage combined with batteries allow the functioning of the system also at hours without solar irradiation.

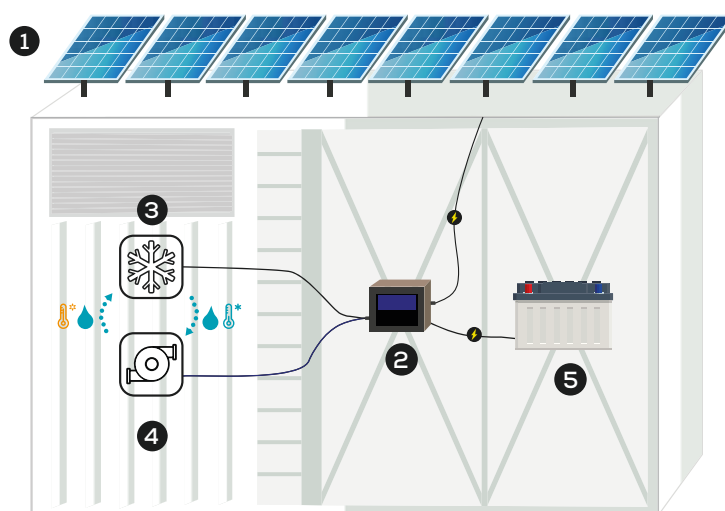
What are common uses?

The cold storage retains the quality of agricultural goods and increases their shelf life. It can be used for fruits, vegetables, flowers and other perishable commodities along the whole value chain. The cold storage helps to reduce post harvest losses, especially during peak seasons at field, cooperative or market level.

Market development

The market potential for solar cooling in East Africa is high. Large amounts of agricultural products are lost post-harvest due to a lack of cooling facilities. Cooling helps reduce food losses and by extension, resource use inefficiencies.

Today, a large number of manufacturers worldwide provides containerized cold storage solutions, offering slightly different approaches and business models. Accessibility to the systems can be improved by adapted financing mechanisms such as rental solutions, pay-as-you-cool or cooling as a service. Also, Do-It-Yourself solutions are available, that promote the use of locally available components for the construction of cold storage.



- ① Solar generator
- ② Controller & inverter
- ③ Cooling unit & ice storage
- ④ Pump
- ⑤ Battery bank



KAZI YETU

Organic tea aggregation and production

Kazi Yetu produces organic tea and spices. The company caters to a diverse customer base, encompassing both B2B and B2C segments. The company serves customers in Tanzania, Germany and the US. In the abroad-markets, Kazi Yetu operates through subsidiaries. Moreover, Kazi Yetu engages directly with consumers through its factory outlet located in Dar es Salaam. This dual approach allows Kazi Yetu to reach both businesses and individual consumers, providing a versatile and comprehensive market presence.

About the company

Situated in Dar es Salaam, Tanzania, Kazi Yetu translates to 'Our Work' in Swahili, symbolizing their commitment to enhancing the lives of more than 2,500 small-scale farmers engaged in the cultivation of teas, herbs, and spices. Kazi Yetu procures its spices and tea brands directly from these small-scale farmers in Tanzania. These farmers collaborate with a champion farmer or aggregators, responsible for gathering the produce and coordinating its delivery to the production facility in Dar es Salaam. Kazi Yetu also has registered entities in Germany and USA for the distribution of products.

Key resources

The process of creating the tea and spice blends involves dehydrating and solar drying the fresh products. Once dry, the products are placed in specialized teabags designed to allow the infusion of flavors when submerged in hot water. Kazi Yetu specializes in solar-drying organic tea blends obtained from a network of more than 2,500 farmers. The solar drying equipment is used both at their facility as well as their aggregation centres in the farms to reduce post-harvest loss. The teas boast natural blends without any additives. Additionally, Kazi Yetu demonstrates a commitment to gender inclusivity, with 80% of their production facility staff being women. At farm level, they were selected for managing the demonstration plots. At the factories, women take part in the production process through sorting and packaging. Also, the majority of leadership positions is also filled with female staff.

Distribution channels

Kazi Yetu employs a multi-faceted distribution strategy for its teas and spices. These products reach consumers through retail shops (supermarkets and gift shops), hotels, and restaurants, with Kazi Yetu also directly selling them at their factory outlet. The hospitality industry in Tanzania has been a large market segment, including hotels and gift shops across Zanzibar and Arusha, as well as Dar es Salaam. In a strategic move, the company has formed partnerships with airport duty-free shops in Tanzania. This collaboration has proven to be highly effective, serving as a key distribution channel and a powerful platform for expanding market outreach. The airport duty-free shops have emerged as a significant avenue for Kazi Yetu to reach a broader audience and make its products more widely accessible.

Revenue Streams

Kazi Yetu primarily generates revenue through the sale of organic tea blends to local and international markets. Further, Kazi Yetu trades the tea, herbs, and spices in bulk. The company also offers a white labeling service, providing private labeling offerings for international brands. 80% of the production facility staff are women.

Value Proposition

Kazi Yetu takes pride in offering 100% organic products, ensuring their tea blends and spices remain free from additives or preservatives. The commitment to maintaining the integrity of the original components is reflected in their solar-drying process and packaging methods.

Kazi Yetu's products stand out with an effective traceability feature, allowing consumers to trace the final

product back to the specific small-scale farmer responsible for cultivating the crop. This emphasis on transparency and traceability underscores the company's dedication to quality, authenticity, and the connection between consumers and the farmers behind the products.

Impact

Kazi Yetu's unique business model sets it apart by embracing an entirely organic approach, ensuring their tea blends and spices are free from additives. Distinguishing itself further, the company prioritizes sustainability through solar drying, contributing to both quality and environmental consciousness. Beyond product excellence, Kazi Yetu operates a training center, educating small-scale farmers on organic practices. Notably, the company empowers women by providing employment, benefits like NHIF coverage, and meals during work hours. This comprehensive and socially responsible approach positions Kazi Yetu as a standout player, combining organic principles, renewable energy, farmer education, and a commitment to gender inclusivity.



MACE FOODS LIMITED

Contract farming for dried chillies and African leafy vegetables

Mace Foods sources and processes chillies and African leafy vegetables. The target customers for the chillies and the dried vegetables are both within the local and international market. Mace Foods sells its product in Kenyan supermarkets, but also targets school feeding programs with the African Green vegetables. Chillies are also offered in bulk and within a white labeling service where they are sold under other brands. In future, Mace Foods also targets the cosmetic sector, where chilli powders are becoming an important ingredient.

Key partners

Mace Foods sources chillies and African Leafy vegetables, including spinach, kales, cowpea leaves, black night shade among others, from smallholder farmers in Kenya. The farmers are contracted and trained by Mace Foods on the farming practices as well as the standards of crops accepted by Mace Foods. Mace foods also provides seedlings and seeds to the farmers as a way of ensuring high quality of products. The company works with champion farmers that support Mace Foods in identifying new potential farmers for contracting. This is followed by training and continuous support from planting to harvesting. After harvesting the crops are transported by local transport providers to the grading centres, where Mace foods collects and transports for processing in the Eldoret plant. Mace Foods has received financial support from Kenya Climate Ventures (debt), a grant from SNV and a convertible note from the Siemens Foundation.

Key resources

Mace Foods uses solar dryers to preserve the chillies and African Green vegetables. For this, the company operates specially fabricated greenhouse drier at the processing factory.

Mace Foods also set up dryers at the aggregation centres to predry the chillies and vegetables. This helps to reduce the risk of loss of produce before being transported to the factory.

Distribution channels

The final product is distributed through a B2B model, both for the local and international markets. In Kenya, Mace foods is distributing through two of the main retail supermarkets, Chandarana and Naivas. The same concept is used for the international markets in Europe and the US, where Mace Foods sells to wholesalers and distributors, who then sell to the final consumer. A small percentage of the produce is also sold through a Mace Foods retail shop based in Nairobi.

Revenue streams

Mace Foods revenues are generated from the sale of processed chillies and African leafy vegetables. 19% of the revenues come from the dried leafy vegetables, while the chillies make up 63% of the total revenue while the remaining 18% is from the sale of seedlings and seeds.

Almost 80% of smallholder farmers that Mace Foods works with are women

Value proposition

Mace Foods provides increased value to small-scale farmers by offering premium prices for their chillies and vegetables. Mace Foods' produce themselves offer a healthy option of African leafy vegetables to final consumers in the global market.

What sets this business model apart from its competitors?

- 1) Mace Foods guarantees a market to its contracted farmers at a price level that is 30% higher than the prevailing market prices, the company uptakes all the produce that meets the production standards as trained by the agronomists.
- 2) Mace Foods pays for the products upon delivery and quality assurance.
- 3) Through the extension officers as well as the two demo sites set up by Mace Foods, the farmers receive training on acceptable.

- 4) farming practices and standards of the crops that Mace Foods uptakes.

- 5) Mace Foods dries chillies and African leafy vegetables through specially fabricated solar driers, a process that ensures the preservation of the quality and nutrients of the crops.

Impact

Almost 80% of smallholder farmers that Mace Foods works with are women, thus significantly contributing to improving income opportunities for women. In order to build capacities of farmers, the company has set up two grading centres at demo farms that are used by farmers to sort and grade their products as well as learn on good agricultural practices. Farmers that have worked with Mace Foods have reported 42% higher incomes than farmers that are under no structured agreement for the sale of their chillies and vegetables. The productivity of the Mace foods contracted farmers is about 40% higher than generic farming. The agronomic support offered by Mace Foods contributes significantly to increased productivity. Through the drying and processing of the vegetables and chillies Mace Foods contributes to food loss reduction and by extension, reduced water and carbon footprints.

Solar dryer | Drying of fruits, vegetables and crops with the power of the sun

What is a solar dryer?

A solar dryer is a technology that enables the reduction of the moisture content of agricultural goods, using solar energy. This approach is a more advanced version of conventional drying in the direct and open sun. The structure keeps the product safe from dust, rain and insects, while achieving higher drying temperatures. This is a big advantage compared to the conventional practice of drying in the open air.

What are the main features?

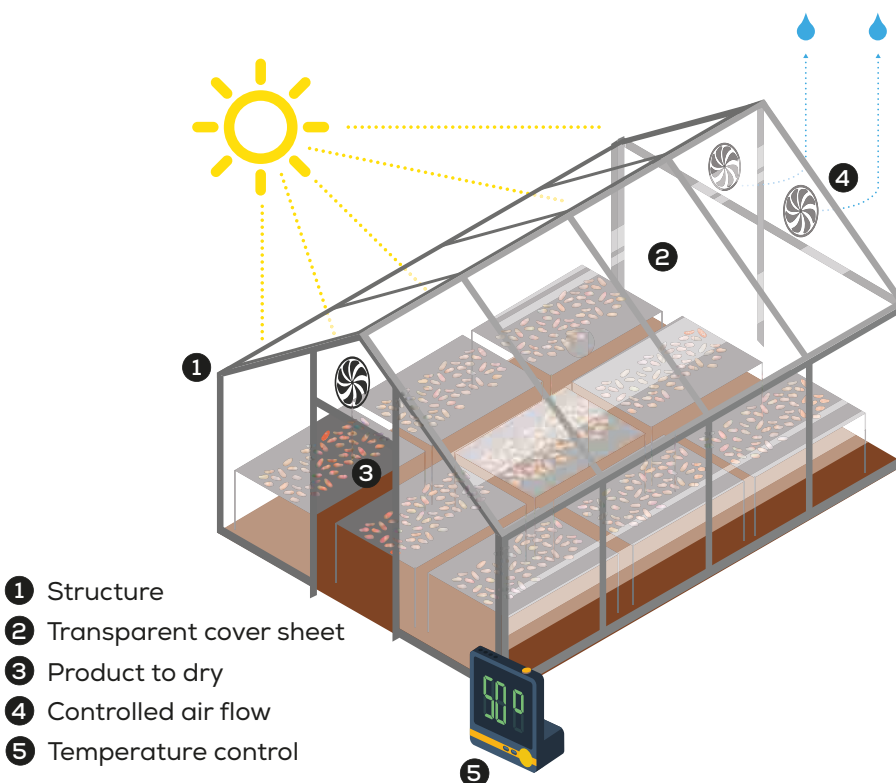
Solar dryers are available in a variety of forms and sizes. The top of the dryer is made of a transparent material that allows the sunlight to pass through. The inside surface is usually black, to absorb the incoming solar radiation and heat up the drying chamber. Solar dryers have a controlled air flow, that removes the humid air from the inside of the chamber. When a product is placed into the dryer and exposed to the sun, it will heat up and reduce its moisture content. Depending on the product, the moisture content is reduced from about 90 % to 10 %.

What are common uses?

The reduction of moisture content leads to a reduced growth of bacteria, yeast and moulds, improving the shelf-life. Perishable products such as mangoes or pineapples can be transformed into dried fruits. Other common products to dry are cassava, chillies, tomatoes and a variety of herbs. Once dried, they can be preserved for several months.

Market development

The market potential for solar dryers is high in regions with agricultural production and a high amount of sunny days. The technical basics are well assessed and different products in type and size are available in the market. This includes tunnel dryers, drying boxes, cabinet dryers or greenhouse dryers. Their high drying efficiencies and low operating costs have led to a rise in demand for them in agricultural processing. However, their dependence on strong and direct sunlight brings a certain risk to the operation, especially for bigger processing companies.





EENOVATORS

Saving money - Making money through energy efficiency

Poor water and energy management introduces risks of wastage, low productivity and inflated costs of production. WE4F and Eenovators Ltd have partnered to set up a ESCO model to tackle energy inefficiency in the agri-food sector and to train young professionals on water and energy efficiency.

Background

Climate change and the rapid population growth in Kenya are putting increasing pressure on food systems. The efficient use of water and energy in will be key in addressing these issues, which is why the **WE4F East Africa Regional Innovation Hub (RIH)** and **Eenovators Limited** have partnered to build technical capacities and develop innovative management solutions water and energy efficient in the agri-food sector.

Project in a nutshell

The project aimed to develop ESCO models that promote food security through energy and water management with a focus on the youth. This included the following measures:

- 1) **Training of ten young professionals** to become energy auditors and complete work placements in

food processing companies in Kenya, where they support the uptake of energy & water management best practices.

- 2) Identification of energy and water saving measures in agro-processing industries through the implementation of investment grade energy and water audits. The audits identify conservation measures to save energy and water costs and to reduce their carbon footprint of the food processing factories.
- 3) Setting up a Water Energy Service Company (WESCO) Model with industry partners to design, finance and implement energy efficiency measures in the agri-food sector.
- 4) Promote and create awareness on energy and water efficiency in the agri-food processing sector through implementation of stakeholder and partner forums both locally and internationally - such as the organization of the World Energy Day.

Project outcomes

- The 10 trainees selected for the Youth in Energy Empowerment Programme (YEEPTM) have been equipped with the essential skills and training to position themselves for employment in the energy industry in East Africa. All the trainees have found employment in various agro-food processing companies in Kenya.
- Significant reduction in energy and water consumption in the 10 agro-processing companies has been observed. This is because of the Installation of the EAGLES Energy management system for monitoring and analysis of energy and water consumption, establishment of energy committees and implementation of energy awareness trainings these facilities.
- Implementation of energy and water audits in 10 factories has identified energy efficiency and renewable options for the facilities that will guarantee reduction in energy and water intensity, savings and reduction in GHG emissions for a healthier environment. Discussions are on-going to facilitate implementation of these measures through a Water and Energy Service Company (WESCO) model with several of the factories.

- Establishment of an Energy Savings Company through regional and global partnerships. The ESCO facilitates the implementation of energy saving measures in agro-processing Industries in East Africa. Eenovators Ltd. and its partners have mobilized private investment of up to EUR 30 Mio. for the ESCO so far.

Looking forward

The audited companies are now in the process of implementing the suggested energy and water saving measures. Some of them are investing their own capital, while others make use of the Energy Service Company model to acquire external investments. If all measures are installed saving in the 10 agro-processing companies, then the following savings can be achieved within one year:

- Energy savings **2,558,804 kWh**
- Water savings **127,678 m³**
- Reduction of GHG emissions **10,007 tons of CO₂e**
- Total investment cost **2.18 Mio. EUR**
- Total Annual reduction on energy bills: in the range of **9.6%-32.5%**

Facts

- Kenyans spend between **50 to 100 EUR** extra on electricity every year because of the inefficient equipment and appliances they use.
- **180,000 kWh** is the annual energy consumption threshold over which all designated facilities in Kenya are required to undergo energy audit.
- Kenya emits **0.03%** of the world's carbon dioxide.

World Energy Day

- Over 1000 participants in the World Energy Day Conferences in 2020 - 2022.
- Over 40 international speakers sharing knowledge and experiences on energy and water efficiency from different continents.
- 3 Youth Energy Innovation Challenges to inspire the next generation of energy champions in Africa.
- Energy Professional Awards to celebrate talents in East Africa.

Training	10 young professionals participated in a 6-month technical training in water and energy management and work placement in food processing companies. All the participants got employment in the field of energy after the training.
Water and energy efficiency	Smart water and energy metering systems were installed in 10 agro-processing companies to measure energy and water flows and advice on measures to reduce consumption and costs.
Water and Energy Saved	Most of the 10 companies implemented energy recommendations, including installation of solar power plants, more efficient lighting solutions or voltage optimization.

Eagles energy management portal- Energy management for improved energy efficiency in agrifood processors

What is the Eagles Energy Management Portal?

Energy and water resources are critical for food security and agricultural productivity. However, the agricultural sector is lacking proper systems and skilled labour to oversee the management of these resources. The Eagles Energy Management Portal is a Python-based energy data analytics platform for energy management and energy audits. It offers real-time monitoring of energy data to reveal and predict trends and performance allowing the customer to make informed decisions and to achieve savings.

What are the main features?

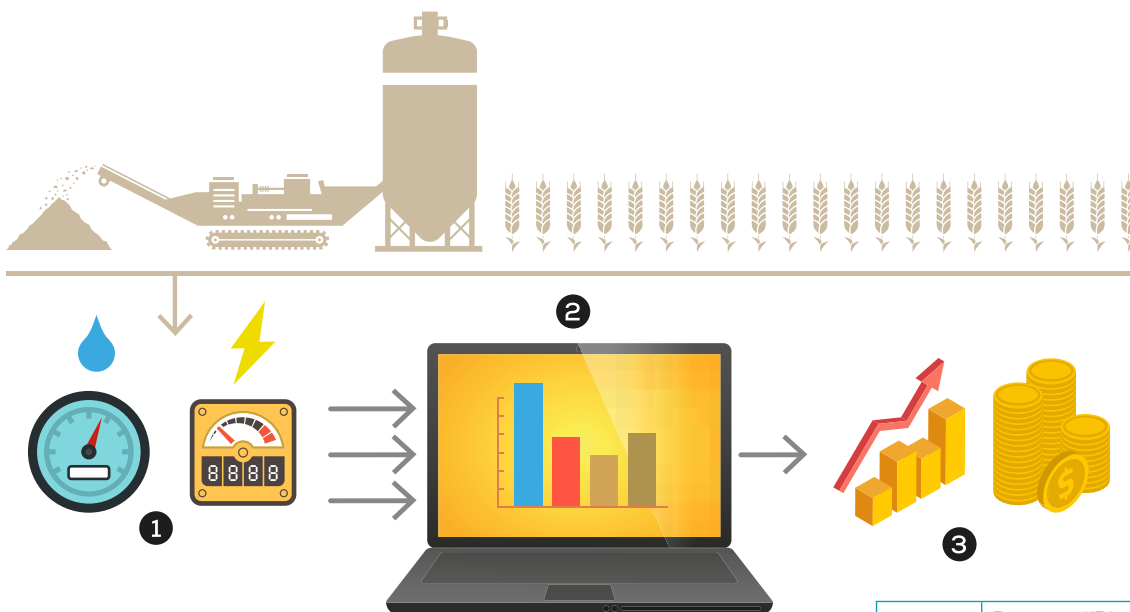
The data gathering and analytics engine collects energy use raw data of clients, and applies powerful analytics. Energy experts can then identify opportunities for increased efficiency. Additionally, it offers comprehensive real time monitoring, granular power quality analytics, machine-learning powered reports and automated audit process tracking among other features.

What are common uses?

The portal closely monitors energy consumption and analyses the data to help energy engineers provide crucial insights on the energy usage of processors. This helps to identify potential issues and opportunities for sustainable solutions towards increased energy efficiency and savings. It is also an audit management tool through which clients can track the audit process and provide the required information for an efficient and comprehensive energy audit exercise.

Market development

A number of processing companies are now investing in energy management platforms for various reasons including high cost of energy and water and lack of awareness on energy and water consumption. The desire to achieve savings on these two resources has increased the demand for energy management programs to monitor consumption and advise on approaches & technologies to reduce energy and water utilization.



- 1 Data inputs from water and energy consumer
- 2 Eagles data analytics platform
- 3 Energy and water saving measures (EWSMs)

Partner:	Eenovators KE Ltd
Type:	integrated Development Partnership with the Private Sector (IDPP)
Focus:	Piloting and training of industry on the use of Eagles
Country:	Kenya



SYNNEFA

Resource efficiency with precision farming

Synnefa provides low-cost greenhouse micro-climate management systems. Synnefa and targets both, the B2C and B2B market. The company sells their systems directly to individual customers or cooperatives, who seek to have a more controlled farming environment. On the B2B side, agricultural banks and insurance companies are targeted. Synnefa also addresses the needs of research organisations on controlled and closely monitored greenhouses for their plant studies.

About the company

Synnefa is a Kenyan agritech company founded in 2014. Synnefa provides low-cost greenhouse micro-climate management systems called FarmShield. The FarmShield system measures a number of environmental parameters through sensors that are installed in greenhouses or on the field. The data is transmitted into the FarmCloud for analysis and visualization. It can then be used by farmers to make decisions about irrigation and the use of inputs to create optimal production conditions. Synnefa also designs and constructs greenhouses for vegetable production, screenhouses for the rearing of Black Soldier Flies, as well as irrigation drip kits.

Products & services:

Synnefa not only provides in-house agri-technologies and greenhouses, but also a wide range of products and services from third parties. This includes water tanks and drip kits, trellising systems for plant support, a farmer-starter kit with seedlings, fertilizer and agro-chemicals, crop insurance as well as farm advisory.

The FarmCloud not only analyzes and visualizes farm data, but also serves as a platform to access other services. Partnering microfinance institutions offer loans to farmers and extension officers provide support to get crop certification and traceability reports for export markets.

The combination of products and services offered by Synnefa provides farmers with the ideal resources to start a modern and efficient crop production.

Revenue streams

Synnefa has diversified its revenue stream by offering the following goods and services:

- The FarmShield is available in different packages to cater for the farmers' needs. The packages differ in the amount of sensors connected with system prices ranging from 500 to 1000 USD.
- The FarmCloud can be accessed via monthly or yearly subscription. Different packages are available, targeting smaller to bigger farm sizes.
- Customized greenhouses and screenhouses that are designed and constructed by Synnefa are offered in different sizes.
- Smart Drip Kits for different land sizes.

Value proposition

Smart greenhouse farming as proposed by Synnefa has a number of advantages:

- **Controlled environment:** By providing the right micro-climate (temperature, humidity, light, water supply) crops find the ideal growing conditions and will thrive. Pest and diseases are better controlled and reduced.
- **Protection from extreme weather:** Rainy seasons often come with strong storms and winds, threatening outdoor crop production. Greenhouses reduce crop losses through heavy rains, hail or strong gusts of wind.
- **Extended growing season:** Controlled greenhouses allow a year-around crop production, independent of the rainy seasons. This allows farmers to maximize their productivity and meet market demands.

The products and services offered by Synnefa can drastically increase the production value per area and create new income opportunities for farmers. By providing them with a ready-to-go solution including farm advisory, market linkages and crop insurance, their farming business is derisked and the returns more reliable. With Synnefa's systems, Kenyan export-oriented farmers can capitalize on the growing demand for high-quality products – such as fresh herbs – in the European markets.

Impact

Synnefa is working with thousands of farmers in Kenya, who use their products and services. Farmers receive data in real time that allows them to make more precise decisions on when to deliver water, pesticide or fertilizer in calibrated doses to only the areas that need it. The technology can also help farmers decide when to plant and harvest crops. As a result, they can improve time management, reduce water and chemical use, and produce healthier crops and higher yields – all of which benefit farmers' bottom lines and conserve resources while reducing chemical runoff. The company Synnefa has recently secured additional investments and will scale its operations to reach even more farmers not only in Kenya, but also in neighbouring countries.



