FARMER-LED ADAPTATION: BEST PRACTICE CASE STUDIES

EASTERN AFRICA FARMERS FEDERATION
EAFF
Voice of all farmers in Eastern Africa

CGIAR

AICCRA
Accelerating the Impact of CGIAR Climate Research for Africa

PAFO
Panafrican farmers' organization

PACJA
PANAFRICAN CLIMATE JUSTICE ALLIANCE

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We also would like to extend our heartfelt thanks to the founders, owners, managers and programme officers of the featured case studies. Your dedication in providing information, coordinating interviews, assisting with photos, and facilitating field visits has been invaluable. While budget and time constraints meant we couldn't visit every site, the insights you shared were immensely valuable. We deeply appreciate your time and effort in contributing to this important study. We hope to honour your work and help to bring the attention and support your exceptional projects deserve.

About AICCRA | Accelerating Impacts of CGIAR Climate Research in Africa (AICCRA) is a project that helps deliver a climate-smart African future driven by science and innovation in agriculture. It is led by the Alliance of Bioversity Intearnational and CIAT and supported by a grant from the International Development Association (IDA) of the World Bank. Explore AICCRA's work at **aiccra.cgiar.org**

About EAFF| The organisation's mission is to represent, lobby and advocate for the interests of Eastern Africa farmers and to build their capacities. EAFF envisions a prosperous and cohesive farming community in Eastern Africa. EAFF envisions a prosperous and cohesive farming community in Eastern Africa. Explore EAFF's work at **www.eaffu.org**

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Foreword EAFF

The Eastern Africa Farmers Federation (EAFF) is a regional organisation founded in 2001 to give a voice to farmers across Eastern Africa. Representing over 20 million farmers, EAFF works to advance sustainable agricultural policies, secure the rights of farmers, and promote sustainable agricultural practices that strengthen food systems across the region. Our commitment is to the farmers who are at the heart of Africa's agriculture and who play a critical role in achieving food security and economic stability.

The EAFF believes in the power and potential of Africa's farmers to lead the way in building resilient, sustainable agriculture systems. As a federation dedicated to representing farmers' interests, we have seen first-hand how farmers are already innovating to overcome the challenges posed by climate change. Whether it's adapting their crops to unpredictable weather patterns or finding ways to conserve precious water resources, these actions underscore a vital truth: farmers are not just beneficiaries of climate adaptation; they are key drivers of change and action.

This compendium of farmer-led climate adaptation practices is a testament to the resilience and ingenuity of African farmers. By documenting and sharing these best practices, we hope to inspire and share lessons among other farming communities, inform policymakers, and encourage investments that will allow farmers to thrive even amid an uncertain climate future.

This work aligns with our commitment to advocate for farmer-led solutions, placing farmers' voices and experiences at the center of the global conversation on climate change. We envision a future where farmers across Africa have the tools, resources, and recognition they deserve to lead in climate adaptation and food security.

Thank you to all our partners, especially AICCRA, for their collaboration and commitment to amplifying the voices of African farmers. We look forward to a future where these insights inspire widespread adoption of resilient agricultural practices across the continent.

Stephen Muchiri

Chief Executive Officer

Eastern Africa Farmers Federation (EAFF)

Foreword AICCRA

Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) is a CGIAR programme focused on building the capacity of African institutions for bundling climate information services and climate-smart agriculture innovations and making these more accessible to Africa's smallholder farmers. Supported by the World Bank, AICCRA aims to bridge the gap between scientific research and practical agricultural solutions to ensure that farming communities across Africa can adapt to climate variability and achieve sustainable resilient food systems.

Recognising that not all innovations come directly out of research institutions, we believe that leveraging and building on existing best practices, traditionally experimented and used by farmers, could contribute accelerating their uptake. Through this collaboration with the Eastern Africa Farmers Federation (EAFF), we aim to showcase a range of farmer-led adaptation practices that are already contributing to resilience on the ground. By documenting and sharing these empirically demonstrated best practices, we aim to create pathways for scaling these "tried-and-true" approaches, helping farmers across Africa adopt and benefit from endogenous climate-smart agriculture technologies and practices. Our work goes beyond simply cataloguing successful adaptations; it seeks to foster an enabling environment where science and local knowledge converge to tackle one of Africa's most pressing challenges—climate change.

This report highlights the critical role of co-development in informing and empowering local solutions, emphasising AICCRA's commitment to making scientific advancements accessible and practical while ensuring inclusion of proven local knowledge. We believe this compendium will serve as both a source of inspiration and an actionable toolkit for researchers, policymakers, public and private extensionists, and farming communities seeking to enhance climate adaptation and build resilience. We are grateful to our partners at EAFF and to the farmers whose innovation, ingenuity, resilience, and leadership drive this initiative. Together, we aim to strengthen the adaptive capacity of African agriculture, and sustainably transform the agri-food systems to ensuring a food-secure future in the face of climate adversity.

Dr. Robert Zougmoré

Director

Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA)

Acronyms

AfDB	African Development Bank
AICCRA	Accelerating Impacts of CGIAR Climate Research for Africa
ALABGRO	Arid-Land Agri Business Group
BMP	Best Management Practice
BSF	Black Soldier Fly
CEO	Chief Executive Officer
CSA	Climate-Smart Agriculture
DAPA	Djibouti Agro-pastoralists Association
DGAK	Dairy Goats Association of Kenya
DJF	Djiboutian Franc
DRSLP	Drought Resilience and Sustainable Livelihoods Programme
EAFF	Eastern Africa Farmers Federation
FAO	Food and Agriculture Organisation of the United Nations
GBP	Great Britain Pound
GCAD	Green Compost in Agriculture for Development
GDAF	Women's Agricultural Development Group
GDP	Gross Domestic Product
GHG	Greenhouse gas
HIMACUL	Highlands Macadamia Cooperative Union Limited
IDB	Islamic Development Bank
IGAD	Intergovernmental Authority on Development
INBAR	International Network of Bamboo and Rattan
IPM	Integrated Pest Management
M&E	Monitoring and Evaluation
MAEPE-RH	Ministry of Agriculture, Livestock, Fisheries, Water, and Maritime Resources
MoU	Memorandum of Understanding
NGO	Non-Governmental Organisation
NMT	Neno Macadamia Trust
PACJA	Pan African Climate Justice Alliance
PAFO	Pan African Farmers Organisation
RAB	Rwanda Agriculture and Animal Resources Development Board
RWF	Rwandan Franc
SADC	Southern African Development Community
SASRI	South African Sugarcane Research Institute
SDG	Sustainable Development Goal
SLL	Sierra Leonean Leone
SUSFARMS	Sustainable Sugarcane Farm Management System
UGX	Ugandan Shilling
UK	United Kingdom
UKC	Uruhimbi Kageyo Cooperative
USD	United States Dollar
UWA	Uganda Wildlife Authority

Introduction

Climate change presents unprecedented challenges to the global agricultural sector, with African farmers particularly vulnerable to climate-induced drought, shifting weather patterns, declining soil health, and a rising incidence of crop and livestock diseases. In response to these pressing challenges, locally driven approaches have emerged as critical strategies for enhancing resilience. This report, produced by the Eastern Africa Farmers Federation (EAFF) in collaboration with Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA), presents ten case studies that highlight existing farmer-led climate adaptation initiatives across Africa.

By compiling a collection of case studies, this report seeks to showcase innovative, farmer-driven solutions and demonstrate their significant impact on climate adaptation and resilience-building. Through the documentation of these approaches, the initiative aims to promote the wider adoption of effective practices, inform policy, and attract financial support to scale locally led adaptation strategies.

Context

In 2024, as part of a long-term partnership, EAFF and AICCRA collaborated to document and showcase examples of farmer-led climate adaptation. This initiative focuses on capturing and disseminating the diverse ways in which farmers across Africa are adapting to climate challenges through context-specific, locally relevant, and innovative practices. In collaboration with local communities, regional farmer organisations, non-governmental organisations (NGOs), and other stakeholders, this project identifies and documents farmer-centred adaptation initiatives across nine countries. The resulting case studies highlight local strategies, the challenges faced, and the factors that contribute to their success.

Relevance

Africa is the continent most vulnerable to climate impacts, yet it has contributed the least to global greenhouse gas (GHG) emissions. Agriculture and food systems are especially at risk from climate-related changes, but they also play a vital role in mitigating emissions, improving soil health, and building resilience. However, many African communities lack sufficient systems to buffer the effects of climate change, with the situation further exacerbated by socio-economic challenges and the unsustainable use of natural resources.

> ***"Addressing Africa's climate and development challenges requires urgent support to strengthen resilience across communities, economies, and livelihoods, enabling Africa to better adapt to escalating climate risks."***
>
> - Romy Chevallier, consultant, Theme 1, AICCRA.

Adapting and adjusting to climate change is already happening on the ground through activities spearheaded by farmers out of necessity and ingenuity. However, much of this work remains unreported or insufficiently documented for numerous reasons, including limited financial resources, lack of adequate capacity, power dynamics and recognition, challenges in scaling and a focus on other more pressing development considerations. It is essential that these activities are showcased, not only to ensure they receive the attention they deserve but also to recognise their contribution to climate adaptation and the resilience-building of agricultural communities and farmers. Currently, very little financial support is being directed towards adaptation in the agriculture sector, with few funds reaching farmers, who bear the brunt of climate impacts and are at the forefront of implementing solutions. These studies highlight diverse methods for promoting climate resilience, ensuring food systems are productive and profitable. Despite their diversity, these projects offer valuable lessons for farmers across different networks, crops and value chains.

This co-produced compendium of case studies serves to document best practices and facilitate learning among peers, with the intention of sharing lessons and building a collective body of knowledge accessible to farming communities.

The importance of locally led adaptation

Locally led adaptation in the agricultural sector refers to strategies designed and implemented at the grassroots level, empowering farmers and their communities to mitigate climate risks and build resilience. By combining traditional and scientific knowledge, innovative techniques, and local resources, farmers are developing solutions to address the unique environmental, climate, and societal challenges that threaten their nutrition, livelihoods, and income. Locally led adaptation prioritises farmer agency, seeking to enhance ownership of measures tailored to the specific needs and contexts of farmers and their communities. While external technical and financial support remains critical, farmers must lead the core activities of these initiatives, showcasing leadership in the adoption of good practices and climate-smart innovations.

Key characteristics of farmer-led adaptation include:

Participation and Ownership: Farmers are actively engaged throughout the process, from identifying their climate vulnerabilities to developing and implementing tailored solutions that address challenges and gaps in their local environment.

Equity and Empowerment: Farmer-led adaptation focuses on inclusivity, particularly supporting marginalised groups such as women, youth, and indigenous communities. **See Box 1.**

Integration of Evidence: Traditional knowledge is combined with modern scientific research to effectively tackle climate challenges. Local solutions must be evidence-based and avoid negative impacts or trade-offs with other sectors.

Improved Resilience: These strategies enhance the long-term resilience of farming communities by improving resource management and diversifying livelihoods.

Alignment with Sustainable Development Goals (SDGs): Locally led adaptation aligns with broader development objectives, such as food security, poverty alleviation, gender equality, and biodiversity protection.

Case Study Selection

To ensure diversity in the approaches to farmer-led adaptation, EAFF and AICCRA worked closely with local and regional farmer organisations, NGOs, and community leaders to identify projects that exemplify effective and innovative adaptation solutions. In May 2024 the EAFF and AICCRA published a call to their networks and delivered a webinar for further information. A total of 55 applications were received from which ten were chosen for further review. Please see **Appendix 1** for the comprehensive list of all applications.

While the case studies vary across regions and communities, they all share a foundation in farmer-driven actions to address climate risks. The case studies were assessed using the following criteria:

- **Farmer-Led:** The projects are primarily driven by farmers, with external partners playing a support role.
- **Innovation and Leadership:** The projects demonstrate unique or best-practice approaches to adaptation and resilience.
- **Evidence-Based Knowledge Integration:** Effective use of local, traditional, and scientific knowledge to respond to climate challenges.
- **Scalability and Replicability:** The potential for these strategies to be applied in other regions or contexts.
- **Economic Viability:** A credible business case for the innovations.
- **Social Development Impact:** Positive socio-development outcomes, contributing to community resilience and addressing broader societal development challenges.
- **Geographical Diversity:** The projects reflect a range of African regions, and a diverse representation of French and English-speaking countries.

Breakdown of Selected Case Studies

The selected case studies provide insights into various climate adaptation and resilient-building practices and including, among other methods:

- Climate-smart agricultural (CSA) practices and technologies, both modern and traditional
- Integrated water management, water efficiency, and conservation approaches
- Circular economy and waste management practices
- Soil health conservation and sustainable farming methods
- Integrated land-use planning and systems thinking
- Collaborative partnerships between farmers, farming organisations, government departments, protected area authorities, research agencies, NGOs, and the private sector
- Community mobilisation for resilience building through networks, cooperatives, and value chain partnerships
- Integrated pest management (IPM) strategies
- Crop diversification strategies, alternative agricultural livelihoods and value-added services

These case studies represent only a small fraction of the adaptation efforts underway across Africa. To address this, we intend this document to be a living report, continuously updated to include more initiatives and showcase the incredible work being done by farmers on the continent. One case example that was not included in this compendium but that deserves attention is the case of agriculture as a transformative force for empowering women in Malawi. See Box 1.

The case studies presented in this report were selected from diverse regions across Africa, representing nine different countries (with two studies selected from Rwanda).

TUNISIA

Women's Agricultural Development Group (GDAF)

Women's network to promote sustainable agricultural practices and innovative organic products

UGANDA

AW Bamboo Enterprises Ltd

Sustainable bamboo production and community-led restoration

DJIBOUTI

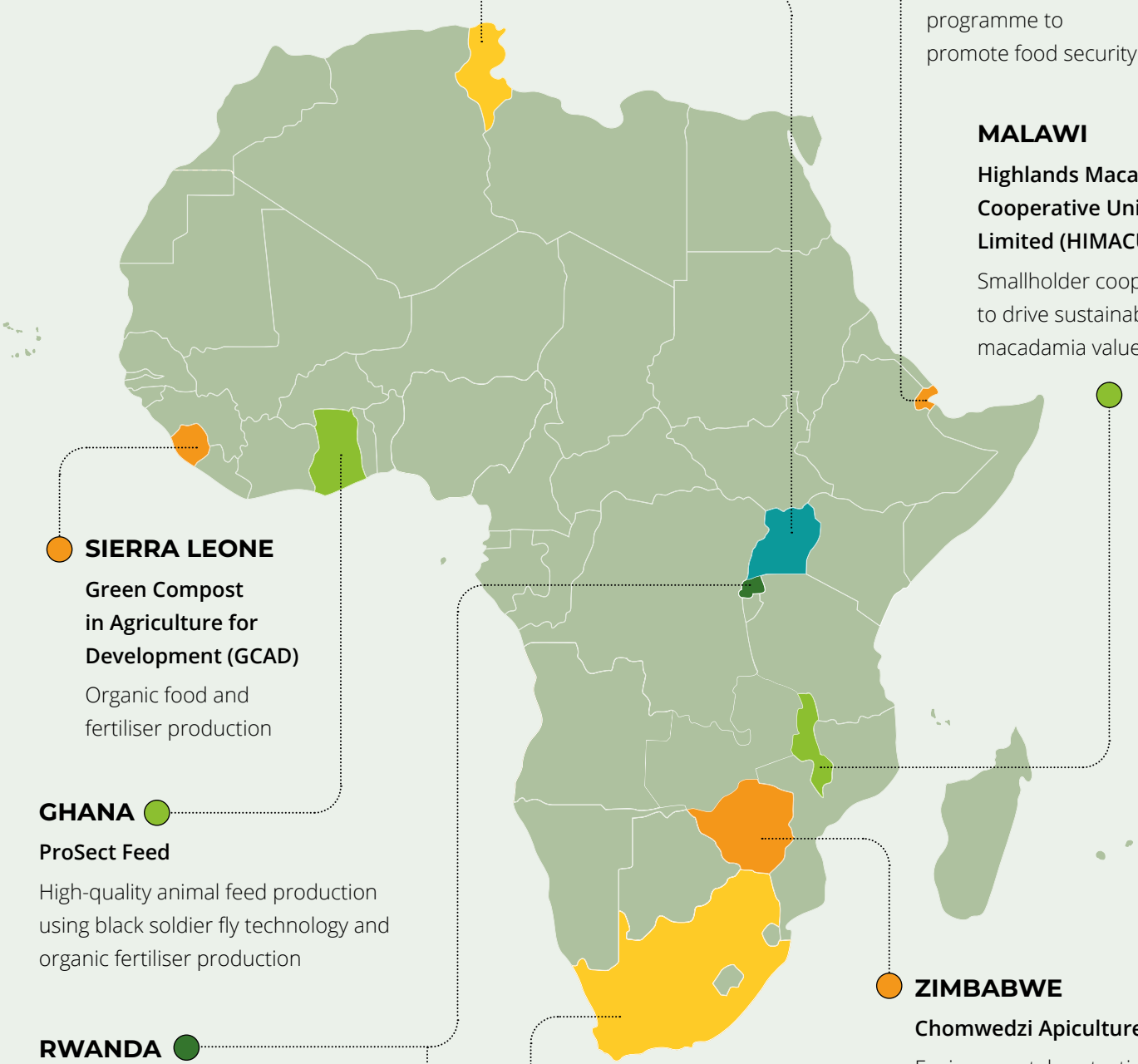
DAPA, national government and FAO

Dairy goat crossbreeding programme to promote food security

MALAWI

Highlands Macadamia Cooperative Union Limited (HIMACUL)

Smallholder cooperative to drive sustainable macadamia value chain



SIERRA LEONE

Green Compost in Agriculture for Development (GCAD)

Organic food and fertiliser production

GHANA

ProSect Feed

High-quality animal feed production using black soldier fly technology and organic fertiliser production

RWANDA

INGABO Syndicate

Capacity and partnership building network to improve farmer opportunities in a cassava value chain

Uruhimbi Kageyo Cooperative (UKC)

Organic hydroponic fodder production

ZIMBABWE

Chomwedzi Apiculture

Environmental protection and sustainable honey production

SOUTH AFRICA

Donovale Farming Company

Sustainable sugarcane production through best management practices

BOX 1

Empowering women through sustainable agriculture in Malawi

In the community of Nkhata Bay Malawi, Catherine Mkalndawire is using agriculture as a transformative force, not only for food production but also for empowering women, challenging cultural norms, and combating poverty.

Born into a family of five girls without a male heir, Catherine faced intense cultural pressures around land inheritance and family expectations. Despite these challenges, she pursued education, supported by her mother's small-scale vegetable business. Observing her mother's hardships, Catherine took initiative by introducing beekeeping, which soon became profitable enough to pay for her and her siblings' education. Determined to achieve financial independence, Catherine diversified into tilapia fish farming, which complemented her beekeeping by utilising pond water to boost honey production. Her ventures laid the groundwork for sustainable income and inspired her to empower other women in her community.

Recognising that poverty forced many young girls into early marriages, Catherine Mkalndawire established a women's group for victims of gender-based violence, offering them training in fish and honey production. Supported by the local chief, this cooperative enabled the women to generate income, gain community respect, and pay for their children's education. The initial group expanded as Catherine provided banana plants and agricultural training, which spread through nearby communities, forming a women's movement in sustainable agriculture. The cooperative not only provided local food sources, such as fish for protein, but also fostered a sense of resilience and empowerment, inspiring women to rise above cultural constraints and redefine their roles within society.

Catherine Mkalndawire has also been a proactive advocate for climate resilience. Noting shifts in rainfall patterns and the vulnerability of certain crops, she diversified into banana, cassava, and rice, which are more resilient to heavy rains. The women's group also planted pine trees to mitigate soil erosion and provide future timber resources, reducing deforestation for charcoal. Catherine's innovative use of organic fertilisers from her livestock and nutrient-rich fishpond water illustrates her commitment to sustainable farming. Moreover, as the community gained electricity from hydropower, awareness grew about protecting forests to prevent soil erosion that could harm their energy source.

Through her work, Catherine showcases how agriculture can be a vehicle for social and environmental change, addressing poverty, gender inequality, and climate resilience in her community.

Contact details

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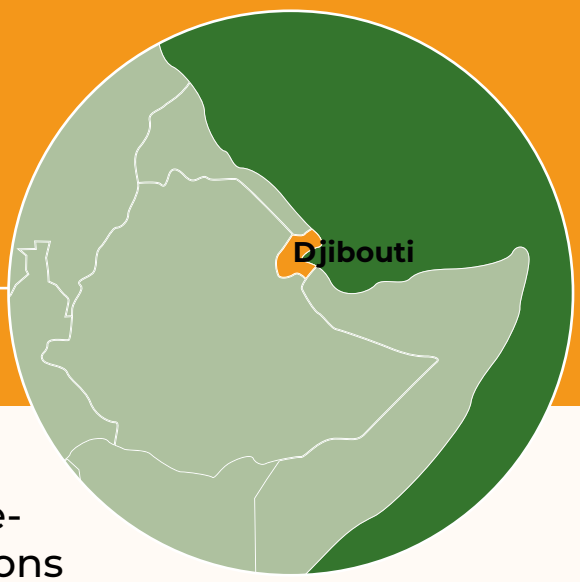
Farmer-led adaptation case studies

Horn of Africa

Djibouti



Crossbreeding Dairy Goats in the Republic of Djibouti: A Path to Climate-Resilient Nutrition for Future Generations

Context

The Republic of Djibouti (hereafter Djibouti) is located in the Horn of Africa. It is a highly arid country with limited arable soil. Close to 90% of the country is classified as desert, 9% as pasture and about 1% as forest.[1] Djibouti's landscape is characterised by arid terrain with sparse shrubbery scattered across its plateaus, plains, volcanic formations, and mountain ranges, some of which rise to 2,000 m in elevation. The country is resource-poor and vulnerable to natural disasters, a situation worsened by water scarcity, poor water management, and inefficient land-use planning. Djibouti is particularly susceptible to the effects of climate change, facing challenges such as rising temperatures, increasing aridity, reduced rainfall, and rising sea levels.[2] Due to its limited annual rainfall (average of 224.52 mm)[3] and largely inhospitable conditions for agriculture, the sector contributes just 3% to gross domestic product (GDP). As a result, Djibouti imports around 90% of its food.[4]

Approximately 23% of Djibouti's population of 1.1 million lives in extreme poverty.[5] In the 2023 Global Hunger Index, Djibouti ranked 93 out of 125 countries, with a severity score of 'serious'. According to the 2024 food security assessment, it is projected that 24% of the population will experience crisis and emergency levels of food insecurity (IPC 3 and above) between July and December 2024. Further, approximately 41,300 children under the age of five are expected to suffer from acute malnutrition.[6]

Background story

The main agricultural activity in Djibouti is pastoralism, with sedentary agricultural activities less prevalent due to the high aridity and infertile soils. Although pastoralism is a means of coping with climate-related challenges, it too is a risky livelihood, with pastoralists losing entire herds during periods of drought.

1 World Bank. 2021. Djibouti. Climate Change Knowledge Portal.
2 *Ibid.*
3 World Bank. 2023. Climate Risk Profile: Djibouti. The World Bank Group.
4 WFP. 2024. WFP Djibouti Country Brief, August 2024. World Food Programme.
5 *Ibid.*
6 *Ibid.*

Goats are a popular livestock type in Djibouti as they can withstand harsh environments. They are reared for multiple purposes including meat and milk production, manure, and for socio-economic reasons. Dairy goats have the potential to contribute significantly to improving household nutrition by increasing protein and energy intake. However, goats in Djibouti are typically managed through traditional nomadic systems, which maintain animals of low productivity. Uncontrolled practices in the dairy goat breeding system have reduced diversity, which has significantly affected productivity, endurance and the resilience of local dairy goat breeds. To address these challenges, the Government of Djibouti has been working on improving policies and incentives to encourage farmers to adopt agro-pastoral activities, recognising the economic and social benefits that these systems offer local communities.[7] Agro-pastoral production systems are land use systems that integrate livestock husbandry and crop cultivation.

Images. *A Djiboutian dairy goat breed known as 'Deer'.*

In 2015, the Ministry of Agriculture, Livestock, Fisheries, Water, and Maritime Resources (MAEPE-RH) launched a national strategy to develop animal genetic resources in sedentary sectors. This was done in recognition of the importance of genetic diversity in livestock to increase resilience to changing environmental conditions, including climate change, as well as socio-economic demands.

About the dairy goat crossbreeding programme

In 2015, the Eastern Africa Farmers Federation (EAFF) visited Djibouti to evaluate the country's agro-pastoral potential and assess its agricultural and climatic conditions. Based on their findings, it was recommended that dairy goat breeding be promoted as the animals were deemed better suited to the harsh environment than dairy cows. A crossbreeding programme was proposed between Kenya Alpine goats and local Djiboutian goats to improve the latter's milk production for enhanced nutritional and financial gains. Local Djiboutian goats produce on average 0.3 l of milk/doe/day, whereas Kenya Alpine goats can produce up to 1 l/doe/day.[8] Further, nutritionally, goat milk is higher in fat and contains more protein, vitamins and minerals than cow milk, and is more easily digested.[9,10] The targeted project outcome of improved availability and affordability of goat milk was especially aimed at bettering local nutrition amongst school children and elderly people.

The dairy goat crossbreeding programme, which became the National Programme for Genetic Improvement of Dairy Goats, aimed to:

- Target 1,500 of local dairy goat breeders (70% women).
- Enhance the incomes of 1,500 families by generating USD 9,000 per family per year.
- Strengthen national food security by meeting 30% of the local demand for fresh milk.

7 Sawe J and Ojango N. 2016. Report of the Technical Support for Dairy Goats. The Second Mission. AgriBiz Consult Limited.
8 Sketch Solutions TV. 2016. EAFF Exports breeding goats to Djibouti. YouTube video. 4 July 2016.
9 Metzger M. 2022. Goat milk versus cow milk: A comparison. Michigan State University.
10 Infonet Biovision. 2009. Goats. Animal species and commercial insects.

BOX 2

Origin of Kenya Alpine goats

The Kenya Alpine goats originate from the French Alpine bloodline which was crossbred with Kenyan goat breeds. This was done to establish a goat breed that was adapted to the local conditions and able to produce high milk yields.[11] The Alpine goats were first brought into Kenya in the early to mid-1990s through a Farm Africa project funded by the German Development Corporation (GTZ).[12,13] The initiative adopted a farmer-led approach with genetic improvement activities based on-farm as opposed to government stations. Farmers and farmer-group members were trained in breeding programme design and management, and animal husbandry and healthcare.

The Djibouti dairy goat crossbreeding programme was implemented in three phases as follows:

- **Phase 1 (2016)** – Importation of Kenya Alpine goats by the Djibouti Agro-pastoralists Association (DAPA) in partnership with the EAFF and the Food and Agriculture Organisation of the United Nations (FAO) - Djibouti office.
- **Phase 2 (2018)** - Importation of Kenya Alpine goats through the Drought Resilience and Sustainable Livelihoods Programme (DRSLP) led by the Intergovernmental Authority on Development (IGAD) and funded by the African Development Bank (AfDB).
- **Phase 3 (2019)** - Importation of Saanen goats through the Dryland Development Project funded by the Islamic Development Bank (IDB).

Phase 1 - First importation and cross-breeding with Kenya Alpine goats

In 2016, the MAEPE-RH launched the first phase of the national programme to improve the genetics of local dairy goats in partnership with the EAFF and the FAO. DAPA acquired 45 Kenya Alpine goats (34 does and 11 bucks) as a start-up herd. DAPA provided criteria for goat selection which was developed in collaboration with the FAO regional office in Djibouti. DAPA then engaged with the Dairy Goats Association of Kenya (DGAK) to select goats with desirable traits (good body size/ growth, appropriate age, and characteristics of good dairy and breeding animals).

The EAFF team visited Kenya from the 9th to the 10th of March 2016 to assist with the selection of the goats and to tag, vaccinate and deworm them. The carefully selected and treated herd was then exported to

11 Njagi SM. 2017. Djibouti opens its door to Kenyan dairy goats. Experience capitalization. Learning from farmer organisations.
12 Amati C, Parkins JR. 2011. Improved goat breeding and mixed crop farming in East Africa: A literature review. University of Alberta.
13 Ahuya CO, Okeyo AM, Mwangi-Njuru, Peacock C. 2005. Developmental challenges and opportunities in the goat industry: The Kenyan experience. Small Ruminant Research, Volume 60, Issues 1–2, Pages 197-206.

Djibouti by air and transferred to a farm in the Arta Region (Figure 1). Air transport was chosen as the preferred means for importing the goats as it was viewed as the safest, quickest and easiest option.

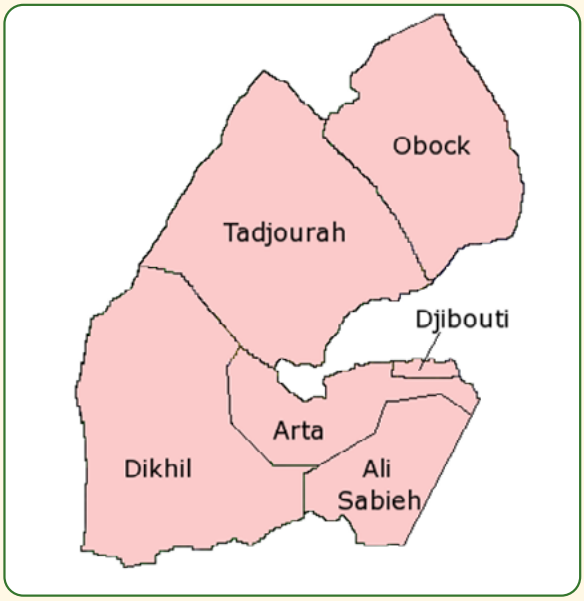


Figure 1. *Map of the six regions of Djibouti, including Djibouti city*[14]

The 45 goats arrived safely in Djibouti on the 4th of April 2016, and were received by the MAEPE-RH, as well as FAO staff. The team worked closely with DAPA to settle the goats ensuring they had suitable shelter and feed. The animals were quarantined for 30 days before being relocated to the farms of seven lead beneficiary farmers from all six regions of the country. The farmers were selected based on the following criteria:[15]

- Should be sedentary, not nomadic.
- Should be ready and willing to invest time and money in the venture.
- Should have a good source of fresh and clean water supply.
- Should have an easily available feed source.
- Should have a fertile field for crop, grasses and other green plant production to ensure the goats are healthy and productive and to reduce feeding costs.
- Should have access to full-time labour for managing the goats.
- The farm should be suitable and comfortable for the exotic breed.
- The goat housing should be neat, light, clean and dry with a proper ventilation and drainage system.

A consultant was hired to develop a goat breeding programme and it was handed over to DAPA for implementation in collaboration with the MAEPE-RH. The programme was community-based, with experienced lead farmers identified to receive the goats for breeding. A farm rotational plan was developed for the bucks to prevent in-breeding. The objective of the breeding programme was to maximise milk production. The programme consisted of both straight and crossbreeding. Straight breeding was necessary to produce more of the Kenya Alpine genetic material for further crossbreeding with the local goats. A decision would then be made as to which generation to take up as the Djiboutian Alpine (later decided as F4). It was also necessary to characterise the local Djiboutian goats to preserve the breed.

14 Wikipedia. 2021. Subdivisions of Djibouti.
15 Sawe J and Ojango N. 2016. Report of the Technical Support for Dairy Goats. The Second Mission. AgriBiz Consult Limited.

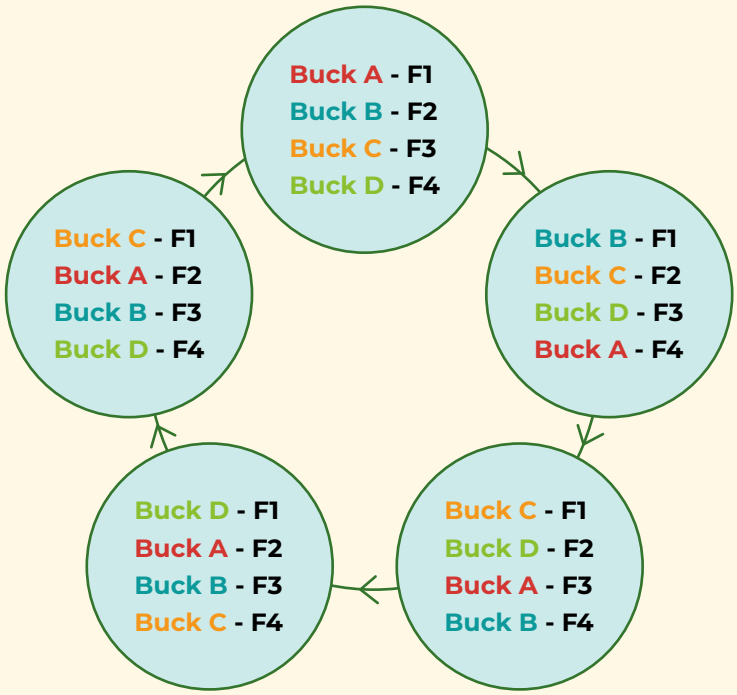


Figure 2. *Crossbreeding programme steps up to the 4th generation. (The bucks rotate between beneficiaries.)*

Between the 17th and the 22nd of July 2016, EAFF visited Djibouti to assess the performance of the goats. The animals were found to be in good health and although five had died there were an additional nine newborns. A further assessment of the goat breeding programme was done from the 7th to the 11th of January 2017, where the EAFF visited DAPA to assess the status of the goat breeding programme and to provide support in finalising their annual work plan.

The overall assessment of the breeding programme was positive:

- Over the nine-month period, the goat herd had increased with 160 newborns of the F1 generation (Kenya Alpine male and Djibouti goat cross).
- From the original 45 pedigree goats, an additional 45 were produced, increasing the herd size to 85 (taking into account the 5 animals that were lost).

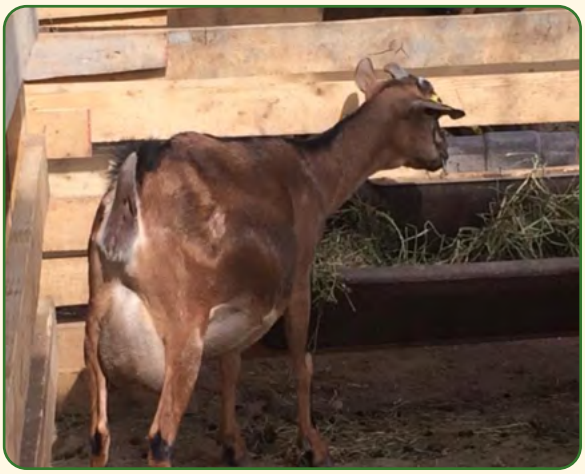


Image. *Kenya Alpine goat in Djibouti.*

Image. *Kenya male Alpine goats in Djibouti.*

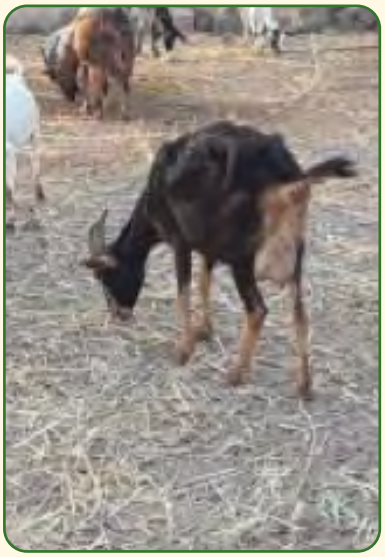
Image. *Selecting female goats for crossbreeding.*

Image. *A dairy goat farm in the Arta region, one of the first beneficiary breeders.*

Image. *Ear tagging F1 generation goats.*

Phase 2 - Second importation and cross-breeding of Kenya Alpine and Saanen goats

The pilot phase of the project was viewed as successful. Therefore a second phase was carried out whereby an additional 38 Kenya Alpine goats and 7 Saanen goats were imported to Djibouti in October 2018. The second phase was carried out in collaboration with IGAD as part of the AfDB-funded Drought Resilience and Sustainable Livelihoods Programme. The second phase had 24 beneficiaries who received top-performing 'elite' local dairy goats as well as imported dairy bucks. Ten elite local dairy goats were given to each beneficiary with one imported buck. Most of the beneficiaries (85%) adopted the crossbreeding system successfully evidenced in the number of crossbred offspring and increased milk production.



Images. *Phase 2 dairy goats, housing infrastructure and feed cultivation (Iye, 2023).*

Phase 3 - Importation and crossbreeding of Saanen goats

A third programme phase was then completed at the end of 2019 which involved the importation of 45 Saanen goats from Kenya as a part of the Dryland Development Project, funded by IDB. This phase was less successful than the prior phases due to weak organisation and poor distribution of the goats. The goats were delivered to underdeveloped areas and to beneficiaries with low capacity and awareness levels of improved goat breeding. As a result only a few Saanen goats survived. There was a lack of capacity building and awareness creation on the benefits of the improved breed and so beneficiaries did not understand the value of the goats and used them for meat production.

Each beneficiary received either a Saanen buck or a doe. Only 14 of the 46 (30%) beneficiaries kept the Saanen goats and as a result there were only 20 crossbred offspring. The offspring were solely from the beneficiaries who received bucks.

Images. *Saanen goats in the Ali Sabieh (Iye, 2023).*

Image. *Saanen goats in the Douda-Arta regions (Iye, 2023).*

Results of the dairy goat crossbreeding programme

Over all three phases of the dairy goat crossbreeding programme, 135 goats (Kenya Alpine and Saanen), were imported from Kenya. A total of 165 dairy goat breeders in the agro-pastoral sector in Djibouti benefited from the programme. The beneficiaries were categorised as 'First-level' if they directly received imported goats for breeding, 'Second-level if they received some of the First-level beneficiaries'

reproduced goats, and 'Third-level' were those who received F1 and F2 bucks from the First and Second-level beneficiaries. There were a total of 76 First-level beneficiaries across the three programme phases. Phase 3 of the project only saw First-level beneficiaries. There were 95 Second-level beneficiaries across the first two programme phases and only 23 Third-level. The reason for the low number of Third-level beneficiaries was attributed to the price increase for exotic and crossbred goats as the First- and Second-level beneficiaries realised their economic value.[16]

Table 1. *Number of imported dairy goats and beneficiaries for each programme phase.*[17]

	Breeds			Bucks	Females / Does	Number of beneficiaries				
PROJECTS	Kenyan Alpine	Saanen	F1 - Crossed (K.A and Local)	Male	Female	1st beneficiary	2nd beneficiary	3rd beneficiary	Sum of the Existed beneficiaries	Breeders that achieved some results
TCP-FAO/ MAEPE-RH	45	0	0	11	34	7	39	14	60	60
Drought Resilience and Sustainable livelihoods development projects - BAD/MAEPE-RH	38	7	0	20	15	24	56	9	89	72
Dry land - IDB/MAEPE-RH	0	45	20	50	20	**45**	0	0	**16**	**4**
Sum	**83**	**52**	**20**	**0**	**0**				**165**	**136**

More than 2,857 goats from different local dairy goat breeds were crossed with Kenya Alpine or Saanen bucks resulting in 5,896 crossbred goats (F1, F2, F3 and F4). Further, due to the increase in public awareness, around 20 dairies were established, each producing 20-24 l of milk daily.

Table 2. *Number of crossbred goats and the relative impact of each programme phase.*[19]

PROJECTS	Sum of crossed generations	F1 - Crossed Outputs	F2 - Crossed Buck Outputs	F3 - Crossed Buck Outputs	F4 - or Djiboutian Alpine Outputs
Genetic improvement projects	**5896**	2789	1920	869	318
TCP-FAO/MAEPE-RH	**	**	**	**	**
Drought Resilience and Sustainable livelihoods development projects - BAD/MAEPE-RH	***	***	****	****	**
Dry land - IDB/MAEPE-RH	Very poor	Very poor	0	0	0

16 Houssein Iye F. 2023. Technical evaluation report of genetic improvement system for the local dairy goat breeds (29/12/2022-16/01/2023). National program of genetic improvement system for the local dairy goat breeds. Ministry of Agriculture, Livestock, Fishery, Water, and Maritime sources (MAEPE-RH).

17 *Ibid.*

18 *Ibid.*

19 *Ibid.*

Benefits of Kenya Alpine vs. Saanen breeds

Both goat breeds were well adapted to the Djiboutian environment, however, the Saanen goats required better housing and feeding to realise their maximum production performance.

Performance of the crossbred goats

- **F1 generation**[20] - Milk yields improved from 0.3 l/day/goat to 0.8 l/day/goat during the second lactation season. Further, in the third to fifth lactation seasons, daily milk yields improved further from 0.8 to 1.5 l/ day/ goat. The lactation length improved from 65 days to 150 days for each lactation season. In addition, birth weight increased from 0.9 kg to 1.5 kg.
- **F2 backcrossed generation**[21] - In the third lactation season the F2 generation's milk yield improved from 1.5 to 2.2 l/day/goat.
- **F3 backcrossed generation**[22] - Daily milk yields increased up to 2.4 l/day/goat and the lactation length increased up to 180 days.
- **F4 Djiboutian Alpine generation**[23] - This generation had higher milk yields in its first lactation period compared to the F1 and F2 generations. It was recommended that the F4 generation be the primary dairy goat breed. Breeders who achieve the third step of the crossbreeding process can expect to double their milk production by practicing selection and recording actions. The F4 generation can produce 3.2 l/ day/goat in the third lactation season.
- The cross between the Djiboutian 'Deer' goat breed and the Kenya Alpine showed the highest productive performance of the cross generations.

Image. *An F1 generation goat.*

Image. *F4 generation goats.*

20 Exotic buck bred with a local dairy goat.
21 F1 generation doe bred with a second-generation exotic buck.
22 F2 generation doe bred with a third-generation exotic buck.
23 Offspring from the fourth backcrossed breeding system.

Improved milk production

The dairy goat genetic improvement programme significantly enhanced milk productivity. The lactation length improved from 50 to 60 days for local dairy goat breeds to 150 and 180 days for F2, F4 and F4/ Djiboutian Alpine goats. This was expected to improve further with the fourth and fifth lactation seasons. Therefore the 5,896 improved dairy goats should in theory contribute an additional 1,330,056 l of milk to the local Djiboutian market.

A beneficiary from phase 1 of the programme achieved 0.8 l of milk/goat daily for the F1 generation in 2018 and with an average of 16 F1 goats in lactation he produced 4,466 l of milk. This doubled to 8,258 l in 2019 and continued to grow in the subsequent lactation seasons to 9,476 l of milk in 2022. This saw his milk income more than double from DJF 1,488,651 in 2018 to DJF 3,158,631 in 2022.

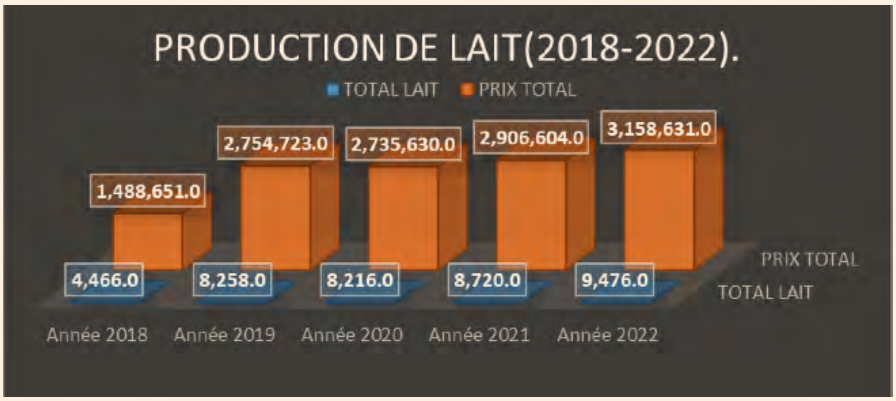


Figure 3. *Milk production records for Djama Geudi farm, Harrou-Dikhil (2018-2022).*[24]

Private sector dairy goat farms

Seven private sector stakeholders established model dairy goat breeding centres. For example, IDRO-Dairy Goat Farm - Damerjok Site, was established by the Arid-Land Agri Business Group (ALABGRO). IDRO Dairy Farm produces 15 – 25 l of milk daily which they sell to the local market. Further, Geeriyo-Dairy Goat Breeding Centre in the Ali Sabieh region has distributed top dairy goats to 18 beneficiaries. The centre houses 31 Kenya Alpine goats and more than 110 crossbred goats (F1, F2 and F3), and it produces 15 - 20 l of milk per day. The centre employs four youth.

Images. *Dairy goat farms developed by private sector stakeholders.*

24 Houssein Iye F. 2023. Technical evaluation report of genetic improvement system for the local dairy goat breeds (29/12/2022-16/01/2023). National program of genetic improvement system for the local dairy goat breeds. Ministry of Agriculture, Livestock, Fishery, Water, and Maritime sources (MAEPE-RH).

BOX 3

Arid Land Agribusiness Group

ALABGRO is a leading enterprise in the dairy goat farming sector. They have established a model dairy goat farm and invested in developing robust marketing channels for goat milk. Additionally, they have expanded into the production of concentrate feed for dairy goats, strengthening the sector's feeding practices. Through collaboration with over 40 dairy goat breeders, they continue to drive growth and innovation in dairy goat farming, positioning themselves as leaders in the field. ALABGRO works in close collaboration with the MAEPE-RH.

Images. *Arid Land Agribusiness Group marketing and distribution vehicles.*

Images. *Arid Land Agribusiness Group dairy goat feed production.*

Products and services

The dairy goat breeding programme yielded an improved goat breed – the Djiboutian Alpine - with the ability to produce more milk than local breeds.

The goat milk produced is sold to local markets within the six regions as well as to Djibouti city. Goat milk is sold for USD 4.5/ l. Due to the quantities of goat milk produced there is potential for value addition by selling yoghurt and cheese.

Climate component

The dairy goats were selected over dairy cows as they are more resilient to disease, heat and drought, and are easier to feed. Further, the high milk-yielding Kenya Alpine goat was crossbred with the local Djiboutian goat to increase its resilience to the arid environment and local pests and diseases. The increase in milk yields from the crossbred goats contributes to improved food security and nutrition for the people of Djibouti, particularly children and the elderly.

Community and marginalised groups component

A total of 165 dairy goat breeders across all regions of Djibouti directly benefited (First, Second and Third level beneficiaries) from the programme and 58 indirect beneficiaries have been identified to date. The indirect beneficiaries constitute farmers who have received a buck from the direct beneficiaries. A total of 136 breeders adhered to the breeding programme and achieved positive results.

The increase in goat milk yields has been targeted to improved nutrition for children and the elderly in Djibouti.

Capacity building component

The first five beneficiaries of the FAO's Technical Cooperation Programme received training on the principles of the crossbreeding process.

Challenges

- **Limited veterinary and laboratory facilities.** Inadequate veterinary services affected the programme's ability to control and manage disease, which is essential for maintaining herd health and improving productivity. Testing the goats for diseases was a challenge and resulted in delays in the project. It was noted that there was a need to improve laboratories for livestock disease identification and analysis as it proved a major obstacle for market access.
- **Monitoring and evaluation.** There was no comprehensive monitoring and evaluation system to track breeding programme outcomes, genetic improvements, and farm conditions. This was attributed to a lack of financial support.
- **Fodder supply and cost efficiency.** There is a need to develop a sustainable solution to address the high costs and logistics of importing fodder (currently US$ 1 per kg) into Djibouti. Each goat consumes up to 5 kg of feed daily, making it crucial to explore cost-effective alternatives. Despite the expense, the economic potential remains strong with goat milk sales at USD 4.5/ l.
- **Transition from subsistence to market-oriented milk production.** There is need for a framework to assist farmers in transitioning from subsistence milk production to a more commercialised approach. This includes organising farmers into cooperatives or groups to improve access to larger markets and advocating for policy support to boost their market reach.
- **Lack of sustainable development plans.** The programme primarily focused on the importation and distribution of goats without including sustainable actions such as wider capacity building, institutional role definition, or policy development.
- **Limited institutional support and framework.** There is need to establish a professional organisation e.g. Djibouti Dairy Goat Breeder Association, to coordinate efforts and represent breeders. Weak collaboration amongst concerned institutions hampered the prioritisation and development of this field. This has resulted in more than 700 interested dairy goat breeders waiting to join the programme.

Further, the establishment of a **National Centre for Genetic Improvement of Dairy Goats**[25] is critical to:

- Strengthening institutional support.
- Strengthening vocational training and capacity building.
- Transferring of animal husbandry and genetics technology.

25 Funding was secured by MAEPE-RH from the AfDB for the development of the centre but progress was impeded by the need to revise the feasibility study.

- Establishing artificial insemination tools and database development.
- Monitoring and evaluation, studies and research.
- Empowering professional organisations.
- Ensuring the sustainability of the programme.

- **Insufficient capacity building and technical support.** The programme lacked initiatives for capacity building, technical advancement, and the provision of dairy farm tools. There is a need for technical trainings on the goat crossbreeding system. The first, second and third beneficiaries did not receive training due to programme financial constraints. A structured approach to knowledge transfer and technical advising is needed to support the dairy goat farmers.
- **Funding limitations.** The programme lacked sufficient direct and indirect funding resources needed for the development and sustainability of dairy goat breeding initiatives.
- **Inadequate milk marketing and transportation infrastructure.** Limited marketing capabilities, poor transportation logistics, and inadequate cold storage and packaging tools restricted breeders' ability to access markets effectively.
- **Lack of data-driven genetic improvement tracking.** The programme relied on surveys rather than professional phenotypic and genetic characterisation studies, making it difficult to accurately assess the impact of genetic improvements.

Contribution to the Sustainable Development Goals

The project contributed to the followings SDGs:

Impact

The national programme for the genetic improvement of local dairy goats significantly revitalised productivity while raising public awareness regarding investment opportunities and the potential for enhanced production within the dairy goat sector. As the first initiative of its kind, this programme transformed the outlook of dairy goat breeders, bolstering their confidence in the viability and profitability of dairy farming. Consequently, numerous private stakeholders recognised the value of investing in the dairy goat sector. Dairy goat farmers also acknowledged the income-generating potential of their farms when enhanced through improved practices. This collective advancement has created employment

opportunities, particularly for youth from agro-pastoral backgrounds. The project aimed to attract more than 1,500 youth to dairy goat farming and the vision could have been achieved if the programme had received adequate financial and technical support. Some of the programme's achievements include:

- 5,896 crossbred goats in F1, F2 and F3 and F4.
- The initial project investment was USD 75,000 – its value increased to be worth more than USD 500,000.
- Creation of employment for Kenya Alpine goat farmers in Central Kenya.
- The goat breeding programme became a national programme.
- 165 farmers directly benefitted from the programme and 58 indirectly benefitted.
- Numerous businesses and jobs were created along the goat milk production value chain. Farmers are now pasteurising milk and packaging it.

Plans for future growth

- **Dairy goat semen to expand the breeding programme.** With dairy goat semen recently made available (over the past six months), it will be possible to scale up breeding initiatives, focusing on enhancing the genetics of local goat populations. The semen availability has the potential to rapidly increase the number of high-yield dairy goats, improving milk production and supporting the goal to make dairy goat herds more productive and climate-resilient. However, for this to be a success the National Centre for Genetic Improvement of Dairy Goats needs to be established as the farmers need technical support.
- **Development of Value-Added Products:** To diversify revenue streams and enhance market competitiveness, there is potential to expand into value-added dairy products, specifically focusing on cheese and yogurt production from goat milk. This expansion will involve establishing processing facilities and training farmers and staff in quality production standards. By producing cheese and yogurt there is potential to cater to a broader market, tapping into the growing demand for specialty dairy products, improving nutrition as well as profitability for dairy goat farmers.

Lessons learnt

- **Necessity of a national strategy for genetic improvement.** The absence of a well-defined National Strategy or Action Plan for genetic improvement threatens sustainable progress in breeding and genetic enhancement programmes. A national plan should include essential activities such as breed characterisation studies, breeder capacity building, technology transfer for genetic improvements, stakeholder awareness initiatives, and policies for dairy breeder development. Without these components, breeders may lack the readiness and continuity required to adopt genetic improvement practices, potentially compromising gains made in local dairy goat breeding.

- **Importance of institutional support and training for breeders.** Institutional involvement is crucial in providing traceability and identification tools, record-keeping systems, and pedigree tracking resources. Training breeders to effectively use these tools and records is essential for enabling them to understand and select for economically significant traits in their breeding practices, particularly when breeders have already reached advanced crossbreeding stages (e.g. F3 generation).
- **Role of a genetic improvement centre.** A centralised facility, such as a Centre for Animal Genetic Improvement, is fundamental to meet the rising demand for a structured genetic improvement system in the dairy goat sector. This centre would provide the necessary guidance, support, and resources to breeders, helping facilitate their transition to improved breeding systems.
- **Urgency in characterising local breeds.** Characterising the main local dairy goat breeds is essential to quantify and assess the genetic improvements achieved by beneficiaries in breeding programmes. Without proper characterisation, the genetic gains from these programmes cannot be accurately measured or justified. Therefore, establishing a national genetic improvement centre as an institutional agency is critical to provide structured oversight and documentation of genetic progress.
- **Opportunity to expand economic benefits through breeding programmes.** Experienced beneficiaries, particularly those with large numbers of exotic and improved goat breeds, could be empowered to create additional income sources by trading the improved goats. Phases 1 and 2 showed initial success in this area, indicating a potential for expanded economic benefits. Leveraging this experience among early beneficiaries could help grow the programme's reach and strengthen the economic foundation of the dairy goat sector.
- **Institutional role in professionalising breeding practices.** More than 200 breeders have expressed both readiness and willingness to adopt genetic improvement systems, emphasising the importance of institutional roles in facilitating access to professional, research-backed results. Establishing clear institutional roles and responsibilities would thus be beneficial in supporting breeders' transitions to advanced breeding practices, thereby contributing to sustainable agricultural development and improved livelihoods.
- **Encouraging selection within breeding programmes.** With many breeders already in the third crossbreeding generation (F3), there is an opportunity to improve selection within their flocks to enhance genetic quality further. Training and guidance on identifying economically valuable traits are essential to maximise the impact of these crossbreeding achievements.
- **Optimal animal housing is critical.** Originally the purebred Kenya Alpine goats were thought to be too fragile for the Djiboutian environment. However, in finding, alterations to the animals' housing (lifting the height of the roofs) led to the pure-bred goats thriving.

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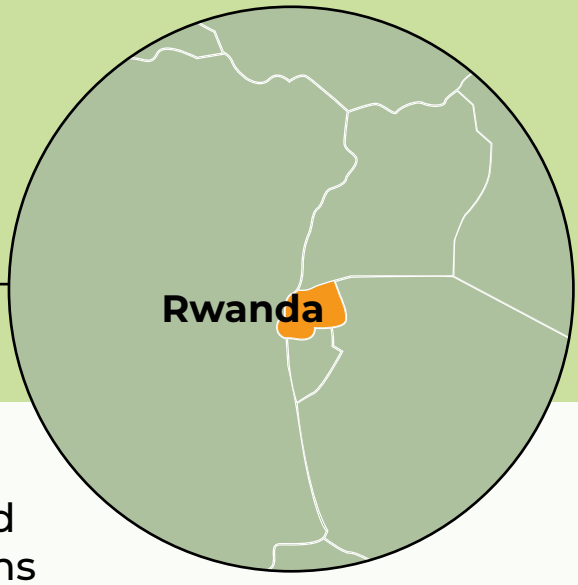
East Africa

Rwanda



Empowering Rwandan Farmers: INGABO Syndicate's Mission to Build Sustainable Agricultural Value Chains

Background story

In 1994, Rwanda endured a catastrophic genocide that devastated its population, infrastructure, and economy. Since then, the country has made remarkable strides in rebuilding its economy and infrastructure, whilst also working to improve the living standards of its 12.5 million citizens. However, a significant portion of the population continues to struggle with widespread poverty, malnutrition, and food insecurity. Recent surveys reveal that 39.1% of Rwandans live in poverty, with the majority concentrated in rural areas, where 83% of the population resides.[26]

Agriculture plays a central role in the economy, with 70% of the population relying on it as a primary source of income and contributing 90% of the country's food supply, though most farmers practice subsistence agriculture.[27] Despite targeted national efforts, particularly towards rural communities, progress in addressing malnutrition, especially amongst women and children, has stagnated, largely due to persistent household food insecurity and poor dietary diversity. In 2021, 20.6% of households were classified as food insecure, primarily in rural areas where agriculture remains the main livelihood.[28] Furthermore, 27% of households reported inadequate dietary diversity, consuming fewer food groups over a seven-day period than necessary to ensure sufficient nutritional balance.[29]

Rwanda is highly susceptible to the impacts of climate change due to its heavy reliance on rainfed agriculture and the need for development in critical areas such as road infrastructure, healthcare systems,

26 FAO. 2021. Rwanda at a Glance. Food and Agriculture Organization of the United Nations.
27 *Ibid.*
28 Paridaens A.-M., Rammala V. 2021. Comprehensive Food Security and Vulnerability Analysis. Commission on Social Determinants of Health, World Health Organization; Geneva, Switzerland.
29 *Ibid.*

and water resource management. Rwanda faces multiple natural hazards including droughts, floods, landslides, storms, wildfires, and disease outbreaks. Annual mean temperature in Rwanda is projected to rise by 1.1°C to 3.9°C by the end of the century, and heatwaves are expected to increase in duration.[30] Temperature increases will affect all seasons. Rainfall patterns are highly variable, with projections indicating an increase in annual rainfall, especially during the primary rainy season from December to April, with drier conditions from July to September. Heavy rainfall intensity is expected to rise by 3% to 17%, with frequency increasing by 9% to 60%.[31] The prevalence of poverty and limited development in many areas constrain the ability of vulnerable households and communities to effectively manage climate risks, thereby heightening their exposure to climate-related shocks.

Backstory to INGABO Syndicate's establishment

In 1992, INGABO Syndicate was conceived by representatives of cooperative organisations and their unions in the Southern Province of Rwanda. At that time, the cooperative movement was well-established and organised around key functions such as farm production, marketing, processing, and craft work. These representatives had already identified a gap in advocacy on issues that extended beyond the immediate scope of cooperatives, such as agricultural laws and policies, and access to essential production resources such as land, technology, and capital.

It was recognised that cross-cutting issues that directly or indirectly affected the agricultural sector such as agricultural financing, agroecology, capacity building, and representation, could not be fully addressed within individual cooperatives alone. This recognition led the representatives to propose the creation of an organisation dedicated to addressing the major barriers to the development of farmers. Thus, in 1992, during a meeting, the cooperative unions' representatives decided to establish INGABO Syndicate. The period from 1992 to 2005 was characterised by efforts in mobilisation, member recruitment, strategic planning, partnership building, and establishing a legal identity aligned with INGABO Syndicate's mission.

About INGABO Syndicate

The INGABO Syndicate, a farmers' trade union, was established by farmers in the Southern Province of Rwanda and was legally recognised by the Government of Rwanda through the Ministry of Labour and Public Services on the 1st of April 2005. Today, INGABO is working with around 16,051 cassava farmers, 55% of whom are women. Its activities span 10 of Rwanda's 30 districts.

INGABO Syndicate is a founding member of the EAFF and is a member of the World Farmers Organisation (WFO).

INGABO Syndicate's mission is to improve the technical and economic capacities of farmers in Rwanda so that they can become competitive players on the market, guiding them through all

30 World Bank Group. 2021. Climate Risk Profile: Rwanda.
31 *Ibid.*

the steps of the productive process from seeds to post-production and marketing. As a farmers' syndicate, INGABO also focuses on lobbying and advocacy, capacity building and establishing strategic partnerships. INGABO Syndicate provides a voice for Rwandan farmers, advocating for sustainable agriculture and farmers' interests. It aims to ensure farmers' voices are heard on various decision-making platforms so solutions can be co-developed.

INGABO Syndicate is headquartered in Muhanga District and initially carried out its activities across the Southern Province and the Bugesera District of the Eastern Province. It now operates in 10 of Rwanda's 30 districts namely, Ruhango, Kamonyi, Muhanga, Nyanza, Gisagara, Nyamasheke, Rusizi, Bugesera, Kayonza and Gatsibo.[32]

INGABO Syndicate has three organisational levels from the grassroots to regional and national levels. Each level houses a congress, an executive committee, a supervisory board and an arbitration commission. INGABO Syndicate also has a general secretariat for the day-to-day implementation of the different programmes.

Figure 4. *Muhanga District in Southern Province of Rwanda.*[33]

INGABO Syndicate currently engages in four programmes including:

- **Farmers' Organisations for Africa, Caribbean and Pacific (FO4ACP)** programme which aims to increase the incomes and improve the livelihoods, food and nutrition security, and safety of organised smallholders and family farmers by strengthening regional, national and local farmers' organisations. INGABO Syndicate works in this programme in partnership with the EAFF, the Pan-African Farmers Organisation (PAFO) and the African Centre for the Constructive Resolution of Disputes (ACCORD).
- **Acting Now** programme aims to foster systemic change in the food system and enhance food and nutrition security of farmer organisations' individual member farmers, with a particular focus on women and youth across six African countries. This programme is in partnership with Agriterra and Solidaridad. INGABO Syndicate contributes to the programme through enhancing cassava productivity, scaling up the adoption of zai pit technology and agroforestry and improving nutrition in farming households in Rwanda.