IGNITA

First weather forecasting model developed specifically for tropical climates

With over 96% of agriculture in Sub-Saharan Africa being rainfed, small-scale farmers are particularly exposed to changes in rainfall patterns that have a negative impact on yields and product quality. As the frequency and intensity of climate shocks and unpredictable weather events increase, the risk of food insecurity intensifies. Yet, the majority of weather models are created for temperate zones, making them highly inaccurate for tropical zones.

Background

Ignitia is one of 20 innovative companies selected as part of a call for innovation by the West Africa cluster of the Water and Energy for Food / Programme Eau et Energie pour l'Alimentation (WE4F / PEEPA), whose main objective is to scale up water- and/or energy-friendly innovations in the agribusiness sector. Ignitia was founded in 2010 on the basis of an implacable observation: high-quality global climate forecasting models are based on high and mid-latitude geographies, typical of the European and North American continents. These are the models that generate the weather forecasts, which are traditionally distributed throughout the world. However, in tropical areas such as West Africa, the climate does not function in the same way as in high and mid-latitude geographies, which generates recurring errors, particularly in precipitation forecasts. In addition, the models available for emerging markets are not very reliable, with only

38% reliability for the best of them. Ignitia has therefore developed a unique solution dedicated to tropical climates, to offer farmers the ability to forecast climatic events, and in particular rainfall episodes. By anticipating these events, they can improve their water and weather management and, as a result, optimize the use of their often already scarce resources. With a proven accuracy of over 84%, Ignitia's solution is already used by more than 2.9 million users in Africa, as well as in Brazil. Ignitia has recently completed its global expansion to the rest of the world.

Innovation

Ignitia's highly accurate weather forecasts help farmers address climate-related vulnerabilities throughout the agricultural value chain. Its flagship product is a 48-hour forecast message, with an accuracy of 3 to 9 kilometers radius, sent daily by SMS directly to the subscriber's phone. Ignitia has transformed since then to provide digital weather and climate information services through different channels such as WhatsApp, App, or Web depending on the local context.

This provision of timely and relevant information enables essential decisions to be taken in the agri-food sector, such as crop selection, soil preparation, the application of inputs, but also the organization of the transport of crops to their marketing areas. Ignitia's technology is based on real-time satellite data, which is improved with emerging technologies AI and Machine Learning, and does not rely on ground stations, which are few in the tropics. Its weather forecasting system also includes monthly and seasonal forecasts, detailing the probability, timing and intensity of weather conditions.

Finally, Ignitia has released an extreme weather alert product onto the market to support the general public in the tropic to prepare ahead of any extreme weather event. Currently, Ignitia is piloting on a last-mile distribution model: village-based advisors to will help farmers by providing key advisory services based on forecasts.

Advantages

Of the almost three million farms equipped with Ignitia's solution, 94% have adapted their farming practices, thereby saving resources essential to their business. When it comes to hiring mechanical or transport equipment, knowing the right time to use it reduces wear and tear by avoiding unnecessary transport, cuts labour costs by optimising time and use, and reduces fuel costs by ensuring efficient driving. It is also the ability to avoid mobilising additional manpower resources for tasks that are necessary but cannot be carried out because of the weather and will therefore have to be postponed. Reliable weather forecasts also have a positive impact on optimising the use of inputs

and seeds by saving on crop nutrition through knowledge of the optimum time to spray, as well as minimising seed costs by identifying ideal planting conditions. Finally, Ignitia's solution enables farmers to increase their income by boosting production. Publications from third party renowned impact evaluation organizations such as 60db has reported increase in productivity, income and farmers well-being as a result of Ignitia service. A Net Promoter Score (NPS) of 71 was achieved by Ignitia in the lasted publication of 60db in the year 2024 from their assessment of digital farmer services in Nigeria.

Goals

- Provide a reliable weather forecasting model to farmers in tropical areas.
- Enhance the use of farmers' labor, machinery and input resources.
- Ensure better use and management of water resources, particularly rainfall management.
- Develop the world's best weather forecasts and support customers in their day-to-day decision-making.

Mobile application for accurate weather forecasts

Ignitia has developed a highly accurate weather forecast model that helps farmers plan their farming activities such as sowing, fertilizer application, spraying, and harvesting at the best possible time.

- A 48 hour forecast message, specific to the subscriber's location, is delivered daily via SMS.
- Information on weather parameters such as rain, timing of rainfall, intensity of precipitation, temperature, humidity, wind speed, among others precisely for locations within a 9 km radius, is provided.
- The forecast messages use key words which are user-friendly and constructed in a way so that low-literacy subscribers can extract the information with little or no training.
- The forecast also features monthly and seasonal predictions including details surrounding the likelihood, timing and intensity of weather phenomena. These messages are sent via sms, WhatsApp, mobile apps, and APIs.
- Ignitia has three main products: "Iska" (rainfall forecast), "CSA" (climate smart advisories), which is designed for smallholder farmers and "Ojo" (mobile and web intelligence platform), which is aimed at actors in agricultural food systems.





FOYER TECH

Increasing the shelf life of agricultural products through solar drying

In many developing countries, local fruit and vegetable markets are often saturated during the marketing periods following harvests. The surplus production unfortunately often leads to unsold goods, and consequently significant post-harvest losses for producers. An important alternative for the enhancement and security of production lies in the preservation of these products through drying.

Background

Foyer Tech is one of the 20 innovative companies selected in a call for innovation by the West Africa Hub of the Water and Energy for Food Program/ Programme Eau et Energie pour l'Alimentation (WE4F), whose primary objective is to scale water- and/or energy-efficient innovations in the agro-industrial sector. Founded in 2016 in Niamey (Niger), Foyer Tech is a company with 11 employees specializing in metalwork, particularly in the design and supply of agro-food equipment such as improved stoves and steam cookers. In response to the issues of shelf life and commercialization of agricultural products, Foyer Tech developed a modern, healthy, and rapid drying device in 2017. This device, through dehydration, facilitates the preservation and processing of food products such as fruits, vegetables, seeds, roots, condiments and aromatic plants, meat, and fish. This solar drying system, which has received numerous innovation awards both in Ni-

ger and internationally, has since been marketed and deployed in over seventy sites in the city of Niamey and its surroundings, over sixty within the country, and a few units abroad.

Innovation

This solution presents a dual innovation in both its structural design and functionality. This dryer uses indirect light and forced ventilation, with the ventilation energy provided by a photovoltaic panel and stored in a battery with a charge regulator incorporated into the device. The system is therefore completely energy-autonomous (off-grid), and it includes a solar thermal collector specifically designed for this type of dryer, made of glass combined with galvanized sheet metal painted matte black. The addition of an efficient ventilation system also reduces the necessary drying time, thereby increasing the processing capacity of agricultural products in rotation.

Designed as a monobloc, the entire device is incorporated into a single system including the solar panel, thermal collector, charge regulator, and ventilation system. It is also perfectly suited for rural areas and for use by individuals with relatively low technical knowledge in this area. Additionally, with a drying surface of 10 m², it provides significant capacity while being compact enough to occupy only a small space.

Advantages

Drying agro-food products with a solar dryer in the Sahel ensures consistently high-quality products in large quantities, freeing the producer from weather and seasonal constraints. This increases the shelf life of the products and thus their marketing period, limiting the waste that can occur with unsold raw products at the end of the season. This allows farmers to have a potential source of income from their harvests throughout the year, contributing to the development of the agro-industrial sector.

Furthermore, with its integrated ventilation system, it increases drying performance by reducing the time needed for the process. Combined with its available 10 m² surface area, it offers superior capacity for farmers to process a larger volume of products compared to traditional open-air drying methods. Compared to this method, solar drying also provides better quality finished products. Indeed, its closed system protects agricultural inputs like fruits and vegetables from external dust and insects, making the processed products more hygienic and compliant with current standards.

Finally, its energy autonomy allows producers to make significant savings on costs (both on access to the electrical grid and on any potential energy input from a generator), while adhering to a responsible and sustainable approach to environmental preservation.

Goals

- Offer an alternative solution to farmers for the processing of their products and their off-season commercialization.
- Improve food security for populations by reducing losses due to unsold and spoiled agricultural products.
- Develop a highly efficient, high-quality, autonomous drying system accessible to small farmers and rural areas.
- Provide an effective locally developed solution to the challenges of conservation, transport, and distribution of agricultural products in the Sahel region.



ogv

Making solar drying accessible to small-scale farmers

Nigerian farmers suffer significant post-harvest losses on their agricultural produce, particularly fresh produce (fruit, vegetables, etc.). Every year, smallholders lose more than 50% of the agricultural produce they have harvested due to the lack of adequate storage infrastructure or an appropriate and efficient agri-food processing industry.

Background

Osomobegbe Global Ventures Limited (OGV) is one of 20 innovative companies selected as part of a call for innovation from the West Africa cluster of the Water and Energy for Food Program / Programme Eau et Energie pour l'Alimentation (WE4F / PEEPA), the main objective of which is to scale up water and/or energy-friendly innovations in the agribusiness sector. OGV, a Nigerian-registered company founded in 2014 with four employees designs and builds solar dryers (small, medium and large) for farms, aggregators and retailers. OGV also provides solar drying services in rural areas for farmers and cooperatives who cannot afford to buy their own dryers. They can then bring in their harvested perishable plant products and have them processed and dried at an affordable price. OGV is also involved in the distribution of the processed products, selling perishable plant products that have been carefully dried using solar energy and hygien-

ically packaged, such as tomatoes, peppers, onion powder and onion flakes, in reusable 50-100g packs. Thanks to its various solutions, OGV is responding to a fundamental challenge in Nigeria's agri-food chain by using solar drying to extend the life cycle of agricultural products, combat food waste and increase shelf life and sales potential.

Innovation

OGV's major innovation lies in its system of pooling and leasing solar dryers, designed to meet the needs of smallholder farmers and rural and urban cooperatives who do not have the resources to finance the purchase of such equipment themselves, even though it is essential for preserving and marketing their crops over time. The drying process is also solar-powered, making it environmentally friendly and helping to combat global warming through the use of renewable energies. As a result, this solution is independent of external energy supplies, such as electricity from the national grid, which would increase operating costs, or which would require additional supply by adding a generator.

The solar drying structure has also been designed to be easy to use, even for beneficiaries with little technical knowledge or time for training.

Finally, this solution is part of an eco-responsible approach that feeds the entire value creation chain for agricultural products, firstly by recycling the used plastic packaging bags used to pack the dried products for sale to customers, and secondly by introducing plant waste into the biodigester of the solar drying center and using it to produce biogas (clean cooking gas) for households and slur (natural organic fertilizer) for farmers.

Advantages

This solution provides a practical response to the issue of preserving agricultural produce and offers additional marketing capacity, over time and by type of product, to the farmers who benefit from it. In this way, they can make the most of their entire production instead of incurring major losses when their produce is not sold immediately after harvesting. This extra capacity is an additional source of income for them, helping to strengthen the economic development of the agro-industrial sector in Nigeria.

In addition, this type of solar drying system has been designed to be affordable, either through direct purchase or rental. So, depending on the financial capabilities of the individuals or communities concerned, everyone can have access to it according to the means they can mobilize.

Finally, the conservation method is natural. From the beginning to the end of the process of drying and

treating perishable agricultural produce for farmers, the processes used are 100% natural and do not use any additives, preservatives or chemicals. As a result, consumers have access to healthy, hygienic food products at an affordable price.

Goals

- Provide farmers with a practical response to the issue of massive losses of unsold agricultural produce post-harvest.
- Feed the market with natural, perishable, healthy, hygienic, dried and organic plant products.
- Increase the value chain for agricultural products, thereby creating additional income and jobs for the beneficiary communities.
- Help combat global warming by providing sustainable, environmentally-friendly solar drying solutions.



COLDHUBS

Solar-powered walk-in cold rooms for 24/7 storage and preservation

In Nigeria, 45% of food spoils post-harvest due to lack of cold storage. This causes 93 million small farmers to lose 25% of their annual income which threatens food security and already precarious livelihoods. In addition, for smallholder farmers, the impossibility of extending the shelf life of products has also meant more pressure in securing regular sales and finding new markets, low negotiating and selling power, as well as the inability to rely on a regular cash flow to plan expenses and investments.

Background

Coldhubs is one of the 20 innovating companies selected through a call for innovation by the West Africa Hub of the WE4F (Water and Energy for Food) programme whose main goal is to scale up water and/or energy friendly innovations in the agro-industry sector.

Coldhubs was created in 2015 in Nigeria. The company, which employs over 78 people, strives to innovatively adapt existing solutions to the local context by offering cold storage. Cooling significantly slows down the rate of deterioration, thereby increasing the storage life of the produce. Furthermore, the company organizes post-harvest management training where participants obtain a certificate upon completion. These certificates allowed some of the participants to access small loans to support their businesses.

Innovation

In 2015, ColdHubs launched a network of 100% solar-powered walk-in cold stations for 24/7 storage and preservation. At the same time, the company offers a pay-as-you-store model and facilitates capacity building on post-harvest management.

The units of the company are usually installed in major food production and consumption centers such as markets and farms. There, farmers can place their produce in clean plastic crates, which are then stored inside the cold room. This allows for the freshness of the produce to be extended from 2 days to about 21 days.

The walk-in cold rooms are made of 120 mm insulating cold room plans which help retain the cold. In addition, solar panels that are installed on the roof-top of the cold room produce energy that is stored in high-capacity batteries. These batteries in turn feed the refrigerating unit.

ColdHubs offers farmers a flexible pay-as-you-store subscription model which means that they pay a daily flat fee for each crate of food that is stored.

Advantages

- In 2021, ColdHubs served 6,317 farmers, retailers, and wholesalers across Nigeria. The company installed 54 cold rooms in 38 farm clusters, horticultural produce aggregation centers and outdoor food markets.
- Reduce post-harvest losses: In its 54 hubs across Nigeria, ColdHubs saved 2.4 tones of fruits and vegetables from spoilage.
- Reduce food waste: The shelf life of perishable food is extended from 2 to 21 days. As of 2021, around 52,700 tons of produce were saved thanks to cold rooms.
- Carbon dioxide (CO²) reduction: By staying away from fossil fuel and relying exclusively on solar panels for energy generation, the company saved 2.4 tones of CO² in 2021.
- Increase Local Farmer Income: With more of their harvest to sell, smallholder farmers increased their annual income by at least 25%.
- Create Jobs for Women: In 2021, Coldhubs created more than 80 jobs for women by hiring and training them as Hub operators and market attendants.

Facts

- In developing countries, **45%** of food is spoiled due mainly to a lack of cold storage.
- In Nigeria, food waste causes **93 million** smallholder farmers to lose **25%** of their annual income.
- Cold rooms can help reduce post-harvest losses by up to **80%**.

Goals

- Increase the use of renewable energy by using solar energy for the cold rooms.
- Reduce post-harvest losses and food waste by extending the shelf life of perishable food.
- Offer a flexible payment method to make cold rooms accessible to smallholder farmers.
- The company's target is to hire mainly women to manage its operations and collection of revenue.
- Extend services by covering the entire cold chain through the inclusion of cold logistics with cold trucks.



FREEZELINK

The one-stop shop for cold chain logistics

Cold chain infrastructure is essential to reduce product spoilage and preserve shelf life, both for agricultural products and for highly critical products such as vaccines. This is a particularly sensitive issue in high-temperature countries such as those in West Africa. Furthermore, in this region, this infrastructure and the associated technical expertise are not widely available and, when they are, very expensive.

Background

FreezeLink is one of 20 innovative companies selected in a call for innovation from the West Africa cluster of the Water and Energy for Food Program / Programme Eau et Energie pour l'Alimentation (WE4F / PEEPA) whose main objective is to scale water and/or energy friendly innovations in the agribusiness sector. FreezeLink was founded in 2018 to provide temperature-controlled storage, transportation, distribution and engineering services to customers handling perishable goods and pharmaceuticals in West Africa. In Ghana, particularly in the agricultural sector, many products are lost at farm gate, even before they reach the market, for lack of the necessary means of preservation and transport. This represents a loss of volume valued at 750 million euros a year. Moreover, throughout the transport logistics chain, these losses increase with each break in the cold chain. FreezeLink, which now has 23 employees, has therefore developed an integrated cold chain logistics service from the point of import or manufacture to the point of distribution

or export. This Ghanaian company also provides the teams and technical expertise needed to build, maintain and repair the infrastructures deployed.

Innovation

FreezeLink is a genuine one-stop shop for the cold chain, integrating all the logistical components of storage, transport and distribution to the end consumer, while also offering all the maintenance and operating services for the infrastructures used.

Based on the latest energy-saving technologies, FreezeLink provides refrigerated storage facilities (cold rooms, warehouses, freezers, etc.) that are both economical and environmentally friendly. In terms of transport, the refrigerated lorries are designed to meet product temperature specifications, taking into account factors such as distance, storage materials, terrain and weather conditions, while factoring traffic contingencies into the planning. With its in-depth knowledge of the African market, FreezeLink uses its cold chain expertise to store and transport fast-moving consumer goods (FMCG) to retail shops, hence allowing manufacturers to focus their time and resources on their core business of production. FreezeLink serves not only the whole of Ghana, but also the entire sub-region, through 170 retail outlets in the Greater Accra region, as well as export horticultural companies in Benin and deliveries of pharmaceutical products throughout the country.

Eventually, the other key feature of the FreezeLink solution is its billing system, based on pay-as-you-use by the customer and investments made with the help of external partners to lower the cost of access to the cold chain for the end users.

Advantages

The use of integrated cold chain logistics services has a proven positive impact on the preservation of the products concerned and the maintenance of their intrinsic qualities from their production centres until they are released for consumption. In the case of agricultural products in particular, losses at farm gate have been slashed by almost a third. Similarly, the degradation of vaccines is reduced by a quarter. Overall, the lifespan of all the products handled is extended by a third. This represents a significant gain in terms of reducing environmental waste, as well as water pollution caused by processing.

FreezeLink is also the only operator to offer a turnkey solution, from the production area to the port or the marketing and administration areas. The entire chain is managed by a single point of contact, guaranteeing that goods are monitored and handled appropriately. As the leading provider of cold chain maintenance, repair and operations services in Ghana, its team of ex-

pert engineers also drives the maintenance and repair of the cold chain infrastructure available to customers, using a data-driven approach that helps them moving from corrective to preventive action.

Finally, the business model developed allows users to reduce the cost of the cold chain, while limiting their production losses, giving them the opportunity to increase their turnover and income.

Goals

- Stop food spoilage and waste on farms and provide a cold chain for transport to retail centers or for exportation, thereby increasing farmers' incomes.
- Help reduce the number of vaccine-preventable deaths per year due to lack of cold storage and refrigerated transport.
- Increase the shelf life of perishable foodstuffs, recover tons of otherwise wasted food and offer healthier food to families by preserving the nutritional quality of products.
- Offer a suitable, cost-effective cold chain logistics solution to agribusiness operators.

A photograph of a white cooler filled with white plastic containers, likely for vaccines, with text overlaid. The cooler is open, and the containers are arranged in rows. The text is in white, bold, sans-serif font, centered on the left side of the image.

Cold chain infrastructure is essential to reduce product spoilage and preserve shelf life, both for agricultural products and for highly critical products such as vaccines.



**CIRCULAR
ECONOMY**

INTRODUCTION

The Water and Energy for Food (WE4F) initiative focuses on efficient resource use to increase agricultural production, while reducing water and energy inputs. Farm inputs, such as energy, fertilizer, and animal feeds, often present the largest production costs. Particularly fertilizers are often imported from outside Africa and are vulnerable to external shocks like inflation, and rising fuel prices and even violent conflicts in producer countries.

A circular economy is one where the 'end-of-life' concept is replaced with reducing, reusing, recycling and recovering materials in production, distribution and consumption processes. This ultimately ensures sustainable resource management, which promotes economic prosperity and environmental quality. Agricultural production generates numerous by-products, such as crop residues, processing leftovers, and animal manure, which are often wasted without being fully utilized. WE4F has worked with several entrepreneurs that transform wasted by-products into valuable farm inputs, including organic fertilizers, animal feed, biogas, or briquettes, through processes involving black soldier flies, composting, biodigesters or hydraulic presses.

Harnessing the opportunities for resource management contributes towards the efforts of climate change mitigation, reduced deforestation, and lower dependency on fertilizer imports. In addition, directly managing organic waste leads to improved health and ecosystems, access to clean water and food, as well as local employment and income opportunities.





OLIVADO EPZ LIMITED

Circular economy model to avocado value chain

Olivado EPZ is a pioneer in the production of extra virgin organic avocado oil in Kenya. It has also innovated its approach to waste management, when Olivado installed two huge anaerobic digesters, each with 1,400m. These digesters produce biogas from Olivado's organic waste, which the company uses to power generators and fuel vehicles, as well as bio-fertilisers, which their farmers use for avocado production. This approach has helped to solve Olivado's waste problem and save electricity and fertiliser costs.

About the company

Olivado works with over 4,000 farmers across Kenya to produce about 600 tonnes of avocado oil and 5000 tonnes of fresh fruit for export. Olivado primarily services retail markets in 35 countries, mainly the EU, UK and USA, worth about 4.8 Mio. EUR annually. The company works with supermarkets, such as Sainsbury's and Aldi, as well as speciality food stores, such as Bio Planète, and cosmetics manufacturers, such as Earth Oil. To this end, the company has partnered with distributors in Europe, the US and Asia, who buy the products and sell on to the final consumers.

Key resources

Olivado processes avocado fruits at its factory, based in Muranga County in Kenya. Field officers buy avocados from the contracted farmers and deliver them to the factory for grading and processing. The company also provides agronomic support to the farmers right from seedlings, soil conditioners and capacity building on organic avocado farming. To guarantee sustainability, Olivado has incorporated a biogas system within their plant which they use to run the machines at the factory as well as lighting. The biogas plant is part of the zero-waste initiative by Olivado, where the waste from the processing plant is used as feedstock for the biogas system. In addition, through the production of the biogas an organic fertilizer is produced as bio-slurry which is sold to the avocado farmers at a subsidised rate lower than the fertilizers available in the market. Due to the substitution of the power source through the biogas, Olivado has significantly lowered the cost of power at the plant lowering the production cost.

Distribution channels

Marketing and sales of Olivado's products in Europe are mainly done by Tanlay AG in Europe and a UK-based agent, whereas in the US, the avocado oil is promoted through Olivado USA Inc, packaging the oil into smaller quantities and selling to end customers. Four sales offices sell directly to supermarket buyers in all the main markets, with traditional distributors in multi-level distribution markets, like Japan, China, and Korea. Olivado also sells in bulk to selected specialty brands and to cosmetic companies.

Revenue streams

Olivado has a number of diversified revenue streams, though its most significant revenue stream comes from the sale of avocado oil for export markets as well as the sale of organically grown fresh avocados across the world. Olivado also offers complementary services to its contract farmers, including the sale of high health avocado seedlings and of a soil conditioner, known as Avogrow. Olivado also provides farm support activities, such as pruning and orchard management and trainings on acceptable and proper avocado fruit growing techniques. All this is part of Olivado's strategy to promote quality production of avocado among its farmers. Farmers are encouraged to grow high-quality avocados as they have a ready market offered by Olivado. The company also plans to expand its business to mango processing.

Value proposition

Olivado buys avocados directly from small, bio-diverse farms, paying a premium set price, thus bypassing brokers and guaranteeing the farmers a regular income. The field officers work closely with the farmers

year-round, ensuring that they understand the requirements of their organic status and providing education in farm management, organic fertilizer use and pruning. The field officers visit regularly and assess the number of avocados each tree is likely to produce. An advance payment can be made against this assessment, ensuring that the farmers have funds necessary to pay school fees or other expenses. Newly recruited farmers must go through a 2-year conversion cycle to meet FairTrade organic standards.

Locally, there has been a surge in the harvesting of unripe and immature crops for export, leading to consumer dissatisfaction. Olivado developed a proprietary process that is used exclusively in its factories, resulting in Olivado's extra virgin avocado oil unmatched in quality and shelf life. A study by food researchers determined that Olivado's extra virgin avocado oil has more natural healthy ingredients than others and it is thought to be due to Olivado's process. Olivado is employing a unique stabilization system that guarantees its freshness in an unopened bottle for up to five years. Olivado trains its own picking teams to harvest mature fruit and has a scientific programme to evaluate the crop and determine when picking should occur, to give the best quality.