32 INGABO Farmers' Syndicate. PowerPoint presentation.
33 Steve I. Rwanda. (Accessed online: 14 November 2024).

- **Gwiza-Muhinzi** project for enhancing cassava productivity and utilisation for food and incomes of smallholder farmers in Rwanda is implemented by INGABO Syndicate in partnership with the International Institute of Tropical Agriculture (IITA) in 10 districts in Rwanda with European Union financial support.
- **Virus Resistant Cassava for Africa (VIRCA) Plus** project, in partnership with Mennonite Economic Development Associates (MEDA), aims to develop farmer-preferred cassava cultivars that are resistant to Cassava Brown Streak Disease and Cassava Mosaic Disease for delivery to East and Southern African small-scale farmers.

As part of these programmes and to meet its own objectives, INGABO Syndicate has three main activity areas – advocacy, establishing market linkages and building the capacity of farmers and extension agents.

Advocacy

INGABO Syndicate engages with various institutions to advocate for critical issues affecting farmers, such as agricultural financing, including market access, fair pricing of agricultural products, and access to essential inputs. Through these efforts, INGABO Syndicate provides informed recommendations that enhance the responsiveness and reliability of policymakers in addressing the most pressing challenges faced by the agricultural sector.

Market linkage and business promotion

INGABO Syndicate supports farmers and cooperatives in identifying and securing favourable markets for their products. Additionally, through the annual 'Cassava Week' initiative, it promotes continuous awareness of opportunities within the agricultural sector, with a particular focus on the cassava value chain.

Capacity building

INGABO Syndicate builds the capacity of its members to adopt sustainable agricultural practices. The promoted farming practices enhance yields contributing to food security and improved incomes. The practices also reduce costs of production, enhance soil erosion control and increase resilience to climate change through improved soils and soil water retention. INGABO Syndicate encourages farmers to adopt CSA practices such as planting drought tolerant and disease resistant varieties to enhance production. It also promotes zai pit technology to assist with water management and soil health. INGABO Syndicate focuses on the following value

chains: cassava, iron beans, banana, soybeans, horticulture and livestock. INGABO Syndicate's key capacity building areas are described below:

Governance - INGABO Syndicate offers comprehensive training to cooperatives and individual farmers on various topics including cooperative management, governance, leadership and access to finance.

Nutrition - INGABO Syndicate provides training to farmers on nutrition and supports the establishment of kitchen gardens through the distribution of vegetable and fruit seeds to enhance household nutrition and food security.

Seed multiplication - INGABO Syndicate provides technical assistance across all stages, from pre-basic and basic to certified cassava seeds. It offers financial support to cooperatives, capacity building programmes for seed producers, and helps strengthen seed producers' organisations. INGABO Syndicate ensures compliance with seed regulations through registration, inspection, and certification processes, while also facilitating access to seed markets.

Zai pits - As part of its climate adaptation efforts, INGABO Syndicate promotes the adoption of zai pits for cassava, a conservation agriculture practice adopted from West Africa aimed at enhancing production and improving soil conservation. This sustainable technology encourages soil cover through mulching and intercropping. To demonstrate its effectiveness, INGABO Syndicate has established demonstration plots in 10 districts.

Image. *Cassava growing in zai pits.*

Intercropping – Intercropping is the practice of cultivating two or more crops in close proximity within the same plot. INGABO Syndicate actively promotes intercropping as an effective method to enhance soil health and optimise the use of plant nutrients. Intercropping serves as an adaptive strategy to address climate change by promoting soil conservation through ground cover and the use of complementary crops. INGABO Syndicate promotes intercropping with the zai pit technology whereby cassava is grown alongside leguminous crops such as soybeans

and common beans, leveraging symbiotic interactions to improve soil fertility. Additionally, INGABO Syndicate encourages intercropping with maize and beans, where the maize stalks provide natural support for climbing beans. This approach minimises soil disturbance and contributes to environmental conservation by reducing the need for external stakes sourced from forests.

Images. *Cassava intercropped with legumes.*[34]

Organic fertiliser - INGABO Syndicate trains farmers on composting to produce high-quality organic fertilisers using locally available materials. This initiative also aims to raise farmers' awareness of soil degradation and the importance of sustainable soil management practices.

Images. *Farmer placing organic fertiliser in a zai pit.*

A focus on cassava

INGABO Syndicate places a strong focus on the cassava value chain, given its significance as a staple food crop in Rwanda. Over half of INGABO Syndicate's farmers are engaged in its cultivation. Cassava is the second most important crop in Rwanda by production volume, after bananas, and ranks third in land area, following bananas and beans. Primarily grown as a food staple, cassava also has various industrial applications, including animal feed, biofuels, bio-ethanol, and alcohol production. Known for its low production costs, cassava can be grown year-round and is more resilient to challenging growing conditions compared to other staple crops, like maize.

Cassava farming in Rwanda relies heavily on an informal seed system, where certified seeds make up only 0.5% of the supply, with traditional seeds

34 INGABO Farmers' Syndicate. PowerPoint presentation.

comprising the remaining 99.5%. This informal system often involves the exchange of planting materials among farmers, which are frequently of low quality. Meeting the country's demand for cassava requires between 1.5 and 3 billion cuttings annually.[35]

Recognising the importance of cassava, INGABO Syndicate has tailored its services to strengthen this value chain. Despite the crop's benefits, however, the cassava value chain in Rwanda faces numerous challenges, including limited access to quality seeds, low productivity, inadequate farming practices, and obstacles in processing, market access, and overall coordination. To address these challenges, INGABO Syndicate organises an annual event known as 'Cassava Week' to promote and develop solutions across the sector.



Images. *Cassava seedling cultivation and harvesting.*

BOX 4

Cassava Week: A transformative platform for the cassava value chain

Cassava Week was initiated in 2017 as 'Cassava Day' in Ruhango District in the Southern Province of Rwanda. It was created to bring together relevant stakeholders including Government, private sector actors, NGOs, development partners and research institutions, amongst others. Each year the event focuses discussions on a specific theme, for instance the 2024 Cassava Week theme was 'Leveraging available opportunities to enhance the cassava value chain's contribution to sustainable food systems'. The purpose of Cassava Week is to discuss opportunities, challenges and possible synergies and collaboration between different value chain actors. Cassava Week offers a platform for:[36]

Image. *Cassava week 2024, Mahungu, Rwanda.*

35 Nduwumuremyi A. 2024. Roots and Tuber Programme National Coordinator, Rwandan Agriculture Board. Presentation delivered at Cassava week on 23 October 2024.

36 INGABO Farmers' Syndicate. 2023. Progress report on resolutions of Cassava Week 2023. PowerPoint Presentation.

- Peer-to-peer learning, knowledge sharing and lessons learnt.
- Disseminating new cassava varieties to the farming community.
- Discussing and concluding business and collaboration agreements between stakeholders.
- Informing and discussing different policies and agricultural investment opportunities.

Key achievement stemming from previous Cassava Week events

Cassava Week has attracted participation from farmers' organisations across the East African Community (EAC), including representatives from the Democratic Republic of Congo, Uganda, and Burundi, who have benefited from insights on event organisation and implementation.

In partnership with the Rwanda Agriculture and Animal Resources Development Board (RAB), Cassava Week serves as an essential platform for introducing and disseminating new cassava varieties to farmers and other stakeholders, including specific climate-resilient varieties. A notable outcome of the 2020 event was the conceptualisation of Cass Venture Ltd., a company jointly owned by cassava producers, cooperatives, and INGABO Syndicate, designed to streamline the commercialisation of cassava products and promote the multiplication of cassava seeds.

Collaborative synergies have proven fundamental. INGABO Syndicate has engaged with multiple partners to support the event's preparation, organisation, and follow-up on key recommendations. This partnership network includes the Ministry of Agriculture and Animal Resources (MINAGRI), the Ministry of Commerce and Industry (MINICOM), RAB, district authorities with high cassava production potential, development partners, farmers' organisations, and private sector actors. The collective effort has significantly strengthened the impact of initiatives promoting cassava production and value chain development.

Cassava Week functions not only as a platform for advocacy and stakeholder engagement but also facilitates the negotiation of trade agreements between farmers and other value chain actors. A key example is the Kinazi Cassava Plant, which has entered into annual sales contracts with various farmer cooperatives, fostering sustainable and mutually beneficial partnerships. Additionally, INGABO Syndicate has strengthened its collaboration with micro-financing institutions, seeking favourable interest rates for farmers and tailored conditions.[37] The success of this initiative has inspired further financial partnerships, with INGABO Syndicate signing two business agreements in 2023 with Clecam Ejo-Heza and Cooperative of Progress and Finance (CPF). In 2024, the same agreement has been signed with Duterimbere IMF PLC. The business agreement establishes a partnership between the financial institution, INGABO Syndicate, and the cooperatives. Under this agreement, INGABO Syndicate and the cooperatives commit to mobilising farmers, providing training, and facilitating access to high-quality seeds, inputs, insurance, and markets. In turn, the financial institution agrees to offer credit to farmers on negotiated terms—covering interest rates, grace periods, repayment schedules, and collateral requirements—adapted to the specific needs of each crop.

Cassava Week has proved effective for mobilising the private sector in terms of access to markets and finance. Over the years, Cassava Week has led to the mobilisation of RWF 1.2 billion to finance cassava farmers.[38]

37 INGABO Syndicate. 2024. Concept Note: Cassava Week 2024.
38 EAFF speech at Cassava Week. 2024.

INGABO Syndicate is inclusive, it currently has 16,051 active members of which 8,685 (54%) are women and 7,366 (46%) are men, with 20% being young farmers. All individual members are also members of cooperatives which allows INGABO Syndicate to work with the groups of producers more easily and demonstrate the power of working together. To support the farmers and their cooperatives, INGABO Syndicate promotes partnerships with companies as a value chain model to ensure producers are integrated in an equitable and sustainable way.[39] INGABO Syndicate works with 30 farmer cooperatives organised across different value chains.

> ***"Our work with farmers starts with awareness creation. Climate change is a big concept that our farmers need to understand - the effects as well as the role they can play to mitigate the effects,"***
>
> - Francis Xavier Mbabazi, Chief Executive Officer of INGABO Syndicate.

Products and services

Elevating importance of cassava and promoting cassava value chain opportunities

INGABO Syndicate uses demonstration plots to train farmers on sustainable farming practices. The farmers establish these plots with the assistance of farmer field school facilitators, farmer promoters and trained farmers. The farmers are shown how to implement improved practices, focusing on zai pits,[40] optimal spacing to increase yields, and intercropping with leguminous crops to improve soils and the nutrition of farm families.

Support is provided across all stages of the cassava value chain, from healthy cassava cuttings to post-production and marketing. Market access, a significant challenge for cassava farmers and cooperatives, is a primary focus. INGABO Syndicate prioritises establishing effective, mutually beneficial contracting systems with companies, which include robust dispute resolution mechanisms. For example, in 2020, INGABO Syndicate played a crucial role as an intermediary between cassava cooperatives and the Kinazi Cassava Plant, successfully negotiating a favourable contract for 15 cooperatives to sell their entire 2021 production directly to the plant at a good price.

39 INGABO Syndicate. N.d. Smallholder cassava farmers in Rwanda get better value for produce partnering with the private sector. Brochure. Farmers' Organisations for Africa, Caribbean and Pacific (FO4ACP).
40 INGABO Syndicate. N.d. Using zai pit (planting pit) technology to boost productivity and allow intercropping cassava with other crops.

INGABO Syndicate developed a model contract that can be adapted and reused by other cooperatives aiming to sell their produce in a regulated manner and at a price that accounts for production costs, which is higher than what producers typically receive when selling crops individually. These long-term contracts also enable cooperatives to apply for loans from commercial banks, using the contracts as collateral - something that is often difficult for farmers to secure without guarantees or collateral. The additional credit obtained can then be invested back into production.

To address the issue of marketing, INGABO Syndicate developed the E-cassava market application that was launched during Cassava Week in November 2020. The application allows for the rapid exchange of information on seeds, farmers' produce and market availability. For example, using the application farmers can locate their preferred cassava varieties without having to visit each supplier. Further, buyers use the application to source cassava in the required quantities.

Promotion of climate-smart and water harvesting techniques

INGABO Syndicate is mobilising farmers to undertake climate smart practices through the dissemination of zai pits, agroforestry, water harvesting and erosion control. INGABO Syndicate, in collaboration with multiple partners, has established more than 100 demonstration plots for the zai pit technology. This approach involves the concentration and conservation of nutrients and water at a crop's root system through the digging of small pits (zai pits) and filling them with compost, with the aim of increasing soil fertility and water infiltration. Zai pits are dug between planting seasons and filled with organic compost which attract worms, termites and other insects, creating a nutrient-rich material that can be used to fertilise crops. Farmers plant cassava cuttings directly in these pits. Rainwater infiltrates the pits more easily than the surrounding soil, preventing runoff and soil erosion. Applying this technology is laborious to implement, but it has been found to assist farmers in times of drought or in arid conditions to produce successful crops by maximising the resources available. Intercropping with legumes and other food crops is also highly encouraged. Further, INGABO Syndicate provides the farmers who adopt the technology with cassava cuttings. The intention is to plant cassava in zai pits on 124 ha of land across 10 districts during the 2025 season.

Additionally, INGABO Syndicate is initiating a project aimed at increasing the irrigated land available to its members.[41] The project is to be implemented by the respective cooperatives in collaboration with the Catholic University of Kabgayi and DELTA TECH and it will be funded by the Rwanda Development Bank (BRD). The project will use advanced water harvesting and distribution technology that has proven to be successful in Egypt.

41 INGABO Syndicate Website. (Accessed online: 14 November 2024).

Nutrition

INGABO Syndicate works with farmers to develop their skills in preparing nutrient-rich meals, this includes teaching them to grow a variety of vegetables in home gardens and supplying them with fruit and vegetable seeds.

Research

INGABO works with numerous partners to promote the importance of cassava in Rwanda's food systems.

In July 2020, INGABO Syndicate carried out a study on the constraints faced by farmers in accessing formal loans. It was found that the financial institutions did not provide a service which met the needs of smallholder farmers and so the following recommendations were made:[42]

- Review credit access mechanisms;
- Reduce credit application requirements;
- Improve risk management;
- Reduce the cost of credit;
- Build the capacity of farmers and their cooperatives on accessing formal loans; and
- Build the capacity of banking institutions to ensure targeted and accessible service delivery.

In August 2020, INGABO Syndicate conducted a study on the challenges faced by farmers in accessing agricultural insurance and provided recommendations for both the farmers and insurance companies to address the barriers, these included:[43]

- Insurance companies need to improve their communication with farmers to understand their needs and tailor their products accordingly.
- Farmer's organisations and other rural development stakeholders need to increase farmers' awareness on agricultural insurance.
- Farmer organisations and other rural development stakeholders need to increase farmer's awareness on the benefits of forming cooperatives.

42 Ngirumpatse P. 2020. Constraints against farmers access to formal loans in Rwanda. INGABO Syndicate.
43 Ngirumpatse P. 2020. Challenges in enhancing farmers access to agriculture insurance in Rwanda. INGABO Syndicate.

Convening and networking platform

INGABO Syndicate hosts Cassava Week on an annual basis with support from the Ministry of Agriculture. The networking event brings together all cassava value chain stakeholders including farmers, farming organisations, development partners, private sector, financial institutions and government decision makers.[44] Discussions held during the weeklong event assist stakeholders in finding solutions to the challenges they face along the cassava value chain. Achievements are celebrated and pledges are made for the following year.

INGABO has also established cassava platforms in 10 districts, which are key hubs in supporting farmers in the sector.

Access to finance

INGABO Syndicate facilitates farmers' access to finance, cooperative savings and credit. It has developed partnerships with micro-financing institutions, such as CPF INEZA and Clecam Ejo-Heza, to develop financial products aimed to readjust credit that adequately meets the needs of its agro-base. The loans are flexible and do not require repayment until the first harvest, giving the farmers an initial grace period. Also, INGABO Syndicate helped to negotiate a more favourable interest rate for farmers – from 24% down to 18%. To date, farmer repayment on loans has been highly successful.

INGABO Syndicate has signed an MoU with CPF INEZA resulting in the creation of the innovative financial product 'Zamuka Cassava Product'. This product has enabled the disbursement of over RWF 200 million in agricultural loans, offering farmers favourable interest rates and tailored conditions. The success of this initiative has inspired further financial partnerships, with INGABO Syndicate signing two business agreements in 2023 with Clecam Ejo-Heza and Duterimbere.

Environmental component

INGABO Syndicate has introduced measures to protect the environment including initiatives to prevent deforestation, promote agroforestry, and encourage farmers to avoid the use of fire on their farms. Instead of using wood or charcoal for fuel, farmers are taught to collect animal manure for biogas production for cooking. Farmers are trained on sustainable agricultural practices including zai pit technology to improve both the quality and quantity of crops and to protect the soil from erosion.

44 INGABO Syndicate. N.d. Smallholder cassava farmers in Rwanda get better value for produce partnering with the private sector. Brochure. Farmers' Organisations for Africa, Caribbean and Pacific (FO4ACP).

Climate change component

INGABO Syndicate creates awareness amongst farmers on the threat of climate change to agricultural production and how it negatively impacts the economy and exacerbates poverty in the region. It encourages farmers to adopt CSA practices including water harvesting and conservation through technology, agroforestry, climate-smart gardening and the planting of crop varieties that are tolerant of dry spells and drought.[45] Further, zai pit technology is promoted which improves water infiltration and retention which is critical for crop growth in times of drought or dry spells.

Community and marginalised groups component

INGABO Syndicate has a gender policy that provides guidelines to ensure gender integration across all INGABO Syndicate's plans and activities. For example, the policy stipulates that at least 40% of all activity beneficiaries must be women, and women should comprise 50% of elected governing bodies. Within INGABO Syndicate, there are dedicated forums for women and youth, allowing these groups to discuss their unique challenges and propose recommendations to the INGABO leadership. As a result, of INGABO Syndicate's 16,051 active members, 54% are women and 46% are men, with 20% being young farmers.

Capacity building component

Farmers and extension staff are trained on multiple subjects including governance (management, leadership and accessing finance), seed multiplication, and sustainable agricultural practices such as zai pit technology, intercropping, CSA and water harvesting and conservation. The are also trained on biogas production and how to use the E-Cassava application. In July 2024, training was also provided on organic and mineral fertiliser production and application.[46] Participants from the training committed to transferring the knowledge and skills they had acquired to farmers in their respective areas.

Images. *INGABO Syndicate training on zai pit technology.*[47]

45 INGABO Syndicate. 2024. Climate-smart agriculture. Blog.
46 INGABO Syndicate. 2024. Organic and mineral fertiliser production. Blog.
47 INGABO Farmers' Syndicate. PowerPoint presentation.

Images. *INGABO Syndicate training on compost making.*

Images. *INGABO Syndicate training on seed multiplication (at screenhouse run by Abahizi Ba Cyesa cooperative in Cyeza sector, Muhanga district).*

Challenges

INGABO currently faces several challenges:

- Limited resources for implementing strategic plan activities and programmes.
- Adverse effects of climate change.
- Limited partnerships in advocacy efforts.
- Low engagement of young people in the agriculture sector.
- Insufficient insurance coverage for all crops and livestock.
- Crop and livestock vulnerability to epidemic diseases.
- Limited access to capital for farmers.
- Skill and knowledge gaps amongst smallholder farmers.
- Underdeveloped agricultural infrastructure and equipment (e.g. irrigation systems, radical terraces, marshland development, local micro-processing units).

Contribution to the Sustainable Development Goals

INGABO Syndicate contributes to the following SDGs:

Impact

- INGABO Syndicate is inclusive, it currently has 16,051 active members of which 8,685 (54%) are women and 7,366 (46%) are men, with 20% being young farmers.
- Since its inception, Cassava Week has mobilised RWF 1.2 billion to finance cassava farmers.

Lessons learnt

Broad-based multistakeholder platforms, such as Cassava week, have made significant contributions to addressing the challenges and opportunities affecting the value chain. Due to its success in Rwanda, similar value chain platforms are being considered in upcoming regional projects targeting other agricultural commodities such as potatoes and livestock.

Future plans

INGABO Syndicate will continue developing partnerships and mobilising resources to implement its Strategic Plan (2023 – 2027).

INGABO Syndicate is to collaborate with the International Fund for Agricultural Development (IFAD) on a new project under the Global Agriculture and Food Security Programme titled 'Strengthening smallholder farmer resilience to (food and climatic) crises for improved food security and livelihoods in Rwanda'.

> ***"The journey is long, we need to collaborate with more partners in the field who have expertise in climate change to see how farmers can be at the centre of the journey, as they are the first to be affected,"***
>
> - Francis Xavier Mbabazi.

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East Africa

Rwanda

Revolutionising fodder production: A climate-smart solution for livestock farming

Context

In Rwanda, projected climate variability and change, including rising temperatures, more frequent and intense heavy rainfall events, and longer dry spells, pose a significant threat to the agricultural sector. The sector is already affected by seasonal shifts, increasingly unpredictable rainfall, limited infrastructure, high post-harvest losses, and restricted access to inputs and financing. Rising temperatures risk diminishing the quality and productivity of temperature-sensitive crops and expanding the range of crop pests and livestock diseases. Moreover, with 90% of crops cultivated on hills and steep slopes, intense rainfall increases the risk of landslides, soil erosion, and degradation of agricultural land.[48] This is especially problematic as only 51% (2021) of Rwanda's land is considered arable.[49]

As the son of a Rwandan farmer, Sylvestre Jackson Karara (Jackson) grew up witnessing how climate change affected his family's livelihood. His family benefited from Rwanda's 'Girinka' programme, a government initiative that provides a dairy cow to vulnerable households to support poverty alleviation, improve nutrition, and foster social cohesion. This cow provided milk for the family, and the surplus milk could be sold for income. Manure from the cow also enriched the soil, enhancing their small-scale cropping efforts. However, as rainfall decreased and the family's small plot struggled to support both food and fodder production, the cow's condition began to decline, and its milk output dropped from 12 l to just 3 l a day. The family adapted by waking early each morning to collect shrubs and grasses from roadsides and riverbanks to feed the cow. This experience was a turning point for Jackson, inspiring him to seek sustainable, climate-smart fodder solutions that could relieve families from this daily struggle and help them cope with climate challenges in the long term.

> ***"My dad cultivated vegetables which he sold to a boarding school. On his quarter hectare farm, he also raised goats and chickens, which reproduced fast. Despite the challenges, he was able to feed his family and provide fees for my studies, so I learnt that you do not need a lot of space to get a good income"***
>
> - Sylvestre Jackson Karara.

48 World Bank Group. 2021. Climate Risk Profile: Rwanda.
49 World Bank Group. 2024. Data: Arable land (% or land area) - Rwanda.

About Uruhimbi Kageyo Cooperative

Although Jackson studied pharmacy at the University of Rwanda his passion always lay in improving the lives of smallholder farmers. Determined to find a sustainable fodder solution, Jackson browsed the internet and came across a new technology 'hydroponic fodder' which had proven effective in Kenya and the Netherlands. Jackson liaised with an expert to improve his understanding of the technology and how to tailor it to the Rwandan context.

In 2018, Jackson and 14 of his fellow pharmacy students sought financial support through the Business Development Fund (BDF)[50] to establish a hydroponic fodder company. Their proposal was approved and they established a cooperative structure, as it provided a more accessible funding route. They invited an external individual to join the cooperative on the basis that he supplied the required collateral. With the capital investment secured, amounting to RWF 12 million, Uruhimbi Kageyo Cooperative (UKC) was launched just as the COVID-19 pandemic emerged. The outbreak caused significant delays, with much of the equipment becoming stranded, which complicated the initial stages of the operation. Despite these challenges, the team managed to consolidate operations by the end of 2020. Notably, they were able to repay the BDF loan ahead of schedule.

The initial tribulations proved too daunting for seven of the initial cooperative members who subsequently left. The remaining eight founders then formed a company owned by the cooperative, to be more attractive to future investors. Jackson and two other of the eight founding members are involved in the daily operations of UKC and receive a salary.

UKC is a youth-run initiative located in Gicumbi district, Northern Province of Rwanda. The company uses hydroponic farming to produce fodder for livestock (cows, pigs, goat, sheep, chickens, fish and rabbits).

The soil-less cultivation method conserves water and land, enhancing food security and reducing greenhouse gas emissions (enteric methane gas from livestock). UKC works to meet the fodder and crop residue needs of Rwanda's dairy farmers. The dairy sector is growing at a rapid rate in Rwanda. However, due to arable land limitations, the government passed a zero-grazing policy thereby accelerating the need for fodder production.

Images. *UKC hydroponic fodder centre in Gicumbi District, Rwanda.*

Jackson and his colleagues obtained a grant from the Mastercard Foundation in April 2021 for USD 20,000 to install and equip two screenhouses for hydroponic fodder production. These screenhouses are made from wooden shelves, shade net covers, aluminium trays for fodder cultivation and incubation materials. The dimensions of the screenhouses were 20 m x 10 m x 3 m, totalling 600m51. The grant also allowed UKC to conduct a 3-day training for 21 youths on "the role of youth in integrating smart technologies in solving livestock feed scarcity in Rwanda".

50 A branch of the Development Bank of Rwanda (BRD) established to support small- and medium-sized enterprises through the provision of loans.

51 Van Mele P, Mohapatra S, Tabet L. and Flao B. 2024. Young changemakers: Scaling agroecology using video in Africa and India. Access Agriculture, Brussels, 175 pp.

UKC produces hydroponic fodder by growing seeds without soil and with around 10-fold less water than traditional methods. In just six to seven days, the seeds from cereal grains (wheat, maize, sorghum, barley, millet and soya) sprout into 30-35 cm tall seedlings that provide highly nutritious feed.[52] The process starts by soaking cereal grains in water for four hours, allowing them to absorb enough moisture for germination. The grains are then placed in an incubation chamber for 24 to 48 hours until root radicles emerge. Afterwards, they are transferred to growing trays without the use of fertilisers, pesticides, or herbicides. Fodder is harvested at different stages depending on the livestock type to be fed. For example, four days of growth the grains are harvested for poultry, six days for pigs, rabbits, goats, and sheep, three days for fish, and seven days for cows. The entire plant (roots, leaves, and seeds) is consumed, making the system completely waste-free.

UKC requires cereal grains to produce the fodder. The Government of Rwanda gives organised youth groups access to land and UKC contracts them to grow maize, wheat, sorghum and to a lesser extent barley. UKC provides free training sessions for young farmers and provides them with relevant copies of training videos afterwards. UKC then buys the youth's harvest (three times a year) and stores it in a warehouse for continuous stock. To produce 120 t of fodder per week, UKC uses approximately 10 t of grains since 2 kg of grains yields between 12 - 13 kg weekly.

Image. *UKC's vertical, soil-less hydroponic maize production.*

Image. *UKC's youthful staff displaying a 5th day fresh hydroponic maize fodder.*

In 2021, UKC produced 6 t of hydroponic fodder weekly. By mid-2023, this had increased to 34 t and the fodder was distributed to farmers across seven districts namely, Ngoma, Rwamagana, Gicumbi, Nyabihu, Rubavu, Kayonza, and Gatsibo. By the end of 2023 the cooperative expanded to four screenhouses, producing 55 t of hydroponic fodder weekly in each of established setups. The fodder is sold at RWF 130/ kg and is delivered either directly to farmers' homes or to milk collection centres, where they can collect the feed after delivering their milk. On average, livestock farmers order 60 kg of fodder

52 Nkurunziza M. 2024. How farmers are saving cows with hydroponic fodder during dry spells. The New Times.

daily, which, when used as a protein supplement mixed with other crop residues like stovers and stalk feeds, which is enough to sustain four dairy cows or 20 goats. However, some farmers order up to 1 t daily. Chickens require much less fodder, with 60 kg sufficient to feed 90 chickens for 10 days.[53]

Fodder sales are seasonal with the demand increasing in summer. In 2023, UKC supplied fodder to 2,100 clients. Eastern Rwanda purchases the most hydroponic fodder as it has the most cattle.

> ***"You can produce fodder in a week on 10 to 20 metres of land that you might have needed three to six months to generate from five acres. It becomes an opportunity to do small set-ups in different countries and areas with low rainfall or limited water supply"***
>
> – Sylvestre Jackson Karara.

UKC supplies 60% of its hydroponic fodder to the dairy sector, 20% to poultry farmers, 15% to piggeries, and the remaining 5% to sheep, goat and rabbit farmers. In urban areas, livestock is typically managed by men, but women dominate the sector in rural areas.

UKC's hydroponic fodder is attractive to farmers because not only is it of good quality but it is available year-round and is more affordable than other locally available feeds with 1 kg of hydroponic fodder costing RWF 90 - 130 (depending on transport) as opposed to the alternative feeds which are priced at RWF 500/ kg. So not only is the cost of hydroponic fodder lower for farmers but due to its quality, their livestock productivity increases. Prior to UKC's establishment, farmers were reliant on expensive imported feed concentrates or those of poor quality (low protein content) that were available locally. In addition, farming families can now use their limited growing space to produce food and cash crops, instead of produce fodder for their livestock. Livestock keeping in the small land plots is also possible with zero grazing units.

UKC ensures their hydroponic fodder is of good quality by testing it on their own livestock on their model farm and monitoring the results. The feed ratio for cattle constitutes 70% crop residue and 30% hydroponic feed. Results show that dairy cows come into heat more frequently, every 7 months as opposed to 8-9 months, and produce more milk on the hydroponic fodder diet. Additionally, the hydroponic fodder achieves a high feed conversion ratio, for example, the fodder was fed to an indigenous goat which was purchased at 30 kg. The goat gained 15 kg over a 2-month period. Similarly, UKC purchased rabbits which weighed around 1 kg and they subsequently gained a further 2 kg on the hydroponic fodder diet. UKC's chickens are also healthy and lay large eggs.

From 2022-2023, the RAB, the government body leading policy and research under the Ministry of Agriculture, conducted research on the benefits of feeding UKC's hydroponic fodder to dairy cattle. They have communicated with UKC that they are impressed by the results but are yet to release the publication.

UKC trains farmers on how to grow their own fodder using simple hydroponic systems, as well as on agroecology and sustainable agricultural practices. Training videos are produced in local languages using a solar powered smart projector obtained through the Access Agriculture initiative. Over a three-year period, from 2022-2024, UKC trained 7,300 people targeting women and youth (70% women and 60% youth).[54] The Government of Rwanda incentivises the farmers to adopt hydroponic fodder production through VAT exemptions for imported hydroponic kits. The Government has also included hydroponic fodder feeding in the national animal feed policy.

Awareness raising and building farmers' and customers trust in hydroponic fodder has been critical to UKC's success. This was achieved by initially providing hydroponic fodder to neighbouring farmers for free and inviting them to visit the demonstration sites to better understand the technology and to witness the lack of chemical inputs. After the site visits and seeing the improvements in their livestock

53 Van Mele P, Mohapatra S, Tabet L. and Flao B. 2024. Young changemakers: Scaling agroecology using video in Africa and India. Access Agriculture, Brussels, 175 pp.

54 *Ibid.*

productivity the farmers then become UKC ambassadors, growing awareness amongst fellow farmers in an organic way. Further, UKC staff market their produce and services through various means. They speak on national television in Rwanda, on TV10, Radio Imanzi (a private radio station), the press media like The NEW TIMES, IGIHE and the Kinyarwanda radio programme which has increased awareness of UKC and contributed to its rapid growth. Jackson also submitted his story to the British Broadcasting Corporation and Voice of America. In addition, UKC success story was featured by Horizon Magazine, an EU research and innovation magazine. He has worked with the Rwanda Development Organisation, a civil society network that connects extension service providers across the country.

UKC employs 23 permanent employees and around 15 casual workers. The permanent staff include greenhouse technicians, agronomists, animal scientists, logistics personnel, drivers, operations managers, and communications and finance staff. Casual workers assist with the transportation of fodder and seeds and undertake the labour and cattle herding responsibilities at UKC's model farm. With the greenhouse expansion activities underway, UKC will create around 500 additional jobs, prioritising the employment of women and youth. The company aims for a ratio of 70% women: 30% men. At the close of 2023, UKC employed 18 youth on a full-time basis.

> ***"It grew and grew to the point of providing decent jobs. The youth are embarrassed when discussing cultivating soil, but they love technology and smart practices. Because this is soilless, dirt-free, and vertical, they were attracted to it,"***
>
> - Etienne Niyigaba (co-partner of UKC).

UKC is committed to:

- Creating dignified work opportunities for Rwandan youth;
- Driving skills development and entrepreneurship; and
- Transitioning from subsistence agriculture to higher-value products and services.

> ***"To be successful, you need to work in partnership with others. Leverage existing opportunities and use these for the social and economic benefits of the underprivileged. Optimise what exists and add value to what you and others do"***
>
> - Sylvestre Jackson Karara.

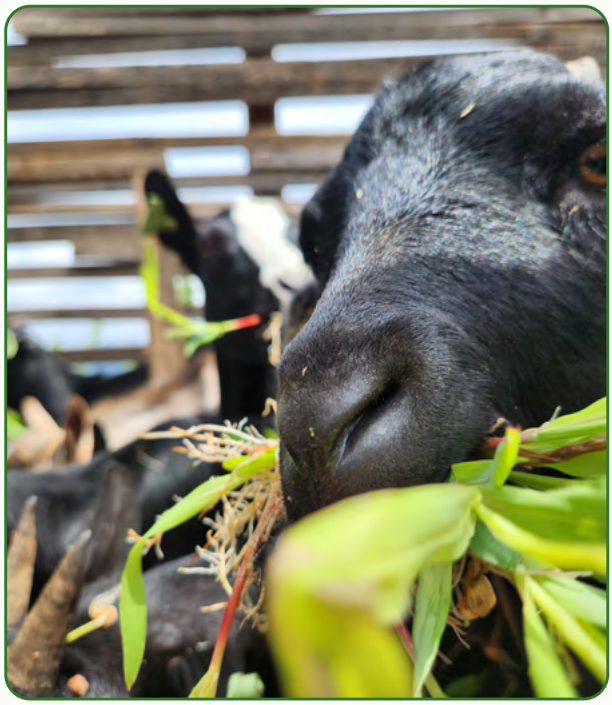

Image. *Goat eating UKC fodder.*

Image. *UKC animal scientist feeding 7th day harvested hydroponic fodder to their Friesian dairy cow.*

Products and services

UKC grows hydroponic fodder for livestock farmers and purchases the required cereal grains from young farmer groups, through a contract-based system. The hydroponic fodder provides a sustainable, affordable and year-round alternative to traditional fodder options. The hydroponic fodder is highly nutritious with essential nutrients, promoting healthier and more productive livestock.

UKC provides training to farmers on setting up simple hydroponic fodder systems as well as to promote agroecological practices such as organic products, soil regenerative practices through livestock incorporation and vertical farming.

UKC's customers include smallholder livestock farmers, dairy cooperatives, young agripreneurs, academia, developmental organisations and NGOs. By empowering youth and supporting local farmers, UKC promotes a resilient and inclusive agricultural community.

Environmental component

UKC trains farmers on agroecological, sustainable practices as well as hydroponic fodder production. UKC's hydroponic fodder system reduces water use by up to 10-fold and due to its intensive and soil-less production it reduces the pressure on Rwanda's arable land in alignment with the Government's no-grazing policy. UKC does not use herbicides, pesticides or chemical fertilisers which reduces the chemical pollution of land and water. The screenhouses provide a controlled environment, with the equipment and materials used are resilient against pests.

Climate change component

The hydroponic fodder system provides a solution in times of drought and water scarcity as it requires up to 10-fold less water than traditional production systems. UKC has reduced their water use significantly by using misting irrigation as well as recycling water within the vertical structures. Fodder irrigation is powered through gravitational pressure and smart foggy irrigation in other mega screenhouses. UKC optimises rainwater harvesting in big 10,000 l tanks making their production costs minimal. Hydroponic production also reduces pressure on land which can lead to land degradation and landslides during periods of intense rainfall in Rwanda's hilly farmlands. The screenhouses protect the plants from heavy rainfall and extreme temperatures and limit outbreaks of pests and diseases. The lack of fertiliser application reduces greenhouse gas emissions released during production, transportation and application.

UKC is studying the impact of hydroponic fodder on methane production in local cattle breeds. The Rwanda Environment Management Authority (REMA) has initiated a carbon credit system so UKC hopes to use the findings from their research to receive payments.

Community and marginalised groups component

Inclusivity is central to UKC's mission, and the diversity of its training programme participants is testament to this commitment comprising 70% women, 5% individuals with disabilities, and 5% refugees. By empowering individuals from all backgrounds, UKC aims to build a more inclusive and resilient future for Rwanda.

Hydroponic fodder production is particularly attractive to youth who are interested in technology and innovation. The initiative is therefore valuable in attracting youth back to the agricultural sector.[55]

Image. *UKC staff with one of their poultry farmers.*

Image. *UKC staff members with one of their new pig farmer clients.*

Capacity building component

Hands-on training is provided to farmers on hydroponic fodder production, agroecological practices, animal feeding and husbandry, business concept development, coaching, mentoring, and establishing market connections with cooperatives across a variety of value chains.

UKC targets marginalised groups such women, refugees and the disabled, to help them understand the hydroponic technology. The participants are then accompanied through their adoption of the technology to ensure they are successful.

UKC has partnered with PUM, a Dutch NGO, that works with small and medium-sized enterprises to optimise their business ecosystems.

55 Horizon Magazine. 2023. Innovating Agricultural Practice One Seed at a Time. Issue 6. Mastercard Foundation.

Challenges

There is a need for:

- **Awareness creation** - Joint farmer training and awareness campaigns between the government and private actors.
- **Access to finance** - Access to low interest loans (i.e. single-digit interest capital) and grants.

Contribution to the Sustainable Development Goals

UKC contributes to the achievement of the following SDGs:

Impact

- Over a three-year period UKC trained 7,300 people targeting women and youth (70% women, 60% youth, 5% disabled, 5% refugees).
- At the close of 2023, UKC employed 30 youth on a full-time basis.
- Distributes hydroponic fodder to 2,100 (2023) farmers across seven districts – 760 women, 589 men and 751 youth.
- 37 farmers, 18 women, 7 men and 12 youth produce their own hydronic fodder.
- 897 farmers, organised in cooperatives and groups, supply grains to UKC.

Plans for future growth

Pelletising fodder: Since fresh fodder has a limited shelf life of 14 days, it is essential for clients to be located nearby, and transport is expensive. To overcome this constraint, UKC is transitioning to pelletising the fodder, which extends its shelf life to up to three years. This innovation will enable UKC to access distant markets as well as expand its customer base to include fisheries and pet owners. While pelletising will increase production costs, this will be mitigated by incorporating dry matter and agricultural residues, such as maize stalks, into the formulation. This approach will create a nutritionally complete pelletised feed while also reducing costs, as the residues are readily available and inexpensive.

Carbon credit market: REMA has initiated a carbon credit system through which UKC aims to receive payments in the future.

Organic certification: UKC is applying for organic certification for their beef, pig and poultry production to expand their offerings and market further.

Client reach: UKC's primary objective is to meet the fodder demand within Rwanda, after which it will expand into neighbouring countries. Notably, UKC has already received inquiries from farmers in southern Uganda, Tanzania, Burundi, Nigeria, the Republic of Congo, and the Democratic Republic of Congo.

UKC started by supplying farmers with hydroponic fodder in Gicumbi district and has since expanded its reach to an additional six districts with the target of establishing production sites and supplying farmers in all 30 districts of Rwanda. Further, by training farmers to produce their own hydroponic fodder, UKC aims to purchase it from them to meet the demands of the growing client base.

Images. *Awareness creation around the benefits of hydroponic fodder.*

Lessons learnt

Innovative practices can attract young farmers: UKC's youth-led model shows that modern agricultural practices can attract young people who may otherwise be reluctant to engage in traditional farming. Using technology and smart agricultural practices, UKC not only provides sustainable employment but also fostered a sense of pride and ownership among young people in the agricultural sector. This has encouraged a shift in perspective, where youth see value in modern, technology-driven agriculture rather than avoiding it.

The importance of visibility, transparency, and local partnerships in fostering acceptance for innovative practices: By offering free initial fodder samples and hosting on-site demonstrations, UKC built trust among local farmers and showcased the benefits of hydroponic fodder. Word-of-mouth advocacy from satisfied farmers proved to be a powerful tool, further strengthening community acceptance and adoption.

Long term commitment: Team building and organisational growth are ongoing processes requiring patience and resilience to achieve a shared vision. This journey demands disciplined planning and execution on a daily, weekly, and annual basis.

De-risking and scaling agribusinesses: De-risking one's agribusiness is essential in making agriculture more attractive, bankable, and scalable. Innovative ideas will only thrive if we prioritise investment in risk management, particularly for advancing new technologies. However, limited access to resources and collateral remains a barrier. It is crucial that youth step forward boldly to seize existing opportunities—or create new ones where none exist. With commitment and initiative, success is within reach!

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East Africa

Uganda

Sustainable Bamboo: Community-led Ecosystem Restoration and Landslide Prevention

Background story

Uganda faces considerable risks from natural disasters, particularly in its mountainous regions. The country experiences extreme rainfall events which lead to mudslides, landslides, flooding and erosion, especially in the Mount Elgon region. Mount Elgon is an extinct volcano situated in eastern Uganda, on the Kenya-Uganda border.[56] Mount Elgon was designated as a forest park in 1938, managed by the Forest Department. Its status underwent minor changes over the years, but in 1993, it was officially upgraded to a National Park. Between 1938 and 1993, the park's management focused primarily on protecting its water catchment areas and biodiversity resources, with limited timber extraction carried out by commercial operations and pit-sawyers.[57] Since 1993, the park has been governed under Uganda's wildlife laws, including the Uganda Wildlife Act of 2019. The Uganda Wildlife Authority (UWA) is the state entity currently responsible for managing and protecting the Ugandan side of the transboundary Mount Elgon National Park.

Mount Elgon has increasingly experienced flooding and catastrophic landslides due to heavy rainfall events which destabilise the slopes of the mountain. Bududa District, situated in the steep foothills of Mount Elgon,[58] has seen the loss of property and

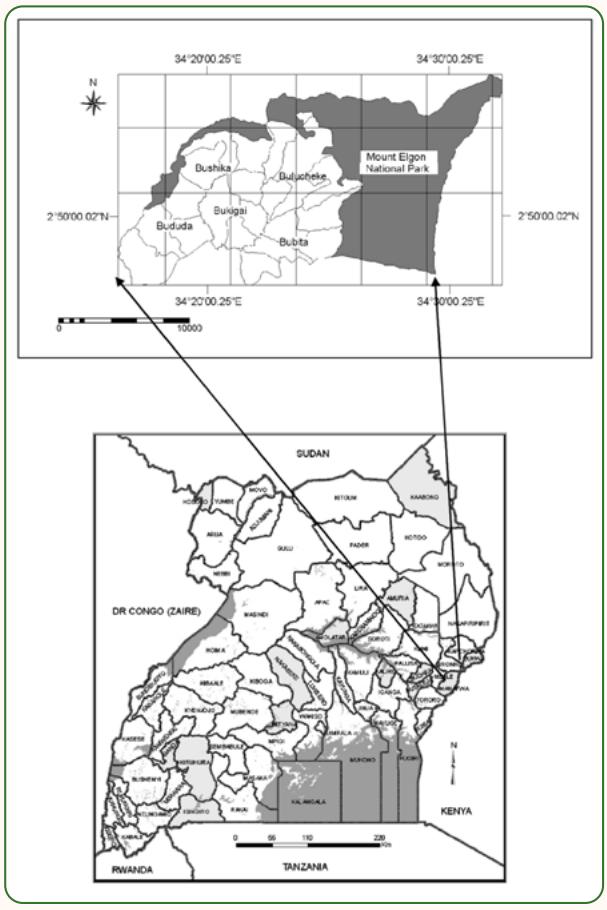

Figure 5. *Bududa District is located on the border of Mount Elgon National Park (Kitutu et al., 2011).*

56 UWA. 2022. Mount Elgon National Park (MENP). General Management Plan. Year 2022/2023 – 2031-2032. Uganda Wildlife Authority.
57 *Ibid.*
58 Kitutu M, Muwanga A, Poesen J., Deckers J. 2011. Farmer's perception on landslide occurrences in Bududa District, Eastern Uganda. African Journal of Agricultural Research.

social infrastructure (schools, bridges and hospitals), the displacement of communities and the loss of human lives as a result of landslides.[59] For example, in 2010 heavy rainfall caused a landslide that killed more than 300 people in Bududa District, with a further 40 lives lost to a landslide in 2018. In 2023 heavy rainfall caused further landslides in the Mount Elgon region, 5 people lost their lives, 7 were injured and 328 people were displaced with women and children being the most affected.[60] Poverty, deforestation, unsustainable agricultural practices and poor local knowledge on disaster preparedness have increased the vulnerability of the local communities living on the National Park's boundary. In addition, erosion is a continuous challenge.

Mount Elgon serves as one of the critical water towers of the region, playing a vital role in the hydrological cycle of the region's major lakes, including Lake Victoria. The mountain was once covered in dense forest and belts of indigenous highland bamboo (*Yushania alpina*), however, a rapidly increasing population and high levels of poverty amongst local communities have led to severe deforestation, encroachment, and overexploitation, reducing the stability of the mountain's slopes. The illegal deforestation activities have caused tension between UWA and the resident communities.

Mount Elgon National Park is divided into six different management zones including tourism, plantation, administrative, collaborative, restoration and wilderness (Figure 5). Communities neighbouring the park are permitted to harvest resources (medicinal, firewood and other approved resources) within the collaborative resource use zone. The zone is a continuous 1-kilometre-wide strip along the boundary of the park. However, access to the park and the extraction of resources are subject to agreements with Mount Elgon National Park management.[61] The restoration zone comprises areas close to the park boundary which were formerly encroached and have now been restored or are undergoing restoration.

As part of the restoration process, UWA plants indigenous tree species, focusing on areas where natural regeneration is poor. The restoration zone will ultimately be classified as a wilderness zone once activities are complete.

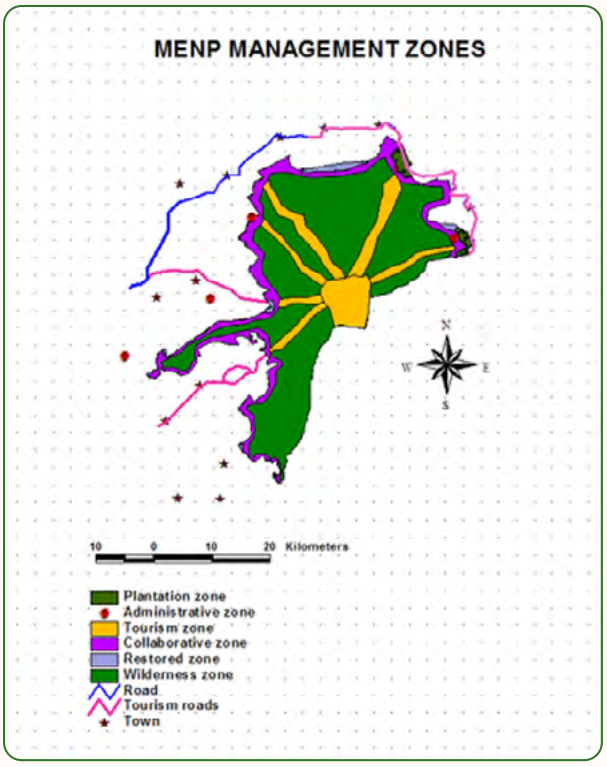

Figure 6. *Mount Elgon National Park Management Zones.*[62]

About AW Bamboo Enterprises Ltd.

In 1998, Irene Walimbwa, a local advocate and champion of women and youth empowerment from Mbale town in Bududa District, mobilised farmers in the area to start a savings group to support small businesses. In 2000, the savings group was given a grant of UGX 4 million which they used to purchase four heifers. When the cows reproduced, the calves were handed to the next four members of the group, and so on. This initiative is still ongoing today.

59 Eseet I. 2013. Landslide risk in Mt. Elgon region, eastern Uganda. Dissertation. Busitema University.
60 Oxfam. 2023. Landslide/Mudslide/Floods Disaster Response in Bulambuli District in the Mt. Elgon Sub Region, Uganda.
61 UWA. 2022. Mount Elgon National Park (MENP). General Management Plan. Year 2022/2023 – 2031-2032. Uganda Wildlife Authority.
62 *Ibid.*

However, with time, the group's focus evolved from livestock husbandry into edible bamboo production and processing. The idea was born from Irene sending edible bamboo shoots (a Ugandan delicacy known as *malewa*) to her friends living abroad and realising there was a gap in the market. Irene recognised that the bamboo could deliver both socioeconomic and environmental benefits by providing a healthy food source for the local community, contribute to stabilising Mount Elgon's slopes as well as climate adaptation and disaster risk reduction.

In 2012, Irene founded **AW Bamboo Enterprises Ltd**. As the land available to grow bamboo was limited, Irene originally sourced bamboo from local markets which proved to be costly. In 2018, at a trade show, Irene met with representatives of the Uganda Development Corporation (UDC) who encouraged her to apply for funds on the basis that the farmers cultivated their own bamboo and were organised as a cooperative society.

Images. *Irene Walimbwa and the AW Bamboo Enterprises team.*

To address the shortage of land for growing bamboo, Irene applied to UWA to use land on the boundary (in the collaborative zone) of Mount Elgon National Park. She wrote a letter to the chief warden who was intrigued by her proposal as it had never been done before. In 2021, a Memorandum of Understanding (MoU) was signed by Bududa District government, UWA and AW Bamboo, giving AW Bamboo the right to use land along the boundary zone of Mount Elgon National Park for sustainable cultivation and livelihood activities. The MoU allows for local communities in ten sub-counties of Bududa District to grow and harvest bamboo on 45.5 ha of land, located within 10 m of the park boundary, in areas which are degraded and require restoration. The area was allocated using geographic coordinates for demarcation. AW Bamboo agreed not to cultivate any area of the Mount Elgon National Park which had already regenerated naturally. The MoU recognises that the land remains the property of the Government of Uganda, managed by UWA. The MoU expires in 2026 and will be renegotiated according to its perceived success.

At the start of the agreement, the Mount Elgon National Park office recommended Irene start the bamboo cultivation activities in Bushiyi sub-county

Image. *AW Bamboo and their UWA partners.*

as there were no incidences of conflict over land in the area and the UWA was successfully operating there with good relations with the community structures in place. Boundary Committees had been established in every sub-county to work in collaboration with UWA community conservation rangers (CCRs) to assist with monitoring and settling any arising conflicts.

AW Bamboo launched a pilot project with the communities in the district. So far AW Bamboo has planted 24.3 ha across 5 sub counties (Bushiyi, Bundesi, Bufuma, Bikalasi, and Mabono). The plots are subdivided into areas measuring 10 m by 15 m for each farmer.

Images. *Plantation drive at the pilot project site on Mount Elgon.*

Products and services

AW Bamboo grows and harvests edible bamboo in Mount Elgon National Park - the first business of its kind. The following practices are carried out to ensure the bamboo harvesting is sustainable:

- The shoots are only harvested when they are 30 – 60 cm high.
- If there are four shoots on the culm, only two are harvested and the remaining two are left to grow.
- The trees are not harvested until they are mature (over five years old).
- If there is a landslide the CCR and Boundary Committee call for a meeting to assess the damage caused to the community's buildings before the bamboo is harvested and distributed for construction purposes.

The bamboo shoots, small offcuts of the main plant, are harvestable after around two years of growth and are either sold fresh or processed (dried, smoked and packaged) for consumption (*malewa*). The dry-smoked shoots are also ground into powder which is used in local cuisine. A solar dryer is used to dry the bamboo, which takes around three days to process. The bamboo is also processed into cosmetic products and the mature stems are sold as construction poles and materials or used to make crafts and furniture.

AW Bamboo currently targets the local market. Edible bamboo shoots trade for UGX 5,500/ 100 g and UGX 5,000/ bamboo pole (cost of a 3 m pole including transport).[63]

Images. *Preparing bamboo shoots to make malewa.*

Images. *Drying and smoking bamboo shoots.*

Images. *Irene selling AW Bamboo products.*

63 *Ibid.*

Bamboo cuttings from Mount Elgon are also transplanted in nurseries in the lowlands to provide shoots for the local communities to plant around their homesteads. The farmers are taught to optimise land use by adopting sustainable techniques such as contouring and intercropping with other important food crops such as vegetables, beans and maize. The farming practices used are largely traditional but AW Bamboo hopes to attain funding and engage with the district technical and extension officers to train the farmers in modern practices. The farmers then grow their own bamboo and after two years they harvest it and sell it back to AW Bamboo. Bamboo cultivation is rainfed and accessible to all community members, requiring minimal maintenance.

Image. *A farmer planting bamboo shoots.*

Image. *Bamboo is collected from Mount Elgon and taken to the lowlands where it is cut and replanted.*

Currently, over 500 women and young people from local communities are involved in the initiative growing not only bamboo but tree species such as Olea welwitschia (Elgon teak), *Podocarpus spp., Prunus africana, mahogany spp., Aningeria altissima, Cordia africana (Sudan teak), Cordia millenii, Strombozia schefulleri, Syzygium spp.*, and *Newtonia buchananii* and Arabica coffee.[64] The indigenous trees are sustainably harvested for timber and fuelwood. The farmers are also permitted to keep bees for honey production. The communities have embraced the project because they are the direct beneficiaries.

In 2021, AW Bamboo became a member of the International Network of Bamboo and Rattan (INBAR) and in 2022 INBAR provided processing equipment (for vacuum sealing packages) to AW Bamboo. AW Bamboo also collaborates with INBAR, and other technical partners, to provide training to community members on bamboo value addition, post-harvest handling, and financial skills.

64 Global Center on Adaptation and Climate and Development Knowledge Network. 2023. Stories of Resilience: Lessons from Local Adaptation Practice. Rotterdam and Cape Town.

2005

- First Bamboo Gift sent to UK Friends
- Start of private edible Bamboo sales directly to interested family and friends

2012

- Registration of AW Bamboo enterprises Ltd
- Started packaging and attended Agricultural trade fair in Jinja
- Member of Uganda Small Scale Farmers Association (USSIA)

2021

- Member with INBAR-(U)
- Signed MOU with UWA to pilot Bamboo growth in the Mt Elgon National Park

2022

- Site visit in Bududa by INBAR and Head of Bamboo growers from Ethiopia
- INBAR committed to provide machines for the cottage plant to process edible Bamboo

Figure 7. *Timeline for establishing AW Bamboo.*[65]

STEP 1
Partnerships
Partnership with UWA, Bududa DLG, INBAR, USSIA among others

STEP 2
Preparation
- Selection and sensitization of farmers and out growers
- Establish of nursery beds
- Distribution of bamboo seed and plantlets

STEP 3
Growth, Harvesting, Processing
Early harvest of edible bamboo, sustainable harvest, processing, and value addition to full grown bamboo

STEP 4
Market
- Social Media Platforms
- Retailers (Duukas and Supermarkets)
- Dealers in wood products

STEP 5
Sustainability
- Highland bamboo re-afforestation
- Proper post-harvest handling
- Audit of full value chain process

Figure 8. *Process followed by AW Bamboo to sustainably grow, harvest and process bamboo on and around Mount Elgon.*[66]

Food insecurity is a major issue in Uganda, with 48% of the population facing moderate food insecurity and 11% experiencing severe food insecurity. Malnutrition is also prevalent, with an estimated 2.4 million children suffering from stunted growth.[67] Bamboo farming presents a promising solution to the food security and malnutrition challenge. Bamboo shoots are nutrient-rich, providing a good source of fibre,

65 AW Bamboo Enterprises Ltd. PowerPoint Presentation.
66 AW Bamboo Enterprises Ltd. PowerPoint Presentation.
67 Nwoha C. 2023. How bamboo farming in Uganda reduces poverty. Borgen project. News.

vitamins (B6 and E), and minerals (potassium, phosphorus, sodium, calcium, magnesium, and iron), protein and carbohydrates making them a valuable resource in combating the nutritional deficiencies that contribute to stunted growth in children.[67] The leaves are also a valuable source of nutrition for livestock.

AW Bamboo's vision, mission and objectives include:

Vision: To support the community in growing bamboo and adding value for livelihood incomes.

Mission: To offer the best quality bamboo (malewa) in its original form at affordable prices to the community, local traders, tourists, exporters and all leading supermarkets and other stakeholders.

Objectives:

- Produce high quality malewa of different exportable grades.
- Provide an excellent service experience.
- Empower local farmers with basic knowledge regarding bamboo agronomy and post-harvest handing.
- Produce bamboo cosmetics.
- Extract bamboo sap for clothing processing.[68]

In terms of the company's governance structure, Irene is the Director of AW Bamboo with other permanent positions including a co-director and head of finance, a marketing and strategy head, a production manager, an accountant, a plantations and community manager, and an Information Technology (IT) specialist. AW Bamboo also hires internship students and unskilled employees comprising 70 out growers as well as machine operators.[69]

AW Bamboo markets its bamboo through mobile network marketing and social media. The company sells its products directly to local consumers as well as to supermarkets.

Environmental component

Deforestation leads to the loss of biodiversity and the destruction of ecosystems that provide essential services such as water purification and climate regulation. Deforestation can also lead to soil erosion, which affects agricultural productivity and food security. Deforestation is a major challenge on Mount Elgon, from the 1970s to 2009, 25% of the mountain's forest was lost.[70] Deforestation is primarily driven by illegal logging for fuelwood, construction materials, and the clearing of land for agricultural production. Bamboo farming in Uganda is ideal for reforestation efforts due to its rapid rate of regrowth after harvesting. Bamboo produces new shoots annually which assists with soil stabilisation and ultimately protects against landslides and soil erosion. Thus, AW Bamboo's bamboo and tree plantations are contributing to land restoration on Mount Elgon as well as preventing the damage and loss associated with landslides.

AW Bamboo promotes organic bamboo cultivation and thereby prevents chemical pollution of the surrounding natural environment.

Overexploitation has led to the near local extinction of *Yushania alpina* on Mount Elgon, AW Bamboo's activities have therefore contributed to the restoration of the bamboo species as well as the other tree species that the communities plant in the National Park.

67 Nongdam P and Tikendra L. 2014. The Nutritional Facts of Bamboo Shoots and Their Usage as Important Traditional Foods of Northeast India. Int Sch Res Notices.
68 This activity is planned for the future, it requires an expansion in bamboo production and funding to initiate.
69 AW Bamboo Enterprises Limited. Company Profile.
70 Sassen M. 2014. Conservation in a crowded place : forest and people on Mount Elgon, Uganda. Wageningen University.

Climate change component

Farmers in the Mount Elgon area traditionally grow Arabic coffee, bananas (matoke), maize, beans, potatoes (Irish), sweet potatoes, cassava, groundnuts and vegetables. AW Bamboo has enabled further diversification by encouraging bamboo cultivation and value addition, thereby enhancing the community's socio-economic resilience and reducing their vulnerability to climate change.

The bamboo cultivation in Mount Elgon National Park is contributing to slope stabilisation thereby reducing the risks of landslides which are increasingly occurring due to extreme rainfall events.

Uganda is increasingly interested in Africa's carbon market, having generated over 33 million carbon credits through the Clean Development Mechanism and Voluntary Carbon Market standards.[71] Woody bamboo has mean carbon storage and sequestration rates ranging from 30–121 Mg/ha and 6–13 Mg/ha annually, respectively.[72] As such, AW Bamboo is contributing to climate change mitigation and simultaneously looking for opportunities to generate carbon credits to increase the revenue streams of local communities thereby reducing their vulnerability to climate risks.

Community and marginalised groups component

AW Bamboo provides livelihood opportunities for the local communities through the bamboo value chain. People (predominantly women and youth) are paid to plant bamboo, clear weeds and maintain it, sustainably harvest its shoots, transport it, process, package and market it. AW Bamboo works to ensure that the communities benefit directly. Local community members who rely on the bamboo for their livelihoods mostly constitute women and youth.[73]

Capacity building component

AW Bamboo sensitises the community on the benefits and opportunities of bamboo cultivation, and trains them on sustainable planting and harvesting techniques. AW Bamboo partnered with INBAR to provide technical training to community members on bamboo value addition, post-harvest handling, and financial skills. INBAR also increases awareness on climate change through workshops and knowledge sharing resources and research.