Impact

- 1) Advisory services for farmers: Extension services to the contracted farmers on organic farming and socio-economic issues affecting avocado farming.
- 2) Improved livelihoods: Olivado assesses the expected yield by the farmers and offers 40% advance payment.
- 3) Job creation in the rural areas: In addition to the 98 permanent staff employed by Olivado. During peak season (March and September/October), Olivado hires 400 casual laborers in the factory and close to 3,600 casuals in the field from the local community.
- 4) Gender Focus: Women make up approximately 30% of Olivado's workforce. 1 of the 3 top managers is a woman, who has been with Olivado for 5 years. Women working in the same operational capacity earn the same as their male counterparts. Olivado also enforces an equal opportunity and a bullying and harassment policy which safeguards discrimination against gender, race etc. Around 43% of the company's suppliers are women.
- 5) Environmental Focus: With its 1.5 kW biogas production unit, Olivado converts its waste into biomass energy, which it uses to power its production plant. As a by-product, Olivado produces bio-slurry, which it can sell to its farmers at a subsidized rate.



HANNY G

Saving costs and improving health through clean cooking

In Tanzania more than 90% of households rely on firewood and charcoals for cooking and heating. This leads to deforestation and other environmental problems. The woman-led start-up Hanny G produces therefore efficient non-carbonized charcoal briquettes. Besides affordable cooking stoves, heaters and boilers. Customers can save 25% of the costs of the regular appliances and deal with the environment more gently.

Background

Hanny G is a woman-led SME founded in 2016 that produces eco-friendly and cost saving energy solutions from agri /bio waste for food processing industries, schools, and domestic use. Its non-carbonized charcoal briquettes (Kuni Poa and Mkaa Poa) are energy efficient. Hanny G also produces affordable and efficient cooking stoves, heaters and boilers that have been proven to save 25% of the cost in comparison to "regular" stoves, heaters, and boilers.

Moreover, briquettes help to repurpose waste, which would otherwise cause pollution and greenhouse gas emissions. They offer an alternative to conventional fuelwood that is often obtained in an unsustainable manner, leading to deforestation and land degradation.

Project in a nutshell

Hanny G has partnered with WE4F to increase the company's production capacity, to improve business operations and to step up marketing for greater awareness of briquette solutions. Specifically, Hanny G focused on:

- Increasing production capacity of briquettes.
- Increasing revenue from the sales of briquettes and improved cook stoves.
- Financial and accounts management to ensure optimal operational efficiency.
- Branding and advertisement to increase awareness in schools, among smallholder farmers and potential investors, with focus on positive environmental impacts.

Business profile

Hanny G generates money through the assembly and sales of improved cook stoves, and the sales of its briquettes, which are affordable, energy efficient and provide long lasting combustion.

- Total Addressable Market (TAM): 710,700 customers from Arusha City, Moshi Municipality and Babati town.
- Serviceable Addressable Market (SAM) of the TAM, Hanny G wants to reach 50% of the households in these urban areas.
- Serviceable Obtainable Market (SOM): Hanny G aims to expand up to 25% of the total market after production and distribution increases.

Innovation

Hanny G currently has three innovative products: modern cookstoves, carbonized and non-carbonized briquettes. There are non-carbonized charcoal briquettes for large-scale, named Kuni Poa, and for small-scale consumption, named Mkaa Poa. They are made from agricultural waste sourced from smallholder, resulting in an energy efficient solution that saves up to 45% of the cost of firewood. This helps to reduce deforestation and preserves the carbon storage these trees provide.

Impact

Hanny G promotes the use of renewable energy and improved efficiency using energy-efficient briquettes (SDG 7). By providing an alternative to fuelwood, Hanny G helps prevent deforestation (SDG 15) and contributes to climate mitigation and biodiversity conservation (SDG 13). It also creates an opportunity for youth employment through local production facilities, and improved livelihoods of farmers from which the bio-waste is sourced (SDG 12).

Business Goal	Outcome	How it was done
Increase briquettes production capacity	Produce 15t of briquettes per day; increase drying volume to 30t per day; acquire 5,000t of raw material from women and youth	Procurement of a high capacity drier; purchase of additional raw materials from women and youth
Increase the revenues from briquettes	Provided briquettes to an additional 36 schools in Arusha	Recruitment and training of additional sales and production staff
Optimize operational efficiency	125,000 USD investments secured	Coaching on financial and accounts management
Increased brand awareness	Increased number of suppliers and sales	Advisory services on branding and advertisement to increase awareness in schools, among smallholder farmers and potential investors



The impact of Hanny G's clean cooking solutions

Over 90% of households in Tanzania still rely on firewood and traditional charcoal for cooking and heating, resulting in environmental degradation and health risks. The Ngorongoro Conservation Area, spanning vast expanses of highland plains, Savanna Woodlands, and forests, holds global significance for biodiversity conservation. Considering the area's ecological importance and the presence of globally threatened species, the Tanzanian government implemented a ban on firewood usage in schools within the conservation area. This directive prompted the search for alternative cooking fuels that would be cost-effective, long-lasting, and environmentally friendly, thereby addressing deforestation, health hazards, and financial burdens faced by schools.

Piyaya Primary School, situated inside the Ngorongoro Conservation Area and catering to over 500 students, was one such school affected by the directive. The reliance on firewood for cooking presented several challenges, including contributing to deforestation due to the high demand for firewood in Tanzania. Moreover, the emission of smoke during firewood burning poses

health risks to the students and staff, leading to respiratory problems and other related issues. To mitigate these challenges, a transition to a cleaner cooking solution was necessary to create a safer environment and reduce the ecological impact.

Hanny G offers an innovative and sustainable clean cooking business model, strategically positioned as a timely and effective solution to address the pressing challenges associated with cooking practices. Through their innovative approach, Hanny G transforms agricultural waste into specialized briquettes, aptly named "Kuni Poa," tailored for their custom-designed large cooking stoves branded as "Jiko Poa". These briquettes offer numerous advantages, including smokeless combustion, ease of consumption estimation, and cost-effectiveness compared to firewood.

Hanny G provided Piyaya Primary School with clean cooking solutions, encompassing the "Kuni Poa" briquettes and corresponding "Jiko Poa" stoves. This transition had profound positive impacts on the school and its students. Firstly, the use of Hanny G's



briquettes eliminated smoke emissions, significantly improving indoor air quality, and reducing respiratory illnesses. This shift positively influenced the overall well-being of the school community. Secondly, the clean cooking solution facilitated precise estimation and prediction of fuel consumption, enabling the school to efficiently manage its cooking fuel requirements, thereby minimizing waste. This predictability resulted in cost savings as the school could allocate its budget more effectively. Additionally, Hanny G's clean cooking solutions proved to be more cost-effective compared to firewood, alleviating the financial burden on the school, and allowing them to allocate resources to other educational needs, consequently enhancing the overall quality of education provided.

With the financial and technical support from WE4F, Hanny G was able to extend their clean cooking solutions to over 34 schools within the Ngorongoro Conservation Area. This widespread implementation significantly reduced reliance on firewood and traditional charcoal, fostering environmental sustainability and mitigating deforestation. The successful adoption of

Hanny G's clean cooking business model and the broad reach of these solutions among schools underscore the significant impact achieved through WE4F's support. Many end-users, including farmers and pastoralist communities in the region, have benefited from the availability of affordable and sustainable cooking solutions. This collaborative effort not only contributes to the conservation of the Ngorongoro Conservation Area's biodiversity but also aligns with the government's initiatives to reduce firewood usage and promote cleaner and more efficient energy sources.

Looking ahead, Hanny G plans to continue installing more stoves in schools within the Ngorongoro Conservation Area, further enhancing energy efficiency while utilizing the *Kuni Poa* briquettes. This expansion aims to extend the positive impact on education, health, and the environment to an even larger population of students, teachers, and communities in the region. With ongoing support from WE4F, Hanny G's clean cooking solutions possess the potential to revolutionize cooking practices and contribute to a sustainable future for the Ngorongoro Conservation Area and beyond.

Biomass Briquettes - From agricultural waste to eco-friendly biofuel

What are biomass briquettes?

Biomass briquettes are made from organic waste. Biomass is collected, crushed, dried and then pressed together under high pressure. The briquettes can be burned for cooking, heating or for thermal and electricity generation. They are an environmentally friendly alternative to charcoal or firewood.

What are the main features?

The briquettes can be of two types; carbonized and non-carbonized to substitute charcoal and firewood respectively. They are mainly made from sawdust, groundnut husks, sugarcane bagasse, charcoal dust, rice husks or other agricultural waste, depending on the seasonality and availability of by-products. Biomass briquettes are technically a renewable form of energy, which only release the same amount of carbon that they had previously sequestered from the atmosphere. Being an alternative fuel to charcoal and firewood, biomass briquettes help to reduce deforestation and emission of CO₂.

What are common uses?

Biomass briquettes are used for industrial and domestic consumption, but also in schools, hospitals or hotels. In households they are mostly used for the purpose of cooking, while in schools, hospitals and hotels they are also burned for heating or hot water. In industries, e.g. driers in the tea sector can be powered by the briquettes.

Market development

Increasing populations, expanding economies and a lack of regulation have led to increasing fuel prices and shortages. This often hits vulnerable businesses and households hardest. As a consequence, the demand in alternative fuels has risen. Governmental programmes and laws aiming to decrease deforestation have also pushed the demand for alternative fuels for heating and cooking. With the source material being agricultural waste, the prices per calorific value are cheaper than charcoal or firewood, presenting a good business case. However, the limited knowledge about the product and consumer preferences are still hampering a large-scale application of biomass briquettes.





ALPHAMUNDI FOUNDATION

Scaling organic fertilizer production across East and West Africa

Water and Energy for Food (WE4F) and the AlphaMundi Foundation have partnered up to support SMEs working in the fields of organic fertilizer by providing result-based financing to help building the capacity of these enterprises to sustainably scale their businesses.

Background

Regenerative agriculture has enormous potential to transform agriculture systems in Africa to increase carbon sequestration in soils, to boost profits for farmers, and to develop greater resilience to a changing climate. Particularly organic fertilizers provide a wide range of benefits. These include improved soil health, reduced GHG emissions, carbon sequestration, biodiversity increase, reduced ground and water pollution and increased smallholder incomes. Numerous companies are working producing organic fertilizers by transforming a waste product into new farm inputs. Many of these companies are still at an early stage, though the topic is gaining more and more traction as demand is rising fast. To increase the overall production and cater to a bigger market, Small and Medium Sized Enterprises (SMEs) working in the field of organic fertilizer need adequate financing to scale their operations.

Project description

WE4F and the AlphaMundi Foundation worked together to scale up the production and use of organic fertilizers in East Africa, helping farmer to improve agricultural productivity whilst using natural resources sustainably. To this end AlphaMundi Foundation supported eight SMEs, producing and selling organic fertilizer in Kenya, Uganda, Tanzania, Ghana, Burkina Faso and Ivory Coast. The SMEs received business advisory services and results-based financing to:

- Raise awareness and train farmers on the use of organic fertilizers (included blended uses)
- Enhance business capacities of organic fertilizer SMEs
- Increase availability of organic fertilizers, including the scaling of production

Project results

AMF worked with 4 SMEs in East Africa and 4 SMEs in West Africa to support their operations and outreach to smallholder farmers.

Safi Organics (Kenya) provided customized training to 986 farmers on topics related to organic fertilizers. Onboarding of a new youth group to supply more raw-materials and installation of a grinder and pelletizing machine to increase the production of fertilizer. During the time of support, Safi Organics sold 740 MT of solid fertilizer and 5,400 liters of foliar fertilizer.

InsectiPro (Kenya) set up 2 main distribution hubs and 3 smaller distribution hubs to get closer to the farmers. To support sales, 10 demonstration sites were created, 8 field agents onboarded and 2,762 farmers trained on organic fertilizers. The efforts led to sales of 95 MT of organic fertilizer.

Chanzi (Tanzania) increased their infrastructure (grinders, grower houses) to increase the production of Black Soldier Fly (BSF) larvae. The larvae feed on organic waste and are processed into a form of animal protein. As a by-product, organic fertilizer is gained. The company set up 3 demonstration sites and trained 300 farmers on black soldier fly production. Beside the animal protein, the company has produced 541 tons of organic fertilizer during the time of support.

Agrisol (Uganda) trained 1,646 farmers on agronomic farming practices and the use of bokashi fertilizer. The setup of 50 demonstration farm has shown farmers the effects of improved soil health on yields. Farmers have started to produce their own bokashi, reaching a production of over 61 MT that was mainly used on their own farms or sold in small quantities.

BioProtect (Burkina Faso) trained 957 farmers on the management of soil fertility and the use of organic fertilizers. With the help of datasheets, radio broadcasts, 26 demonstration fields, guided tours, 12 demo schools and video messages, BioProtect increased the awareness on organic fertilizers. The production capacity was increased by the purchase of a granulator, grinder and mixer. New fertilizer formulas and a new biopesticide were created.

Lono (Côte d'Ivoire) produced and supplied 100 MT of compost to 12 cooperatives, with whom they set up 60 demonstration sites, trial, and training plots. Lono purchased and installed a biochar production reactor to produce 10 MT of biochar monthly. The company started operating 4 compost production facilities with an output of 10 MT monthly. 653 farmers were trained on improved compost production methods.

AgriCentric Ventures (Ghana) fabricated machinery including carbonizers, mixers, oxygenators and sack sealers for the production and packaging of solid organic fertilizer. The company set up two production facilities to increase production capacity and recruited 30 new employees to support in operations. AgriCentric trained 586 farmers on the use of organic fertilizer.

Sabon Sake (Ghana) held theoretical and practical farmer training sessions with 749 participants. To increase their production capacity, the company installed additional mixers and pyrolysis machines. During the time of support, Sabon Sake produced and sold over 38,6 MT of organic fertilizer.

The measures have supported both, the demand and the supply-side. By trainings, setting up demonstration sites and recruitment of field agents, the awareness of farmers for organic fertilizer has improved. At the same time, the production capacities of organic fertilizers have improved.

Result-based financing (RBF)

RBF refers to an intervention that rewards the recipient after agreed-upon results are achieved and verified. It's a way to incentivize the fulfilment of defined goals while the recipient can decide on the action required to reach the goals.

- 1) Milestones are defined that trigger disbursements once completed
- 2) The recipient implements own solutions to fulfil the agreed-upon milestones
- 3) Independent verification of milestones by the funder
- 4) Disbursement of funds once milestones have been verified

ORGANIC FERTILIZER

Processing agricultural waste into nutritious plant food

What is an organic fertilizer?

Organic fertilizers are made from natural materials and provide nutrients for an enhanced plant growth. They can be produced based on plant residues, bone meal, manure, animal waste from food processing plants or others. By upcycling organic wastes into a useful product, organic fertilizers are a perfect circular economy solution.

What are the main features?

The source material of organic fertilizers consists of residues or by-products from agricultural production. These can include rice husks, the peel of fruits or animal manure. The preparation usually includes processes like drying, crushing, composting, pyrolysing, pressing or pelletizing, depending on source material and final form. Once applied on the field, the organic fertilizers bring many advantages, ultimately increasing the yield. Some fertilizer types contribute to improving soil structure, texture and aeration, thus increasing the soil water retention capacity. Some organic fertilizers are even carbon negative. Their application stores carbon in the soil, making them a climate-change mitigation measure.

What are common uses?

WE4F's partners sell their products to a wide range of farmers, including small scale and export-market farmers in their respective countries. The fertilizers are available as biochar, top dressing and foliar and can be used for growing fruits, vegetables, food crops and commercial flowers.

Market development

The market potential for organic fertilizers in East Africa is huge due to its economic viability and environmental sustainability, especially in light of recent price-increases of inorganic fertilizers. Organic fertilizers provide a suitable alternative. However, awareness needs to be created for farmers to understand the benefits of the product and its application. Facilities should also be set up across the region for local production of the fertilizers, to improve access by farmers, support local value addition and to further manage agricultural waste.



Improving soil fertility and crop yields with organic fertilizers

Organic fertilizers

Organic fertilizers are inputs that provide nutrients to plants so that they can grow. They are composed of organic matter, i.e. animal or plant matter. They mainly add nitrogen, potassium and phosphorus to the soil, helping to ensure its fertility. Organic fertilizers come in different forms. They can be solid or liquid. Compost, organic plugs, manure and droppings are just few examples of organic fertilizers.

Biochar

Biochar is an abbreviation for charcoal of biological origin. The term is generally used to describe any carbonized organic material for soil application or carbon sequestration. It is produced by a process known as biomass pyrolysis. This means that it is obtained by heating biomass of plant or animal origin in an environment where oxygen is limited or almost absent. The carbon contained in the biomass is returned to the soil without producing carbon dioxide, thus avoiding pollution.

Advantages

WE4F's partners sell their products to a wide range of farmers, including small scale and export-market farmers in their respective countries. The fertilizers are available as biochar, top dressing and foliar and can be used for growing fruits, vegetables, food crops and commercial flowers.

Market development

- They increase the amount of plant nutrients and improve the soil's organic matter content, helping to stimulate micro-organisms.
- This helps root development and improves soil structure.
- They are also environmentally friendly, as they provide clean fertilization that is safe for people, animals and the environment.





SAFI ORGANICS

From organic waste to farm input

Safi Organics' target customers are 40% large scale and 60% small scale. Of the small scale category, their customers are smallholder farmers who have limited income and can only afford the cheapest, synthetic fertilizer varieties (e.g. urea) that in the long run can acidify and degrade their soil.

About the company

Founded in 2015, Safi Organics Limited is a for-profit company in Kenya that produces and sells organic fertilizer, known as SafiSarvi®. The company employs a blend of hardware technology and an online real-time control and sensing system to decentralize and streamline the fertilizer production process. By allowing the process to take place at the village level, the reaction conditions can be adjusted, and the fertilizer's properties customized to suit the specific soil types of the region. This level of customization surpasses what traditional fertilizer production methods can achieve. Safi Organics operates in five counties in Kenya: Kirinyaga, Nyandarua, Nakuru, Uasin Gishu, and Kisumu.

Key partners

Safi Organics is supported through its partnerships with various stakeholders, ranging from national and international organisations, investors, research institutes, suppliers, governmental bodies, NGOs, other social and environmental enterprises and more. This includes universities such as the Massachusetts Institute of Technology (MIT), youth groups, the National Cereals and Produce Board (NCPB) and a vast network of farmers.

Distribution channels

At Safi Organics, the distribution strategy relies heavily on field services, employing a specialized team of field agents. These agents not only educate farmers through trainings on the usage and benefits of bio fertilizers but also actively demonstrate the application processes. Moreover, they collaborate closely with farmers to understand the specific needs of their farms, considering factors such as farm size, the variety of crops being cultivated, and the challenges unique to each farmer's agricultural practice. Ultimately, sales are driven by a variety of channels at Safi Organics, primarily through the efforts of field salespeople, social media outreach, the company's online presence, direct calls, and the provision of extension services. These strategies often lead to farmers transitioning into clients as they recognize the value and benefits offered.

Revenue streams

SafiSarvi© is a carbon-negative, locally produced fertilizer blend that increases a farmer's yields while reducing soil acidity. Their product has been shown to be suitable for a variety of agriculture and horticulture including maize, rice, wheat, beans, peas, vegetables, fruits, flowers, and grasses. Safi Organics' product offering is the following:

- **Safi Biochar (Acidic Soil Amender):** boosts soil fertility, quality by retaining agrochemicals and metals, and improves the soil's capacity to hold nutrients.
- **Safi Sarvi Topper Fertilizer:** biochar-based and made from nutritious plant residues for a slow steady release to improve soil fertility for maximum yields, used as a top-dressing fertilizer.
- **Soil Foliar Fertilizer:** used to supply plants with macronutrients and trace elements and ensures better and healthy crops.
- **Safi Organics Consultancy:** provides detailed in-season evaluation for the control of weeds, insects, and diseases, contract research, irrigation systems planning and designing, greenhouse establishments, and livestock waste management, among others. Safi Organics gives tailor-made economic advice to farmers to see improved yields, increased systems efficiencies, and lower production costs.
- **Soil Testing Services:** Safi Organics tests farmers' soil for the type, quality, and amount of nutrients availa-

ble to determine which fertilizer type to apply to get the best yields.

Value proposition

Safi Organics' solution eliminates most of the energy and fuel costs otherwise required to produce synthetic, chemical fertilizers in large-scale, centralized plants and import these fertilizers to rural areas. The organic fertilizer also helps the local soil retain moisture and nutrients more effectively, such that farmers can reduce the amount of both chemical inputs and irrigation needed for their crops to succeed by more than 15%. Safi Organics improves the overall livelihood of rural smallholder farmers and raises their income by 50%, through creating an additional revenue stream by purchasing their farm waste. Safi Organics also uses bi-products from other agricultural value chains to transform them into their organic fertilizers. Through this circular economy approach, a previously wasted by-product is now transformed into an organic farm input. The product increases long-term soil fertility, acidified soils benefit from a liming effect restoring their soil pH while reducing plant toxicity. This promotes beneficial microbial life and improves nutrient and moisture retention in the soil.

Impact

Safi Organics' approach has multiple positive impacts. These include enhancing the quality of life for smallholder farmers, resulting in yield increases of over 30%. The company's operations create job opportunities in rural areas, which in turn helps in stemming rural-urban migration. Their efforts disproportionately benefit rural and underserved communities by offering additional unskilled livelihood opportunities and entry into the carbon market for the first time. Around 40% of the farmers they serve are women, and the increased crop yields they obtain contribute to their financial independence from their spouses. The company aims to raise this percentage to over 50%. Moreover, Safi Organics contributes to the well-being of its employees by providing health benefits and supporting their pension plans. In terms of environmental impact, Safi Sarvi fertilizers contain high levels of recalcitrant carbon, resulting in the sequestration of approximately 1.5 tonnes of CO₂ equivalent into the soil per acre of field annually, persisting for hundreds of years. Their conversion process also curbs the particulate emissions from traditional open-field crop residue burning by more than 95%. Safi Organics is certified through existing offset standards and is actively seeking engagement with potential carbon offset buyers to gain a deeper understanding of the market. While Safi's product may result more costly per unit compared to their competitors, it requires significantly fewer applications compared to its competitors, utilizing only 3-4 bags per acre as opposed to the standard 10 bags per acre used by others. Additionally, Safi's approach is carbon negative.



INSECTIPRO

Circular economy with black soldier flies

InsectiPro's main customers are feed millers who utilize the black soldier fly larvae for feed formulation and farmers who utilize the black soldier fly frass fertilizer. The company has also launched new products for human consumption – cricket powder and dried crickets. These products are high in protein, iron, zinc and vitamins and can support a balanced diet.

About the company

Founded in 2018, InsectiPro is creating circular, sustainable, and nutritious food chains using Black Soldier Fly to up-cycle organic waste, that would otherwise go into landfills. The resulting products are low-cost, high-quality animal feed and organic fertilizer (BSFFF). Within Kenya, InsectiPro currently has a production facility in Limuru that includes a breeding facility and waste processing facility. Two distribution hubs across the country help with the distribution of bio-fertilizer to farmers. InsectiPro works with field agents in each of its regions to support farmers through training and continued monitoring during the land preparation, planting, and growing seasons to provide continued farmer education on the usage of organic fertilizers. InsectiPro is looking to establish a dedicated building breeding facility in Nakuru to increase production and meet demand for animal feeds and fertilizer.

Key partners

InsectiPro currently runs operations in Kenya and invests in research to ensure continued product development and that the products are delivering the best quality nutrients. The company works with vast farmer networks, cooperatives and produce aggregators to sell their products. InsectiPro has set up a network of organic waste suppliers include Takataka Solutions, juice processors, county governments and seed oil manufacturers. The company works with a number of R&D partners, including the International Center of Insect Physiology and Ecology (Icipe) and the Jomo Kenyatta University of Technology (JKUAT). Technology partners (for insect breeding or farmer outreach) as well as financial institutions are further supporting the operations.

Distribution channels

Field services are a key distribution channel for InsectiPro. The team includes field agents who closely work with farmers to offer training seminars on the use and benefits of biofertilizer and run demos with the farmers. They also help mapping out farmers' needs based on farm size, crops grown, and experienced challenges.

InsectiPro is also working to set up the Ugavi app which will digitize farmers to ease their access to various inputs and services. This includes the BSFFF, support with traceability of produce, support of aggregation and to reduce middlemen to allow for farmers to have more bargaining power thus contribute to fair pricing of produce.

Revenue streams

InsectiPro generates income from the following products:

- Black Soldier Fly Frass Fertilizer (BSFFF) called Fertigro
- Dried black soldier fly larvae
- Roasted crickets
- Cricket powder

Value proposition

Affordability – InsectiPro sells their fertilizer at KES 30 per kilo which is currently lower than most fertilizers in the market.

Through research conducted with Icipe, Fertigro has shown to result in higher crop vigor and chlorophyll concentrations in plants which increases yield.

Fertigro is also a slow-release fertilizer which ensures that a plant can take up essential nutrients from the early stage to the maturity stage. The high organic matter content increases the water holding capacity of the soil, making the crop more tolerant to droughts.

The large populations of microbes have a positive impact on the aeration of the soil.

Impact

The application of Fertigro leads to an average increased yield of up to 30%. Trials with 200 farmers in Meru resulted in an increase in yields from a subset of sorghum farmers from 350 kg to 550 kg from a quarter acre of land – a 57% increase.

The fertilizer also lead to a reduction in the use of inputs such as pesticides. Farmers who used to spray pesticides on their farms 6 times reduced to 2-3 times. Fertigro contains keratin which helps to reduce bacterial disease by up to 25%.

Better and earlier germination was observed by potato farmers (from 21 - 26 days to 18 days), stronger stems in tea plants and more pinnacles in sorghum (an indicator of improved yields).



AGRISOL

Towards sustainable agricultural systems

Founded in 2020, Agrisol Africa Limited (Agrisol) sells organic fertiliser and other farming inputs to smallholder farmers in Uganda. Their customers mostly produce maize, soybeans, sunflowers, and sorghum and have high demand for extension services and farm inputs. Agrisol meets this demand and in return, obtains organic matter from the farmers for fertilizer production.

About the company

Agrisol Africa Limited (Agrisol) provides farmers in rural regions with access to sustainable and high-quality products including seeds, seedlings, fertilizers and crop protection products for climate-friendly agriculture. Further products are irrigation kits and agricultural equipment. Agrisol provides free extension services to farmers to educate them on agronomic farming practices and empowers them using existing farming groups to promote joint growth. Agrisol also provides training on how farmers use readily available materials to produce their own biofertilizer which greatly reduces the cost of inputs. Farmers are also supported in their post-harvest management, through selling produce in their behalf at the Agrisol store as well as providing them with access to markets for their agricultural produce.

Key partners

Agrisol has an established connection to smallholder farmers and farmer groups in and around Lira region, Uganda. They provide organic matter for Bokashi (organic fertilizer) production and in return purchase their farm inputs from Agrisol. The company obtains most of their products from suppliers such as African Fertilizer and Agribusiness Partnership (AFAP), Naseco Seeds, Bookola Chemical Industries, Jubaili Agrotec and Grain Pultse Ltd, which has led to well established business partnerships. Funding and financing partners include DAI-USAID, GIZ, Norad, Feed the Future, Palladium, Stanbic Bank and Absa Bank. Agrisol is also in exchange with officials from the agricultural department, research and training institutions.

Distribution channels

Agrisol has an outlet in Lira town from which it sells agricultural products including fertilizers, herbicides, pesticides, seeds and fruits and vegetables. The company also consists of a team of trainers who educate farmers on agronomic farming practices and empowers them to make their own organic fertilizer to utilize agricultural waste and reduce reliance on chemical fertilizer.

Agrisol's key distribution channels are:

- Direct marketing to farmers
- Farmer groups including Parish Development Model groups
- Social media including Facebook and YouTube
- Partner organizations and their farmer networks

Revenue streams

Agrisol's main revenue stream is the sale of inputs including:

- Seeds
- Commercial crops and fruit seedlings
- Fertilizers, insecticides, herbicides, and pesticides
- Irrigation kits and agricultural equipment

Value proposition

- Free extension services – Agrisol has provided free training and demos to over 2,000 farmers on good agronomic practices and the production of organic fertilizer.
- High quality inputs – Farmers face challenges around accessing good quality farming inputs as the market can be flooded with counterfeits. Agrisol provides good quality inputs to ensure that farmers achieve high yields.
- Recycling and value addition of agricultural waste – Bokashi is made from agricultural waste such as ash,

charcoal granules, dry farm matter, rice and maize husks and manure from cows and rabbits which upcycles waste that they would have otherwise thrown away.

- Affordability – Through upcycling farm waste into fertilizer, farmers can save on the cost of farming inputs and afford good quality seeds and other agricultural inputs.
- Soil health and yields – Bokashi improve the soil health and structure and leads to healthier plants and improved yields.

Impact

- Improved soils – Farmers noted that the Bokashi-treated soils had increased water retention and increased nutrition as plants grew healthier with thick stems, greener leaves and more flowers.
- Increased yield – Agrisol worked with 1,500 farmers over a 10-month period conducting training and demos of good agronomic farming practices. Those producing and utilizing Bokashi noted that their collective yields increased from 0.9 MT to 22.1 MT within the period.
- Access to high quality input – Agrisol directly works with certified producers and suppliers of farm inputs and offers a liable access while reducing the risk of counterfeits.



CHANZI

The transformative power of the black soldier flies

Chanzi produces two agricultural inputs, that are sold B2C and B2B: animal protein and a frass fertilizer. The dried larvae is used by livestock, poultry and fish farmers to substitute more expensive sources of animal protein, such as fish meal. Feed mills are processing the dried larvae to produce animal feed. The frass fertilizer is utilized by (organic) crop farmers and sold directly to them or via agro dealers.

About the company

Founded in 2019, Chanzi uses black soldier fly (BSF) larvae to convert food waste into organic fertilizer and nutritious protein for animal feed which ultimately reduces the sector's dependence on environmentally ruinous fish and soya beans. Over the years, Chanzi has developed innovative and efficient methods to grow, breed and harvest BSF. It has set up construction projects including infrastructure such as grower houses for the BSF larvae, and dark rooms and mating chambers for the flies in operating sites in Tanzania and Kenya and has the goal of expanding their model into other East African regions with similar organic waste management problems.

Key partners

Chanzi has a vast partnership network covering the whole ecosystem of its operation. A number of international companies and investors supported the company with grant funding to construct bigger processing facilities. Chanzi works with different suppliers of organic waste, including waste collectors, smallholder farmers but also by-products from a Tanzanian brewery. Dried larvae and Black Soldier Fly Frass Fertilizer are the output of processing. Larvae are sold to the poultry industry, while the fertilizer goes to organic coffee producers and farmer groups. A number of research & development partners such as universities and research institutes are in partnership with Chanzi to improve the nutrient contents of the final products.

Distribution channels

Chanzi has different distribution and marketing channels to sell their animal protein and organic fertilizer. These include:

- Direct marketing to farmers
- Media including interviews, social media, and documentaries
- Working with Tanzania Horticultural Association (TAHA) and community leaders to reach farmers.

Revenue streams

Chanzi generates income from the following products:

- **Chanzi Whole**, made from dried BSF larvae that contains up to 50% crude protein, 20% fat and have an amino acid profile that is similar to that of fishmeal. It is recognized and utilized as alternative sources of protein for feed of poultry, livestock, and fish.
- **Chanzi Ground**, produced from grinding dried BSF larvae and can be utilized as an alternative source of protein in animal feed or pet food.
- **Chanzi Fertilizer** (Black Soldier Fly Frass Fertilizer/BSFFF), an organic by-product that results from the processing of food waste by the black soldier fly larvae. The fertilizer contains a blend of Nitrogen-Phosphorus-Potassium and other minerals. BSF frass can be used as a chemical free fertilizer or soil conditioner to cultivate crops such as maize, vegetables and fruits, flowers or lawns.

Value proposition

Through the waste management side of Chanzi's business, the company reduces the strain on local landfill infrastructure. By purchasing spoiled crops and other organic waste from farmers, Chanzi provides them with extra income opportunities. In addition the company collects waste from local markets for free and have a network of registered waste aggregation agents who they pay by volume for delivery to Chanzi's factory

gate. Chanzi further sees an opportunity to source for brewer spent grain and waste from local breweries in Tanzania which provides the breweries with a streamlined waste disposal mechanism. The spent grain is then combined with organic food waste from the community to provide a better-quality feed for the BSF.

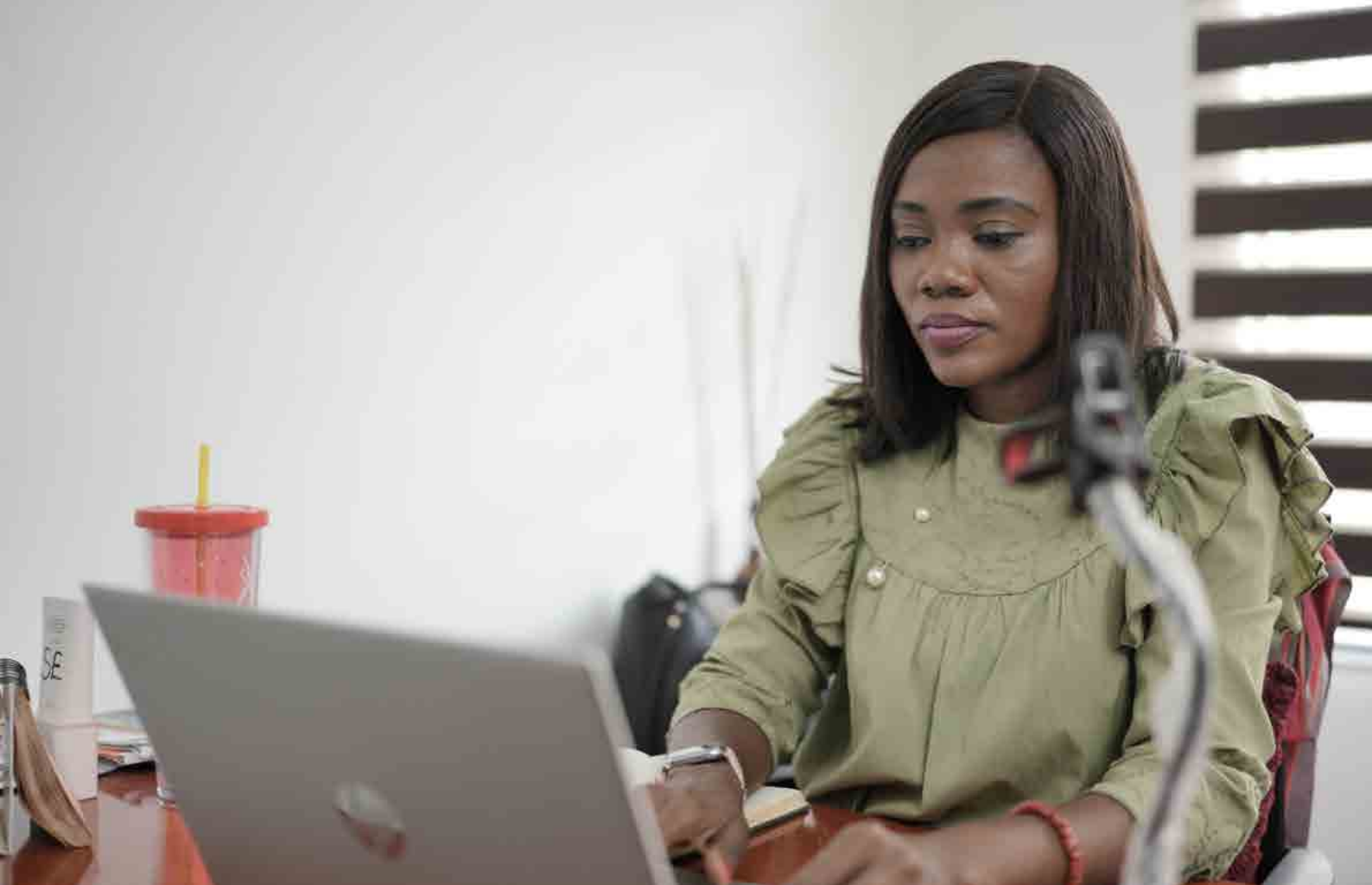
Chanzi produces bio-fertilizer consisting of BSF frass and biochar and when utilized by farmers, it has the ability to improve soil structure, microbial activity, long term yields and sequester carbon. The bio-fertilizer is cheaper and more sustainable and environmentally friendly than available chemical fertilizer alternatives. Farmers have also reported higher yields and better soil health as compared to when using compost or manure and synthetic fertilizers currently on the market.

Impact

BSF larvae is a sustainable alternative to fish meal and soy. 37 percent of fish caught globally is processed into animal feed. 80 percent of soya grown is fed to livestock. This comes in light of global fish stocks depleting and soy production contributing to deforestation. The use of BSF for organic waste transformation is a self-sustaining, cost-effective method that results in high resource recovery and generated value-added products like protein additives for animal feed and organic fertilizer.

BSF can produce 2,500 times more protein per acre per year than soy, using less water and land, and generally has higher levels of amino acids, fat and cholesterol. A single Chanzi site is avoiding producing 0.4 metric tonnes of methane per day, 9.4 metric tonnes of CO₂ per day, all of which is equivalent to taking off 642 cars off the roads. A single Chanzi site moreover has the capacity to have over 4,800 hectares of land under sustainable management, so by developing greater demand for BSF larvae, a single site will help to protect over 2.4 metric tonnes of wild fish a day.

Insect use as a protein source is estimated to reduce the protein cost of feed production by between 25-37.5 percent, which increases affordability for smallholder farmers. 50% of Chanzi's frass currently goes to smallholder farmers, who largely operate production on a subsistence level. In a recent study, coffee farmers who used BSFFF experienced 130% higher profit in a season than those using synthetic fertilizer or other organic fertilizers. This is because Chanzi Frass Fertilizer is significantly cheaper than synthetic fertilizer and results in higher yields. Additionally, BSFFF has a high fraction of organic matter resulting in long term improvements in soil structure, especially in areas where soils are heavily degraded. Finally, the residual chitin present in BSFFF plays a crucial role in promoting plant health and microbial activity resulting in more resilient plants which require less pesticides and fungicides, further increasing a farmer's profits.



HUSK POWER SYSTEMS

Recycling agricultural waste for energy access and improved food processing

Energy access is vital for quality of life: it enables pumping drinking water from wells, comfortable living conditions and modern production processes for healthier economies. In Sub-Saharan Africa, only about 40% of people have access to electricity. At the same time, renewable resources useful in producing sustainable energy are under-exploited. For example, waste biomass from agricultural production chains can be used to produce energy through a biodigestion process.

Background

Husk Power Systems (“Husk Power”) is one of the 20 innovating companies selected through a call for innovation by the West Africa Hub of the WE4F (Water and Energy for Food) program whose main goal is to scale up water and/or energy friendly innovations in the agro-industry sector.

The Nigerian company was founded in 2008, with the mission of providing communities in the developing world with renewable energy through solar and biomass systems. It currently works in Sub-Saharan Africa and South Asia, installing systems specially designed to process rice waste biomass and are thus ideal for rice producing rural communities. The company has currently more than 400 employees across four continents.

Husk Power started its activities in Nigeria in 2020 and counts with 40 staff members in the country.

Rice is the eight most important crop in Nigeria and one of the country's most important staple foods. Husk Power is deploying their innovation in Nasarawa State, a leading rice-producing region in Nigeria, where opportunities exist to boost and optimize rice production. Many small-scale farmers and millers also lack access to energy for adequate rice processing, which affects the quality and market price of their final product. Diesel prices are often prohibitive, while the use of firewood, which is still widely used for rice processing activities, burdens forests and local women, who must spend a considerable amount of their time collecting the wood.

Innovation

Husk power has developed an electric mini-grid system for rural communities. It is based on an adapted biodigestion system to transform rice husks, corn leaves and other agricultural waste into electric power. The biodigester operates without water, which is an additional advantage in comparison to other biodigestion systems. Solar panels and batteries complete the mini-grid, assuring a stable and reliable power supply. In Nasarawa, Husk Power will install modern and efficient irrigation and rice processing facilities powered by the mini-grids. The processing facilities include a parboiler mill, destoner, packaging equipment and a cold room for storage. Beyond rice farming and agro-processing units like rice mills, installed mini-grids can power water wells and provide lighting for schools and homes. Farmers and communities who want to benefit from Husk Power's systems are offered adaptable financing options.

Advantages

- Husk Power's mini-grids can provide 16 to 22 hours of daily electricity.
- The company provides flexible pay-as-you-go service to customers by using a mobile-enabled smart metering system.
- In their first year of operations, Husk Power provided mini-grids for over 400 farmers to process over 1200 metric tonnes of rice in the first year worldwide.
- The company has 12 mini-grids operating in Nigeria with about 500 SMEs and factory customers.
- Customers are observing a 30% reduction in monthly expenses by switching from diesel to solar.

Facts

- About **40%** of people in Sub-Saharan Africa have access to electricity.
- **998 million** tons of agricultural waste are produced in Nigeria yearly. These can be used for energy production through biodigestion.
- Biogas could cover around **20%** of global energy demand, but currently supplies only around **3%**.

Goals

- Install more than 100 mini-grids in Nigeria by 2024.
- Install at least 500 mini-grids by 2026 which will benefit more than 2 million people and allow for the replacement of 25,000 diesel & gasoline generators.
- Provide affordable energy to 8000 women-led business customers.

Biodigester – Transforming organic waste into biogas and fertilizer

What is the KubeKo?

- A mobile biodigester, designed by the Ivorian company LONO, that converts organic solid and liquid waste from households, farms and SMEs into biogas and liquid fertilizer.
- Composed of an airtight container where organic waste such as agricultural waste or animal manure is added.
- It functions without any external electricity source. The technology is based on the activity of bacteria that break down the agriculture waste in three different steps.

Biogas and organic liquid fertilizer production

- 1) chamber: the microorganisms present in the waste break down the agricultural waste or animal manure into simpler organic molecules like sugars and alcohols. The solid matter is trapped in the first chamber until fully broken down.
- 2) chamber: once the first chamber is full, the liquid overflows to the second chamber where the sugars and alcohols are converted into organic acids such as acetic acid (one of the main components of vinegar).

- 3) chamber: once there is an overflow again, the liquid circulates to the third chamber where the acids are converted into combustible methane and CO² mix called biogas. The liquid left after this step is an organic fertilizer.

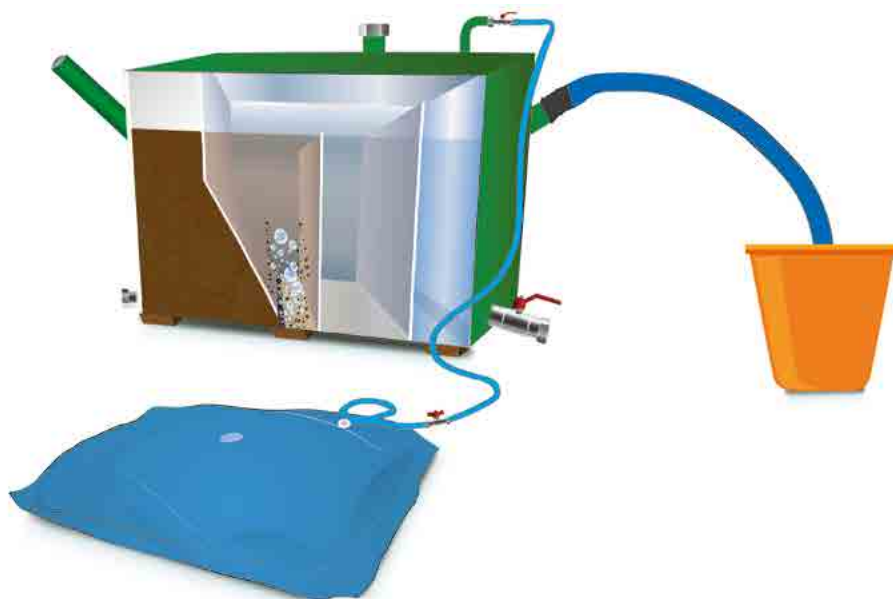
The biogas is then collected through a pipe with a shut-off valve into a bag which can be detached and transported to another place for cooking. As for the liquid fertilizer, it is collected in a bucket and can be stored for up to 2 weeks.

Main features of the KubeKo

LONO offers two models for the KubeKo biodigester:

- 1) a domestic model of 1 m³ designed able to service 1 or 2 households
- 2) a community model of 16 m³ able to service up to 30 households

With the input of 10 kg of organic waste per day, the domestic KubeKo biodigester produce enough gas for up to 4 hours of cooking as well as enough liquid fertilizer to cover an area of 2 ha. Meanwhile, the community model can produce up to 50 hours of cooking gas and enough fertilizer to cover up to 30 ha.





LONO

The mobile biodigester transforming organic waste into clean cooking gas and organic fertilizer

Côte d'Ivoire's economy remains agriculture focussed, with the sector contributing 20% of its GDP. The country is a world leader in the global value chains of cocoa, cashew nuts, rubber, and several other agricultural products. The agricultural sector generates between 20 and 30 million tons of carbon and nutrient rich waste material each year, which does not yet contribute to the local economy.

About the company

LONO is one of the innovative companies selected through a call for innovation by the West Africa Hub of the WE4F (Water and Energy for Food) program whose main goal is to scale up water and/or energy friendly innovations in the agroindustry sector.

It was founded in 2016 in Côte d'Ivoire with the conviction that all countries and communities should benefit from innovation and technology. The company, which employs 12 people, strives to adapt existing solutions to the local context by offering sustainable and affordable solutions to transform organic waste into a valuable resource. To achieve this, LONO offers services and products that support farmers, companies and cooperatives in the agroindustry to make the most out of their waste.

Furthermore, LONO conducts feasibility studies to determine the possibilities of waste valorization, con-

sidering the advantages and inconveniences of each approach. By researching different types of locally available feedstock, the company also explores the best waste-to-energy and waste-to-compost solutions.

Innovation

LONO developed and is popularizing local technologies that allow raw organic waste material mainly from the agroindustry sector to be transformed directly on-site into energy products and organic fertilizer.

One of the proposed flagship products is the “KubeKo”, a mobile biodigester that transforms all types of organic waste into biogas and liquid fertilizer. With the input of 300 kg of waste per day, the KubeKo can produce 250 liters of liquid organic fertilizer and about 30 kg of biogas sufficient to cover the needs of up to 30 households.

LONO is promoting a biogas as a service model to rapidly scale the number of sites using KubeKo biodigesters: By using a containerized model with a volume of 16 m³ the innovation provides clean cooking energy for up to 30 households or 150 people and sufficient fertilizer to cover 20 hectares.

The KubeKo biodigester is best suited for the agroindustry sector as different agricultural waste from banana, cocoa, cassava, palm, fruits & vegetables etc. or abattoir waste can be used in addition to animal manure which is needed to operate the biodigester. This makes it also suitable for agricultural households with livestock as manure is already available on site. The company also provides training sessions to farmers on how to use the KubeKo and how to best apply the fertilizer.

Advantages

- The KubeKo biodigester has already been installed at various sites in Côte d'Ivoire where it benefits 1) a cooperative of women who use the biogas to cook attiéké (a cassava-based dish) and the fertilizer to fertilize the cassava as well as vegetable plants, 2) a group of mango smallholder farmers using the liquid fertilizer for the mango trees while the biogas is used by the farm workers to cook food onsite, 3) a private agropastoral farm that has opted for biogas as fuel for its fruit dryer 4) a cocoa and plantain banana plantation, where the organic fertilizer is re-applied to the plants and enriches the soil for a higher productivity and 5) school canteens in Abidjan where the biogas is used for cooking while the fertilizer benefits the schools' vegetable gardens.
- LONO plans has now set up 20 demonstration sites including a domestic size and the containerized biodigesters in agricultural areas throughout Côte d'Ivoire to build the capacity of small producers, proces-

sors and other potential users.

- Decrease deforestation: The KubeKo biodigester converts organic waste (solid or liquid) into biogas for productive use. Using biogas created from locally available organic waste reduces the need to cut for or purchase firewood, which saves time and money in addition to helping protect the environment by decreasing deforestation.
- Promotion of circular economy: The use of biodigesters to produce biogas and fertilizer contributes to addressing the issues of waste management and soil fertility by creating value from what is considered waste. It also contributes to achieving the goals of the integrated national strategy for the promotion of circular economy 2023-2027 as well as its action plan that the Ivorian government is working on.

Goals

- Valorize organic waste by producing biogas for agro-industrial transformation and domestic use.
- Produce local, organic fertilizer by using agriculture waste products Reduce deforestation as well as the use of chemical fertilizers & fossil fuels.
- Make gas and fertilizer accessible to rural areas.
- Contribute to waste management and circular economy.

Impact

- Biogas could cover around **20%** of global energy demand, but currently supplies only around **3%**.
- As of 2019, around **90%** of the population in Côte d'Ivoire uses wood and charcoal for cooking.
- In Côte d'Ivoire, cotton and cocoa alone account for more than **60%** of annual fertilizer consumption, bananas, oil palm and sugar cane for about **20%** and cereal & vegetables for **20%**.