Image. *A farmer training session.*

71 Climate Finance Innovators. 2023. Carbon report, Uganda.
72 Nath AJ, Lal R, Das AK. 2015. Managing woody bamboos for carbon farming and carbon trading. Global Ecology and Conservation, Vol. 3, Pp 654-663.
73 AW Bamboo Enterprises Ltd. PowerPoint Presentation.

Challenges

The key challenges faced by AW Bamboo are limited financial resources to scale operations and to access modernised practices and technology, specifically to help with drying and packaging. The process is currently done by hand and is extremely time consuming. Also, the solar drier only functions when there is sun, which limits the operations on rainy days. Funding is needed to scale up marketing and distribution, for quarterly training and upskilling of women and youth out growers, and the purchasing of refrigeration and refurbishment of storage facilities.

Funding is also needed to expand the bamboo production activities to the remaining seven sub-counties which will require sensitisation activities, further research, capacity building, processing equipment and land.

Another significant challenge is accessibility to the demonstration site and transport. The road to the site is unpaved and extremely difficult to use, making the area hard to access without a 4 x 4 vehicle. AW Bamboo would ultimately like to purchase its own transport vehicles and small scooters to move produce around.

Contribution to the Sustainable Development Goals

AW Bamboo contributes to the achievement of the following SDGs:

Impact

Over 6,000 bamboo seedlings have been planted with more than 500 women and young people from local communities involved in the initiative. AW Bamboo demonstrates how community-led ecosystem restoration, combined with the cultivation of indigenous species, can create business models that are sustainable environmentally, socially, and economically. The aim is for the value chain model to be replicated in other districts within the Mount Elgon region.

Future plans

The bamboo market is large with over 200 million bamboo users in East Africa. There are approximately 2 million people in Uganda consuming bamboo shoots and around 5 million Ugandans using other bamboo products.[74] AW Bamboo currently services the local market but plans to undergo the necessary certification standards to supply retail shops in Uganda, as well as to export regionally and

74 AW Bamboo Enterprises Ltd. PowerPoint Presentation.

internationally in the future. Ultimately, AW Bamboo aims to expand production to 300 – 1,000 t/annum and export their products to the Asian and American markets (Figure 9). It also plans to explore the carbon credit market to generate an additional revenue stream for the local communities.

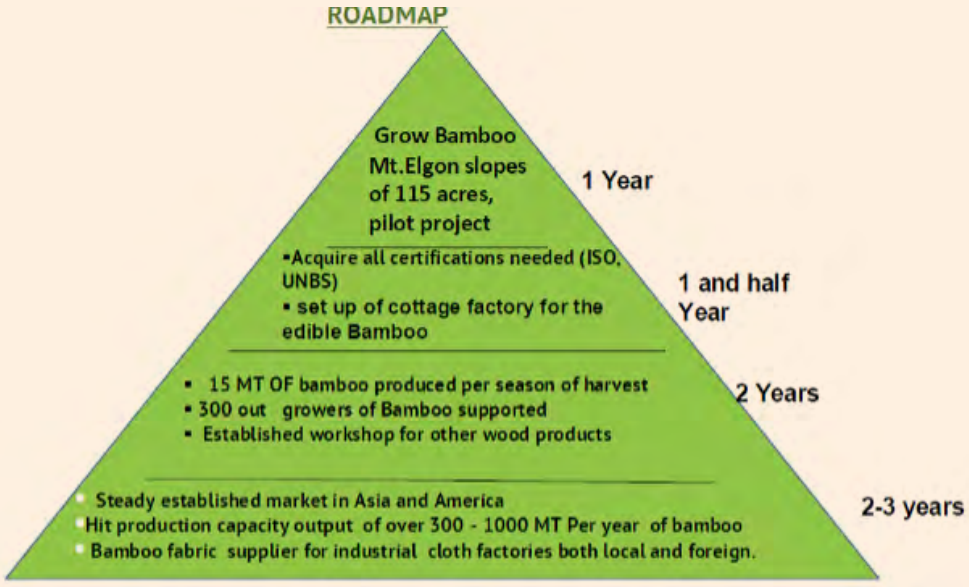

Figure 9. *AW Bamboo's expansion roadmap*[75]

Lessons learnt

Truly community-driven approaches foster ownership and sustainability: Involving local communities in bamboo cultivation and restoration efforts not only enhances livelihoods but also builds trust and reduces conflicts between stakeholders, such as local farmers and conservation authorities.

Broad-based collaborative partnerships enhance long-term project success: The agreement between AW Bamboo, local government, and the conservation authority, combined with technical and financial support from organisations like INBAR, have been instrumental in overcoming resource limitations and implementing scalable and sustainable land restoration initiatives.

Mutual accountability strengthens collaboration: Effective partnerships between communities and protected area authorities depend on both parties adhering to the terms of the MOU. When each side fulfils their commitments, trust is reinforced, conflicts are minimised, and shared conservation and livelihood goals are more likely to be achieved.

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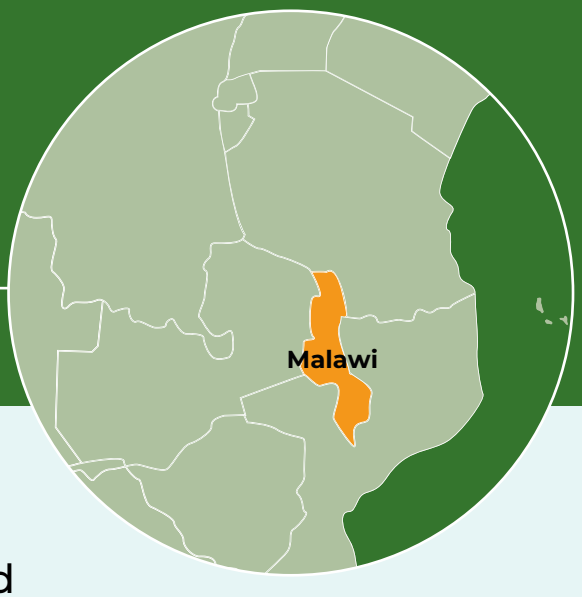
75 AW Bamboo Enterprises Ltd. PowerPoint Presentation.

Southern Africa

Malawi



Growing resilience: How a macadamia cooperative empowers smallholder farmers to combat climate change and food insecurity

Context

In recent decades Malawi has faced significant climate change and variability, resulting in devastating climate shocks that have become increasingly frequent. The most notable of these shocks include erratic rainfall, droughts, prolonged dry spells, and strong winds.[76] Malawi's economy is predominantly agricultural, with the sector supporting approximately 80% of rural livelihoods and contributing about 30% to gross domestic product as well as 80% of export revenue.[77] The performance of other sectors is closely tied to agriculture, which primarily relies on rainfed systems and is therefore highly susceptible to climate change and variability. Malawi is one of the poorest countries in the world and climate change is reinforcing the vicious cycle of malnutrition, disease, and poverty.

Smallholder farmers who depend on maize and other annual crops are particularly vulnerable to the compounded impacts of rising droughts, floods, and extreme temperatures, especially in areas prone to soil erosion. These farmers typically rely on wood and charcoal for 85% of their energy needs, which is becoming harder to obtain and increasingly costly as forest reserves are depleted.[78] With the urgent need to adapt to these challenges for continued production and food security, farmers have identified macadamia agroforestry as a potential solution.

Image. *A photo of southern Malawi's drought-impacted land with evidence of soil erosion and deforestation.*

76 World Bank Group. 2021. Malawi. Climate change overview, country summary. Climate Change Knowledge Portal.
77 *Ibid.*
78 Nutcellars blog: Working to achieve the Sustainable Development Goals.

Background story

Macadamia trees have been cultivated in Malawi for several decades, primarily in the southern region where most of the production and processing activities have historically been concentrated. While macadamia cultivation is often associated with large commercial estates, a significant number of small- and medium-scale farmers across the country have also established macadamia orchards. These smaller farmers operate independently, as part of cooperatives and associations, or as out growers linked to commercial estates.

In recent years, the Malawian macadamia industry has expanded significantly, especially in the central and northern regions. Macadamia production has offered farmers an opportunity to diversify their livelihoods and income-generating activities providing a buffer against crop failures due to climate variability as well as assisted them in moving away from tobacco farming, the demand for which has drastically declined. As a high-value cash crop, macadamia nuts increase smallholder farmers' incomes, reducing their economic vulnerability. Macadamia nuts are also a valuable addition to household nutrition and food security, particularly during the 'hunger season' (January-April) when rainfall declines and annual dryland crops are scarce and expensive.

In addition to enhanced resilience and food and income benefits for farming communities, macadamia trees also offer a multitude of environmental and climate change mitigation benefits. As a perennial crop, macadamia trees help reduce topsoil erosion, promote organic matter buildup, and support beneficial microbial activity. Their canopies provide habitats for pollinators and pest predators, whilst also helping to cool soil surfaces and retain moisture, fostering biodiversity and contributing to carbon sequestration.

Due to these various benefits, macadamia is increasingly seen by the Malawi Government to be of strategic importance as part of its 2063 strategic development plan.

Despite the benefits offered by macadamia production, small- and medium-sized farmers face several challenges in production:

- Limited access to necessary inputs (e.g. quality seedlings and credit) to ensure good yields and quality.
- A lack of technical knowledge and support specific to macadamia cultivation, including orchard management and post-harvest practices.
- The need to sustain the crop for several years before the first harvest.
- Challenges related to coordination, aggregation, processing, and marketing.
- Disruptions related to unavoidable and unpredictable global market and trade volatility.

Image. *Macadamia tree in flower and macadamia nuts in and out of shell.*

About the Highlands Macadamia Cooperative Union Limited

In 2011, the Highlands Macadamia Cooperative Union Limited (HIMACUL), a smallholder farmer cooperative organisation, was established to address the challenges faced by small- and medium-sized farmers in successfully engaging in macadamia agroforestry. HIMACUL is structured as a cooperative union (management, secretariate, and board), with seven district primary cooperatives and farmers groups organised as 'business centres'. (It should be noted that in some districts there are more than one cooperative). These business centres comprise both large and small farmers collaborating to support smaller, marginalised farmers, particularly women and youth, in cultivating macadamia trees.

HIMACUL's formation was rooted in two key initiatives:

- The Neno and Mwanza district cooperatives were started with support from the Emmott family in the 1990's and subsequently through Neno Macadamia Trust (NMT). While initially focused on assisting macadamia farmers in the Neno District, NMT shifted its efforts to support HIMACUL after its formation, thereby linking southern region cooperatives with others across Malawi.
- The central and northern region district-level cooperatives were established following the Macadamia Smallholder Development Project (MSDP), funded by the African Development Fund and managed by the Government of Malawi, which began in 2001. This project was initiated by the government to enhance the smallholder macadamia sector.

Currently, HIMACUL represents 400 active trading members, managing approximately 180 ha of land. The members receive payments for both nut-in-shell macadamia and carbon credits, as HIMACUL aggregates macadamia production and purchases directly from farmers.

HIMACUL represents smallholder macadamia farmers on the Malawi Macadamia Association board in all three regions of Malawi with district-level cooperatives owned by smallholder macadamia farmers. The cooperative received Fairtrade certification in 2024, along with Nutcellars.

HIMACUL Districts:

1. Rhumpi – HIMACUL are present but no farmers were involved in the pilot project

Piloted districts:

2. Ntchisi - location of HIMACUL head office
3. Dowa
4. Neno
5. Mwanza
6. Mchinji – location of a tree nursery, but there are no registered farmers

Figure 10. *Districts in which HIMACUL activities take place.*

The smallholder macadamia partnership

HIMACUL is a core member of the Smallholder Macadamia Partnership which includes NMT (a charity based in the United Kingdom (UK)) and a UK-based macadamia trading company called Nutcellars. The partnership began in 2001 when the manager of HIMACUL (Ken Mkengala[79]), and the Managing Director of Nutcellars and Chair of NMT (Andrew Emmott), participated in the MSDP. Their collaboration led to several key developments, including the incorporation of macadamia into the Fairtrade nut standards in 2003, the formation of NMT in 2004, the establishment of HIMACUL in 2011 with primary cooperatives formed between 2008 and 2011, and the founding of Nutcellars in 2019. Andrew and Ken began developing the Malawi smallholder macadamia supply chain to the UK in 2008 through Twin Trading and Liberation. After Twin Trading ceased operations in 2019, Andrew established Nutcellars to maintain the export connections that had been created.

The three partners developed two export value chains: the sale of macadamia nuts and the sale of carbon credits for macadamia tree damage mitigation. Both value chains are designed to promote community wealth creation and enhance systems resilience for macadamia production. The primary goal of all three entities is to strengthen farmers' resilience against climate, nutritional, and economic shocks, with support from internationally recognised experts in land use change management and smallholder value chains. By collaborating on both value chains, they aim to encourage more farmers to engage in climate-smart macadamia agroforestry and to foster rural cooperative economies that benefit these farming communities.

Image. *Ken Mkengala - Manager of HIMACUL and Andrew Emmott - Chair of NMT (from left to right).*

> ***We are thrilled to partner on this macadamia agroforestry initiative which is transforming food security and resilience for smallholder farmers. By supporting diversified incomes and sustainable practices, we're helping families secure their livelihoods and nutrition, even during difficult seasons. Together, we're building a stronger foundation for Malawi's future,"***
>
> – Ken Mkengala, Manager of HIMACUL.

79 Ken Mkengala manages HIMACUL and provides the secretariate role for the HIMACUL and primary cooperative boards. Ken also sits on the Malawi Macadamia Association board as the representative of all smallholder macadamia farmers in Malawi.

BOX 5

Who are Nutcellars and Neno Macadamia Trust?

Nutcellars is an impact-driven exporter and brand retailer of macadamia nut products. Privately incorporated in 2019 and based in the UK, Nutcellars sources macadamia nuts from the Malawian cooperative producers. To support the growth of smallholder cooperatives, Nutcellars launched a range of macadamia products in partnership with the UK ethical retailer, Central Co-op. This partnership includes a five-year 'Our Malawi Partnership' project, which commits at least GBP 85,000 annually to cooperative support, including assistance for HIMACUL.

NMT is an impact-driven charity that has been working with smallholder cooperatives in Malawi since 2004. Their involvement began in 1992 with macadamia demonstration projects and community nursery development in the Neno district. As a charitable incorporated organisation (CIO), NMT focuses on tree planting and sustainable macadamia production through cooperatives.

The trust has implemented a Carbon Damage Mitigation System to assist farmers in planting and maintaining trees throughout their lifecycle, including end-of-life management. Climate-smart macadamia agroforestry is a central aspect of NMT's engagement with farmers. NMT has consistently provided approximately GBP 20,000 to GBP 30,000 annually in support to HIMACUL and its farmers, with carbon payments now accounting for more than 50% of these funds. These carbon payments are exclusively available to farmers who trade with HIMACUL. These carbon payments are exclusively available to farmers who trade with HIMACUL. Of the payments, it is guaranteed that 20% (after administration and annual tree surveys) goes to the farmers and the rest is allocated to projects on an as-needs basis within local, farmer-owned cooperatives. NMT pays HIMACUL, and HIMACUL distributes the funds to the farmers and manages payments for surveys and other activities as agreed with the farmer cooperatives on a year-by-year basis.

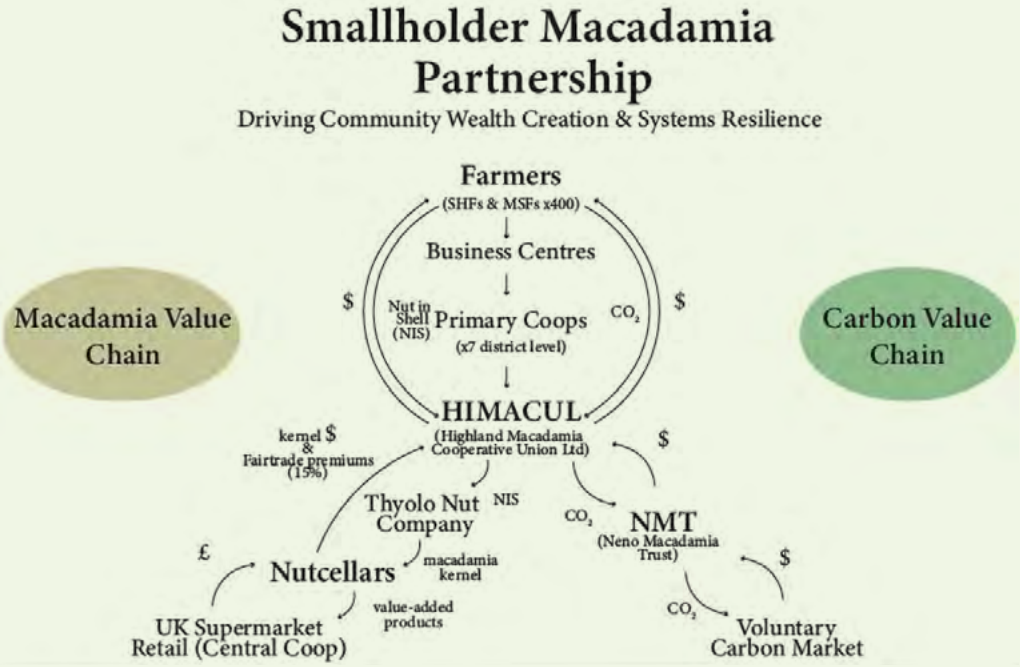


Figure 11. *Macadamia nut and carbon value chains and partner interactions.*[80]

80 HIMACUL partner profile – July 2024.

A collaborative and farmer-led approach

Nutcellars, NMT, and HIMACUL have developed a collaborative agricultural model that is uniquely suited to the local context and conditions faced by Malawian smallholder farmers interested in macadamia production and accessing value-added markets. HIMACUL offers its member farmers evidence-based technical support in various areas, including crop establishment, cultivation, harvesting, post-harvest activities, and cooperative governance. This support encompasses input loans, aggregation, quality control, and supply chain coordination with processors to supply kernels to Nutcellars.

To increase food security at the household level, and to diversify activities, farmers intercrop macadamia trees with their annual crops such as maize, groundnuts, and soybeans. They deliver their macadamia harvest to HIMACUL after performing initial dehusking, drying, and grading. HIMACUL then transports the macadamias to a third-party cracking facility known as Thyolo Nut Company in Thyolo in the southern part of Malawi. After cracking, Nutcellars coordinates the export of the macadamia through Beira, Mozambique to the UK for further value addition, such as producing macadamia butters and chocolate confections, as well as packaging. The need to add value locally is recognised with some small-scale processing already taking place, for example, HIMACUL produces oil from the Grade B nuts.

Images. *The processed macadamia products.*

Research to understand farmers' needs

HIMACUL and its partners are working with Open University (UK) researchers to better understand farmer perspectives on the impact of climate change on traditional cropping systems versus those that integrate macadamia agroforestry. The goal is to build an evidence base that supports macadamia agroforestry as a system for mitigating climate-related damage, with particular attention to its economic, food security, and environmental benefits. While previous research conducted in partnership with Imperial College, London, over the past 5-6 years has provided science-based evidence of these benefits, much of

this analysis has been external to the agricultural system under study. Thus, there is a critical need to examine the issue from the viewpoint of the farmers themselves. Currently, many farmers do not necessarily perceive macadamia agroforestry as a climate resilience strategy. Farmers are still grappling with the opportunities that this presents - instead focusing primarily on immediate concerns, such as ensuring the next meal for their families. This research project seeks to address this gap by exploring farmers' experiences, perceptions, and needs related to climate resilient macadamia agroforestry practices and innovations. To achieve this, the project will engage 25 farmers across five different agro-ecological zones of Malawi, aiming to document and analyse the farming practices that are currently being utilised. In addition to identifying opportunities and constraints, the project will promote farmer-to-farmer knowledge exchange, helping to foster peer learning and the adoption and scaling of best practices. Over time, the initiative will explore ways to enhance integrated climate and pest-resilient practices, such as intercropping, the introduction of improved varieties, and other related technologies and innovations. Currently, approximately 30 macadamia clones are being cultivated by farmers across Malawi including HIMACUL smallholders.

HIMACUL recently supported a Malawian PhD researcher, to better understand the impact of climate change on the viability of macadamia production across Malawi. This research also assessed farmers' preference for different clones. Further, HIMACUL is employing citizen science research to encourage planting of select clones to climate-proof future production. By leveraging climate modelling and projections of future agro-ecological conditions, this project will also focus on identifying the most suitable macadamia varieties for grafting and scaling up production, ensuring that macadamia agroforestry can serve as a sustainable, climate-resilient agricultural system for the future.

> ***"By expanding macadamia agroforestry across Malawi, we're proud to support HIMACUL smallholder farmers in creating climate resilient, diverse farming systems that ensure food security and economic growth. Together, we're building a lasting legacy for communities across the country,"***
>
> - Andrew Emmott, Chairperson of Neno Macadamia Trust.

Products and services

Macadamia tree seedlings:
HIMACUL's tree nurseries produce grafts of a wide range of clones and provide the macadamia plants to its farmer members. NMT supports HIMACUL's tree nurseries located in the different cooperatives' districts so that the farmers can purchase grafted clones at a subsidised price and Our Malawi Partnership donates macadamia plants to the more marginalised farmers (women and youth).

Images. *A HIMACUL macadamia tree nursery.*

Linkages to international markets: HIMACUL purchases macadamia nuts from the cooperatives and through its partners processes and exports them. Currently all Grade A kernels are exported to the UK Fairtrade market. HIMACUL receives a Fairtrade premium which is a 15% uplift on seasonal commercial prices. HIMACUL also provides support to its member farmers to improve quality control and supply chain coordination.

Linkages to the domestic market: Farmers trade nuts-in-shell locally with informal traders at between MWK 1,500 – 2,000 /kg. Grade B nuts are processed locally for oil and household/local consumption. Farming families use macadamia nuts in a maize-macadamia flour mix to improve their household nutrition.

Evidence-based, technical support to farmers: Through its respective partnerships HIMACUL offers free technical support on improved agricultural practices including crop establishment, cultivation, harvesting, and post-harvest activities.

Support for cooperative governance: Through the Our Malawi Partnership, Coop College and the Malawi Federation of Cooperatives (MAFECO) HIMACUL is given cooperative governance support.

Financial support: in the form of input loans and farmer aggregation support.

Linkage to the carbon market: NMT links HIMACUL farmer members to the carbon market, enabling them to generate additional income.

Environmental component

As a perennial crop, macadamia trees reduce topsoil erosion, promote organic matter buildup, and support beneficial microbial activity. Their canopy creates habitats for pollinators and pest predators (reducing the need for pesticides), whilst also cooling soil surface temperatures. The extensive root structure of macadamia trees enhance soil stability, foster biodiversity and contribute to carbon sequestration. Field trials by Open University students are currently underway to determine the benefits of macadamia agroforestry on intercropped annual crop yields in Malawi.

Pests such as stinkbug, borer, and *botrytis* (a fungal disease) are significant challenges for the macadamia sector in Malawi. Intercropping and wide tree spacing is promoted as opposed to chemical applications to help mitigate these challenges.

HIMACUL is currently exploring compost fertilisers as the macadamia market is interested in organic produce. However, achieving organic certification will be challenging as the whole system, including the intercrops, must be produced organically.

Climate change component

The macadamia trees directly contribute to climate mitigation as each tree sequesters an average of 20 kg of CO_2 per year.

HIMACUL and its partners are working to identify the most suitable macadamia varieties for upscaling to ensure that macadamia agroforestry can serve as a sustainable, climate-resilient agricultural system for the future.

Macadamia trees are drought tolerant and provide fruit in the 'hunger season'. This is a time of the year when the main food crop in Malawi, maize, is growing but not yet ready for harvest. During this time, farmers are short of food and have limited sources of cash to purchase food or other necessities. However, as macadamia harvesting starts at this time the nuts can be consumed or used as a source of cash to buy food.

Macadamia production is promoted to smallholder farmers in higher rainfall areas to mitigate the need for irrigation.

The spacing of macadamia trees allows farmers to plant other crops between them maximising the productivity of the land and contributing to diversification which is an important means for enhancing resilience. The macadamia canopies provide shade for the other crops, reducing increasingly high temperatures (Image below), and the trees' roots stabilise the soils reducing wind and flood erosion. The tree litter enhances soil organic carbon, soil microbial activity and soil water retention.

Images. *Cooling effect of the shade of a large macadamia tree.*

Macadamia shells provide a useful source of energy to replace wood and charcoal thereby reducing deforestation. NMT and HIMACUL are working with Imperial College to develop solar kettles and gasifier cookstoves which use macadamia shells for fuel. Further, the activated carbon by-product can be used to filter water, allowing for cleaner and safer drinking.

NMT established a Carbon Damage Mitigation project for macadamia smallholder farmers by connecting the trees planted (which absorb CO_2) with the CO_2 emitted by purchasers in developed countries. The project helps farmers manage the risks associated with climate shocks by providing an additional income stream. HIMACUL and its partners have since started a Plan Vivo[81] accelerator programme to develop a project design document for accreditation in 2025. The accelerator will assist in scaling the current pilot carbon project. The lessons learnt through the Carbon Damage Mitigation pilot project (which was based on Plan Vivo standards V4) will inform the new Plan Vivo project design document.

81 Plan Vivo is a system that helps smallholder farmers and rural communities participate in carbon markets.

Community and marginalised groups component

Macadamia is a low-input tree crop that does not require the same level of cultivation as annual crops like maize and groundnuts. This makes their production particularly accessible to elderly and women farmers who are constrained by time poverty.

HIMACUL is working with NMT to ensure the inclusion of marginalised farmers through developing targeted incentives and assisting them in increasing their orchards to between 50 and 100 trees. HIMACUL is structured on business centres which include young and female farmers who might otherwise not be able to afford to plant macadamia trees. Rather than only sell the trees to farmers who can afford the full commercial price of macadamia tree seedlings, NMT and HIMACUL deliberately allocate a proportion of the trees to marginalised farmers. For example, in the 2024/2025 season NMT and HIMACUL budgeted for 18,000 trees to be allocated to vulnerable farmers. Further, Our Malawi Partnership donates free seedlings to marginalised farmers.

Both HIMACUL and Nutcellars hold Fairtrade certification, which allows smallholder farmers to receive a 15% Fairtrade premium.

The Carbon Damage Mitigation carbon credit programme compensates farmers (a form of payment for ecosystem services) and supports their investments in macadamia production. Current pilot customers are purchasing carbon credits at GBP 30/tCO_2eq.[82]

The initiative also has a valuable nutrition facet. Macadamia nuts are a rich source of energy, fibre and omegas-3, 6, 7, and 9, vitamins and minerals[83] which are important for rural communities (particularly children) that suffer from nutritional deficiencies.

Capacity building component

To ensure a bottom-up farmer-led approach, HIMACUL works with the smallholder farmers to help them organise and build their capacity. Farmers have been trained on macadamia agroforestry and their organisational capacity has been enhanced through the cooperatives. HIMACUL offers technical support to its member farmers in various areas, including crop establishment, cultivation, harvesting, post-harvest activities, and cooperative governance. The farmers are taught sustainable agricultural practices such as intercropping with annual food crops, soil conservation measures including bunding with vetiver (a large perennial bunchgrass), and minimum tillage to retain organic matter in the field.

82 NMT. 2022. Carbon cost calculator. Neno Macadamia Trust.
83 WMO. N.d. Healthy and nutritious macadamia nuts. World Macadamia Organisation (WMO).

Challenges

Macadamia nurseries and tree planting. HIMACUL's macadamia tree nurseries are currently underperforming and require upfront orders to ensure the production of sufficient trees each year. HIMACUL is working with NMT to identify farmers needing replacement or additional trees, necessitating an updated community survey to assess membership demographics and tree planting needs. A priority for the partners is to enhance nursery capacity to produce more high-quality grafted macadamia trees. To achieve this HIMACUL is working closely with Ministry of Agriculture staff at the District and Extension Planning Area offices.

Aligning smallholder supply with market demand. Progress in developing a farm-to-export market value chain has been slow since 2008. Although HIMACUL achieved Fairtrade certification in 2016, larger farmers were selectively recruited by other programmes, hampering growth. Global economic downturns and low macadamia prices have further impeded progress. While Nutcellars has established a route to international markets and has strong customer demand, the current smallholder volumes are insufficient to capitalise on these opportunities. As supply increases, Nutcellars has the potential to significantly boost export volumes, but there are challenges in scaling, such as improving post-harvest handling and establishing aggregation centres.

Production, processing, and trade finance. Some HIMACUL members have received training and invested in macadamia planting and post-harvest handling, but many lack the financial resources to expand. Other farmers do not trade with HIMACUL due to limited trade finance and delays in payment from third-party processors. With Fairtrade certification, there are new opportunities to secure trade finance through contracts with loan guarantees, enabling more timely payments and access to Fairtrade premiums.

Membership and marketing. The Fairtrade and carbon value chains aim to incentivise farmers to join HIMACUL and boost production. Following Fairtrade certification, many smallholder farmers are interested in membership, but outreach efforts need to clearly articulate the benefits of joining HIMACUL. There are opportunities to engage anchor farm out growers and cooperatives, but maintaining these relationships can be challenging due to market fluctuations, trust issues, and financial difficulties faced by anchor farms.

Aligning lending with organisational capacity. Financial institutions typically have minimum lending thresholds, which require organisations to possess a certain level of capacity, particularly in areas of financial management and administration, to effectively manage and implement funded projects. This highlights the importance of business accelerator programmes that provide mentorship and training, enabling organisations to rapidly scale and meet these demands. There is a critical need to match an organisation's existing capacity with the scale of its ambitions, while also ensuring that organisations can demonstrate their capacity to manage funds—something that is not always feasible for smaller entities.

To meet financial needs, three of the primary cooperatives have established Village Savings and Loan Accounts (VSLAs). The aim is to establish more VSLAs at the business centres.

Challenges of carbon credit certification standards. International carbon credit certification standards are constantly evolving,

with entry requirements becoming increasingly prohibitive for smaller organisations. These rising standards pose a significant barrier to smaller entities seeking to engage in carbon markets, as they often lack the resources and capacity to meet the rigorous criteria for certification, limiting their participation in carbon credit trading.

Barriers to accessing funding. The application processes for securing funding are often complex, technical, and time-consuming, making them inaccessible to many community-based organisations. These processes require a high level of technical expertise, often necessitating the hiring of consultants to prepare proposals. However, this external support may result in proposals that do not fully reflect the needs and interests of the farming communities they aim to support. Simplifying application processes and making them more accessible to grassroots organisations is essential to ensure that funding reflects the realities of those on the ground.

Contribution to the Sustainable Development Goals

HIMACUL contributes to the achievement of the following SDGs:

Impact

- HIMACUL represents 400 active trading members.
- 40% of HIMACUL members are women headed households.
- Macadamia is seen as a retirement crop for elderly farmers.