REVITALIZ

NGALEE - Transition to organic farming with organic fertilizers

80% of the workforce in Burkina Faso is employed in agriculture, mostly in climate-vulnerable subsistence farming. Increased use of chemical fertilizers and low levels of soil organic matter are causing a significant decline in soil fertility and water pollution. In order to protect the 7 million rural Burkinabè from extreme poverty, the enormous potential for improving agricultural productivity and climate resilience should be used.

Background

Revitaliz is one of 20 innovative companies selected as part of a call for innovation by the West Africa cluster of the PEEPA / WE4F program (Projet Eau et Energie pour l'Alimentation / Water and Energy for Food), whose main objective is to scale up water- and/or energy-friendly innovations in the agribusiness sector. Revitaliz is a social enterprise founded in Burkina Faso 2017 with the mission of providing small-scale farmers in the Sahel with organic fertilizers to increase their agricultural yields and restore soil vitality. Indeed, more and more producers have become aware of the dangers of "all-chemical" agriculture and are increasing their soil organic matter through composting. But the composting process usually used in Burkina Faso requires large quantities of water and is labor-intensive, two factors that are increasingly limited in Sahelian countries. What's more, the low nutrient content of compost means

that growers are unable to maintain or increase their yields from the first application. Lacking an effective alternative, growers continue to use chemical fertilizers, watching helplessly as their soils are depleted.

Innovation

With the ambition of offering a truly accessible, effective and organic alternative, Revitaliz has developed **Ngalee**, a range of organic fertilizers that both increase yields thanks to its fertilizing effect and revitalize soils thanks to its amending and deacidifying effects. To achieve this, organic urban, agricultural and agro-industrial waste is transformed into fertilizer that is of similar performance to chemical fertilizers and at an equivalent price. Currently, the NGALEE fertilizer family already includes three products:

- **NGALEE Cereals:** A nitrogen-enriched organic fertilizer specially formulated to give more vigorous stalks, denser ears and soils that retain water better.
- **NGALEE Vegetable:** A 100% natural organic fertilizer specially formulated to guarantee high yields for market gardeners, with vegetables that taste better and keep longer.
- **NGALEE Organic:** 100% organic fertilizer with a composition adapted to organic farming.

Finally, Revitaliz has chosen to address small producers directly, offering them Ngalee on credit, with repayment only after the harvest. This strategy has enabled the company to double its sales volume over three consecutive years.

Impacts

- Approximately **1,200** growers use fertilizers that protect their health and soils.
- an average of **42%** increased yields thanks to the use of Ngalee.
- **53** million FCFA additional income due to the higher yields.
- **182** hectares of land restored.
- **326** tonnes of organic waste collected and recycled.

Facts

- **61%** of agricultural land in Burkina Faso is degraded.
- The city of Ouagadougou alone produces almost **300,000** tonnes of organic waste every year.
- Producing compost the traditional way is labor- and water-intensive.
- Chemical fertilizers are often too expensive and can be harmful to the environment and human health.

Goals

- Improve soil fertility and thus yields.
- Transform organic waste into concentrated organic fertilizer for the benefit of farmers.
- Produce a high-quality fertilizer at a competitive price. This includes achieving the same short-term performance as chemical fertilizer at the same price.
- Improve production capacity by making the industrial process more efficient.
- Strengthen the existing production site and open a new unit focusing on mango and cassava production.



ADFS

Producing energy from organic waste through bio-digestion

The agro-industrial units in Benin generate large quantities of organic waste without having an effective management strategy in place. This is leading to increased pollution problems and additional costs. At the same time, these agri-food businesses need energy, which they acquire at a high cost.

Background

ADFS is one of 20 innovative companies selected as part of a call for innovation from the West Africa cluster of the Water and Energy for Food Program / Programme Eau et Energie pour l'Alimentation (WE4F / PEEPA), the main aim of which is to scale up water- and/or energy-friendly innovations in the agro-industry sector. ADFS is a Benin-based company specializing in the processing of farm products, in particular poultry, but which has also developed a business building bio-methanation equipment to produce biogas. Its agro-industrial activity was generating such a large volume of waste, with its associated environmental nuisances and financial constraints, that it felt it was necessary to find a solution not only to treat it but also to recycle it. With this in mind, ADFS created ADFS Energy to provide a sustainable solution using a biodigester. The biodigester has made it possible to manage organic waste on site without compromising hygiene or

causing offensive smells, thereby avoiding any disturbance to the neighboring areas. This successful experience with the biodigester was so profitable and beneficial that ADFS decided, together with ADFS Energy, to make this technology available to all businesses and households. Since its launch, the marketed biodigester has been installed with more than 80 customers, having a positive impact on more than a hundred people and creating more than thirty direct and indirect jobs within the companies benefiting from this solution.

Innovation

The biodigester not only makes it possible to manage organic waste efficiently, but also to produce biogas, thereby contributing to the sustainability of agriculture. It is a concrete device that provides an anaerobic environment for decomposing organic matter, such as agricultural waste, food residues or livestock effluents, to produce biogas and digestate, a nutrient-rich natural fertilizer.

Thanks to its expertise, ADFS guarantees the design and commissioning of the biodigester so as to maximize its added value and to size it as closely as possible to the customer's needs. The approach used is based on a meticulous analysis of actual energy consumption and the capacity to generate waste. This study results in an accurate vision of the size and costs associated with the biodigester that would be best suited to each situation. In this way, all customers can assess the profitability of this solution for their company and plan its acquisition. In addition, this device incorporates a biogas storage system that simplifies its future use for heating or electricity production.

Finally, to guarantee the durability of the biodigester, ADFS offers support for regular servicing and maintenance. The aim is to increase its longevity and keep it operational long enough to fully meet the identified needs.

Advantages

Biodigesters offer an ecological and sustainable solution for managing organic waste and producing renewable energy. The biogas generated is a renewable energy source that can replace fossil fuels, reducing fuel costs for the agro-industry concerned. In terms of waste management, too, the benefits are twofold, both for the company, which no longer needs to mobilize as many resources to evacuate the quantity of organic waste produced, and for the community, particularly in urban areas, which sees the volume of accumulated waste reduced thanks to its transformation and recovery. Anaerobic digestion also reduces methane emissions into the atmosphere compared with traditional landfill sites, so plays an active part in combating climate change. The biogas obtained can be used to produce green electricity, which replaces the supply from the national grid.

In addition, the digestate obtained at the end of the process is an excellent natural organic fertilizer, improving soil fertility and the productivity of the farms on which it is spread.

Finally, designed to be sustainable and adapted to the needs of its user, the ADFS biodigester requires very little maintenance.

Goals

- To provide a useful and effective solution to the problem of managing organic waste generated by the agro-industrial sector.
- Promote green energy from a waste treatment and recovery process.
- Protect the environment and public health.
- To create a virtuous value chain generating employment around the recycling of organic waste, the creation of energy and the manufacture of fertilizers.



**CLIMATE CHANGE
ADAPTATION**

INTRODUCTION

Climate change poses a significant challenge for farmers, disrupting agricultural systems with unpredictable weather patterns, extended droughts, rising temperatures, and increasingly frequent extreme weather events. These changes threaten crop yields, reduce soil fertility, increase pest and disease outbreaks, and all in all, make farming more difficult and less reliable. Farmers in Africa are especially vulnerable because of their strong economic dependency on climate-related activities and products and low adaptive capacity. As a result, they face heightened risks to their livelihoods and food security, underscoring the urgent need for effective adaptation strategies.

Climate change adaptation refers to the process of adjusting to current or expected changes in climate to minimize harm and take advantage of potential opportunities. For farmers in East and West Africa, adapting to climate change is crucial, even though their contributions to global greenhouse gas emissions are minimal.

WE4F works with entrepreneurs that offer promising solutions to farmers to adapt to climate change. For instance, hydroponics allows for soil-less farming, using less water and enabling crop production in arid regions. Solar Powered Irrigation Systems (SPIS) offer a sustainable way to irrigate crops when there is no rain. Climate adaptive farming practices can also be source of additional income for farmers as they can become accredited to sell carbon credits for their sustainable environmental management.





ASILI FARMS

Agilis is the largest producer of grains and oilseeds in Uganda through Asili Farms, the group's farming division. Asili is an integrated food security platform for East Africa. The company helps farmers sustainably increase their profitability, climate resilience, and overall nutrition by offering agricultural land management practices and marketplace solutions.

Company description

Asili cultivates and manages agricultural land in the Northern and Western regions of Uganda. This includes large-scale production of maize, soybean, sunflower, and beans. Their farms comprise over 8,000 hectares of land under management, storage, and processing facilities. Asili further provides a package of farm management advisory, agronomic, financial, and marketing services to around 15,000 smallholder farmers. The services are centred around regional hubs, which act as centres for field services, agronomic innovation, grain storage and handling, and catalyze the supply and demand of grains. All of this enables Asili to aggregate grains from smallholders and in turn, create a vital link between small-scale and large-scale producers, agricultural commodity buyers, and service providers.

Goals

Asili aims to identify and quantify monetary incentives to its climate-smart practices, which will also encourage and support the adoption of these activities by smallholder farmers. Within this, Asili specifically wants to measure the water and amount of carbon stored in their soils. For example, by assessing the amount of carbon sequestered (and therefore, the amount of greenhouse gas emissions avoided) through its climate-smart practices. These insights can be used to generate carbon credits, which can eventually be monetized and sold to organizations that wish to offset their own greenhouse gas emissions. In this regard, carbon credits can benefit smallholder farmers, as they represent an additional income source that incentivizes farmers to apply climate-smart practices and in turn, reduce greenhouse gas emissions. With support of WE4F, Asili commissioned a study to analyze the potential monetization of climate-smart agriculture through carbon credits. From the conservative analysis, the potential gross greenhouse gas emission removals/carbon credits of the proposed project were estimated at 707,242 tonnes of carbon dioxide equivalent (tCO₂e) over the 20-year crediting period. The projected carbon credit revenues obtained from carbon credit investors/buyers would pay of the required investments and the project could reach breakeven in 13 years. Asili therefore aims to turn this study into an innovative carbon transformation project.

Testimonials

“The study indicated great potential in sequestering carbon through climate smart agriculture. These modules will enable us to do digital crop monitoring for farmers. We can also provide extension services through training and capacity building with farmers to ensure high adoption rates, enable carbon retailers to buy carbon credits, provide a marketplace to distribute credits to different farmers through input, cash, and so on.”

Patrick Katungi, Producer Services Manager

“Our practices result in healthier soil. But we’ve seen results above the soil. Better crops, better yields, lower inputs.”

Federico Tonelli, Director of Development & Partnerships

Food security

- Tackle chronic food insecurity affecting >12% of country’s population.
- Sustainably increase yields from 0.772 MT/ha/year (IFC baseline study) to 3.551 for smallholders & 4.823 MT/ha/year for commercial farms.

Livelihoods

- Gross profit from <\$10/ha/year to ~\$100/ha/year for smallholder (excluding labor costs), large commercial farms reach \$750/ha/year.

Resilience

- Reduce impact of recurrent droughts (every 1-6 years).
- Stable and higher yields and incomes even in harsh and unpredictable weather and market conditions.

Climate mitigation

- Carbon sequestration / carbon credits of 2 to 4 tCO₂e/ha/year.
- Total potential of 1.5 million tCO₂e in 20 years, for 15,000 smallholder farmers.



LAKE TURKANA BASIN INSTITUTE (TBI)

Growing vegetables where no vegetables grow: Using innovative water and energy technologies for agricultural diversification

WE4F East Africa Regional Innovation Hub and Lake Turkana Basin Institute (TBI) piloted an integrated system of solar reverse osmosis and hydroponics to make use of the saline water for local food production in the arid North of Kenya.

Background

In the very North of Kenya in Marsabit County, living conditions in the village Ileret are extremely harsh. With an average precipitation of around 300 mm/year, the region is classified as arid land and crops can't be grown only relying on rainfall. Available water sources in the area are heavily mineralized, polluted and are generally not safe for human consumption without treatment. Extreme weather events, such as droughts and floods, result in starvation, famine, and livestock deaths, triggering inter-community conflicts and forcing people to find food and shelter elsewhere. Vegetable production is almost unheard of, so it also takes rethinking, awareness, and a willingness to try something different to find innovative ways to access nutritious food.

Project in a nutshell

The aim of the partnership between TBI and WE4F is to improve livelihoods of people in Ileret, support local entrepreneurship and increase local food security despite the challenges posed by a changing climate. A solar-powered reverse osmosis system for water treatment is at the heart of the project. The water serves both TBI and the local community and enables hydroponic production of vegetables. The following steps have been implemented during the project duration:

- 1) Installation and operation of a novel solar-powered reverse osmosis system.
- 2) Set up and operation of a hydroponic farm.
- 3) Training of local community members in hydroponic farming and supporting them to start own hydroponic vegetable production.
- 4) Nutritious food research and awareness outreach.
- 5) Information collection and dissemination.

Project outcomes

The first step in the project was to drill boreholes to access groundwater. Despite earlier hydrological surveys, these boreholes failed to yield any water, so an old borehole located 8.5 km away is now being used as water source for this project. However, this source only provides hot (70 °C) and brackish water, leading to reduced pump operation. This means that the solar reverse osmosis system is not operating at full capacity until a new water source has been found. Even with these limitations, the desalinated and treated water was the only remaining local freshwater source during the drought in 2022/2023.

Hydroponic agriculture has proven to work in the project region. Fresh greens are sprouting everywhere in the normally sparse environment and transforming the landscape. The system in Ileret is producing good yields of spinach, kale, tomatoes, amaranths, lettuce, cabbage, beetroot, chillies, and even watermelon. It is a very water-efficient way of farming, with plants absorbing all of their required nutrients from a special solution that circulates around the roots.

The trained hydroponic entrepreneurs are selling their produce locally, a novelty in the region. Prices are still being assessed as demand is high and the awareness of the local community of the nutritious value of these vegetables is growing thanks to an outreach campaign with the local health providers.

Looking forward

- 1) TBI is working on increasing the raw water input to the RO system by developing other sources. With higher input, the machine could operate at maximum capacity, increasing the amount of available clean water.
- 2) Hydroponic entrepreneurs continue to manage their hydroponic plots, produce fresh vegetables and generate income for themselves and their families.
- 3) TBI, GIZ and other partners have published a "Hydroponics Guide" to capture the experience with hydroponics in ASAL settings.

Facts

- Arid and semi-arid lands cover 80% of Kenya's land surface and hold 25% of its population, mainly in rural settings.
- Hydroponic farming is relatively new in Kenya and a climate-smart agricultural and water efficient alternative.
- Reverse osmosis water purification process can remove suspended and dissolved impurities, salts as well as bacteria and viruses.

Mitigating drought impacts

- During the project period, the Northern part of Kenya, including Ileret, was hit by a severe drought. Most open water sources got depleted and a massive die-off of livestock has occurred.
- Water treated by the Reverse Osmosis System at the TBI was brought to the local community of Ileret to ensure the availability of clean water for household consumption.
- The highly water-efficient hydroponic systems allowed production of nutritious food even under drought conditions.

Capacity Development	15 people (of which 12 women) from the local community have been trained in hydroponic farming and entrepreneurship over the course of 12 months. They are considered multipliers within their communities.
Food security	6.2 tons of nutritious food have been produced within the hydroponic systems at the TBI in Ileret. This includes 1.7 tons that the hydroponic trainees have harvested from the systems managed by themselves and that is used for their own consumption or sale.
Water, Energy & GHG	10,847 m ³ of water has been pumped, using 9,082 kWh of solar energy. 5,666 m ³ of clean water has been produced with the Reverse Osmosis system, using 8,049 kWh of solar energy for the treatment. 92 tons of Greenhouse Gas Emissions have been avoided, compared to the previously used diesel generators for the pumping and treating of water.

Desalinization for water and food security

What is a Solar Powered Reverse Osmosis?

Reverse Osmosis (RO) is a water purification process that filters out unwanted molecules and particles such as chlorine, salt, dirt or microorganisms. The technology uses a partially permeable membrane and applied pressure to purify water. Energy is needed to operate the system, mainly to power the different pumps and electronics. Conventional systems that operate off the grid, need a diesel generator to power the RO, causing high CO₂-emissions, noise and operating costs. In Solar Powered Reverse Osmosis, the energy is generated by solar panels - a clean alternative to diesel.

What are the main features?

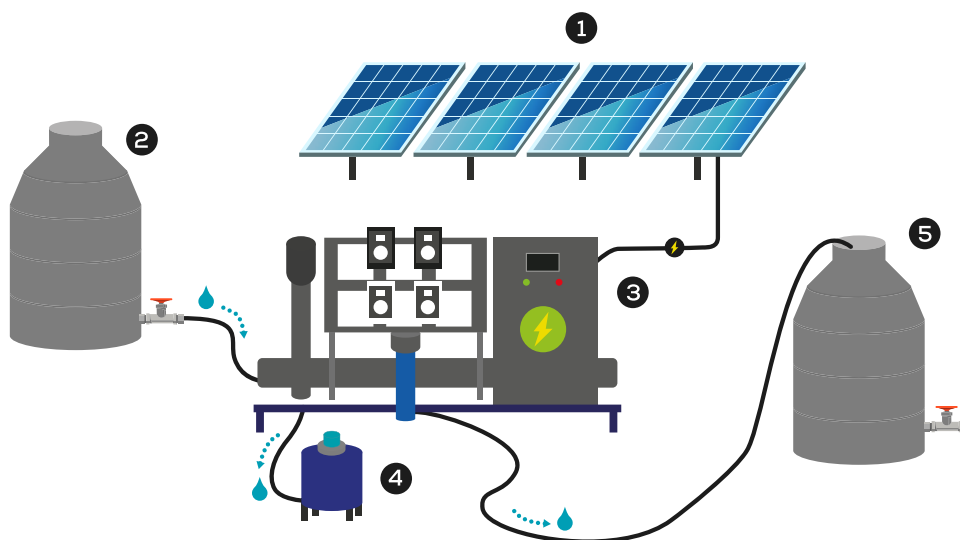
Water from the sea, brackish water or groundwater with high salinity levels cannot be used directly for agriculture or human consumption due to their high content of minerals. Other water sources, such as rivers or lakes might be polluted and unsafe to use. RO can purify water from such sources and bring the quality up to drinking water standards recommended by the World Health Organization. The system installed in Northern Kenya can produce up to 20 m³ of clean water per day, consuming 1.5 kWh per m³. The energy is provided by 32 panels (7.4 kWp).

What are common uses?

Besides treating water for human consumption, RO can be used for agricultural purposes. This includes production of fresh water for irrigation in highly efficient farming systems, like hydroponics, or the use of cleaned water for the production of ice, that can be used for the cooling of agricultural products.

Market development

The Solar Powered Reverse Osmosis Technology is technically proven, reliable and suitable especially for remote off-grid areas that only have water of minor quality. There are several established manufacturers, while a number of startups are innovating the market. Solar Powered Reverse Osmosis Systems are adapted to different types of raw water and amount of daily treated water.



- 1 Solar generator
- 2 Raw water
- 3 Reverse Osmosis System
- 4 Concentrate
- 5 Fresh water



HYDROPONICS AFRICA LIMITED

Hydroponics Africa Limited

Soil-less farming technology for increased yields and food production in a changing climate.

Background

Hydroponics Africa Limited is East Africa's pioneer and leader of simplified hydroponic farming systems. The company was founded in 2015 with the aim to develop efficient and affordable products for small-holder farmers. The company began by blending fertilizer targeted at smallholders, but later diversified to hydroponic farming solutions. Hydroponic farming involves suspending plants in a water solution with each essential nutrient necessary for a plant to grow, removing the need for soil. This way, crops can be grown regardless of climatic conditions, availability of cultivable land, or soil quality. Hydroponic farming has the potential to provide fresh, local food for areas with extreme droughts and low soil quality.

Project in a nutshell

Hydroponics Africa worked with WE4F expand its business operations, including additional products and services for hydroponic systems. The main goals are to:

- Train smallholder farmers on the use of hydroponic farming systems.
- Conduct soil testing and facilitate the production of tailor-made fertilizer for increased food production and reduced water and energy consumption.
- Install solar desalination systems to convert saline to irrigable water.
- Develop agribusiness ventures together with smallholder farmers to market hydroponically produced vegetables and herbs.
- Provide market linkages for these smallholders.

Business profile

Key revenue sources for Hydroponics Africa are 1) Manufacturing and installation of simplified hydroponic systems, bio-pesticides and nutrients; 2) Distribution and installation of intelligent plant responsive systems; 3) Manufacturing and selling of hydroponic fertilizers; 4) Provision of agronomy crop support and management, and 5) Training and consultancy on hydroponics and plant responsive technologies.

The company has recognised that selling of inputs, like fertilizers, biopesticides, as well as off-taking of fresh produce, are more profitable and ensure a more stable cash flow than offering technology hardware, like hydroponics systems and other capital-intensive products. Hardware sales are more suitable for a B2B model with institutional partners and organisations, while the sales of inputs and services allow for more flexible B2C models.

Impact

Hydroponic systems are highly resource use efficient, helping to save up to 80% of water and accounting for ¼ of land space compared to conventional agriculture. This allows farmers to produce food even during extreme climatic events and despite significant pressure on environmental resources. The systems offered by HAL do not use any form of energy to irrigate the crops as water flows by gravity; instead of soil, they use an inert medium and is, hence, free from soil borne diseases. Since no chemical pesticides and only organic fertilizer are being used, the environmental footprint of food production remains small. HAL reports up to 30 percent faster crop growth. Finally, hydroponics is labour extensive and typically focuses on high-value crops to generate more income.

Business Goal	Outcome	How it was done
Increased access and use of hydroponics	2,825 farmers trained in Kenya 2 agronomists advise farmers 50 small-scale solar desalination systems leased out and 14,000 m ³ of water treated	Training of smallholder farmers on hydroponics Leasing model for solar desalination units
Increased food production	1,000 soil tests at different parts of the country 19,450 tons of food produced by farmers using the innovation	Soil testing to produce customized fertilizers Increased food production
Improved market access for food produced	Market linkages for horticultural produce for 500 farmers. 30 tons of fresh produce have been off taken from farmers.	Contracts with farmer groups to sell hydroponic produce Developed last mile distribution systems

Hydroponic farming

Doing more with less

What is a hydroponics?

Hydroponic farming is a way of producing crops, such as vegetables or fruits, without soil. Different types of substrate can be used as a growing media, while the nutrients required by the plants can come from various sources, like fish excrement, manure, chemical fertilizers or artificial and organic nutrient solutions. Nutrients are dissolved in the water that circulates through the system, reducing the consumption to a minimum. In hydroponics, the environmental conditions (temperature, light, water, nutrients, pests, diseases) can closely be monitored and controlled, allowing optimal growing conditions, including locations that are not suitable for conventional crop production.

What are the main features?

Hydroponic systems can be constructed with locally available materials, such as PVP-pipes, plant pots and shade nets. Typical growing media include volcanic rock mixed with coco peat, gravel, or peat moss. HAL is producing artificial solutions to provide nutrients for their systems. An alternative is to experiment with organic substances to tailor-make nutrient solutions for

specific crops. Systems are scalable in size and complexity and can be used from individual to large-scale level. Hydroponics allow plants to grow under optimal conditions, leading to high yields, low pest and disease rates, and reduced growing time.

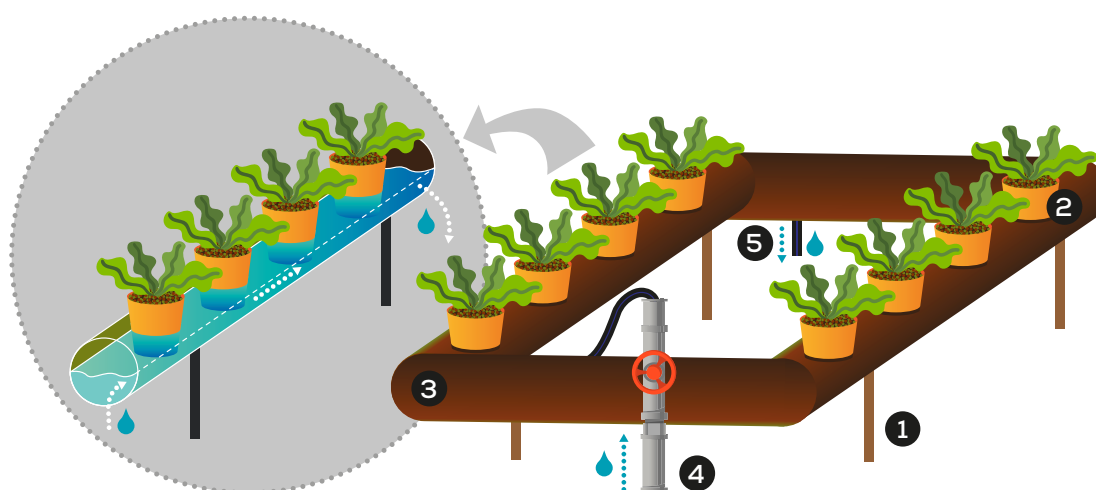
What are common uses?