Future plans

Plans are being implemented to facilitate rapid scaling to reach 2,500 farming households (around 12,000 people in total) covering an area of 1,125 ha.

HIMACUL is engaging with Our Malawi Partnership, which is the pilot project of a wider body of work, to facilitate trade with cooperatives in developing countries and cooperative retailers in export markets.

Nutcellars is looking to access the European Union and the United States' markets.

Lessons learnt

Partnerships and stakeholder engagement are essential. Successful project implementation hinges on strong partnerships and active stakeholder engagement. Collaborating with research institutions is crucial for generating the evidence needed to inform capacity-building activities on the ground. Similarly, engaging with government authorities is vital to garnering institutional support for the initiative. Such partnerships provide a foundation for sustainability and scalability.

Many global events, such as COVID-19, the war in Ukraine, and shipping disruptions through the Red Sea, have impacted HIMACUL's exports over the past 5 years. Despite these challenges, the long-term relationships established with partners and key stakeholders have enabled HIMACUL to engage in Our Malawi Partnership and achieve Fairtrade certification, providing a robust platform for future HIMACUL expansion.

Fostering trust and embracing adaptive learning. Building and maintaining trust with stakeholders requires navigating difficult periods together. Challenges such as the COVID-19 pandemic, rising inflation, and the cost-of-living crisis can strain relationships and operations. However, these moments offer valuable opportunities for learning. It is not just about achieving success but also about gaining insights and adapting through the lessons learnt from overcoming barriers along the way.

Long-term commitment is necessary. A long-term approach is required to achieve lasting impact. Even though the macadamia project has been active for 30 years, it remains in an early phase of development. The adoption of macadamia agroforestry is still in progress, with only early adopters having planted trees. Efforts continue to engage more farmers in the process, encouraging them to not only plant and manage trees to maturity but also to successfully implement intercropping techniques. The project's long-term success depends on ongoing farmer engagement and the gradual scaling up of agroforestry practices.

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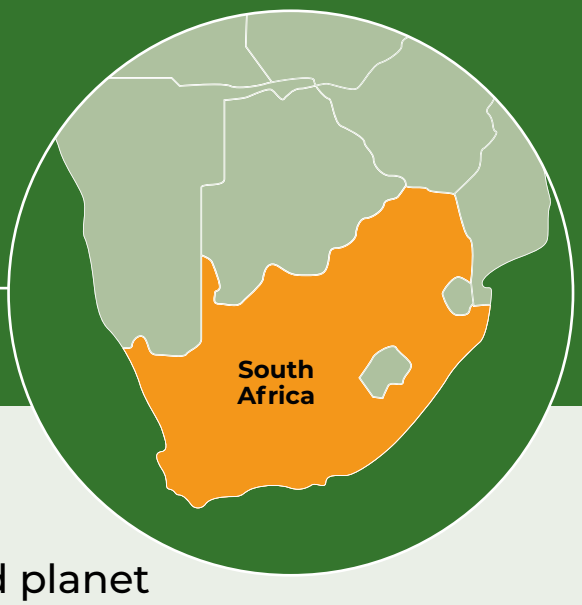
Southern Africa

South Africa



Best management practices for sugarcane production in South Africa: the triple win of prosperity, people and planet

Background story

South Africa's agricultural sector is affected by climate variability and intensifying climatic hazards. Climate change projections for South Africa indicate increasing temperatures across the country, an increase in precipitation in some parts of the country and a decline in precipitation in other parts; as well as increases in the magnitude and frequency of extreme events such as floods and droughts.[84] Mean monthly temperatures are projected to rise by 2.0°C by the 2050s and 4.2°C by the 2090s, under a high-emission scenario (RCP8.5).[85] Precipitation in South Africa shows high interannual variability, with weak overall annual trends. However, observations indicate a decrease in the number of rain days across most hydrological zones, suggesting more intense rainfall events and longer dry spells. While projections remain uncertain, most models indicate a decline in annual rainfall.

Changes in rainfall and temperatures and increasing climatic hazards will continue to impact agriculture and food security in the country. Reduced rainfall and higher temperatures, including heatwaves, have already triggered water restrictions and an increased demand for water and energy for cooling across all sectors.[86] Further, extreme rainfall events are accelerating soil erosion and land degradation in exposed areas.

South Africa's sugar industry, valued at over R20 billion, is highly competitive, consistently ranking amongst the top 15 of approximately 120 sugar-producing countries worldwide.[87] Spanning the Mpumalanga and KwaZulu-Natal provinces (Figure 12), sugarcane production positively impacts over a million people and drives local economic growth, especially in rural areas. The industry provides vital employment, education, and training opportunities as well as supports research, technology development, and sustainable resource use.

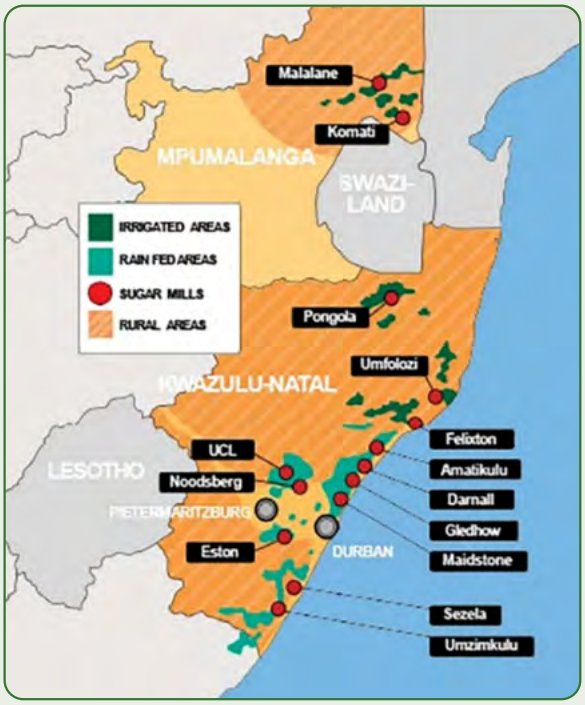


Figure 12. *South Africa's sugarcane producing area.*[88]

84 Mnkeni PNS, Mutengwa CS, Chiduza C, Beyene ST, Araya T, Mnkeni AP, Eiasu B, and Hadebe T. 2019. Actionable guidelines for the implementation of climate smart agriculture in South Africa. Volume 2: Climate Smart Agriculture Practices. A report compiled for the Department of Environment, Forestry and Fisheries, South Africa.

85 Climate Risk Profile: South Africa (2021): The World Bank Group.

86 *Ibid.*

87 SASA. 2024. The sugar industry at a glance. South African Sugar Association.

88 *Ibid.*

Climate change is projected to have both positive and negative impacts on sugarcane production in South Africa. Dryland yields for both high-sucrose and high-fibre sugarcane cultivars are projected to increase by 8%–19%.[89] In high-potential irrigated areas, yields are expected to remain relatively stable (1%–5%) with sufficient water, while currently cooler areas could see substantial yield gains of around 20%. However, water and irrigation demands are anticipated to rise by 9%–15% under future climate conditions.[90] Additionally, new areas may become suitable for both irrigated and dryland production.

Image. *Donovale Farm on the border of the uMgeni river.*

About Donovale Farming Company

Donovale Farming Company (Donovale Farm) is located 10 km northeast of Pietermaritzburg in KwaZulu Natal. Managed by brothers Anthony and Chris Edmonds, the farm has been part of the family heritage for three generations. The 840-ha farm is planted with 355 ha of sugarcane, 66 ha of hass avocado, 13 ha of tea tree and 20.3 ha of navel oranges. The remaining farm area is conserved, with a portion integrated into the Cumberland Nature Reserve which borders the uMgeni River.

Products and services

Donovale Farm operates a diversified farming system, producing a variety of crops to enhance stability and resilience against market fluctuations and unpredictable weather and climatic events. The farm's primary crops include:

- Sugarcane – Producing an average of 36,000 t per annum, which is processed at the Illovo Noodsberg facility into refined sugar, mainly for the local South African market.
- Avocados – Yielding around 550 t annually, with process handling by the Fruit Farm Group. Approximately 60% of the produce is exported to Europe, while the remainder is sold domestically.

89 Singels, A., Jones, M.R. & Lumsden, T.G. Potential for Sugarcane Production Under Current and Future Climates in South Africa: Sugar and Ethanol Yields, and Crop Water Use. Sugar Tech 25, 473–481 (2023).

90 *Ibid.*

- Navel oranges – Averaging 1,116 t per year, packed directly on the farm and supplied to the local market.
- Tea tree – Producing around 3 t of tea tree oil annually, processed at a nearby distillery. Although primarily marketed overseas, this product faces strong competition in a saturated global market.

This diversified approach supports Donovale Farm's long-term sustainability and market resilience.

Image. *Sugarcane in various growth stages on Donovale Farm.*

Best management practices for agronomic resilience, environmental sustainability and climate adaptation

In 2004, extension specialists from the South African Sugarcane Research Institute (SASRI) developed Ecozones to assist the biosecurity manager in pest control and variety selection. The broader Midlands North region, where Donovale Farm is located, is divided into 11 Ecozones based on KwaZulu-Natal's Bioresource Units (BRUs). Donovale Farm lies within Ecozone 2, or BRU Ub14 (Albert Falls), characterised by moderate to steep slopes and Coast Hinterland Thornveld vegetation. This area receives approximately 700 - 750 mm of rainfall annually, with an altitude ranging from 450 to 900 m.[91]

Although Donovale Farm is located in an Ecozone classified as having marginal production potential, the implementation of effective land, water, and biodiversity management practices over the years has significantly improved sugarcane yields. In fact, Donovale Farm has achieved the highest sugarcane yields in its Ecozone, averaging 102 t/ ha, with a Recoverable Value (RV) of 0.5% to

91 *Ibid.*

1.0%—a quality measure that calculates sugar content higher than the mill average—placing the farm in the top 10% of growers delivering to Noodsberg Mill.[92]

Ant and Chris's long-term vision for farming operations centres on generating environmental and economic benefits by improving soil health and building agricultural resilience through regenerative practices. Donovale has aligned its sugarcane operations closely with the Sustainable Sugarcane Farm Management System (SUSFARMS), a locally relevant and globally recognised continuous improvement system designed to help sugarcane producers and millers transition to more sustainable and regenerative practices.[93]

Key aspects of this initiative include:

- Implementing a sustainable sugarcane management system backed by scientific evidence and incorporating climate change projections and considerations.
- Optimising integrated land-use planning, soil mapping and conservation, water management, and resource use efficiency.
- Employing IPM strategies, including reduced pesticide usage, pest-resistant sugarcane varieties, natural predators, and push-pull strategies.
- Focusing on biodiversity planning, mapping, and management.
- Voluntarily monitoring and reporting GHG emissions.

Donovale Farm serves as a model farm demonstrating the positive impacts of Best Management Practices (BMPs). Today, it is regarded as a leading farming entity in regenerative farming and climate-smart agriculture.

BOX 6

The Farmer-led Sustainable Sugercane Farm Management System

Noodsberg Canegrowers, the grower body representing farmers who supply cane to the Noodsberg mill and are affiliated canegrowers, is composed of three mill groups: Illovo Noodsberg, Illovo Eston, and UCL Company Limited. In 2002, Noodsberg Canegrowers initiated efforts to establish a sustainable management system for South Africa's sugar industry. This initiative aimed to minimise environmental impacts while meeting the rising demand for sustainability and traceability standards sought by buyers.

In collaboration with neighboring UCL farmers, SASRI, and conservation partners such as WWF South Africa (WWF-SA) and the Mondi Wetlands Programme, these entities developed a framework for sustainable practices.[94] Inspired by the forestry sector's proactive adoption of certifications like the Forest Stewardship Council, the sugarcane industry also wanted to spearhead a comprehensive sustainability process, driven by growers rather than external mandates.

The South African National Biodiversity Institute's (SANBI's) Biodiversity and Land Use (BLU) project further supported the development of this system. Through a partnership with WWF-SA, SANBI secured Global Environment Facility (GEF) funding for the initiative, channeled through the United Nations Development Programme (UNDP).[95] The initiative, branded SUSFARMS (Sustainable Sugarcane Farm Management System), was developed with a bottom-up approach — 'by growers, for growers'.

92 South Africa Sugar Journal. 2010. Conservation and land reform success. Issue March 2010. South African Sugar Association, Kwazulu-Natal.
93 Illovo. 2024. Illovo hosts SAI platform global conference in Durban: Small-scale growers and regenerative agriculture in the spotlight.
94 WWF. 2013. Sugarcane. World Wide Fund for Nature (WWF).
95 SANBI. 2018. SUSFARMS collaboration wins second place at Bonsucro inspire awards. South African National Biodiversity Institute.

SUSFARMS promotes responsible sugarcane production by implementing BMPs[96] aimed at reducing environmental impacts, ensuring legal compliance, promoting social responsibility, and achieving financial sustainability. Each BMP is expressed as a 'measure', allowing growers to track and monitor their progress over time.

The SUSFARMS Progress Tracker, an Excel-based tool, provides a list of legal requirements and BMPs, serving as a practical tracking system for growers to monitor their implementation. It indicates whether a BMP has been fully, partially, or not achieved, with each measure cross-referenced to the SUSFARMS manual for detailed guidance. An online version of the tracker is available to registered growers from select mill regions, who are encouraged to submit self-assessments digitally. The tracker generates a progress report to support the creation of action plans for achieving new measures. BMPs are grounded in scientific research or the best available knowledge where data is lacking, ensuring the system remains adaptive and evolves as new technologies and methods emerge.

SUSFARMS acts as a guiding framework, while growers retain responsibility for compliance with all applicable laws. The system aligns with global sustainable agriculture trends, supports South Africa's strategic agricultural development goals, and aligns with the Department of Agriculture's policies on sustainable development.

The SUSFARMS framework is organised into four hierarchical tiers: principles, criteria, indicators, and verifiers. This structure integrates international and South African legislation with sugar industry standards, enforced through BMPs. The SUSFARMS model is built on three core principles: prosperity, people, and planet (Figure 13).

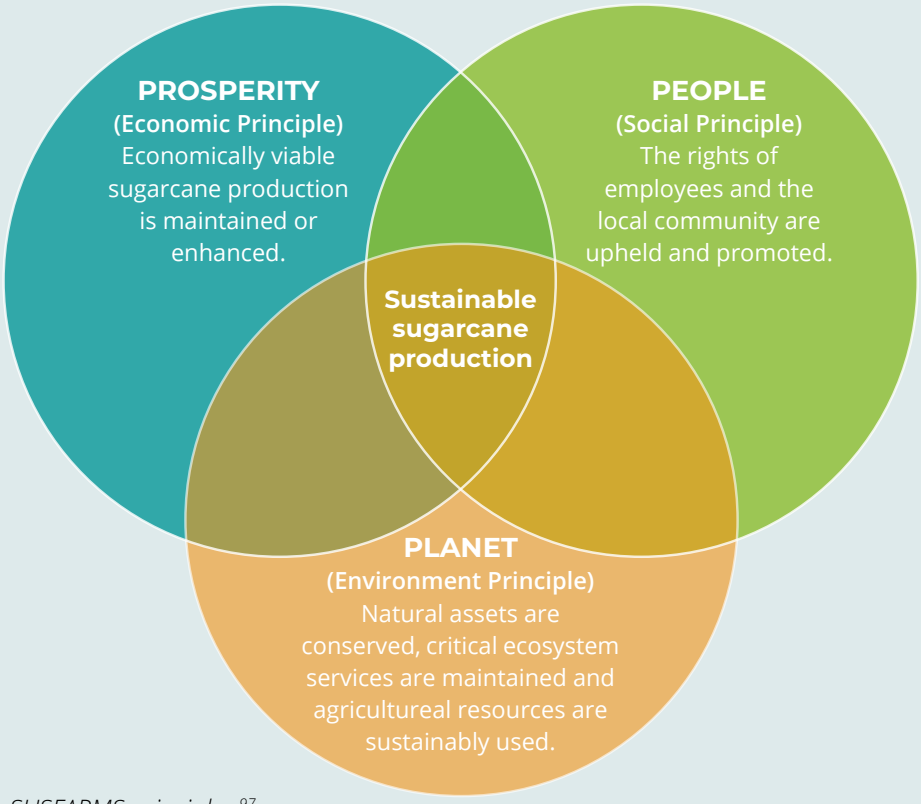


Figure 13. *Three SUSFARMS principles.*[97]

96 South African Sugarcane Research Institute. 2019. SUSFARMS – Sustainable Sugarcane Farm Management System – 4th Edition. South African Sugar Association.

97 *Ibid.*

Environmental and climate change component

Donovale Farm has voluntarily implemented a comprehensive set of SUSFARM's recommended BMPs, grounded in science-informed land use planning, biodiversity mapping, and sustainable agricultural interventions. These practices aim to improve yields, increase sustainability, and enhance resilience to climate related challenges.

> ***"The approach emphasises the importance of viewing sustainability practices not as a cost but as an investment in the farm's long-term productivity and ecological stability. While immediate benefits may not be visible, the cumulative impact of these measures over time strengthens the farm's resilience"***
>
> – Ant Edmonds, Executive Director of Donovale Farm.

Land use planning

At Donovale Farm, the core of the farming approach is a structured and carefully integrated land-use plan that uses science-backed decision-making to establish a resilient, climate-smart agricultural system. The farm's first Land Use Plan was created in the early 1980s by the Land Use Planning Department of SASRI. Since then, all plans have been developed by a qualified land use planner, Nobuhle Gumede, in collaboration with Donovale Farm's leadership and an extension specialist.

This approach incorporates a range of interventions that work together to maximise benefits. Donovale Farm uses spatial mapping and holistic, systems-based planning to guide its farming practices. These strategies aim to reduce unnecessary transport costs, minimise erosion, conserve water, protect biodiversity and ecosystem services, and strengthen resilience to extreme weather and fire events. Significant attention is given to managing farm infrastructure, particularly roads, terraces, dams, waterways, and stormwater drains. For example, natural waterways have been constructed to channel concentrated rainwater from terraces into designated drainage lines. These waterways are carefully maintained through weeding and composting, which helps reduce erosion, control runoff, and minimise water wastage. The farm has also implemented contour layouts and strip planting to mitigate the impact of extreme weather events, such as flooding.

Image. *Current Land Use Plan for Donovale Farm.*

Biodiversity protection

A comprehensive biodiversity plan ensures that cropping practices align with the farm's ecological assets. The farm protects its natural vegetation to support a diverse mix of wildlife—including grazers and browsers like cattle, zebra, and giraffe—that roam the farm. These animals offer ecological benefits such as seed dispersal, soil nutrient enrichment through manure deposition, improved soil water infiltration from soil crust breakage, creation of micro-catchments through hoof prints, maintenance of natural vegetation structure, and fire prevention by reducing fuel loads. Additionally, beehives and flowering plants (such as rosemary and lavender) are integrated within the planning structures and serve as biodiversity refuges, attracting bees to enhance pollination and ultimately improve crop and fruit yields.

As part of its pest control strategy, the farm also conserves natural habitats for both pests and their predators, using beneficial plants to support a push-pull approach. Ultimately, the presence of indigenous and diverse flora and fauna fosters a balanced ecosystem that enhances farm productivity and resilience. Controlling invasive plant species further helps maintain stream flow and water availability, which are increasingly at risk due to climate change.

Image. *Biodiversity refuge and pest predator garden.*

Integrated Pest Management

To reduce pesticide usage, Donovale Farm has adopted an IPM strategy to prevent pest outbreaks, which are increasingly attributed to climate change. The eldana borer, one of the most serious pests in the South African sugar industry, poses a significant threat. The eldana borer is the larval stage of *Eldana saccharina Walker* (Lepidoptera: Pyralidae), a small brown moth indigenous to Africa.[98] This pest damages the soft tissue inside sugarcane stalks, commonly resulting in infection by red rot fungus (*Glomerella tucumanensis*), leading to further cane quality loss.

As part of its IPM strategy, Donovale has implemented an eldana habitat management programme focused on rehabilitating riparian zones and wetlands to support natural predator populations that help control eldana borer numbers. Because sugarcane alone cannot sustain these predators, enhancing farm biodiversity is essential. This approach involves planting native sedges, such as *Cyperus dives* and *Cyperus papyrus*, in riparian areas and managing alien invasive species. Additionally, 'push' plants like melinis grass (*Melinis minutiflora*, or molasses grass) are introduced within sugarcane fields to deter female eldana moths from laying eggs. Molasses grass emits volatiles that repel or 'push' borers away, while nearby natural habitats attract or 'pull' the eldana and support predator populations, creating a balanced ecosystem that keeps eldana numbers in check.

Soil management also plays a role; soils high in silicon content, which naturally reduce pest feeding efficiency by wearing down the pests' mouthparts, are maintained and monitored. Silicon acts as a micro-nutrient with protective benefits for plants, helping them resist both water stress and pest damage.

Other pest management strategies at Donovale Farm include installing raptor perches and bat boxes to attract natural predators, further reducing pesticide reliance. Plants such as wild bananas are grown to attract beneficial predators, such as bats, and strips of land between riparian vegetation and sugarcane are managed to aid predators in targeting pests. Fields are routinely scouted, and pest populations are closely monitored to enable early intervention. Donovale Farm also selects pest-resistant crop varieties and uses targeted spraying instead of blanket applications, collectively reducing pest populations.

The benefits of these biocontrol strategies include the restoration of functional riparian and wetland areas, increased biodiversity through natural predator attraction, and a reduction in eldana infestations within sugarcane fields. This approach reduces the farm's dependence on chemical pesticides, promoting a more environmentally sustainable approach to pest management.

> ***"IPM is a complex feature of how we reduce reliance on chemicals. We believe we have been successful through our concentration on biodiversity planning - working with nature rather than against it"***
>
> – Ant Edmonds.

98 SASRI. 2005. Guidelines and recommendations for eldana control in the South African sugar industry. South African Sugarcane Research Institute (SASRI).

Soil conservation and nutrient management

Donovale Farm's land-use plan prioritises soil erosion control, water retention, and farm-wide efficiency. No or minimal tillage practices are applied on steeper land to enhance soil conservation by reducing disturbance and maintaining soil structure. Additionally, the fibrous root system of sugarcane enhances soil stability, while crop residue left in the field after cool burning enriches soil fertility and aids in water retention.[99] The sugarcane root system is left intact post-harvest unless replanting (a relatively rare event occurring about every 10 years), which limits soil disturbance compared to annual crops, thereby enhancing carbon sequestration and reducing GHG emissions.

Donovale Farm also uses cover crops to stabilise soil, improve soil structure through soil amelioration, and promote carbon sequestration, contributing both to soil health and climate change mitigation.

Soil fertility is a top priority, with soil maps and routine soil sampling after each crop cycle guiding nutrient management strategies. The farm has installed probes to monitor the water content of soils in its avocado orchards, while an understanding of the soil's natural nitrogen mineralisation capacity enables precise nitrogen application, reducing fertiliser use and associated costs. Fertiliser use is carefully refined following SASRI's Fertiliser Advisory Service guidelines and soil sampling recommendations, ensuring efficient nutrient management, minimising environmental impacts, and reducing greenhouse gas emissions, particularly nitrous oxide.

Water conservation and efficiency

Donovale Farm adheres to regulated water use through a water-use license that ensures sustainable irrigation practices. Of the farm's total 840 ha, only 36 ha of sugarcane, 67 ha of avocado, and 23 ha of citrus are irrigated, with a total application rate of 4,400 m^3 /ha. This volume has decreased over time due to a number of factors such as improved efficiency and rainfall. To maximise efficient and cost-effective irrigation (influencing energy costs, water availability, plant health, fruit set, and quality), Donovale Farm has tailored its irrigation system to its specific needs, using accurate scheduling to prevent over- or under-application and opting for off-peak tariff structures. A surface drip irrigation system with micro-jets is used to deliver water directly to the crop's root zone, maximising water-use efficiency and minimising waste. This low-pressure system also reduces energy requirements. Additionally, real-time monitoring and weather forecasting support the optimal use of stored water and rainfall.

Soil moisture probes further enhance irrigation precision, providing data on soil moisture levels in relation to Field Capacity and the Permanent Wilting Point, which prevents both moisture stress and water wastage. This data-driven approach has significantly reduced water and energy consumption compared to traditional methods. Furthermore, Donovale Farm plants drought-resilient crop varieties developed by

99 Burning the sugarcane in the morning when there is a lot of dew.

SASRI, lowering irrigation needs. The farm also actively controls alien invasive species, especially around water sources.

Terraced sugarcane structures channel rain runoff safely into stable, grassed waterways. These are planted alongside strip cropping to reduce the impact of intense runoff and prevent inter-panel erosion. After each harvest, crop residues are scattered in the field, enhancing both water absorption and retention.

Image. *Water course management through the use of cleared waterways.*

Climate change adaptation and mitigation

Donovale Farm's physical infrastructure is purposefully designed to address risks associated with extreme climatic events, such as storms and floods. Key elements, including contoured fields, strategically placed waterways, and effective erosion control measures, form an integral part of the farm's land-use plan. These measures protect the landscape from water runoff and associated soil degradation, contributing to long-term soil health by significantly reducing erosion and maintaining soil structure.

The farm utilises improved sugarcane varieties developed by SASRI with enhanced drought tolerance and pest resistance, promoting crop stability during water stress and pest outbreaks.

Controlled or 'cool' burns further reduce GHG emissions, enhance soil moisture retention, and lower water usage by preserving crop residue.

Diversifying operations through the addition of fruit trees (avocado and citrus) and tea tree enhances economic stability and resilience, buffering against market fluctuations. Cultivating multiple sugarcane varieties, each selected for specific beneficial traits such as pest, disease, or drought resistance, strengthens resilience to climate change by reducing vulnerability to environmental stresses. Donovale Farm currently grows six to seven sugarcane varieties, chosen through soil mapping, trials, and testing, which ensures a stable supply to mills and minimises the risk of total crop loss.

The farm has also initiated voluntary monitoring and reporting of its GHG emissions, including tracking emissions from fertiliser use, electricity, and diesel consumption. Soil carbon content was recently assessed to explore potential for carbon sequestration on the farm, with the aim of eventually participating in the carbon credit market. However, challenges persist, particularly regarding soil carbon measurement due to inconsistent measurement techniques and limited access to accredited laboratories for analysing soil carbon stocks.

SUMMARY

In summary, the farm's commitment to BMPs embodies a holistic approach to sustainability, resilience, and environmental conservation. From soil and biodiversity management to climate adaptation and pest control, these practices represent a forward-thinking model of sustainable agriculture. The BMPs implemented at Donovale Farm are scalable and adaptable for smaller farms, demonstrating that agricultural intensification can indeed be both sustainable and climate-resilient, delivering long-term benefits for both the farm and the environment.

Additionally, the SUSFARMS tool, which is available freely across South Africa's sugar industry, provides valuable guidance for sustainable practices. While uptake has been gradual, its principles are beginning to gain traction beyond the initial areas. Although developed specifically for sugarcane, SUSFARMS and similar best practice management tools have cross-crop potential, offering adaptable 'all-farm' elements that can be applied in various agricultural contexts.

Land ownership reform to address systemic inequalities

Ant and Chris's proactive approach to land ownership at Donovale Farm reflects a commitment to social equity and reconciliation with South Africa's historical land injustices, undertaken even in the absence of a formal restitution claim.[100] They initiated a voluntary shift in land ownership, establishing an inclusive partnership with the farm's 60 permanent employees—many of whom have generational ties to the land. Formalised in March 2009 through a 10-year agreement, this initiative was supported by government funding and facilitation from the Inkezo Land Company, leading to the creation of the Silwanentuthuko (Striving for Development) Land Trust. This Trust now owns the land and holds a 49% share in Donovale Farm, with Ant and Chris retaining 51%. Donovale Farm leases the land from the Trust and includes additional leases for three nearby sugarcane farms.

The partnership has brought substantial benefits to the farm's employees, providing them with both land ownership and a stake in the farm's profits, alongside regular wages. This approach combines economic opportunity with ongoing community involvement, fostering a sustainable model of shared land and business ownership.

A critical factor in the success of this model was the continued collaboration between Ant, Chris, and the employee-owners, with mentorship and technical support ensuring smooth operations. Additionally, the Department of Rural Development and Land Reform and Inkezo Land Company played pivotal roles in financing the farm's acquisition, while the Department of Agriculture, Environmental Affairs, and Rural Development provided further support through irrigation, fencing, and equipment for protea production at the time.

The Donovale Farm model illustrates a successful path for community ownership, contributing to land reform and poverty alleviation. This approach not only serves as an example of inclusive, equitable land ownership but also strengthens community ties and provides a pathway to shared prosperity.

Challenges

- The farm faces challenges with pests like the eldana borer, which threaten sugarcane quality and yield. Managing pest populations sustainably, without relying heavily on chemical pesticides, requires ongoing investment in IPM practices and habitat conservation.
- Despite efforts to monitor and report GHG emissions, accurately measuring soil carbon has been difficult. Limited access to accredited labs and the lack of standardised measurement techniques complicate efforts to assess carbon sequestration and enter the carbon credit market.

100 South Africa Sugar Journal. 2010. Conservation and land reform success. Issue March 2010. South African Sugar Association, Kwazulu-Natal

- Efficient irrigation practices have been implemented, but challenges remain with water availability and ensuring consistent soil moisture, especially given climate variability. Monitoring water usage, optimising irrigation, and maintaining drought resilience are ongoing priorities.
- While the farm uses the SUSFARMS tool to implement sustainable practices, broader adoption across the industry has been slow, limiting widespread impact and potential collaborations within the sector.

Contribution to the Sustainable Development Goals

Donovale contributes to the achievement of the following SDGs:

Impact

- Donovale Farm has set a model for others to follow by proactively adopting sustainability practices, showcasing leadership in the agricultural sector and encouraging others, both in the sugarcane value chain and in other crop sectors, to implement similar strategies.
- The farm's sustainability initiatives are backed by scientific research and economic reasoning, with significant scalability potential. Currently, three milling groups have adopted these practices, covering approximately 40,500 ha, demonstrating widespread industry acceptance and growth.
- The land ownership model at Donovale Farm, involving the farming community and former employees, exemplifies an inclusive and equitable approach to land distribution, promoting community empowerment, shared prosperity, and long-term sustainability.
- Adopting BMPs, such as IPM, habitat restoration, no-tillage, and cover cropping, has improved biodiversity, soil health, and water efficiency, all of which contribute to long-term environmental sustainability. Additionally, initiatives like crop diversification, drought-resistant varieties, and erosion control enhance climate resilience, while reducing pesticide reliance and supporting cost savings, making the approach economically viable and socially beneficial for the farming community.