WE4F's partner uses the hydroponic system to produce different high-value and nutritious vegetables and fruits, including Spinach, Kales, Melons, Passion Fruit, Tomato, Courgette, Pumpkin or Chili.

Market development

The market potential for hydroponics in East Africa is high, especially in contexts where conventional agriculture is difficult. Especially in arid and drought-prone regions, hydroponics offers a viable production method. As land and water resources are under increasing pressure, hydroponics is a way of doing more with less.

While do-it-yourself solutions are possible, some companies on the market also provide custom-made systems.



- 1 Supporting structure
- 2 Plant pots
- 3 PVP pipes
- 4 Water and nutrient input
- 5 Circulation system



SUNCULTURE

Solar-powered water pumps – affordable and climate friendly

SunCulture is the largest distributor of solar water pumps and solar irrigation solutions for smallholder farmers in Africa. It was selected by Fast Company as one of the World's Most Innovative Companies in 2021 and convinced many investors in the following years.

Company description

SunCulture is a climate-tech platform for emerging markets. The company provides affordable solar water pumps - a zero-emissions alternative to diesel-powered pumps. The pumps enable farmers to gain access to a reliable water source for irrigation, which is not dependent on unpredictable rainfalls. By having access to a year-round, reliable water source, farmers can grow more crops over a larger portion of the year. This can boost their overall yields and in turn, increase income.

Project in a nutshell

In addition to financial and social benefits resulting from increased agricultural production, solar-powered water pumps are both, contributing to climate adaptation and mitigation.

By accessing groundwater, solar pumps help farmers to reduce the impact of climate change on their fields. By providing a reliable water source, farmers can better adapt to unreliable rain patterns or droughts - farmers are getting more resilient through irrigation.

In their operation, solar water pumps also don't emit greenhouse gases. Estimates show that around 600 kilos of carbon dioxide emissions are avoided annually by replacing a small-scale petrol irrigation pump with a solar alternative. Kenya alone has an opportunity to avoid over 1 million tonnes of carbon dioxide emissions annually by replacing petrol pumps with solar irrigation products, like the ones that SunCulture provides.

Overall, solar water pumps like the RainMaker (and renewable energy more broadly) represent a growing trend worldwide. This leads to decreased costs for renewable energy technologies. In fact, prices of large-scale solar photovoltaics decreased by 89% between 2009 and 2019, according to the latest edition of the UN's Human Development Report. Together with technological improvements and innovations, the costs for complete solar irrigation systems will continue to decrease, making solar pumps more affordable, farmers more resilient while reducing the climate impact of diesel pumps.

Project outcomes

SunCulture is now the largest solar pump distributor in Sub-Saharan Africa, as a new report from GOGLA (the Global Association for the Off-Grid Solar Energy Industry) indicates. With more investors on board, the company seeks to further grow and reach more customers.

Testimonial

"It takes a lot of work and dedication to build a company in the renewable energy sector, but the results are definitely worthwhile. From being able to empower lives and the testimonials that come from our customers, especially in light of the climatic changes globally, are gratifying."

Lucy Jong'a – Kenya General Manager, SunCulture



Solar powered irrigation

Providing water where there is no rain

What is a solar powered irrigation?

Solar powered irrigation systems consist of electric water pumps that are connected to solar panels. The pumped water is either directed directly to the field or into a water tank from where it is released at a later point in time. This makes water available even in the absence of rainfall.

Most water pumps utilized for irrigation purposes worldwide are powered by engines running with fossil fuels or on electricity supplied from the grid. As energy prices have increased, solar pumps for irrigation have become an economical and environmentally viable alternative.

What are the main features?

Solar water pumps are available in different sizes. Depending on the depth of the borehole, the water requirement and the solar radiation, a suitable system can be designed. Compared to conventional pumps, the solar alternatives come with higher initial investment costs but have no operational costs. A typical pump for a smallholder farmer with 2 acres of land

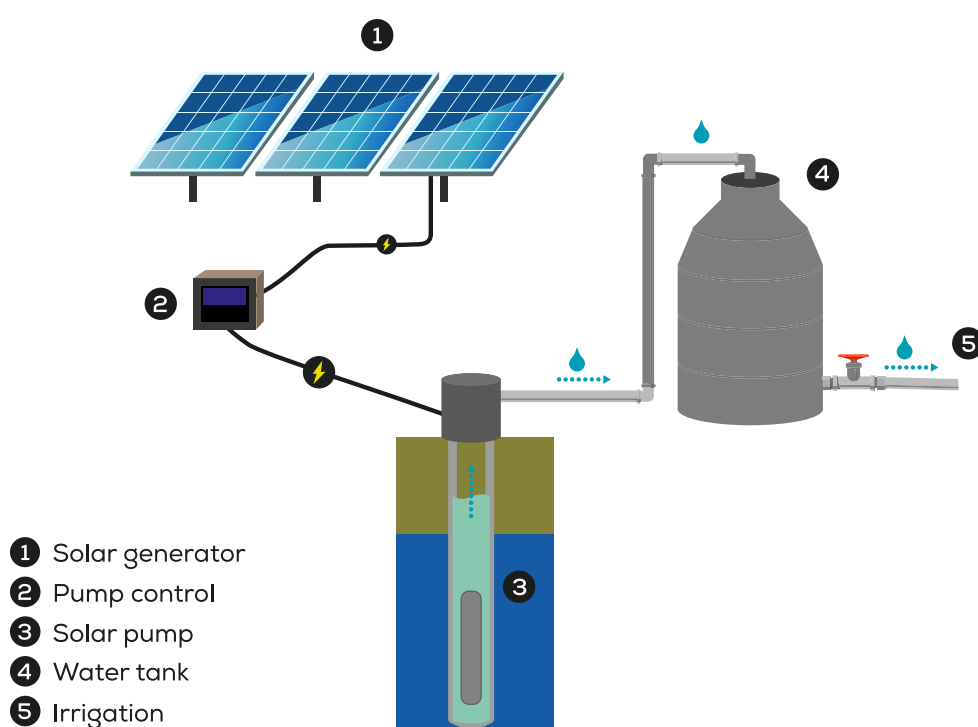
can pump up to 1500 litres per hour from an 18 m deep well, using 600 Wp of PV. During the hours of sunshine, the water is pumped into a water tank. From there it is distributed to the field when needed. The solar water pumps are ideally used for drip irrigation.

What are common uses?

Solar powered water pumps are used for the irrigation of crops and watering livestock. Under irrigation crops can get the ideal amount of water and yields can be increased significantly, leading to a higher income for the farmers. The effects of climate change, especially droughts and unpredictable rainfalls can be mitigated by the use of solar powered water pumps.

Market development

The market potential for solar powered water pumps in East Africa is high. Pumps are locally produced or can be imported from international suppliers. To tackle the initial investment cost, some companies are offering finance, such as pay-as-you-grow or payment plans, that make the product more accessible to farmers.





TRANSLIGHT SOLAR

One-stop-hub for electricity and water

Electricity is vital for a good quality life and for healthy economies. However, only about 40% of people in Sub-Saharan Africa have access to electricity. In some countries in West Africa, like Burkina Faso or Niger, as little as 19% of the population has access to electricity. Access to irrigation and drinking water is an additional challenge for many West Africans: only 1,6% of irrigable land is equipped with irrigation infrastructure and around 60% of people lacks access to safe drinking water services.

Background

Translight Solar is one of the 20 innovating companies selected through a call for innovation by the West Africa Hub of the Water and Energy for Food (WE4F) Programme whose main goal is to scale up water and/or energy friendly innovations in the agro-industry sector.

Translight Solar was founded in Ghana with the aim of providing reliable solar energy at an affordable price. Since its inception in 2015, the company which now employs 13 people, has installed 2000 systems in homes and industrial facilities in West Africa. Recently, the company prototyped the „Sunbox“, an innovative energy-access option geared towards rural communities who wish to improve their energy and water access as well as boost their agribusiness activities in Ghana and beyond.

Innovation

The multifunctional Sunbox from Translight Solar is an independent power station equipped with solar panels and batteries to generate electricity. The power can be used to operate different equipment, according to users' needs. Target users are rural communities and especially rural agribusinesses such as restaurants, food shops, processing units and agricultural cooperatives. There are several options for using the Sunbox:

- As a water pumping and filtering facility, to provide drinking and irrigation water.
- Use the energy to power agri-food processing machinery such as dryers or mills.
- Wire homes and other buildings to the power supply, allowing users to have domestic electricity. One Sunbox can provide power for around 2000 people.

The Translight Solar Sunbox is a modular box that can start with one or two functions and then be upgraded as other uses are identified. This is not only a technical innovation, but also a job-creating business model. Each box is an income source for two people, who by operating the box and selling its products (energy, drinking water or processed products) can generate income while being self-employed.

Advantages and impacts

- Three Sunboxes have already been installed: two in the Volta region and one in the Central region of Ghana, currently providing solar pumping for irrigation and for a honey-processing unit. In the south, a pilot off-grid box also pumps water for irrigation and powers the manufacture process of drinking water bags and dried fruit.
- Translight Solar also focuses on providing a source of income to rural women. As of April 2023, 30 small-holder farmers, 60% of whom are women, operate and use the Translight Sunboxes for various agricultural production.
- Translight Solar has provided two communities in the Volta region of Ghana with a population of more than 3,000 with clean drinking water.
- Clients of Translight Solar see their bills reduced by 40% or more.
- In places where electricity is generated in excess, it can be fed into the national grid.

Facts

- Only **40%** of people in Sub-Saharan Africa have access to electricity.
- In Ghana, **85%** of people has access to electricity but not everyone has access to reliable power 24/7.
- **60%** of people in Ghana does not have adequate access to safe drinking water.

Goals

- Install more than 2,000 residential solar and 100 Sunboxes in Ghana over the next five years.
- Establish a business model for affordable access to sustainable energy.
- Create thousands of jobs especially for women.
- Reduce carbon emissions (CO² abate) by more than 120,000 tons per year.



AFRICA ENERGY SOLAIRE

Solar irrigation for providing water and energy access to smallholders

Food security is a fundamental issue for a country like Burkina Faso, where traditional agriculture still has limited access to modern irrigation methods, primarily due to insufficient financial capacities and connections to existing electrical grids. The promotion of solar energy and the deployment of effective solutions could, on the contrary, improve yields and sustain agricultural production and processing activities.

Background

Africa Energy Solaire (AES) is one of the 20 innovative companies selected in a call for innovation by the West Africa Hub of the Water and Energy for Food Program/ Programme Eau et Energie pour l'Alimentation (WE4F), whose primary objective is to scale water- and/or energy-efficient innovations in the agro-industrial sector. Established in 2009 in Ouagadougou, AES is a company with 28 employees specializing in the installation of solar equipment in rural areas to address the energy production and distribution deficit experienced by the country. AES provides and installs solar-based electrification solutions (both on-grid and off-grid), pumping systems, water heaters, induction cooking, and electric mobility solutions. In solar energy (photovoltaic, thermal, and microgrids), AES has expertise from study, realization, maintenance, to monitoring of solar installations. Responding to the food needs of the population, AES has also decided to ap-

ply its expertise in water, energy, and irrigation supply to agricultural production. Their innovative solution ensures efficient water management while increasing water availability in all seasons. Thus, production is guaranteed throughout the year, along with the operation of processing units. Since then, AES has completed over 115 solar irrigation station installations, generating 115 direct jobs and 575 indirect jobs.

Innovation

Through the provision of an integrated system combining solar pumping and water supply, AES aims to replace traditionally used electric pumps, whose maintenance, fuel consumables, and upkeep costs are very high for farmers. The system includes a solar pump, either surface or submerged, capable of delivering up to 20 cubic meters of water per day, paired with a storage and water supply device to enable field irrigation day and night.

This solution allows agricultural lands and processing units to operate year-round, including during the dry season, facilitating off-season vegetable production. Noting that the majority of agricultural operations are small-scale and owned by low-income households, groups, or cooperatives, AES has developed an innovative economic model for this specific solution based on a pay-as-you-go system. This pricing model charges only for the actual consumption by the user, with no financial burden when not in use. This system enables even low-income smallholders to access an efficient irrigation solution, thereby increasing their production and improving their livelihoods.

Advantages and impacts

The solution offered by AES ensures optimal utilization of water resources and their availability throughout the year. Likewise, energy production is continuous across seasons without the need for supplementary energy inputs, particularly fossil fuels, whose costs can be prohibitive for small farmers.

AES provides access to sustainable, renewable, and environmentally friendly energy, reducing the use of traditional generators and electric pumps that contribute to greenhouse gas emissions and global warming.

This solution also allows each farmer to extend their production period year-round, improving field yields. Additionally, with its extensive experience in the field and a team of engineers and technicians, AES enables easy installation of the irrigation and pumping system at a low cost, while ensuring maintenance throughout its operational period.

Finally, with its lower investment and operating costs compared to traditional installations and its pay-as-

you-go model, smallholders can allocate a larger portion of their income to improving their living conditions and to the local development of the agricultural value chain through the gradual implementation of small processing units.

Goals

- Provide small farmers, particularly market gardeners, with an efficient and sustainable solution for energy and irrigation access for their crops year-round, without consumable expenses, particularly fuel.
- Offer innovative solutions to the challenges of agricultural development in Burkina Faso and throughout West Africa.
- Promote and structure the solar energy market by demonstrating its capacity to provide practical solutions to structural issues.
- Contribute to the development of the country's agro-industrial sector, generating employment and economic growth.



GLOBAL BUSINESS TECHNOLOGIE

Remote control of irrigation systems via mobile phone thanks to HADARI technology

In Africa, particularly in Mali, small-scale farmers find it difficult to use their irrigation systems efficiently to ensure optimum crop growth. One of the reasons for this is a lack of control over the system, particularly when they are not in the field.

Background

Global Business Technologie (GB Tech) is one of 20 innovative companies selected as part of a call for innovation by the West Africa cluster of the Projet Eau et Energie pour l'Alimentation / Water and Energy for Food (PEEPA / WE4F) program, whose main objective is to scale up water and/or energy-friendly innovations in the agro-industrial sector.

The Malian company GB Tech, founded in 2017, develops digital and robotic innovations in the agricultural sector. The GB Tech team is made up of 17 people including several technicians and engineers. Six of the team members are women (4 salespeople and an administrative assistant.)

One of the company's flagship innovations is HADARI technology, a remote-irrigation device that enables watering and irrigation systems to be controlled re-

motely. This innovation enables more efficient use of water, while reducing farmers' workload.

Innovation

Tele-irrigation is a process that enables the irrigation system to be controlled remotely, regardless of time and space. HADARI technology enables the irrigation system to be triggered remotely using a telephone, simply by sending an SMS. The device works with any type of phone and can be used without internet, which is an advantage in regions with a weak or absent mobile network.

The system itself consists of a box, fitted with a GSM chip, which is connected to the irrigation system and its piping network, which are installed in the fields. Via the cell phone, the system can be remotely controlled by means of an SMS sent by the farmer, triggering irrigation which can be programmed for a set period of time. To ensure access to water for irrigation, pumps powered by solar panels are installed. Finally, the box is installed between the water tower and the irrigation system.

Advantages and impacts

- The Hadari system can be adapted to new farming techniques.
- The system is autonomous and uses solar energy.
- The system provides the water needed for irrigation.
- The system optimizes yields while reducing labor input.
- The system can be controlled remotely via a cell phone.
- Elements such as humidity control or video surveillance can be integrated into the system.

Facts

- In Mali, the agricultural sector employs around **70%** of the working population.
- Mali has an estimated potential irrigable area of **2.2 million** hectares, only **12%** of which are actually irrigated.
- In Africa, the mobile phone penetration rate has exploded in the last 10 years, reaching almost **80%**.

Goals

- Optimize the remote irrigation process to save time, water and energy.
- Help maximize farmers' yields and thus contribute to food security.
- Offer affordable solutions to low-income farmers.



GREEN AGRO VALLEY

Low-cost laser spray irrigation system saves water while boosting agricultural production

Agriculture is the main driver of economic growth in Côte d'Ivoire, with almost half the working population employed in this sector. However, the country's agricultural productivity remains low, due in part to low mechanization levels, specifically low irrigation rates. Although irrigation holds great promise for strengthening the agricultural sector, the high costs associated with its design, acquisition and installation limit its expansion.

Background

Green Agro Valley CI is one of the 20 innovative companies selected through a call for innovation by the West Africa Hub of the Water and Energy for Food (WE4F) programme whose mission is to scale water and/or energy friendly innovations in the agricultural sector.

Green Agro Valley is an Ivorian company founded in 2018 and based in Abidjan. It employs 21 people, including seven women. The company aims to improve access and the use of irrigation systems by making them affordable to smallholder farmers.

Innovation

Green Agro Valley offers boreholes equipped with solar pumps and Laser Spray irrigation kits. The Laser Spray irrigation system consists of low-density polyethylene (PELD) sheaths laser-perforated to micron-sharp diameters. These are connected to a hydraulic pump by a pipe made of polyvinyl chloride (PVC) or high-density polyethylene (HDPE), both of which are plastic materials. Once in operation, the sheaths produce rain-like jets of water that slowly infiltrate the soil.

The system operates at low pressure and requires less energy than a conventional high-pressure system. The PELD sheaths can be cut to the desired size according to the surface area of the plot to be irrigated.

Green Agro Valley aims to make irrigation accessible to as many farmers as possible by offering low-cost systems. Prices are competitive with other commercial products available on the Ivorian market. In addition, several versions of the irrigation system are available to suit different customer needs.

Advantages and impacts

- Green Agro Valley's Laser Spray irrigation system makes efficient use of water and energy possible, while its low cost makes it affordable for farmers.
- The company has installed irrigation systems on 400 ha and has over 500 customers in six countries.
- Farmers using Laser Spray have tripled their yields and are able to grow three crop cycles per year instead of two.
- Fuel consumption by farmers using conventional pumps has been cut by a third.

Facts

- In Côte d'Ivoire, **65%** of the territory is classified as agricultural land, and **46%** of the country's workforce is employed in this sector.
- Only **2%** of cultivated land in Côte d'Ivoire is irrigated.
- With global warming, farmers who don't use irrigation systems have seen their production drop **by 20%**.

Goals

- Build a factory where the Green Agro Valley team can produce and assemble irrigation systems.
- Put together a pay-as-you-go business model to allow more farmers to have access to our solar powered irrigation systems.
- By 2027, install Laser Spray irrigation systems on at least 10,000 ha of agricultural fields in West Africa.
- Green Agro Valley aims to impact 50,000 farmers over a 5-year period.



AD SOLAR

Local integrated irrigation solution combining solar energy and water supply

Vegetables production in Côte d'Ivoire is expanding thanks to the specialization of numerous producers who are gearing themselves with irrigation equipment or practicing seasonal market gardening in open fields. However, this dynamism is not sufficient enough to tackle the shortfall in vegetable production for national consumption. This is due in particular to the difficulty for small farmers in traditional and peri-urban areas of accessing reliable and affordable electricity and water supply solutions

Background

AD Solar is one of 20 innovative companies selected as part of a call for innovation by the West Africa cluster of the Water and Energy for Food / Programme Eau et Energie pour l'Alimentation (WE4F / PEEPA), the main aim of which is to scale up water- and/or energy-friendly innovations in the agribusiness sector. Comprising a team of six engineers, AD Solar was founded in 2014, initially to provide cost-effective solar-based electrical power solutions. It offers quality solar products such as solar lamps, solar kits, tailor-made solar installations for electricity and hot water, as well as solar pumps for livestock or agriculture. Since 2021, following requests from its customers who could not find an irrigation solution adapted to their needs, it has set about designing a system to enable farmers to control and save water, and to provide them with a low-cost water supply that increases their production capacity while ensuring efficient irrigation.

Moreover most of the existing systems on the Ivorian market are imported, which makes them more expensive and more complex to maintain. Hence AD Solar has developed a locally assembled irrigation system that can be adapted to all types of water flow required for different types of production.

Innovation

AD Solar supplies a locally manufactured irrigation system in PVC and HDPE that can be configured for all types of watering: laser spray (jet to jet), drip and sprinkler. The standard version of this system has an effective area of 500 m², spread over four sprinkler lines, each with eight sprinklers, but it can also be tailor made. It includes a device for controlling flow rate, watering speed and jet length - up to two metres for the sprinklers.

A truly integrated solution for irrigating small agricultural areas, AD Solar's solution also combines rainwater harvesting in portable aluminium storage tanks with water supply via a solar pump. As a result, the crops are irrigated for as long as they need to be, without any additional energy input, thanks to its gravity-fed operation. Given its local design, production and maintenance, it can also be deployed for use in greenhouses or for hydroponics. It has already been installed on market garden and agroforestry farms.

AD Solar also offers to combine the irrigation system with programming software installed on site, which makes it possible to pre-determine the system's operating periods in order to adapt it to the needs of the crops and the seasons.

Advantages and impacts

In the Ivorian backdrop, market gardening is most often carried out on small-scale traditional open-ground farms (less than 2 hectares), where the land is flooded and not irrigated, mainly due to a lack of available energy. AD Solar's innovation provides these growers with a complete solution tailored to their needs. It includes all the types of irrigation required for each crop, and its design and materials make it a durable solution that won't clog up like other systems, and is affordable. What's more, its local manufacture makes it perfectly adaptable to different types of agriculture - open-ground, soilless and urban - and easy to maintain. Finally, the combination of irrigation, water storage and solar pump systems makes it a solution that can be deployed without any prerequisites, whatever the type of water source available in the area (recovery or conveyance).

This solution, designed and manufactured in Côte d'Ivoire, plays an active role in the development of the national value chain, while offering an effective response to the need to increase agricultural productivity.

Goals

- Support producers specializing in rain-fed market gardening to enable them to produce all year round by helping them gain access to irrigation.
- Make controlled, economical irrigation accessible to farmers with small rural areas.
- Help to develop the national agro-industrial sector through the widespread use of Ivorian-made irrigation and energy support systems.
- Promote greenhouse and hydroponic farming in urban and peri-urban areas.



TECH-INNOV

Remote control of irrigation, collecting, analysing and modelling data in real time using remote irrigation

In Africa, and Niger in particular, irrigation is a factor limiting food production. It is still practiced rudimentarily, taking up a large part of the farmer's time. It does also contribute to water loss and waste, as well as using physical and fossil energy, which pollutes the environment.

Background

Tech-Innov is one of 20 innovative companies selected as part of a call for innovation by the West Africa cluster of the Water and Energy for Food (WE4F) programme, which aims to scale up water- and/or energy-friendly innovations in the agri-business sector.

TECH-INNOV SARL, a Niger-based company set up in 2013, develops and distributes digital agricultural innovations. Its flagship innovation is Tele-Irrigation, which reduces the need to fetch water and optimizes the work of farmers. The company employs seven computer scientists and hydrologists, supported by 12 subcontractors.

Tech-Innov's mission is to participate in a paradigm shift in the development of the Sahel and Africa by

capitalizing on the reach of digital technology and the continent's assets to kick-start the digital agricultural revolution in the Sahel.

Innovation

Tele-irrigation is a process that enables a farm's irrigation system to be controlled remotely, irrespective of time and space, using mobile phones, solar panels and IOT sensors to distribute water intelligently (needs, quantity, time, speculation, vegetation cycle, etc.). It offers the possibility of collecting meteorological and hydrological data in real time, i.e. temperature, humidity, rainfall, solar radiation, air speed and quality.

The system itself consists of a box fitted with a GSM chip, which is connected to the irrigation system and a network of pipes installed in the fields. Using an application on the mobile phone, the system can be remotely controlled by a call from the farmer, which triggers the irrigation and can be programmed for a set period. Farmers can also check the weather in the area where their fields are located to decide whether watering is appropriate. To ensure access to water for irrigation, pumps powered by solar panels are also installed. Finally, the box is installed between the pump and the solar panel.

Advantages and impacts

- Around 275 farms use the remote irrigation system in Niger.
- Remote irrigation saves (i) time and energy, (ii) an increase in irrigable area, (iii) higher production and income and (iv) controlled management of irrigation water.
- Thanks to its irrigation system, Tech-Innov saves 60% of water, reduces the time farmers spend on irrigation by 80% and saves 80% of the energy used to irrigate.

Facts

- Agriculture employs **87%** of Niger's population.
- In Niger, irrigation takes up an average of **2/3** of a farmer's time.
- In Africa, the telephone penetration rate has exploded in 10 years, reaching almost **80%**.

Goals

- Optimise the remote irrigation process to save time, water and energy.
- Radically transform agricultural practices (irrigation water management, fertilisation, watering) by 2035.
- Modernise and professionalise agriculture by digitalising farms in Africa to give meaning to agricultural entrepreneurship.
- Increase the irrigable area, which will boost agricultural production.



SOLAFRIQUE

Solar-powered irrigation for agricultural development in Burkina Faso

In a country where food production heavily relies on rainfall, episodes of drought pose a significant obstacle to agricultural activity. Providing the vast majority of farmers with access to water for crop irrigation and potable water is therefore a major challenge for maintaining and developing rural communities.

Background

Solafrique is one of the 20 innovative companies selected in a call for innovation by the West Africa Hub of the Water and Energy for Food Program/ Programme Eau et Energie pour l'Alimentation (WE4F), whose primary objective is to scale water- and/or energy-efficient innovations in the agro-industrial sector. Located in Burkina Faso and represented in all 13 regions of the country with its headquarters in Ouagadougou, Solafrique was founded in 2014 and now has around twenty employees thanks to the progressive development of its activities. Initially focusing on the supply and installation of solar products (photovoltaic panels, converters, batteries, pumps, solar lamps, and accessories), it later incorporated solar ovens and solar cookers that it manufactures itself. Eager to provide an effective response to food security challenges in the country, Solafrique has expanded its areas of intervention to now include solar-powered boreholes and solar-pow-

ered irrigation systems. Solafrique benefits from a team of qualified and competent experts who provide solutions in the field of energy solutions, training, and sustainable development. Services include the installation and deployment of solar photovoltaic energy systems, diagnostics and maintenance of systems, as well as training for rural and isolated areas.

Innovation

The solution designed by Solafrique leverages solar-powered irrigation to effectively address the challenges of water supply for agricultural use in rural areas. Beyond the technical characteristics of energy autonomy and water supply capacities, which are already essential contributions for vulnerable communities dependent on weather conditions for their agricultural activities, Solafrique offers a financing solution tailored to the economic resources of these populations through a pay-as-you-go and pay-as-you-pump model. Thus, the beneficiary only pays when they actually use the installed system, rather than a fixed fee that would impose a significant financial burden. This arrangement is particularly relevant as it is coupled with an intelligent and comprehensive solar pumping system that can be controlled and adjusted remotely, closely matching the needs identified by farmers. The introduction of digital payment, by smart card or mobile payment, further increases the user's management autonomy.

Finally, Solafrique also offers technical training, which includes modules on the basics of solar power, system installation and troubleshooting, as well as information on new technologies and installation methods.

Advantages and impacts

Solar-powered irrigation offers numerous advantages, particularly in terms of energy savings and financial resource mobilization. This system provides sustainable and cost-effective solutions for energy supply and water distribution. Capable of providing electricity from solar energy, they are not only non-polluting but also very profitable as they do not require fossil fuels or connections to the existing electrical grid. Moreover, the intelligent pump operating system with a control interface ensures that resources are only mobilized when absolutely necessary. In a constrained environment where water resources are under pressure, this capability offers additional leeway for efficient and sustainable management.

The proposed pay-as-you-go economic model also results in savings for farmers, who can tailor their consumption to the requirements of their crops without financial overload.

Finally, access to mechanical irrigation emancipates farmers from climatic uncertainties and allows for ag-

ricultural production twelve months a year, generating additional income.

Goals

- Support the African continent towards food self-sufficiency.
- Offer a solution adapted to the challenge of water access for both irrigation and human consumption, in a climate and financially constrained environment.
- Contribute to the development of the national agro-industrial sector, particularly in employment for the most vulnerable categories: women's and youth associations.
- Leverage technological innovations to adapt solutions and practices to future uses.



IPREN

Optimizing irrigation through innovative technology and sustainable commitment

In countries experiencing water stress, such as Niger, access to irrigation is a critical issue for families who rely on their crops for survival. Faced with the economic, environmental, and social challenges posed by water resource availability and management, the adoption of smart technologies becomes essential to ensure sustainable and profitable agricultural production and to mitigate the already significant negative effects of climate change in these regions.

Background

IPREN is one of the 20 innovative companies selected in a call for innovation by the West Africa Hub of the Water and Energy for Food Program/ Programme Eau et Energie pour l'Alimentation (WE4F), whose primary objective is to scale water- and/or energy-efficient innovations in the agro-industrial sector. With its products present in more than five countries, IPREN addresses Africa's challenges by combining innovation with social impact. It leverages technologies such as advanced sensors, real-time analytics, and automated control to create data-driven solutions. By putting these technologies in the hands of Africans, IPREN empowers communities and fosters sustainable development. In the field of irrigation, IPREN has used this expertise to develop the SMART'O solution, which offers a sophisticated technological response to the issue of optimizing water resource usage, providing a proactive approach to increase the productivity of cul-

tivated agricultural areas and improve the food security of the affected populations.

Innovation

SMART'O is a significant advancement in modern agriculture, combining precise measurement instruments, data analysis, and automated control systems accessible remotely.

With SMART'O, advanced sensors, strategically placed in each plot, continuously measure a variety of essential parameters, including soil moisture, temperature, light levels, soil electrical conductivity, and other key indicators. These sensors provide a comprehensive view of the specific environmental conditions in each cultivated area. The data collected by the sensors is transmitted in real-time to a centralized platform via wireless communication technologies. This platform uses secure protocols to ensure data confidentiality. The information is securely stored, ready for in-depth analysis. These data are then processed by intelligent analysis algorithms, integrating predictive models based on years of research and data collection. These algorithms consider the specific characteristics of each plot, including crop types, local weather conditions, and specific agricultural practices. Finally, the system uses real-time information and analysis to automatically adjust irrigation parameters such as flow rate, duration, and frequency. This can also be customized by the farmer via a mobile web interface and remote control, allowing them to monitor their fields' data in real-time, wherever they are, and to adjust parameters, set irrigation time slots, or even manually trigger the irrigation process, offering total flexibility. In case of exceptional weather conditions, abnormal moisture levels, or other critical events, the system also sends instant alerts to users, ensuring a quick and proactive response.

By adapting to the specific needs of each area, SMART'O ensures efficient water use, avoiding waste while maintaining optimal conditions for crop growth.

Advantages

SMART'O offers a triple advantage for farmers. First, it reduces costs related to water consumption and the time spent by the farmer irrigating their fields. On average, SMART'O reduces water consumption by nearly 70-80% compared to traditional irrigation methods, as well as 80 kg of CO₂ per kWh due to reduced energy consumption. Moreover, the adaptive irrigation feature allows quick response to climatic changes. In the case of unpredictable weather conditions, the system automatically adjusts the parameters to maintain optimal conditions, enhancing the overall resilience of crops. In the face of water shortages, it ensures targeted and efficient use, helping farmers maintain the health of their crops even during periods of limited re-

sources. Finally, the provision of detailed data via the web and mobile interface allows them to benefit from specific recommendations based on real conditions, data histories, and best agricultural practices. Thus, with more precise crop management and improved yields, farmers can expect a significant increase in their incomes. On average, SMART'O contributes to a 26% increase in producers' incomes.

Goals

- Water optimization: Reduce consumption and intelligent management based on real-time data to effectively analyze the specific needs of each cultivated area in terms of duration, type, and intensity of irrigation.
- Productivity increase: Precise and adaptive irrigation to climatic conditions increases yields per hectare and growth conditions for each crop type.
- Water resource preservation: Avoid waste and promote responsible use to reduce pressure on local water sources.
- Environmental footprint reduction: Significantly decrease the amount of energy consumed by indiscriminate irrigation through data analysis and tailored recommendations provided by the interface.

The digital platforms “Porc’Ivoire” and “Pharmanimal”

Veterinary services have access to conclusive data to improve knowledge of the animal’s health, monitor the spread of diseases and plan emergency interventions.

In 2023, the Ivorian company Grainotech launched two digital platforms (also accessible on apps via smartphones) that provide inclusive access to profitable markets and veterinary services.

Porc’Ivoire offers online sales of pork meat, connecting pig breeders and farmers in Côte d’Ivoire to buyers and consumers without going through intermediaries. A transport service is integrated to ensure delivery. There are 3 tabs:

- 1) The store: which is the e-commerce portal for sales.
- 2) A forum: which enables farmers to share best practices, formulate the pigs’ diet and access advice on emergency precautions.
- 3) FarmersPay: to manage mobile payment for livestock product purchases.

Pharmanimal offers an online remote veterinary consultation service. The platform also aggregates all the information needed to provide the most relevant solutions for optimizing the performance of livestock farms. There are 4 tabs:

- Online consultation: make an appointment and consult a veterinarian.
- Issue digital prescriptions and treatment protocols remotely.
- E-pharmacy: antibiotic delivery by drone.
- Knowledge of general the animal health situation in the locality.





**EMPOWERING
WOMEN**

INTRODUCTION

Women in East and West Africa face numerous challenges in both their workplace and daily life, including limited access to education, unequal job opportunities, wage disparities, and societal norms that restrict their roles and responsibilities. These barriers hinder their economic empowerment and overall well-being, continuing cycles of poverty and inequality. Additionally, women often shoulder a disproportionate burden of unpaid domestic work and caregiving, further limiting their ability to participate fully in the workforce.

To promote gender inclusiveness and enhance women's participation, companies supported by the Water and Energy for Food (WE4F) initiative implement different strategies. Providing equal opportunities for education and training helped to equip women with the skills needed to compete in the job market. Companies also established mentorship and leadership programs to support women's career advancement and foster a more inclusive workplace culture. Several WE4F innovators have implemented strict gender policies as part of their company culture, ensuring that women make up at least 50% of their workforce. They also actively work to break down stereotypical roles by for example specifically hiring female technicians and drivers.

By actively addressing the issues that women face in both their workplace and daily life, the WE4F innovators not only contribute to the empowerment of women but also benefit from the diverse perspectives and talents that women bring to the workforce.





AMPED

Solar appliances – A tool on the road to gender equality

Even though Kenya's government has made many efforts over the last years, gender inequality remains a big challenge in the country. Studies show, that having access to energy has a positive impact on the participation of women in society and work life. Through their solar appliances it becomes possible for low-income consumers, especially women, to simplify tasks at home and be a part of everyday work life.

About the company

Amped Innovations ('Amped') designs solar appliances to provide low-income consumers with reliable, affordable, and environmentally sustainable products. The company is headquartered in Kenya with operations in both Kenya and Uganda. While previously focused on solar lighting and television kits, the company has expanded its product offering to include solar refrigerators. Amped's high-performing solar refrigerator utilize a thermal battery to deliver consistent cooling at an affordable price. The solar refrigerator enables farmers in east Africa to access refrigeration for food storage, thereby reducing waste and increasing their incomes.

Gender landscape in the renewable energy sector

Kenya has made big efforts in recent years to promote gender equality. Numerous policies aim to promote women's opportunities such as the National Gender and Development Policy. Despite this progress, Kenya still faces barriers when it comes to gender equality. Adult literacy is lower among women (80.3%) compared to men (85.6%), while women are also more likely to experience vulnerable employment (68.3% for women versus 51.8% for men). Energy scarcity disproportionately affects girls and women in poor households, as these groups spend more time and effort collecting and preparing wood and other household fuels than men traditionally do. Studies clearly show that access to energy can have transformative effects on women, such as increased participation in non-farming jobs outside their homes, increased labor productivity, greater hourly wages, and improvements in child educational outcomes like school enrollment, weekly study time, and test scores. Solar appliances can thus reduce women's workloads at home, provide greater flexibility in how and when they perform domestic chores, and free up their time for income-generating activities.

Despite this great opportunity, many women lack access to the resources necessary to purchase solar appliances. Formal credit is often beyond women's reach because they lack credit history or assets to collateralize loans. Asset-based financing models like pay-as-you-go (PAYGo) thus offer a way around this challenge by enabling customers to build transaction histories that financial services providers can use to underwrite loans and increase women's access to finance. These models also offer flexible payment options that are better suited to women's needs than traditional loans.

Existing gender priorities at Amped

Amped offers appliances that alleviate the burdens of daily life in rural villages. For instance, refrigerators enable women to reduce the frequency of shopping trips. Moreover, their efficient appliances such as freezers and power hubs contribute to income generation, which has the potential to significantly transform the course of their lives. By providing an autonomous source of income, these appliances play a crucial role in empowering the residents of rural communities.

Being a women-led organization, Amped has made intentional efforts since inception to promote greater opportunities for women at the company. Within its work, Amped has also intentionally hired and promoted women into upper and upper middle management positions. Currently, almost 30% of the employees and 33% of the contractors are women.

In addition to these efforts, the company has a Gender Equality Policy to ensure that Amped supports a

gender equitable work environment for its employees by developing and implementing a workplace program that will attempt to eliminate gender discrimination and contribute to gender equality in employment and in the workplace.

The company has moreover published their 2023 Gender Action Plan, outlining the company's objectives and strategies to foster gender equality within the organization, such as eliminating gender bias in policies, practices, and decision-making processes, increasing female representation across all levels at the organization, developing an inclusive culture that values diversity, promotes mutual respect, and supports work-life balance, enhancing policies and benefits to ensure they are gender-sensitive and raising awareness about gender equality through regular workshops. To ensure the successful implementation of the Gender Action Plan, the following measures have been implemented:

- A designated individual was appointed to overseeing and monitoring the plan's progress.
- Periodic assessments are conducted to measure the effectiveness. Amped's commitment to support gender equality in the workplace is monitored by providing a report containing information relating to Amped's gender equality indicators. Once per year, the elected gender officer leads a company survey to see how Amped is doing on supporting gender equality.

The gender equality indicators that Amped reports on are:

- Gender composition of the workforce
- Gender composition of governing bodies of Amped Innovation
- Equal remuneration between men and women and any other genders
- Available and utility of employment terms, conditions and practices relating to flexible working arrangements for employees; supporting family or caring responsibilities
- Consultation with employees on issues concerning gender equality in the workplace
- Any other matters such as gender-based harassment and discrimination



GOT IT

Cheaper food while challenging gender inequalities

GOT IT sells fresh and dry food products. To lower the prices of their products, the company sources the goods directly from local smallholders. Through this procedure not only the farmers profit, but also the customers. Within the organization GOT IT also aims to integrate important social standards. Gender equality is a big topic for the company's management. They challenge existing gender norms and encourage the female employees to apply for higher positions.

About the company

GOT IT is a food distributor, sourcing, processing and distributing fresh produce and dry goods. The company supplies these products to hotels, high-end lodges, restaurants, embassies, and catering kitchens across Rwanda.

Within its work, GOT IT sources produce directly from local, small-scale farmers to cut out middlemen and to offer higher quality products at a lower cost. As an organization committed to combating climate change, the company further advises and assists small-scale farmers in ways to practice sustainable agriculture methods.

Existing gender priorities at GOT IT

Women still face social and economic barriers in Rwanda, largely due to existing societal norms. Amongst 46% of women engaged in the workforce, many are in lower paying jobs than men, such as domestic helpers and shopkeepers, while only 34.8% of people in managerial positions are women. Due to these persistent challenges, GOT IT's management has made intentional efforts to promote opportunities for women at the company. For example, GOT IT has hired and promoted women into upper and upper middle management positions. Within this, sensitization programs are in the pipeline to challenge existing gender norms and ensure that women feel supported across the organization. Currently, 35% of the workforce are women, including the warehouse manager, the quality assurance manager, the senior sales coordinator and the agricultural engineer. The company is working on improving gender representation to 40% by early 2024.

As an organization at large, GOT IT strives to close gender gaps and meet the needs of their female employees through different means, such as providing one extra day off per month to female employees and, increasing maternity leave for female employees from 12 to 14 weeks, providing sanitary pads to all female employees free of charge, less working hours for female employees during their pregnancy and accommodating their health needs in their daily tasks scheduling. GOT IT is gender sensitive and supports gender balance at the workplace by encouraging women to apply their skills and develop to occupy higher positions, e.g., encouraging female employees to shift from farming workers to improve to developed agronomists. From supplier to market, GOT IT accommodates gender in all its aspects by identifying and supporting female farm owners and farmers, organizing female farming workshops to strengthen their capabilities, and accommodating their needs in their scheduling of work. GOT IT's processing team is composed largely by female employees (60% of the processing teams are female). The company is moreover in the process of drafting a gender policy that will guide gender promotion activities.

Testimonials

"I wanted to grow with the company. They gave me promotions and now I am a warehouse manager...I see no challenges as a woman because I have a passion and I love this work."

Lillian, Warehouse Manager

"I love it. I've received good training and mentorship from them. And now, what I like most about my job is working with farmers and seeing them succeed because of what I contributed. I can remember this one time where farmers were getting 250 kilograms of dried chilies per hectare. But after sharing knowledge with them on things like good agricultural practices and the importance of commitment, they are now able to get one tonne of chilies per hectare."

Marie Claire Nyiribambe, an Agricultural Engineer who partners with GOT IT to train smallholder farmers on ways to increase their yields



MUNYAX ECO

A gender-forward approach for productive uses of renewable energy

Munyax Eco, a certified supplier and installer of solar systems, caters to the B2C market with a diverse range of products in Rwanda. Munyax Eco is a women-led enterprise that goes the extra mile to ensure women are integrated along its entire value chain - from driver to technician.

About the company

Munyax Eco is a Rwandan women-led enterprise providing access to clean and affordable energy in urban and rural areas. Its products are available to individuals, cooperative, private companies and the public sector. Urban households are the prime customers for solar water heaters, while solar home systems are in high demand with rural customers. Cold chain solutions are typically sold to cooperations, and street lighting is offered to enhance public infrastructure in Rwanda. The company's core business focuses on installation and financing of solar appliances. Munyax Eco recently expanded its portfolio to include a broader range of technologies, including hybrid panels, solar back up systems and diverse solar cooling solutions.

Gender approach

Munyx Eco boasts a balanced workforce with at least 50% women, including female drivers and technicians. The company is dedicated to empowering and equipping more women with the technical and soft skills necessary to thrive in Rwanda's predominantly male-dominated renewable energy sector. To achieve this, Munyx Eco engages in gender-sensitive capacity building for local youth and women, fostering a new generation of women technicians. This initiative is paving the way for a more inclusive solar energy sector, capable of effectively addressing energy poverty.

Revenue streams

Munyx Eco generates income from the following services:

- Sale of solar water heaters
- Solar PV and related components
- Solar kits (LED lights and back ups)
- Solar cooling systems
- Rooftop solar installation (commercial & industrial)

Value proposition

Munyx Eco's solar appliances offer a transformative value proposition for both rural and urban households in Rwanda. Solar water heaters provide an eco-friendly and cost-effective solution for consistent hot water supply, reducing reliance on traditional energy sources. The Solar Home Systems (SHS) deliver reliable, off-grid electricity, enhancing the quality of life by powering lights, phones, and essential household devices. Solar refrigeration units ensure safe food storage and preservation, crucial for both daily living and small-scale businesses. By harnessing the power of the sun, Munyx Eco helps households cut energy costs while contributing to a greener and more sustainable future.

Impact

Munyx ECO has provided access to energy to more than 10,000 people in Rwanda and equipped hundreds of houses with energy efficient technologies, such as solar water heaters or solar LED lights. The company is also very big on women empowerment by providing opportunities for female staff. 50% of Munyx ECO staff are women and more than 40 young women have benefited from capacity building and working with the Company.





Empowering women in agriculture: The transformative journey of Kimumu women's group

In a world marked by persistent gender disparities in economic empowerment, Mace Foods has emerged as a beacon of change, working tirelessly to bridge the income inequality gap through innovative initiatives. The broader context, as highlighted in the IMF Blog article *"Empowering Women, Tackling Income Inequality"* by Sonali Jain-Chandra, Kalpana Kochhar and Monique Newiak underscores the urgency of addressing gender gaps in economic opportunities, education, health, and finance.

At the heart of Mace Foods' mission lies the empowerment of women in agriculture. Collaborating with women groups spanning Rift Valley, Western, and Nyanza region, Mace Foods operates produce grading centers that play a pivotal role in upholding produce quality, focusing on chili and native traditional vegetables. One such group that has felt the transformative touch of Mace Foods is the Kimumu Women's Group, presided over by Mitchell Omariba, a 27-year-old from Uasin Gishu County. The group was founded in May 2022, a collective of 16 women, 7 of whom are core

members. These women, aged between 22-35 years, juggle familial responsibilities while striving to make ends meet.

Before the inception of the Kimumu Women's Group, these women were often relegated to roles as housewives or engaged in sporadic tasks such as laundry services locally known as *"mama fua"* and selling vegetables commonly known as *"mama mboga"*. With these jobs being seasonal in nature, the women had a lot of idle time in their hands. However, the start of Mace Foods' initiative revolutionized their lives, offered meaningful occupation, and instilled a newfound sense of organization in their day-to-day activities. According to Mitchell, this shift from idleness has significantly improved not only their relationships within the group but also their interactions with the broader community.

One of the driving forces behind the Women's Group's dedication is the stability provided by monthly payments, a departure from the daily wage structures of



other businesses. This change has translated into enhanced financial accountability and the opportunity to invest in various ventures. Individuals like Mitchell have expanded their grocery market stalls, diversifying their product offerings. Moreover, Mitchell has been able to achieve her personal milestones including the acquisition of eco-friendly cooking stoves that not only improve family health but also contribute to reduced carbon emissions through decreased charcoal and firewood usage.

Mace Foods extends its support beyond the grading centers, delivering training that arms the women with invaluable skills. Leadership, governance, problem-solving, work dynamics, and communication are embedded in their leadership and governance workshops. Moreover, the hygiene and sanitation training offered also imparts vital lessons to ensure health and well-being at home and at their workplaces.

Mace Foods' collaboration with WE4F has fortified its resolve to expand its footprint. Kimumu Women's

Group stands as a testament to the transformative potential of such initiatives. With their newfound financial literacy, the women are now more empowered, well versed with record-keeping and finances as they embrace the opportunity to have a regular income. With the support of WE4F, Mace Foods' horizon now extends to more groups as they aspire to establish daycares, providing women with the space to channel their energies into work while nurturing their families.

The story of Kimumu Women's Group is not just a narrative of transformation but a testament to the potential of women when provided with the right opportunities. Through WE4F's support, Mace Foods, has ignited a spark that has kindled empowerment, shattered conventional gender roles, and cast a beacon of hope upon the path of these women. As the world grapples with gender inequality, initiatives like these illuminate the way forward, underlining the necessity of collaborative efforts to turn the tide towards a more equitable future.



**ENABLING
ENVIRONMENT**

INTRODUCTION

“It takes a village to raise a child” – and it takes a well-functioning ecosystem to enable private companies and their innovations to thrive. This ecosystem, also known as the enabling environment, encompasses the conditions in which companies operate. The better these conditions, the easier it is for companies to succeed both now and in the future.

In many Eastern and Western African countries, private sector companies face numerous obstacles that hinder their operations and growth. These challenges often stem from poor communication between governmental ministries and a lack of channels connecting the private sector, researchers, civil society, and policymakers. This can lead to problematic policies, complicated business regulations, and unclear processes that make it difficult for companies to navigate. Additionally, the availability of markets, finance, quality standards, and consumer awareness are crucial for businesses to function effectively, shaping a country’s readiness for innovation. The enabling environment also includes human capital, such as the availability of skills, networks, and creativity that companies need to develop innovative products and business models.

The Water and Energy for Food (WE4F) initiative not only directly supports innovative companies through technical and financial assistance but also works to improve the enabling environment. This indirect approach is achieved by bringing together relevant stakeholders to collaborate on policy recommendations and action plans, and by developing regional strategies with governmental agencies. WE4F also promotes functioning ecosystems through end-user trainings, awareness programs, technical studies, event participation and the support for pilot projects.





GLOBAL ASSOCIATION FOR THE OFF-GRID SOLAR ENERGY INDUSTRY (GOGLA)

Public-private policy dialogue on productive use of renewable energy

Encouraging a supportive policy environment for productive use of renewable energy (PURE) technologies in the food and agriculture sector is key for market development and the wider uptake of PURE technologies. WE4F worked together with GOGLA and national renewable energy associations to develop roadmaps for policy change in East Africa.