Lessons learnt

- **The importance of evidence-based decision making** with Donovale Farm's practices informed by scientific research, such as collaboration with SASRI for expert advice on mitigation strategies.
- **Integrated, holistic planning with a long-term vision** ensures sustainability, informed by evidence rather than regulatory pressure.
- **Multiple factors contribute to success**, including sustainable soil, water, and pest management, government support for land ownership models, and a skilled, committed team.
- **Incremental progress is essential**—implementing BMPs may seem daunting initially, but setting clear goals and focusing on gradual improvements fosters environmental responsibility and climate resilience.

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Southern Africa

Zimbabwe

Sustainable Honey Production in Zimbabwe: A Path to Climate Resilience and Forest Restoration

Context

Nyanga district, located in the northern part of Manicaland Province in Zimbabwe's Eastern Highlands (Figure 14), is characterised by diverse topography, including rolling hills, mountain peaks, river gorges, waterfalls, and steep-sided valleys. The region's altitudes range from 1,500 to 1,900 m, with the highest peaks of the Chimanimani Mountains and Umkondo Highlands exceeding 2,000 m.[101] Rainfall patterns vary across the area, decreasing from east to west. The eastern slopes, with their higher rainfall, are well-forested, while the western slopes, which experience drier conditions and lower rainfall, are dominated by grasslands and woodlands. These western areas also feature poor, leached soils.

The local communities in Nyanga are primarily dependent on rainfed agriculture, with livestock such as cattle, goats, and pigs, alongside crops like maize, potatoes, and fruits such as apples and plums in the wetter, eastern regions.

Zimbabwe faces several climate-related challenges. Mean annual precipitation has declined in recent decades, with delayed rainy season onset and early cessation across all agro-ecological regions. The country is also experiencing warming, with the average annual temperature increasing by around 0.03°C per year from 1970 to 2016. Natural hazards such as droughts, floods, storms, and epidemic diseases continue to pose significant risks, with droughts becoming more pronounced during the January–March period. Given that 80% of agricultural production is rainfed, the increasing climate stress is a major concern for the sector.[102]

101 FEOW. 2019. Eastern Zimbabwe Highlands.
102 *Ibid.*

The Eastern Highlands, which form part of Zimbabwe's border with Mozambique, are particularly vulnerable to cyclones. Cyclone Idai in 2019, for example, caused widespread devastation, claiming 340 lives, displacing 270,000 people, and damaging over 1,500 km of roads. The region is also experiencing increased migration from drier lowland areas, as farmers seek the cooler and wetter conditions of the Eastern Highlands. This influx has led to greater population pressure, contributing to challenges such as water scarcity, deforestation, land degradation, and conflicts over resources with local communities.[103]

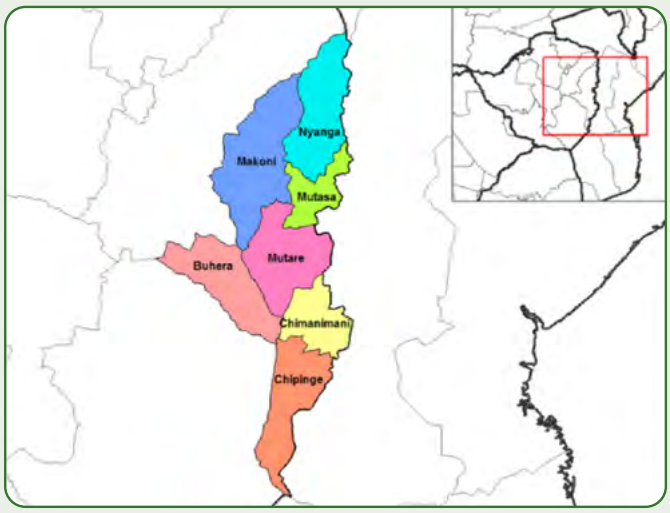

Figure 14. *Nyanga district is located to the north of Manicaland Province in the Eastern Highlands of Zimbabwe.*[104]

About Chomwedzi Apiculture

Established in 2013, Chomwedzi Apiculture (Chomwedzi) is a community-led organisation committed to the protection of bees (aphis mellifera) and their environment through innovative management systems. Operating in Nyanga district, Zimbabwe, Chomwedzi covers a diverse landscape extending from the slopes of Nyangani to the low-lying Honde Valley. The organisation was founded by Charles Hamilton, who was born and raised in Nyanga. His interest in bees began at a young age, when he would play in the natural bush and follow honey guides to find wild bee colonies and harvest honey. Charles is currently the Managing Director of the organisation.

> ***"In poverty, self-preservation and family protection supersede environmental conservation. Over the years I observed that the trees that are left standing, in a once diverse and prolific forest, are those that provide food. To this end, I decided that there was a way to make all trees provide food and income through bees. A bee farmer would protect trees that his bees were pollinating, this was his family income. The better the income the more protection was given to the forest. It is imperative that bee farmers are reimbursed at a fair and profitable amount"***
>
> - Charles Hamilton, Managing Director of Chomwedzi Apiculture.

Chomwedzi's core mission is to reduce poverty among rural communities through honey production and other bee products, while prioritising the protection of bee colonies. The project addresses the global decline in bee populations, which is driven by unsustainable management practices, pesticide use, and habitat degradation, along with an increased demand for bee-derived products.

103 Mambondiyani A. 2021. Zimbabwe's climate migration is a sign of what's to come. Climate Change and Energy. MIT Technology Review.
104 Nyanga District. 2024. Wikipedia. (Accessed: 11 November 2024).

Chomwedzi provides beehives and necessary equipment (such as bee suits, gloves, and smokers) free of charge to rural communities, and trains them in ethical and sustainable honey production. The training covers beehive construction, baiting, hanging, aging, harvesting, problem-solving, and value addition. Once trained, the communities construct beehives using sustainable materials under the supervision of Chomwedzi's accredited trainers. Chomwedzi then purchases the bee products from these communities at prices above the market average, and then transports the honey to customers in and around Harare, Zimbabwe.

The beehives are placed in areas of low human impact, and by understanding local flora, Chomwedzi produces honey with different flavours. The hives are strategically located according to flowering seasons and monitored through bee flight paths and pollen colour. As a result, Chomwedzi offers a variety of honey types, including Nyangani wild flora honey, Riverine wild flora honey, Miombo woodland honey, Wild wattle honey, and Gum honey. Farmers are encouraged to eliminate the use of pesticide and chemicals in their planting. Also, hives are placed as far away from commercial enterprises using pesticides in order to promote the pollination of pesticide free areas.

Chomwedzi also uses modern technology to assist communities with seasonal hive management and marketing. Additionally, the organisation generates open-source data for research and other purposes.

In addition to the sustainable bee hives, this organisation also places hives in gardens in Harare to support bee homes, and not honey harvesting.

Chomwedzi's goals are to:

- Manufacture and distribute over 10,000 beehives across Zimbabwe.
- Scale and expand operations into Mozambique, Angola, Zambia, other Southern African Development Community (SADC) countries, and eventually South America.
- Develop and utilise technology-driven management systems.
- Create innovative products to enhance and support production, such as composite recycled standardised beehives.

BOX 7

Mozambique venture

Chomwedzi was contracted by Rift Valley Forestry and the Mozambique Forestry Commission to support a forestry protection programme in a remote part of northern Mozambique. The project aimed to distribute 30,000 beehives alongside training, monitoring, and evaluation efforts, directly benefiting 1,200 community members while conserving 4,000 ha of miombo woodland. The indigenous miombo forests in the area are increasingly threatened by charcoal production and small-scale farming, so Chomwedzi worked with local communities to highlight the woodlands' potential to offer reliable, sustainable income if managed responsibly. Unfortunately, the programme ended prematurely after only the first payment was made, leaving many promises to the community unmet.

Chomwedzi collaborates with the private sector through Corporate Social Responsibility (CSR) programmes, as well as with international and local NGOs, local ministries, and rural communities. This partnership benefits all stakeholders—supporting both the environment and the production of high-quality, sustainable bee products.

Products and services

Beehive production

Chomwedzi has developed a standardised wooden top bar beehive made from sustainable resources, which is provided free of charge to rural communities. This beehive is simple to construct and easy to manage, designed to be bee-friendly and closely resemble traditional indigenous log hives. The wood used for the beehives is sourced from local sawmillers who process pine and eucalyptus, both of which are considered invasive species in Zimbabwe. Although Chomwedzi also promotes the use of log hives, these currently offer lower returns for farmers.

The beehives provided to rural communities are:

- Flat packed for easy storage and transport.
- Easy to assemble with no tools required.
- Designed to be transportable, with the capacity to carry up to six beehives on a bicycle or up to 20 in a sedan.
- Designed to maintain an optimal temperature for the bees.
- Easy to clean, with effective pest and disease management capabilities within the colony.
- Fully weather-protected to ensure durability.

Chomwedzi trains trainers who, in turn, teach local communities how to make the beehives themselves, ensuring that each hive is standardised, of high quality, and sustainably made.

In addition, Chomwedzi collaborates with a local seamstress to produce bee suits and a local metalworker to craft smokers. These efforts help support local businesses and ensure that the necessary equipment is available for effective bee management.

Chomwedzi is also in the process of developing recycled composite beehives. These beehives are designed to improve all aspects of bee management, productivity, and colony protection, further advancing Chomwedzi's commitment to sustainable practices in apiculture.

Images. *Chomwedzi beehives.*

Raw honey

Chomwedzi's honey is raw, hand-pressed, and single-filtered. It is not pasteurised, which helps retain its natural nutrients and high content of pollen, propolis, and comb. This process ensures that the honey retains its full range of beneficial properties, offering a product that is pure, unaltered, and rich in the natural compounds found in bees' work.

Image. *Chomwedzi honey.*

Image. *A honey extraction bush press made from local materials.*

Lip, hand and heel balms

Chomwedzi's lip and body balms are crafted from a blend of Zimbabwean natural seed oils, including mongongo, marula, and mafura, combined with essential oils such as tea tree, geranium, and rosemary, along with beeswax. These oils are sourced from a community-based project that ensures the sustainable harvesting of tree seeds.

Chomwedzi is currently expanding this area of its business to offer a broader range of value-added products, further supporting local communities while promoting natural, high-quality skincare solutions.

Other services

- Apiculture training
- Baseline surveys
- Identification of beneficiaries and target areas
- Tree planting programmes
- Market linkages and distribution

Images. *Chomwedzi apiculture training.*

Environmental component

Bees play a crucial role as pollinators for both crops and wild plants, enhancing productivity and the associated ecological benefits. Chomwedzi ensures that its honey is managed and harvested sustainably, with a primary focus on the wellbeing of the bee colonies, their brood, and their habitat.

Chomwedzi is also actively working on the restoration of indigenous teak forests. This project tackles complex challenges such as human encroachment, drought, hunting, and timber harvesting. Local communities rely heavily on forest resources for food, firewood, and grazing, which has led to a decline in local wildlife, pollinators, and essential species crucial to the forest's ecosystem. Climate change has exacerbated these issues, with water sources drying up and making it harder for the forest to sustain life.

While professional hunting aims to control problematic wildlife, it can be misused, and timber harvesting, though important for providing employment and resources to the community, needs careful management to ensure the forest remains intact. Restoring the forest requires a holistic approach, which includes educating local communities on sustainable practices, reintroducing pollinators and small animals, and setting up community block farms to safeguard crops and alleviate hunting pressures.

By empowering local communities to manage the forest sustainably, improving water sources, reintroducing key species, and enhancing agricultural practices, it is possible to regenerate the forest. This benefits both the environment and the people who depend on it. As part of this effort, Chomwedzi conducts training to raise awareness about the importance of forest protection and tree planting. These efforts have already led to a noticeable reduction in bushfires in the forested areas, further contributing to the restoration of the ecosystem.

Climate change component

Climate change hazards, such as drought, extreme rainfall events, and the resulting pest and disease outbreaks, have significantly impacted the productivity of small-scale farms in Nyanga, leading to increased poverty and food insecurity. In response, communities are increasingly turning to forests for food (through hunting wildlife and harvesting fruits), medicine (medicinal plants), fuel (firewood and charcoal), and income generation (sale of forest products). The forests also serve as a source of forage for livestock. However, the pressure on these forests is severe, with natural bee colonies being destroyed for honey, and wildlife, including birds, being hunted or killed to protect crops.

Chomwedzi offers a sustainable solution by training small-scale farmers in apiculture (beekeeping) as an alternative livelihood and income source. Farmers are taught not only the skills required for successful honey production but also the importance of conserving and restoring forests to increase honey yields and secure a stable income. Through the knowledge gained, the provision of apiculture materials, and improved financial returns, farmers are better equipped to cope with the impacts of climate change. Moreover, they actively contribute to forest protection, which, in turn, enhances carbon sequestration and supports broader environmental sustainability efforts. This approach not only boosts resilience to climate change but also fosters a sustainable relationship between the communities and their environment.

Community and marginalised groups component

Chomwedzi is committed to supporting disadvantaged and vulnerable members of the community by providing them with livelihood opportunities and the tools they need to improve their lives and contribute to the development of their communities. Traditionally, men take on the role of beekeepers, while women play a vital part in processing the honey and producing lip, hand, and heel balms. Additionally, women are responsible for managing record-keeping and quality control in the processing shed.

Chomwedzi has launched a 'honey for school fees' programme, which allows children from poverty-stricken areas to collect and deliver honey to their schools. Chomwedzi then purchases the honey, with the proceeds going towards the children's school fees. Six schools have been approached, and eight children have already participated in the programme. Chomwedzi plans to expand this initiative in the future to help more children access education.

In addition to supporting schoolchildren, Chomwedzi also engages with local schools by giving talks on the importance of conserving bees and the natural environment. The organisation further promotes environmental awareness through 'movie afternoons' on Fridays, where they use a projector to screen natural history and environmental documentaries. These movie afternoons have become a popular and well-attended event, enjoyed by both adults and children, helping to foster a deeper connection to the environment within the community.

Capacity building component

Chomwedzi provides comprehensive training programmes that emphasise the importance of bee colonies and their crucial role in the preservation of the local and global environment, alongside the need to protect forests. These training sessions equip beekeepers with the skills and knowledge necessary to produce high-quality honey and balm products, while also ensuring the sustainability of the bees and their natural habitat.

Additionally, Chomwedzi runs monitoring and evaluation (M&E) programmes tailored to the needs of the targeted communities. As part of these efforts, Chomwedzi has trained two local individuals—one woman and one man—in beekeeping auditing. These auditors are provided with motorbikes to enable them to regularly inspect the hives, ensuring that they are well-managed and kept clean. The auditors also participate in the honey harvesting process, overseeing that best practices are followed throughout.

To further support quality control, Chomwedzi employs women at its processing shed, where they are responsible for inspecting honey to detect any signs of poor hive management or improper honey harvesting practices. This ensures that Chomwedzi's honey products remain of the highest standard, benefiting both the community and the environment.

Challenges

- **Funding limitations:** The scaling of Chomwedzi's activities is restricted by a lack of sufficient funds, limiting its ability to expand its reach and impact more communities. With limited financial resources, the organisation faces challenges in meeting the growing demand for beekeeping training, materials, and equipment, hindering its potential to make a larger contribution to improving livelihoods in rural communities.
- **Farmer engagement and motivation:** While some farmers lacked motivation to engage in sustained beekeeping, recent increases in honey prices have sparked renewed interest in the practice. However, this surge in interest has brought about some negative effects. The higher honey prices have attracted more producers who, unfortunately, do not adhere to good beekeeping practices. This compromises the bee colonies and the quality of honey produced, undermining the reputation of Chomwedzi's products and the sustainability of the initiative. Additionally, the increased value of honey has led to a rise in beehive theft, which is a major concern, especially for farmers who have invested in beekeeping as a livelihood.
- **Environmental pressures:** The growing demand for honey and bee products, coupled with environmental stresses such as deforestation and the destruction of natural bee habitats, presents ongoing challenges. Chomwedzi's efforts to promote sustainable beekeeping practices are further complicated by pressures on local forests, which are often used by surrounding communities for food, firewood, and grazing. These practices contribute to habitat loss, affecting bee populations and making it more difficult to manage sustainable beekeeping.
- **Logistical challenges:** Transporting honey from rural areas to markets in Harare is time consuming and costly, effectively the price of the final product. Poor road infrastructure and the remoteness of some beekeeping communities further complicate the transportation process. In addition, the expansion in number of hives is challenging to audit.

Contribution to the Sustainable Development Goals

Chomwedzi contributes to the following SDGs:

Impact

- Approximately 700 operational beehives;
- 1,200 beneficiaries;
- Over 74,000 ha of protected indigenous forest; and
- Reduced number of bush fires.

Plans for future growth

- Manufacturing and distribution of over 10,000 beehives in Zimbabwe.
- The expansion of production within the SADC region, starting with neighbouring countries Mozambique, Angola and Zambia.
- There is a goal to also move continents and extend operations to South America.
- Chomwedzi is in the process of expanding their business to include a wider range of value-added products.
- Chomwedzi is working to scale up their 'honey for school fees' school programme.

Lessons learnt

Financial sustainability and securing long-term funding: Without a reliable and continuous source of funding, even well-designed programmes can falter, leading to unmet promises and a loss of trust from local communities. Ensuring financial stability is essential to maintaining project momentum, fostering lasting impact, and safeguarding both environmental and socio-economic goals.

Quality over quantity: Initially, Chomwedzi aimed to scale up the number of hives rapidly. However, it became evident that maintaining effective oversight and auditing of a large number of hives was challenging. Chomwedzi made the strategic decision to reduce the number of hives – from 1,000 to 700, until it had the requisite capacity to perform comprehensive M&E on all hives. This adjustment allowed for better management and more thorough auditing, ensuring sustainable beekeeping practices, well-maintained hives, and high-quality honey production. This experience underscored the importance of balancing growth with organisational capacity to ensure that the health and sustainability of bee colonies are not compromised by overly ambitious expansion plans.

Integrating traditional knowledge: Local beekeepers possess valuable, often generational knowledge of bees and hive behaviour, even if they lack formal scientific training. Mutual learning between traditional beekeepers and

project teams enriches project outcomes, blending traditional insights with scientific practices to create a more holistic understanding and sustainable beekeeping model.

Community-led simplicity: Projects that keep processes simple and allow communities to take the lead tend to build stronger local ownership and are more responsive to community needs, fostering sustainability.

Market viability before commitment: Promising beekeeping projects without an established market for honey risks wasted efforts and unmet expectations. Ensuring market demand before project initiation is critical to its success and financial viability.

Ethical challenges in retail markets: Retail markets are driven mainly by profit, sometimes diminishing the pride of local producers. Bulk honey can be diluted or adulterated, eroding the quality of the final product. Project leaders should prioritise understanding local contexts and uphold product integrity.

Cost and value addition: Community beekeeping initiatives require substantial initial investment—not just in hives but in setup and ongoing support. As profit margins on raw honey tend to be small, value-added products can significantly enhance income opportunities. Additionally, marginal areas, while often eager for income-generating projects like beekeeping, may lack the necessary resources, such as water and floral diversity, for bee sustainability. Evaluating an area's carrying capacity, especially during low flowering seasons, is essential.

Environmental suitability: Beekeeping is inherently linked to the availability of natural resources, such as water and flowering plants. Communities that have suffered extensive deforestation may struggle to support bee populations, underscoring the need for ecological assessments before project implementation.

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Ghana

Pioneering organic animal feed with insect technology

Background story

The story of ProSect Feed began with four young men who met through the 3rd AgriTech challenge of the Kosmos Innovation Centre[105] in 2019. The team members brought diverse yet complementary skills in marketing, project management and civil engineering. Initially the team aimed to establish a digital platform to sell meat (beef and poultry) in Ghana. However, early interactions with farmers quickly revealed that local meat was expensive due to the high cost of livestock feed in the country. As a result, consumers opted for cheaper imported produce. For instance, Ghana currently imports over USD 300 million worth of chicken annually - the equivalent of 5 million chickens each week - due to the high cost of local poultry. Local poultry farmers are unable to compete in the market due to high feed prices that make up 80% of their production costs. The challenge of high feed costs also affects pig and catfish farming, both of which have experienced surging demand.

Another challenge faced by Ghana's poultry industry is organic waste production, with farmers in the Greater Region alone producing 70 t of organic waste daily. Poultry waste production is considered both an environmental and societal challenge in the country.

To tackle the dual issues of feed costs and waste, the four entrepreneurs explored potential solutions and discovered insect technology. In 2020, they founded ProSect Feed to produce high-quality protein feed using black soldier flies (BSFs) (*Hermetia illucens*). ProSect Feed leased part of a poultry farm in Medie, a town in Ghana's Eastern Region, and began the pilot phase of feed and fertiliser production in 2020. Over two-years, the business tested and refined its production processes, logistics framework, and efficacy of its insect protein. ProSect also set up demonstration farms to trial its organic fertiliser and livestock feed, achieving a crude protein level of 58% for its flagship larvae meal product, ENTOPAC.

ProSect Feed then moved to a larger facility, enabling it to produce 2-2.5 t of feed and 5 t of organic fertiliser per month. In 2021, the company hired its first

105 The Corporate Social Responsibility arm of Kosmos Energy in Ghana.

two employees, both women, who quickly learned Prosect's operations through practical experience and the company's Standard Operating Procedures, which ensure data-driven activity recording.

The BSF eggs are sourced through a partnership with the Animal Research Institute at the Centre for Scientific and Industrial Research in Ghana. The BSFs lay their eggs in decomposing organic waste, from which the larvae hatch. As the larvae feed on the waste, they produce protein-rich larvae biomass and nutrient-rich excrement (frass). The larvae are then harvested for livestock and fish feed, offering a sustainable and affordable alternative to traditional livestock feed. The insect-based protein feed saves local poultry, fish and pig farmers up to 30% in feed costs. The second product, the nutrient-rich frass, provides an affordable, high-quality organic fertiliser for farmers.

By recycling organic waste into fertiliser and livestock feed, Prosect Feed reduces the amount of waste dumped in landfills and the subsequent release of methane as the waste decomposes. Producing organic fertilisers also offers farmers an alternative to synthetic options, which are expensive and contribute to climate change through carbon emissions associated with their transportation, high energy consumption during manufacturing, nitrogen oxide emissions during production and use, as well as soil health degradation[106] and water pollution after use. ProSect Feed's organic fertiliser costs approximately USD 0.10/kg, significantly cheaper than inorganic fertilisers at approximately USD 1.5/kg.[107] Demonstration plots have been established to showcase the benefits of this organic fertiliser to farmers.

Farmers in Ghana are increasingly moving away from inorganic fertiliser use. For example, some farmers have noted that tomatoes grown with inorganic fertilisers have a much shorter shelf life than those produced with organic fertilisers.[108] The benefits of organic fertiliser are becoming more widely recognised.

Products and services

ProSect Feed produces high-quality insect-based protein feed and organic fertiliser. Additionally, the company offers training in waste handling, health and safety, pre-processing methods, agribusiness, traditional and digital marketing, financial management, access to finance, and animal nutrition and feed formulation.

106 Synthetic fertiliser has been linked to a loss of soil biodiversity and enhanced decomposition of organic matter and humus resulting in a change in the soil's physical structure and physiological processes (Tripathi et al., 2020).
107 Pers. Comms. Kwabena Tufuor. September, 2024.
108 *Ibid.*

Climate change and environmental component

ProSect Feed adopts a climate and nature-positive production system which ensures the sustainable use of resources and minimises environmental pollution. The recycling of organic waste reduces the amount of waste that reaches water bodies, eliminates strong odours from waste decomposition, and contributes to controlling vectors such as rats, mosquitoes, and flies that transmit diseases such as malaria, cholera, typhoid, and dysentery. In addition, the production of organic fertilisers reduces water pollution associated with runoff and soil degradation from synthetic fertilisers.

ProSect Feed aims to process over 10,000 t of organic waste from farms, hotels, restaurant chains and food manufacturing companies within five-years, significantly reducing Ghana's food and agricultural carbon footprint. Recycling organic waste lowers greenhouse gas emissions from waste decomposition and burning, while organic fertiliser use reduces emissions from producing, transporting (typically imported) and applying synthetic alternatives.

> ***By harnessing organic waste streams, Prosect can help mitigate the carbon footprint across multiple sectors, including the poultry and food manufacturing industries, as well as municipal waste management.***

ProSect Feed plans to participate in carbon credit trading but faces technical constraints in measuring carbon uptake. The company is working to engage a partner to assist with measurement.

Community and marginalised groups component

ProSect Feed provides an outgrower scheme, WASTE4CASH, targeting women and young farmers in the poultry sector. This system teaches farmers to process their waste, which ProSect Feed then purchases, allowing farmers to earn over USD 50 per month as supplementary income. Women farmers are also offered training tailored to their respective farm operations, with guidance from industry experts. Women processing sorghum for porridge, for example, have been grouped by ProSect Feed, which purchases their sorghum for larvae meal production. ProSect Feed is committed to gender balance and aims for a 50:50 gender ratio across all company levels within five years.

Capacity building component

Through partnerships with the **Kosmos Innovation Centre** and research institutions, ProSect Feed offers comprehensive training covering waste handling, health and safety, pre-processing, agribusiness, marketing, financial management, access to finance, and animal nutrition. Women receive targeted training from industry experts. This ensures a holistic training is provided, not only limited to waste management.[109]

109 GoGettaz. 2021. Nana Yaw Antwi-Boasiako. (Accessed online: 14 November 2024). https://gogettaz.africa/agripreneurs/nana-yaw-antwi-boasiako-prosect-feed-ghana/

Challenges

The main challenges ProSect Feed faces are raising funds to purchase more equipment and **scaling production**. Pests, such as **rodents**, have also been problematic. Fresh larvae meal needs to be consumed within a week before the larvae develop into flies, requiring frequent, small-batch distribution, which raises **transport costs**.

Contribution to Sustainable Development Goals

ProSect Feed creates employment within the value chain and reduces waste which contributes to decreased greenhouse gas emissions and improved food security in Ghana in line with the United Nations' SDGs:

Impact

Since its creation in 2020, ProSect Feed has received feed orders from 500 farmers (about 60% women[110]) and the company has distributed more than 25 t of feed.[111] Its organic fertiliser is used by 20 vegetable and crop farmers, with around 100 additional orders placed. The WASTE4CASH scheme has 10 participating farmers, five of whom are women, with plans to reach over 1,500 farmers within the next 3-5 years.

> ***ProSect Feed is producing an alternative protein, if well incorporated into feed, can lower feed costs by up to 30%. This ensures a fair price for both farmer and consumer.***

Future plans

Over the next two years, ProSect Feed aims to produce 10-15 t of larvae meal from their current production premises. The company plans a decentralised expansion to reduce costs, targeting production of 50 t of larvae meal per month by the fifth year, 100 t by the eighth year, and 250 t per month by the tenth year. Localised production sites, closer to the users, will reduce distribution costs and support scaling.

110 Pers. Comms. Kwabena Tufuor. September, 2024.

111 Access Agric. 2023. ProSect Feed, A Ghanaian startup transforming livestock farming with Internet of Things. (Accessed online: 14 November 2024 https://accessagric.com/prosect-feed-a-ghanaian-startup-transforming-livestock-farming-with-internet-of-things/

ProSect Feed also plans to introduce poultry feed targeted to specific chicken types (e.g. broilers or layers), as well as fish and pig feed for different growth stages (e.g. fingerling to adult and weaner, grower to finisher respectively). The company is partnering with key research institutions to investigate further innovations in insect technology and attract young innovators in entomology and research and development (R&D) to enhance the company's products. ProSect Feed is also exploring partnerships with mechanisation business and an input dealership to expand production and improve marketing and distribution.

Currently, ProSect Feed's market is local, but there is interest from countries like Benin, Ivory Coast, Nigeria, Zimbabwe and Botswana. However, limited funds for rapid scaling mean that the company needs to grow organically and gradually. ProSect Feed is working towards United States Food and Drug Administration certification and is engaging with the Ghanaian Standards Board to develop quality standards for insect protein.

Lessons learnt

- **Testing assumptions to minimise risk:** Prosect started by identifying key pain points, gaps, and the unique needs of its customers, then tested assumptions through market feedback. Shortly after beginning operations, Prosect piloted specific production processes to determine what would work effectively, helping to mitigate risks in a challenging, unpredictable, and relatively unstructured market.
- **Incorporating frugal operations and a lean mindset:** While initially unplanned, Prosect adopted a frugal, lean approach to technology due to supply chain bottlenecks and market barriers, particularly those arising from COVID-19 disruptions. This led to a focus on local solutions, such as constructing a home-built solar dryer that, though basic, proved effective. Prosect is now exploring ways to integrate local suppliers and fabricators into its operational ecosystem.
- **Resilience in the face of international disruptions:** The challenges brought on by international disruptions required Prosect to remain resilient, maintaining ongoing activities and adapting when necessary. For example, as COVID-19 led to the closure of many small and medium poultry farms, Prosect demonstrated a 'bounce-back' mentality and pivoted to new markets, such as supplying the catfish industry, showcasing its ability to stay nimble and adjust course when needed.

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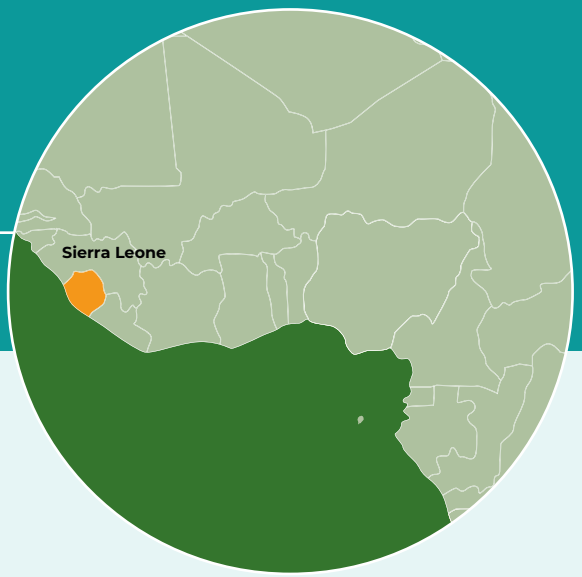

Enhancing sustainable food production through green composting

Context

The World Food Programme's 2024 Food Security Monitoring System Report indicates that 82% of the Sierra Leonean population are food insecure, and 18% of households are severely food insecure. Also, 68% of the surveyed households reported spending more than 75% of their total expenditure on food. The report also discusses the increased input costs for agricultural production such as fertilisers, improved seeds, farm tools, and high transportation costs which impact the income levels of smallholder farmers. Considering the nation's economic dependence on the agricultural sector, which constitutes over half of its GDP, these stressors translate into increased food insecurity levels for most Sierra Leoneans living in both rural and urban areas. Further, a lack of alternate economic opportunities in rural areas diminishes income opportunities for rural communities.