Background

Productive use of renewable energy (PURE) technologies, such as pumps, mills, oil presses, dryers or cooling systems are powered by renewable energy. The application of PURE has the potential to increase productivity, to make users more resilient towards the impacts of climate change, to reduce postharvest losses through processing and storage, and to add value to products during processing. Despite the benefits that these appliances bring, market conditions are still unfavourable in many East African countries. This includes barriers, such as taxation, import duties, missing standards or limited access to finance for manufacturers and users. Identifying such barriers on a national and regional level and bringing them into the discourse of public entities (ministries, authorities, standard offices) is the first step to create a more enabling environment.

Project in a nutshell

In partnership with GOGLA the following was achieved:

- 1) Established working groups of PURE actors and stakeholders on regional and national levels.
- 2) Development and implementation of roadmaps of priority actions to improve the enabling environment.
- 3) Facilitation of engagement bringing the action points into the relevant public entities.
- 4) Knowledge generation on PURE applications and markets.

Project outcomes

Together with WE4F, GOGLA and the national renewable energy associations designed a multi-stakeholder process to develop national roadmaps and action plans in Kenya, Uganda, Rwanda and Ethiopia with the aim of promoting an enabling environment and increasing access to productive use renewable energy technologies for agriculture. The action plans outline specific goals, targets and strategies, including:

- Increasing availability and adoption of productive use renewable energy technologies
- Awareness campaigns and capacity building for users
- Creating sustainable markets for quality products through standards and certification
- Engaging government for policy reforms, subsidy programmes etc.

The roadmaps were discussed with key stakeholders, including national ministries. The extensive consultation process secured the buy-in and ownership of these roadmaps by the national renewable energy associations and their members, who are expected to continue driving their implementation going forward.

Looking forward

- 1) Market assessments and action plans have been conducted and presented to ministry representatives. Nevertheless, continuous engagement with policymakers is necessary to ensure that the outcomes of these action plans are actively used to influence national policies.
- 2) The working groups, led by the national renewable energy associations, continue to meet and actively push for their interests as outlined in the action plans.
- 3) With the support of other donors, GOGLA is sustaining the policy processes by building upon the already-developed market assessments and action plans.

National associations

- In all four focus countries, GOGLA worked together with the national renewable energy associations to implement project activities. This improved the capacity of the associations and the sustainability of the project.
- They were involved in market assessments, managing the working-group meetings and facilitating the exchange with policy makers.
- Energy Development Association (ESEDA) in Ethiopia
- Kenya Renewable Energy Association (KEREAA)
- Energy Private Developers (EPD) in Uganda
- Uganda Solar Energy Association (USEA)

Facts

- In Kenya over **100** specialist companies are active in the PURE space.
- While solar panels are exempt from VAT and import duty in Uganda, many solar components are not.
- The same solar pump model costs on average **2.4** times more in Ethiopia than in Kenya.
- **14%** of the population is electrified through an off-grid solution in Rwanda.

Exchange formats	Working groups were set up in the different countries and at regional level. A total of 34 meetings have been organized, joined by over 800 participants. The resulting roadmaps were presented and discussed at high-level workshops.
Market assessments	National market assessment were carried out in Uganda, Rwanda and Ethiopia.
Action plans and guide	PURE action plans were developed for Kenya, Uganda, Rwanda and Ethiopia, and launched with the support of national ministries. A regional PURE handbook for Governments and Development partners was also published.



LAKE BASIN DEVELOPMENT AUTHORITY

Integrating the water-energy-food-environment nexus in regional development

The WE4F East Africa Hub and the Lake Basin development Authority (LBDA) worked together to improve the livelihoods of people in the Lake Victoria Basin through strategy development and best practices of efficient water and energy use for food production and processing

Background

The Water and Energy for Food (WE4F) Innovation Hub in East Africa and the Lake Basin Development Authority (LBDA) have joint forces to demonstrate what it means to efficiently use water and energy in the food and agriculture sectors, and to work towards a vision for regional development that takes into account the water-energy-food-environment nexus. LBDA works across 18 counties under its jurisdiction with the mandate to act as a strategic driver of socio-economic development, empowerment of communities and to spur regional development through sustainable utilization and conservation of natural resources.

Project in a nutshell

The aim of this partnership was to improve the lives of people in the Lake Victoria basin and to spur regional development, whilst using and conserving natural resources sustainably. More concretely, LBDA and WE4F demonstrated how to do that by working on:

Best practices

- 1) Solar irrigation trainings through local Integrated Technology Transfer Centers (ITTC) to improve agricultural productivity
- 2) Energy audits of rice mills and public water supply systems for greater energy efficiency
- 3) Rice value chain analysis for improved marketing and promotion of local produce

Development of Integrated Regional Masterplan (IRMP) for 2022 - 2042

- 1) Situational analysis to understand past and present developments
- 2) Visioning exercise with key stakeholders for the Lake Basin region

Project outcomes

By conducting energy audits in 13 rice mills and irrigation pumping stations, it was demonstrated how cost savings as well as energy and CO₂e emission reductions can be achieved. That's a win-win for those paying for irrigation or milling as a service as well as for the environment. Studying and advising on how to create new market linkages along the rice value chain further helps to strengthen economic development.

Training 146 LBDA staff and extension officers on the design, use and maintenance of solar irrigation gave them the necessary knowledge and tools to pass

on this knowledge to farmers that are interested in switching or already using solar irrigation to increase agricultural productivity and incomes. The ultimate aim, trainings organized by LBDA to reach and train end users in the Lake Basin on SPIS was not continued by the partner.

Due to elections in late 2022 the leadership and structures within LBDA changed and some of the open activities were put on hold.

Key recommendations from the situational analysis

- Structured collaboration with the private sector to promote technology and innovation within the mandate of the authority.
- Development of knowledge hub and digitalization of processes for continued learning, protection of institutional memory and efficiency of the processes.
- Exploring Private Public Partnerships in the implementation of the mega projects by the authority.
- Defining the role of the authority in the context of devolution.

Facts

- LBDA's jurisdiction covers **18** counties around Lake Victoria with about **42%** of the total Kenyan population living in this region which is only **6%** of the total land area in Kenya.
- The mandate of the Authority is centered around the sustainable utilization of the natural resources within the lake Region including Lake Victoria.

Trainings	146 LBDA staff and extension officer were trained on solar powered irrigation 16 technical staff were trained on energy efficient practices in rice production.
Water and Energy Efficiency	13 rice mills and pumping stations underwent energy and water audits and developed action plans towards greater water and energy efficiency.
Policy Support	Kick-off of strategy process to develop regional Nexus development plan in the Lake Basin: a) Situational analysis (past and present) and b) visioning exercise (future).
End Users	LBDA is to train and work with farmers in the Lake Basin on irrigation, helping them to increase productivity and income opportunities.



Enabling an environment for water-energy-food nexus innovations in West Africa

In West Africa, Water and Energy for Food (WE4F) has provided support to two Ivorian ministries in their efforts towards developing two policies and strategies:

1. Assistance in finalizing the “Integrated National Strategy for the Promotion of the Circular Economy (SNIPEC),” backed by MINEDD.
2. Collaboration in drafting the decree outlining the implementation procedures for the agricultural advisory policy in Côte d’Ivoire, led by MEMINADER.

In pursuit of these objectives, a presentation and consultation workshop on the development of the Integrated National Strategy for the Promotion of the Circular Economy (SNIPEC) for the period 2023–2027, along with its Action Plan, was conducted in November 2022, involving MINEDD experts. Subsequent to adjustments made to the strategy, it was agreed upon to schedule a validation session for the strategy. The final validation workshop for the strategy was convened in June 2023. Additionally, a study examining intersectoral policies impacting water, energy, and food in Côte d’Ivoire was initiated, in collaboration with MEMINADER, to identify a policy needing innovative interventions. This endeavor aimed to support the formulation of a national policy in 2021 and 2022, in partnership with the Ministry of Agriculture and Rural Development.

In the context of enhancing the political and sectoral framework, WE4F facilitated the development and validation of a text pertaining to agricultural legislation in Côte d’Ivoire (LOACI). Notably, Article 48 of Law No. 2015-537 of July 20, 2015, on Agricultural Orientation in Côte d’Ivoire, emphasizes the strategic focus on spatialization measures, intensification, diversification, and sustainability of local production. WE4F’s support extended to refining the provisions of Article 48 concerning the development strategy for agricultural production, emphasizing spatialization, intensification, diversification, and sustainability of local production.

Furthermore, WE4F has established a partnership with the regional organization ECREEE to promote and disseminate best practices and scale high-potential innovations in agribusiness at the water-energy-food nexus in West Africa. As part of this collaboration, two significant webinars focusing on framework conditions and enhancing financing in West Africa were conducted: “Creating a Favorable Environment for Sustainable Agro-Industries” (November 18 and 19, 2020) and the 2020 ECOWAS Forum on Sustainable Energy, session IV on “Productive Uses of Energy: Energy, Water, and Food – the Nexus of Success” (November 26, 2020). This partnership laid the groundwork for developing and implementing awareness-raising formats for decision-makers.

WE4F's commitment to scaling innovation on the global agenda

Since the beginning of the program, Water and Energy for Food (WE4F) and its strategic partners of the Water-Energy-Food (WEF) Nexus have jointly participated in a wide range of global events, from educational webinars to global conferences and high-level policy forums. This diverse engagement supports the program's mission to promote energy and water-efficient innovative solutions to overcome global challenges such as the climate, water and food crises, while actively creating an environment to scale these innovations. In this sense, WE4F has been attending influential global events over the past years including the European Development Days, Stockholm World Water Week, World Water Forum, the UN Water Conference, and the COP.

The importance of a nexus approach

Beyond participation in these events, WE4F aims to disseminate innovative ideas and solutions globally while overcoming sectoral silos. By working across the WEF Nexus, the program takes a holistic approach to addressing the interlinked challenges of climate change, biodiversity loss and air, soil and water pollution.

WE4F builds on the initial academic findings by Hoff (2011)¹ on how to translate the theoretical concept of the WEF Nexus into governance and practical frameworks for resource efficiency and synergy creation. By adding the private sector and innovation components it takes the concept beyond the governance dimension into practice. In international discourses the perception of the nexus concept remains vague². A few perceptions among which the previous programs of WE4F such as Powering Agriculture and Securing Water for Food, reduce it to two sectors, Energy-Water or Food-Water or Energy-Food, while others include further dimensions such as Environment³ or even more globally refer to the Resource Nexus (United Nations University-Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES)).

In a meta review of Nexus research, the environmental

economist Floor Brouwer and additional researchers highlight some key components for Nexus work, such as "the involvement of relevant actors considering not only drivers of change but also actors being affected by the consequences of the nexus issue"⁴.

Other Nexus components are interconnectivity not only between sectors, but various governance levels, actors and spatial-temporal scales by taking a broader system perspective.

Linking actors from different sectors and levels, especially smallholder farmers and overall end-users with the private and finance sectors to access innovative solutions, is one of the key elements of WE4F. This alone shows that the program's approach is perfectly suited to putting the above concepts into practice. To showcase such multi-actor implementation at different scales, the program has used various international platforms and conferences.

WE4F's participation in global events

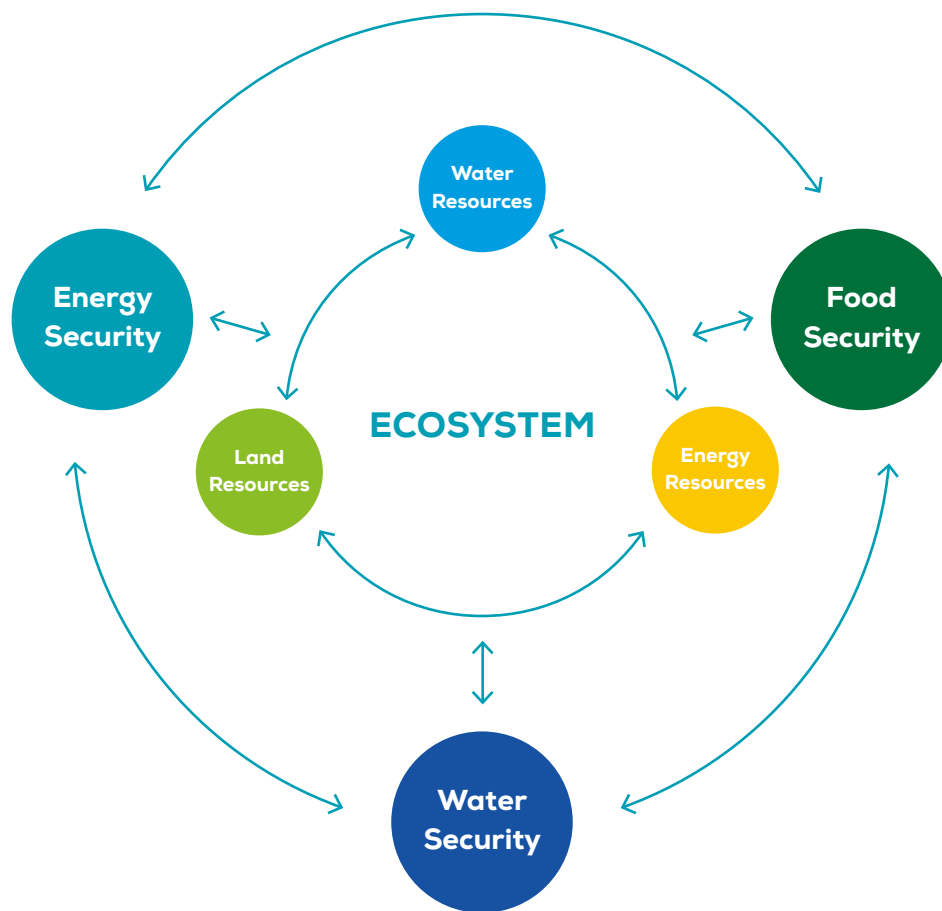
International conferences often follow sectorial policy agenda. WE4F attended several conferences in the agricultural sector such as the United Nations Food Systems Summit (UNFSS), the German African Agro-business Forum (GAAF) or the African Fertilizer and Soil Health Summit (AFSHS). In the water sector the program attended events such as the World Water Forum, the World Water Week, UN Water Conference or the trade fair for water, sewage, waste and raw materials management – IFAT. In the broader field of climate change and sustainable development WE4F presented its approach during UNFCCC COP 27 and 28 and Climate Adaptation Summit or the European Development Days (EDD). The initial focus in the first year of the program was on promoting innovation, raising awareness of the challenges and potential of local businesses in East and West Africa, and the need for access to finance and investment opportunities. However, as the implementation progressed, the key objectives, particularly for the sector-prone conferences, were to showcase innovative solutions, success-

1 Hoff, H., (2011). Background paper for the Bonn 2011 Nexus Conference: The Water, Energy and Food Security Nexus. Stock. Environ. Institute, Stock.

2 Brouwer, F., Caucci, S., Karthe, D. et al. Erratum: Advancing the resource nexus concept for research and practice. SNF (2024). <https://doi.org/10.1007/s00550-024-00536-y>

3 GIZ, Factsheet The Water-Energy-Food-Environment Nexus in the Niger Basin, https://uploads.water-energy-food.org/resources/NEXUS-2-Page-NBA-guidelines_WEB.pdf

4 Vgl. Brouwer, F., Caucci, S., Karthe, D. et al.



ful activities up to the program’s achievements and impact, and lessons learned from the field on working cross-sectorally with Nexus innovations. Specifically, WE4F organized sessions around solar-powered irrigation systems (SPIS), green cooling solutions, end-user financing models or the business case of organic fertilizer production. Within UNFCCC the call for more cross-sectorial cooperation has led to a new agenda setting, moving away from sector-led policy days and calls to a joint Water-Food Day and the launch of a Water-Resilient Food Systems Partnership with key stakeholders from the water and agro-food sectors.

Through these global events, WE4F not only disseminates crucial knowledge but also fosters valuable connections. This multi-pronged strategy establishes WE4F as a key player in the WEF Nexus, delivering tangible benefits and empowerment to its key stakeholders, particularly smallholder farmers and innovative businesses in East and West Africa.

WE4F’s commitment to global collaboration

Participation in high-level policy forums allows WE4F to influence decision-making processes and advocate

for frameworks and policies that support the adoption of sustainable innovations. To achieve this, the program collaborates with strategic partners to create an environment where WEF Nexus solutions can thrive. This global engagement with key partners enhances the program’s credibility and amplifies its advocacy efforts for innovations in agriculture in East and West Africa and beyond. Among these key partners are:

Climate Resilient Food Systems Alliance (CRFS)

Born out of the UN Food Systems Summit (UNFSS) of 2021, the CRFS Alliance provides a platform for creating climate-resilient food systems through synergies between the Alliance’s members including parties / member states, United Nations organizations, NGOs, civil society, research institutions, regional organizations. Co-led by the UNFCCC secretariat, the Alliance aims to join forces to accelerate action towards climate-resilient, sustainable, equitable and inclusive food systems in a unified manner, with a focus on the most vulnerable countries and regions. Recognizing the intricate links between the Earth’s water and agri-food systems, CRFS hosts the two-year WE4F-supported partnership on water-resilient food systems,

	Event	Contribution/ Session Title
2021	European Development Days	<u>Session:</u> It's a match?! Linking Water, Energy and Food with the Private & Finance Sectors – The role of the private and finance sectors in increasing smallholder agricultural productivity and eradicating hunger in Africa
	United Nations Food System Summit – Pre-Summit	<u>Session:</u> Strengthening Water-Energy-Food Nexus to expand small-scale farmer-led irrigation solutions for climate-friendly and more resilient food systems
2022	World Water Forum	<u>Session:</u> Governance: Policy dialogue: Access to smallholder financing to drive groundbreaking water-energy-food (WEF) nexus innovation scaling in Africa for climate adaptation.
	IFAT Munich	General WE4F Program Presentation at World's Leading Trade Fair for Water, Sewage, Waste and Raw Materials Management
	European Development Days	Joint booth with Energypedia showcasing WE4F program information on activities, partners and solar powered innovations for awareness raising, promotion and networking
	Stockholm World Water Week	<u>Session:</u> Scaling water-energy-food innovations through end-user financing for climate adaptation
	COP27	<u>Session:</u> Nexus solutions for climate-resilient water, energy, food and environment security: lessons learned from the ground
2023	German Africa Agribusiness Forum	<u>Session:</u> The Agri Energy-Nexus: How to Combine Food Security with Energy Transition
	UN Water Conference	<u>Session:</u> Water Management in Action for Productive, Climate Resilient Food Systems
2024	African Fertilizer Soil Health Summit	<u>Session:</u> The organic business case: Enabling an environment for private sector development in East and West Africa for organic fertilizer production

which seeks to address the critical interdependencies between soil health, water cycles, and food production, processing, and transportation.

International Water Management Institute (IWMI)

IWMI is an international research-for-development organization that works with governments, civil society and the private sector to solve water problems in developing countries and scale up solutions. Headquartered in Sri Lanka, IWMI is a CGIAR Research Center with offices in 15 countries and a global network of scientists operating in more than 55 countries. In 2021, WE4F and IWMI partnered to jointly contribute to the European Development Days (EDD) in Brussels discussing how to best expand small-scale farmer-led irrigation solutions for climate-friendly and more resilient food systems globally. Later on, WE4F collaborated with IWMI for the incorporation of the suitability

map into the SPIS Toolbox, coordinated the launch of the CRFS Alliance and supported the “Knowledge exchange conference: Investing in farmer-led irrigation development in sub-Saharan Africa” in Ghana in 2023.

Leibniz Centre for Agricultural Landscape Research (ZALF)

The Leibniz Centre for Agricultural Landscape Research is working on societally relevant issues in connection with the use of agricultural landscapes, such as climate change, food security, sustainable management of natural resources, biodiversity and ecosystems. WE4F cooperates with ZALF's WEare4F project, which closes research gaps and gains evidence-based scientific, neutral and unbiased knowledge to strengthen the potential dissemination of innovations in the water-energy-food nexus, especially

on the financial access to renewable energy driven equipment for food production and food processing. In this sense ZALF supports international students in Germany, Kenya and Côte d'Ivoire addressing challenges and potential of organic fertilizer production and application in East and West Africa.

Collective leadership institute

The Collective Leadership Institute is an international non-profit organization with offices in Potsdam (Germany), Cape Town (South Africa) and Cairo (Egypt). It has supported more than 40 local, national, and international multi-stakeholder dialogue projects for the successful implementation of the SDGs. Almost 6,000 change agents have gained competency in dialogue processes and cooperation through competence development programs. CLI and WE4F cooperate on supporting the enabling environment for organic fertilizer producer and by supporting an innovator's network on expertise building, peer support and promoting innovative processes on organic fertilizer.

CGIAR nexus gains initiative

CGIAR is a global research partnership for a food-secure future dedicated to transforming food, land, and water systems in a climate crisis. The initiative's vision is building a world with sustainable and resilient food, land, and water systems that deliver diverse, healthy, safe, sufficient, and affordable diets, and ensure improved livelihoods and greater social equality, within planetary and regional environmental boundaries. The CGIAR Initiative on NEXUS Gains works at the critical intersection of food, energy, and water security while conserving the ecosystems underlying food systems in selected transboundary river basins regionally and globally. Key activities are among others developing research and capacity to strengthen systems thinking, and providing tools, guidelines and training. WE4F and NEXUS Gains cooperate on knowledge exchange and dissemination of good practices on Nexus implementation on the ground. For example, in Ethiopia, the collaboration with WE4F focuses on activities including creating an enabling environment for solar-powered irrigation.

Working with these action-oriented partnerships reflects WE4F's commitment to achieving tangible impact in addressing the complexities of the WEF Nexus.





CONCLUSION

Beyond WE4F: The importance of supporting innovations and sustaining achievements

As showcased in this compendium, the international initiative Water and Energy for Food (WE4F) has demonstrated remarkable success in its mission to intertwine sustainability with agricultural productivity. Over the course of its implementation from 2020 to this date, WE4F has not only met but exceeded almost all its objectives, marking significant strides in energy and water conservation and sustainable food production across East and West Africa. These achievements underscore the programme's capability in fostering technologies that advance agricultural productivity while ensuring environmental sustainability.

The innovations developed under WE4F are not just temporary solutions; they represent sustainable business models that will continue to operate and expand even after the programme ends. These enterprises are committed to ongoing collaboration with smallholder farmers financial institutions and other stakeholders, ensuring that the benefits of sustainable technologies continue to grow over time and contribute to long-term climate resilience.

The project's reach has extended through the effective introduction and dissemination of sustainable technologies to smallholder farmers, enhancing both their livelihoods and the ecological health of their farming practices. Innovators within the WE4F framework have not only received support in terms of resource allocation but also gained access to crucial networks and markets, thereby increasing the impact of their sustainable solutions. These networks and markets are expected to continue beyond the programme, enabling innovation at scale.

A pivotal component of WE4F's strategy has been its Regional Innovation Hubs, which have facilitated the integration of these technologies across 53 countries, demonstrating the scalability and adaptability of the solutions across diverse environmental and socio-economic landscapes.

WE4F's achievements serve as a beacon for future projects and for potential donors and investors looking to invest in sustainable agricultural programmes and technologies. The success stories and data generated provide a solid foundation for expanding the initiative's impact, scaling up existing innovations, and exploring

new opportunities to enhance the nexus of water, energy, and food sustainability. The programme's ability to adapt to ongoing global challenges, such as the impacts from the Russian-Ukraine conflict, the global climate crises, and the resultant food security issues, has proven the resilience and relevance of the WE4F's approach. By aligning with international sustainability goals and local development priorities, WE4F not only supported the global agenda for sustainable development but also provided a replicable model for future initiatives seeking to make a similar impact.

WE4F's success highlights the power of collaboration. By bringing together international donors, regional and national stakeholders from finance, politics and research, innovative enterprises, smallholder farmers, and local innovative enterprises, the programme has created a dynamic ecosystem where shared goals drive collective action. This collaborative approach not only multiplied the impact of individual efforts but also ensured that the solutions developed were and continue to be well-suited to the unique challenges of each region, paving the way for broader adoption and greater environmental sustainability.

We look forward to future initiatives and partners to continue WE4F's trajectory of innovation and impact. The innovations supported and scaled under the programme stand as compelling investment opportunities for stakeholders interested in fostering sustainable development, climate resilience, and food security globally.

LINKS AND PUBLICATIONS

WE4F Website



Follow WE4F on Social Media



WE4F GIZ Worldwide



East Africa Digital Exhibition



East Africa Hub Subpage



West Africa Hub Subpage



WE4F Publications



WE4F Blog



Most QR codes may become invalid after the end of the international initiative in summer 2025. However, the WE4F GIZ Worldwide QR Code will remain with relevant information about the program as well as links, factsheets, publications and more.

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