Climate change is a key driver of food insecurity in the country, affecting the livelihoods of most of the population. Over the past fifty years, mean annual temperatures in Sierra Leone have risen by 0.8°C, with this increase accelerating in recent years.[112] As temperatures continue to rise, extreme temperatures are expected to become the new norm for the population. By the 2030s, average monthly temperature increases are projected to range from 0.8°C to 1.1°C, and by the 2050s, they may rise between 1.4°C and 2.2°C.[113] Rainfall patterns have become increasingly erratic, with a noticeable decline in mean annual precipitation. This trend is expected to persist through the mid-century, although seasonal variations will be significant. The primary climate-related hazards facing Sierra Leone include flooding and landslides, along with additional risks from wildfires and droughts. As a result, rainfed agriculture, which dominates in the country, faces risk of crop and livestock losses that could significantly worsen already low levels of food security.[114]

112 International Bank for Reconstruction and Development/The World Bank. 2023. Climate and Health Vulnerability Assessment: Sierra Leone.
113 *Ibid.*
114 UN. 2022. Climate action for Sierra Leone. Partnerships Resource Brief. United Nations.

Background story

Abubakarr Ibrahim Ndopaie's commitment to addressing food insecurity in Sierra Leone is deeply rooted in personal experience. As a child, his mornings began at 6:00 am, when he would sell surplus vegetables that his mother cultivated. The family's garden, producing potatoes, carrots, okara, onions, bitter balls (also known as jakato), peppers, and eggplants, amongst others, provided sustenance and a modest income. However, in one particularly difficult year, drought severely impacted their vegetable and rice yields, leaving the household without enough food. This experience ignited Abubakarr's desire to improve food security within his community.

Additionally, Abubakarr observed the mismanagement and underutilisation of organic waste matter, particularly in urban areas where streets and marketplaces were littered with poorly disposed waste, posing environmental and health risks. These observations reminded him of his mother's practice of using organic household waste to fertilise her own garden, a sustainable method he believed could be scaled to improve agricultural productivity.

During his student years in tertiary education he became aware of a growing trend: young people in Sierra Leone increasingly viewed agriculture as a 'poor man's job' and were reluctant to engage in the sector. Recognising the potential of agriculture to drive economic growth and improve livelihoods, Abubakarr committed himself to changing this perception, with the goal of attracting young people into farming as a livelihood and to revitalise the agricultural sector.

About Green Compost in Agriculture for Development

In response to the interrelated soil degradation, fertiliser shortage, food waste and food security challenge, in 2018, Abubakarr and his partner[115] established **Green Compost in Agriculture for Development** (GCAD) in Dauda town, Kenema City, in eastern Sierra Leone. GCAD is a registered member of the National Federation of Farmers in Sierra Leone and the National Fertiliser Regulatory Agency (NaFRA).

GCAD is a youth-led, eco-friendly business whose vision is to ***'Improve income security of smallholders' farmers in rural communities as a means of promoting sustainable agriculture through the use of innovative technology to produce and sell high quality organic compost fertiliser to farmers'***.[116]

In addition to using innovative technology to turn organic waste into compost fertiliser, the company also pursues its own cassava, vegetable and bee farming activities.

By October 2024, GCAD was servicing 4,400 clients including individuals, groups and cooperatives. The clients are low and medium-income farmers, 60% of which are engaged in horticultural activities, with some involved in organic farming, and a few in floriculture, urban permaculture and seed nurseries (Figure 15). The number of GCADs compost users increases in the dry season when many people (mostly women) engage in vegetable production. GCAD also supplies compost to NGOs engaged in organic farming and mining companies working to restore land.

115 Abubakarr established GCAD with a partner who subsequently sold his shares in 2023 giving Abubakarr full ownership.
116 Green Compost in Agriculture for Development. 2024. GCAD website.

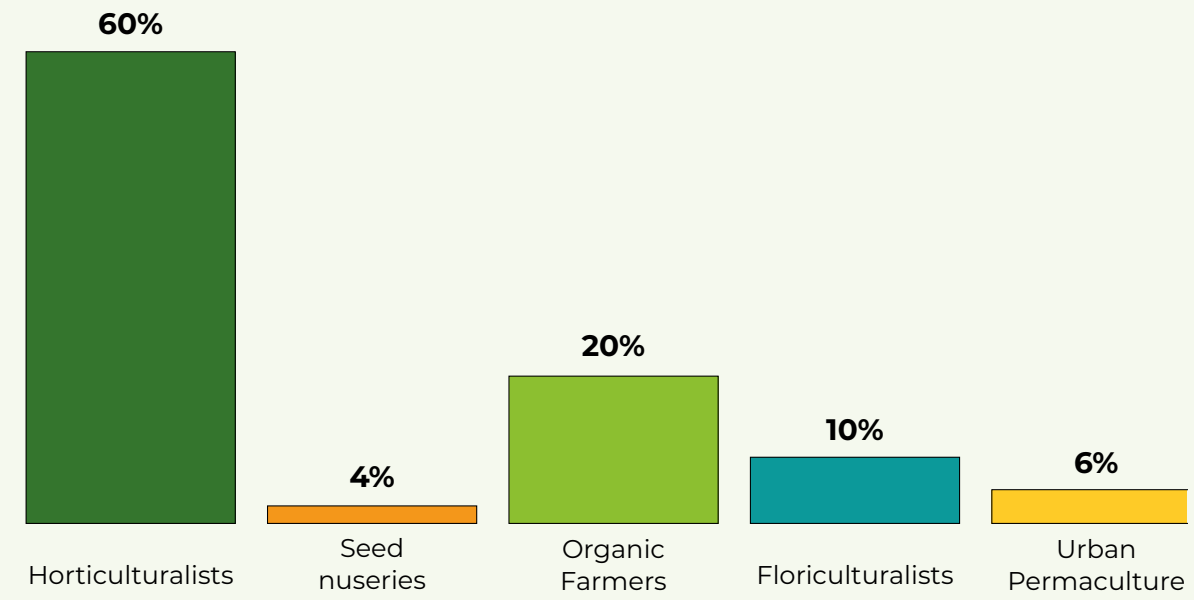

Figure 15. *GCAD's main client groupings are low and medium-income farmers.*[117]

GCAD currently has permanent 12 employees and Abubakarr is the CEO and head of programmes. The company is youth oriented (all employees are below the age of 35) and gender inclusive. During peak production, temporary workers and volunteers assist GCAD with the cultivation and processing of cassava.

> ***"Our farmers have chosen us because we care about the food grown, the resources we use, the people we employ, the communities we serve and the planet we are all living on"*** - Abubakarr Ndopaie.

GCAD's product and services offerings

GCAD offers several products and services to its clients. Initially the company's focal offerings were compost fertiliser and vegetable production and associated training services. However, due to growing market demand, the business has rapidly expanded to include the production of rice, cassava, briquettes, and honey, as well as land restoration and plastic recycling activities.

117 Ndopaie A. 2024. Green Compost in Agriculture for Development. Organic Compost Fertiliser. PowerPoint Presentation.

Organic fertiliser production

Composting, and associated training services, provide GCAD's main revenue stream. GCAD performs waste management through the composting of brown and green waste[118] sourced from nearby markets, supermarkets, hotels and restaurants, households, farms, and a dumpsite in Tiloma community, Kenema City. The waste is collected daily using tricycles and transported to the production site where it is sorted and processed. The waste is mainly given to GCAD for free as clients see the benefit of waste removal and management. However, the poultry waste and manure from cattle and pigs is at cost, as it is valuable due its rich nutrients.

Once the waste is received at the processing facility it is first sorted to remove unwanted materials including plastic for the company's recycling stream. Next the organic waste is manually fed into a shredder machine to reduce the size of the waste particles for easier decomposition. The shredded organic waste is then put into large wooden boxes for composting. The compost is processed over a period of 45 days and requires regular turning and watering. Compost that is ready for sale has an earthly smell and is dark brown in colour. The compost is then sieved, weighed and packaged.

The organic fertiliser (compost) is sold in 25 kg and 50 kg bags. One sack of organic fertiliser (50 kg) sells for SLL 400 (approximately USD 17.50). This is considerably more affordable than the average synthetic fertiliser (NPK) available to the farmers which costs SLL 1,500 (approximately USD 66) for a 50 kg bag.

There is a large and growing market for the organic fertiliser, with demand sometimes outweighing supply, particularly during the dry season when farmers focus on vegetable production.

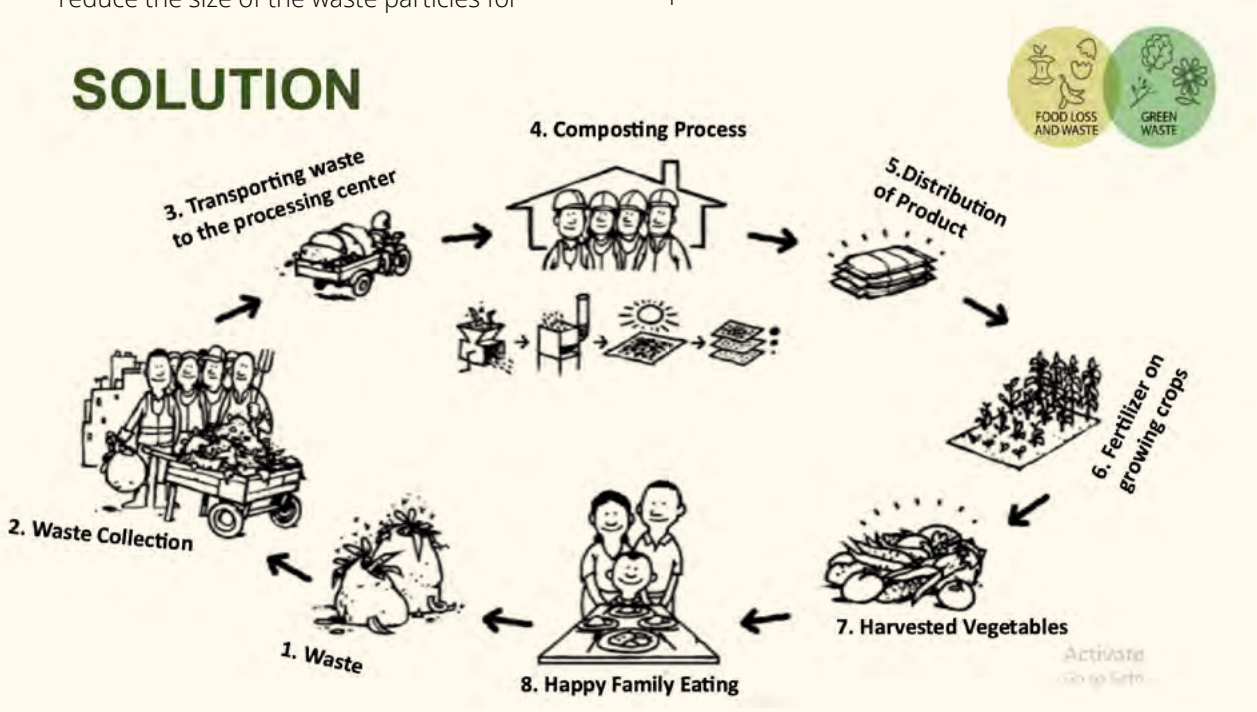

Figure 16. *Composting solution to organic waste management.*[119]

118 Green waste is biodegradable waste that comprises materials that are rich in nitrogen (e.g. grass, branches, woodchips, bark, wood, and weeds). They tend to heat a compost pile up because they help the microorganisms in the pile multiply quickly. Brown waste is biodegradable waste that is predominantly carbon (e.g. dry leaves, hay, paper, sawdust, maize cobs, manure, cardboard).

119 Ndopaie A. 2024. Green Compost in Agriculture for Development. Organic Compost Fertiliser. PowerPoint Presentation.


Figure 3. *Organic fertiliser (compost) product.*

Organic agricultural production

GCAD leases land to grow its own organic produce including, rice, maize and vegetables (onion, ginger, eggplant, garlic, tomatoes, cabbage, peppers, cucumber, maize, etc.)[120] on a small scale in Dauda Town. Although GCAD's produce is organic it is currently not certified.

GCAD also grows cassava on 20 ha of its own land in Panderu and Kpai villages in the Kenema District. *Garri* production (processed cassava) is GCAD's second greatest revenue source, with a 50 kg bag selling for SLL 900 - SLL 1,000 (USD 39.50 – USD 43.80). The *garri* is sold locally and the price fluctuates with the season - demand is higher in the rainy season.[121] In 2025, GCAD plans to register and certify their produce with the Standards Bureau of Sierra Leone.


Images. *Processing cassava into garri.*

120 Green Compost in Agriculture for Development. LinkedIn.
121 *Ibid.*

Bee keeping and honey production

Honey production is a new and expanding business venture for GCAD. GCAD has arranged for a consultant to train GCAD staff and out growers on modern bee keeping practices in November 2024. The training will include the construction, installation and monitoring of bee hives and the harvesting and extraction of honey according to good bee management practices.

GCAD has acquired a small piece of land and has established a memorandum of understanding with farmer cooperatives in the district to produce honey. The hives are to be installed in the forested areas of Kambui Hill, as well as in other forested areas of Kenema District. GCAD is supplying the beehives and tools to the farmers and will purchase the honey from them for distribution to the local market.

Sustainable energy source

GCAD produces biomass briquettes from organic waste (e.g. coconut and rice husks and maize stalks) for use in eco stoves. However, the briquettes are currently more expensive than charcoal (more than double the price), and so sales are low.

Images. *Making biomass briquettes for use in eco stoves.*

Plastic collection and recycling

GCAD started its plastic recycling work stream in 2022. The company has established a network of plastic collection sites in urban areas and works closely with local communities, businesses, and government bodies to collect and recycle single use plastic and pet bottles. GCAD recycles the plastic by heating it and mixing it with sand to form compound paving dialect which is sold to private construction companies, households and government entities. The product is in high demand and so GCAD is currently seeking opportunities to modernise their plastic recycling facilities to scale up production.

As GCAD's current plastic recycling technology is rudimentary, they cannot engage in mass production of compound paving dialect. Excess plastic waste is processed using a baling machine and is sold to a company in Guinea that uses more advanced plastic processing technologies.

Images. *Compound paving dialect and excess plastic baled for export.*

Agricultural consultancy and other services

GCAD offers consulting services in a variety of specialist areas drawing on Abubakarr's six years of experience in composting and agricultural training, the knowledge of two staff members with degrees in agriculture, as well as the knowledge and experiences of external experts. Capacity building of farmers and farmers' groups is free as part of GCAD's corporate social responsibility unless contracted by an NGO or agribusiness to train targeted communities. GCAD also collaborates with the local district authorities to equip community members (waste pickers, and local leaders) with skills for effective composting, recycling, and sustainable *garri* production techniques.

The services offered by GCAD include:[122]

- Soils testing and GPS land measurement; and
- Capacity building
  - Provides practical training on climate-smart good agronomic practices for farmers, farmers groups, and university students studying agriculture. The training includes agroforestry,

122 Ndopaie A. 2024. Green Compost in Agriculture for Development. Organic Compost Fertiliser. PowerPoint Presentation.

mulching, soil management and testing, efficient fertiliser application, composting, post-harvest handling and storage, crop management including cover cropping and crop rotation, and harvesting and storage of local seeds.

- Works with NGOs to train farmers on vegetable seed production, storage and planting as well as composting and how to conduct soil tests.
- Contracted by Welt Hunger Hilfe to provide practical compost training to university students from the Eastern Technical University in Sierra Leone.
- Trains farmers on establishing vegetable nurseries and tree transplanting.

Further, stakeholders from the private sector, government and development partners invite Abubakarr to consult on business growth opportunities and challenges, and ways for improvement.

Images. *Student and farmer training sessions.*

GCAD's overall impact

Since 2018, GCAD has worked with 4,400 farmers to build long-term, sustainable farming practices by sharing best practices in small-scale agricultural production and manufacturing and providing organic fertiliser that meets farmers' needs.

GCAD's socio-economic and environmental impacts include:

- 35% increase in income security for smallholder farmers.
- 25% increase in smallholder farmers' yields.
- 4,400 farmers reached since inception of which 70% are women, 30% are men and 60% are youth (35 years or below).
- 110 jobs have been created since inception, including 12 direct jobs (5 women, 7 men, all youth) and 98 indirect jobs (58 women, 40 men, and 75% of which are youth).
- 25,000 t of organic waste composted and thus diverted from the landfill.
- 142 ha of degraded land restored.
- A large amount of plastic waste diverted from landfills (exact number unrecorded).

Climate change and environmental contribution

Organic fertilisers benefit the environment by diverting waste from the landfills and enriching soil health naturally, promoting biodiversity, and reducing the need for synthetic fertilisers which contribute to greenhouse gas emissions, and if used inappropriately, enhance soil degradation. Organic fertilisers improve soil structure, increase water retention, and support long-term sustainability in agriculture without polluting ecosystems.

GCAD restores land by growing indigenous and cash crop trees in degraded areas. Additionally, their production of biomass briquettes has the potential to reduce deforestation activities preventing further land degradation.

GCAD promotes sustainable agricultural practices that conserve water and improve soil health, enhance biodiversity and reduce erosion. The practices prevent environmental pollution by chemicals, reduce greenhouse gas emissions, and protect natural ecosystems, whilst supporting long-term agricultural productivity.

Composting contributes to climate change mitigation by reducing methane emissions from landfills. Further, organic fertilisers enhance soil health and carbon sequestration, reducing the need for synthetic fertilisers, which are energy-intensive to produce and release nitrous oxide - a potent greenhouse gas.

The sustainable production of biomass briquettes reduces the need for harvesting of wood for fuel and thereby reduces deforestation activities which contribute to carbon emissions.

Plastic recycling reduces the need for new plastic production, which is energy-intensive and relies on fossil fuels, thus lowering greenhouse gas emissions. It also decreases the volume of plastic waste in landfills, cities and communities, as well as in rivers, streams and drainage areas thereby reducing greenhouse gas emissions from its decomposition and preventing environmental degradation.

GCAD engages in land restoration activities such as agroforestry in areas degraded by illegal mining, timber logging, unsustainable agricultural practices and urbanisation. The company has a social commitment to plant 500 trees a year. It runs tree-planting campaigns in collaboration with educational institutions and community organisations. Both common (palm trees) and cash crop trees (cocoa, avocado and cashew nut) are planted in areas affected by deforestation or degradation. The palm tree seeds are collected from mature trees for germination during the dry season. The areas for reforestation are designated by the Government of Sierra Leone. The tree-planting initiatives aim to restore ecosystems, boost biodiversity, stabilise the soil and he and contribute to carbon sequestration.

Social impact

GCAD is youth-oriented and gender inclusive, it employs three women in top management positions, two in production as well as a disabled person.

The majority of the smallholder farmers who attend GCAD's trainings are women (75%).

The improved productivity and associated additional income from the use of GCAD's organic fertiliser is used by the farmers (predominantly women) to embark on other small business ventures.

Advocacy and awareness

Joint public awareness campaign: GCAD collaborates with local district councils, Welt Hunger Hilfe and government departments on plastic recycling and organic farming awareness campaigns. The campaigns educate the public on the need for proper waste management and promote compost as an alternative to chemical fertilisers. This is done via radio every Wednesday from 20:00-21:00. Further, on Sunday the 28th of October 2024, Abubakarr spoke about waste segregation on Nyapui Radio with representatives from Welt Hunger Hilfe, Kenema City council, and Klin Kenema Youth group.

Policy inputs: GCAD provides insights and data to local district authorities to contribute to policy development. For example, GCAD actively contributed to the formation of the Sierra Leone National Plastic Policy. Further, Abubakarr, through an invitation from the Environmental Protection Agency of Sierra Leone, participated in the National Consultation workshop on 31 October 2024 in preparation for the 5th session of the Intergovernmental Negotiating Committee on Plastic Pollution Republic of Korea.

Contribution to the Sustainable Development Goals

GCAD contributes to the achievement of the following SDGs:[123]

Plans for future growth

GCAD has established demonstration gardens in four different locations (Panderu, Elizer Amputee Camp, Dauda Town and Foindu) in Kenema city to prove the efficacy of the organic fertiliser. If achieved, GCAD will lobby the Ministry of Agriculture to purchase organic fertiliser though its flagship programme 'Feed Salone', this would require rapid scaling.

123 Green Compost in Agriculture for Development. 2024. GCAD website.

GCAD grew from USD 30,000 and 1,000 farmers (clients) in the first year of operation (2021) to USD 90,000 and 3,500 farmers in 2023.[124] The company plans to expand its reach nationally and to export regionally growing to USD 250,000 and targeting 8,000 farmers by 2025. Some of GCAD's targets include:[125]

- Increase annual production of organic fertiliser from 500 t to 1,000 t in the fiscal year ending 2024.
- Increase annual production of *garri* from 200 to 1,500 bags in the fiscal year ending 2025.
- Increase annual profit from USD 50,000 to USD 80,000 by the end of December 2025.
- Plant 2,000 trees annually (both cash crops and common trees).
- Restore 50 ha of degraded land annually.
- Production of premium-grade honey for the international market.

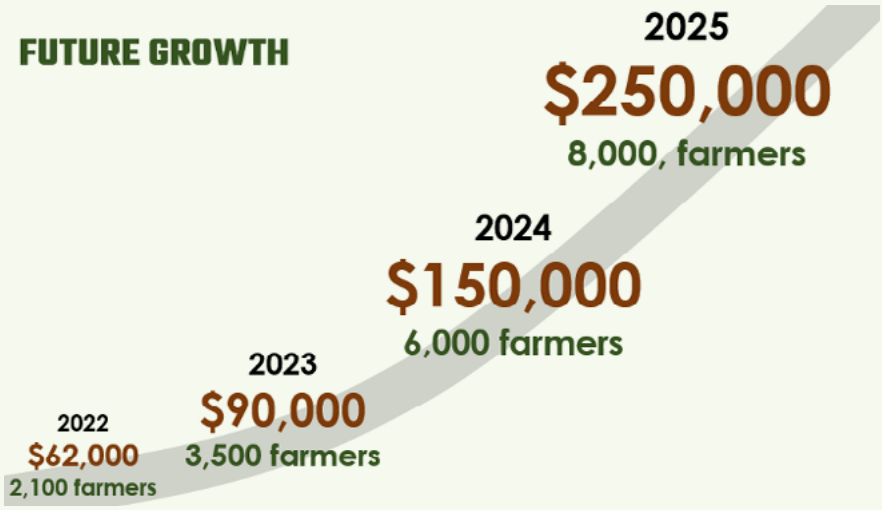

Figure 17. *Future growth plans for GCAD (Source: Ndopaie, 2024).*

10-year vision for GCAD

Over the next decade, Abubakarr aims to expand GCAD's market presence across the entire African region, extending beyond West Africa. A key priority is the restoration of 10,000 ha of degraded land, alongside the empowerment of 10,000 farmers through the adoption of CSA practices. These efforts are expected to enhance agricultural productivity, with a targeted 50% increase in crop yields.

Abubakarr seeks to leverage technological innovations to boost production capacity and strengthen market penetration within Africa, laying the foundation for future export opportunities. In alignment with its social impact goals, the initiative aims to generate employment opportunities for young people, thereby contributing to the reduction of youth unemployment.

A self-sustaining national food system is envisioned as the ultimate objective. To achieve these ambitions, Abubakarr recognises the importance of establishing strategic partnerships for mentorship, technology transfer, and innovation, which will be essential for scaling up agricultural production effectively.

124 Ndopaie A. 2024. Green Compost in Agriculture for Development. Organic Compost Fertiliser. PowerPoint Presentation.
125 Green Compost in Agriculture for Development. 2024. GCAD website.

Challenges

- Funding is needed for composting machinery, equipment and vehicles (granulator machines, a diesel generator, a delivery van and a truck for waste collection, automated packaging machines and materials, weighing equipment, a compost turner and screening equipment, a water supply system, a tractor with a front loader and motorbikes for marketers to reach remote communities), and work site expansion.[126]
- Funding is also needed for automated cassava processing machinery (a cassava washing machine, a peeler, grater and hydraulic presser, a fermentation tank, *garri* frying equipment and appropriate packaging).
- Packaging materials are of poor quality in Sierra Leone. GCAD needs good quality eco-friendly packaging materials, such as brown paper packaging which easily decomposes after use.
- Laboratory tests to determine the NPK value of the organic fertiliser is expensive. GCAD is looking to establish its own testing facility with the necessary equipment and personnel.
- Transporting waste is a challenge as the road is in poor condition which damages the tricycles with time. The tricycles used to transport the waste are expensive, around USD 4,000 each. The business needs good working trucks to carry the waste.
- GCAD also needs new office equipment, such as printers, computers, projectors, and desks, for their newly built training facility, as well as internet connectivity and an improved website.

Lessons learnt

- **Using local organic waste for composting.** Local waste materials, including crop residues and food scraps, serve as accessible, low-cost inputs for compost production. Reducing reliance on very expensive chemical fertilisers and external resources lowers costs and encourages sustainable practices at a local level.
- **Farmers' education and awareness raising on composting and use.** Educating farmers on the benefits of compost use over chemical fertilisers is essential. Demonstration plots, training workshops, and sharing success stories have been effective in shifting farmers' perspectives toward adopting organic farming practices.
- **Agroforestry, multi-cropping, and tree planting.** Integrating trees with crops improves soil health, retains moisture, and enhances biodiversity. Trees like nitrogen-fixing species (e.g. Acacia spp.) support the growth of crops by enriching soil nutrients, resulting in increased yields and ecosystem resilience.
- **Creating value-added products from cassava.** Processing cassava into *garri* and other value-added products extends its shelf life and increases its market value, providing farmers with additional income sources and food products to enhance food security.
- **Building partnerships with stakeholders.** Collaborating with local governments, NGOs, and international

126 Ndopaie A. 2024. Green Compost in Agriculture for Development. Organic Compost Fertiliser. PowerPoint Presentation.

organisations brings essential resources and support. These partnerships can provide funding, technical expertise, and advocacy support that enhances the success and scalability of sustainable business and composting initiatives. GCAD's partnership with Welt Hunger Hilfe and Kenema City Council, have brought to fruition numerous opportunities such as the provision of a shredding machine, market space, training, and radio advertisement programmes.

- **Subsidised economic incentives for farmers.** Farmers are more inclined to adopt agroforestry and organic farming when they see financial benefits. Offering incentives like subsidised compost, supporting them with working tools, inputs like seeds and seedling or short-term financial assistance helps transition more smallholders to sustainable organic farming practices.
- **Empowerment and encouraging youth participation.** Youth engagement in organic composting and agroforestry not only promotes sustainability but also addresses youth unemployment. Training programmes and workshops targeting young people can foster a generation of environmentally responsible entrepreneurs, this will enable them to also start their own businesses.
- **Invest in a durable and sustainable transport system.** Given the challenging road conditions, using only heavy-duty vehicles suited to rough terrain is essential. Tricycles, while affordable, are not equipped to handle the wear and tear of bad roads, leading to frequent breakdowns and high maintenance costs. Investing in a robust vehicle, like a small truck or 4-wheel drive vehicle, may have a higher upfront cost but can prove more reliable and cost-effective in the long term.
- **Potential for scalability and market opportunities.** The demand for organic produce is rising, creating opportunities for farmers using compost to enter niche markets and improve their income. Successfully implemented composting programmes can be scaled up or replicated in other regions, amplifying environmental and economic benefits.
- **Composting reduces waste and promotes a circular economy.** Composting organic waste from farms and households reduces the amount of waste sent to landfills and supports a circular economy. By turning waste into a valuable resource, communities promote sustainability and reduce their environmental impact.

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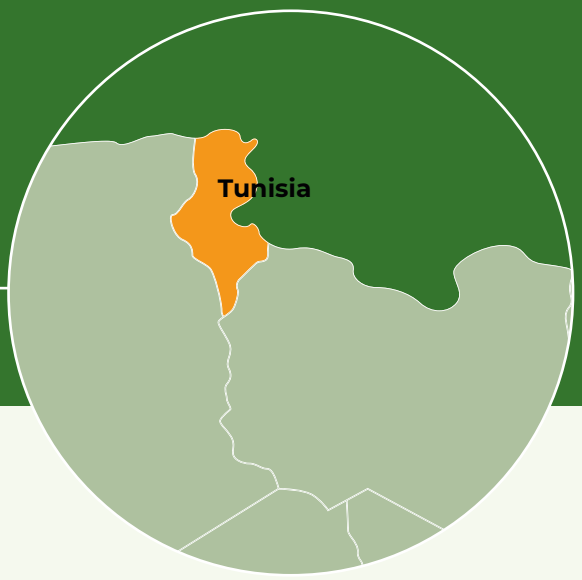

North Africa

Tunisia

Women's farmer network: Driving sustainable agriculture and collective business opportunities

Context

Tunisia is a largely arid country with limited annual rainfall. Most precipitation is concentrated along its relatively humid coastal areas, while southern regions receive as little as 150 mm annually. Tunisia faces high vulnerability to climate change, with projections indicating rising temperatures, increased aridity, reduced rainfall, and rising sea levels. Under high-emission scenarios, the frequency and intensity of heavy rainfall events are also expected to increase. These shifts will further disrupt Tunisia's water balance, with forecasts suggesting a decline in water availability by the 2080s. Water scarcity will bring socio-economic and environmental challenges, particularly affecting agriculture, ecosystems, and public health.

Establishment of the Women's Agricultural Development Group

Rim Bensoud resides in Baddar, a village in the Cap Bon region of Northeast Tunisia.[127] The village is rural, and the community is heavily reliant on agriculture. Rim, a farmer herself, is recognised for founding the local Women's Agricultural Development Group (GDAF).

Rim's involvement in her family's rainfed farm gave her first-hand experience of the vulnerabilities farmers face, particularly as droughts and groundwater overuse have worsened local water scarcity. Following five consecutive years of drought, Tunisian authorities introduced stringent water management policies, prioritising high-value crops and restricting irrigation of water-intensive vegetables. These restrictions directly impacted smallholder farmers, especially women, who face additional challenges such as limited land ownership, restricted access to finance, and the dual burden of domestic and agricultural responsibilities. Lack of access to training in climate resilience and water management has also compounded their vulnerability.

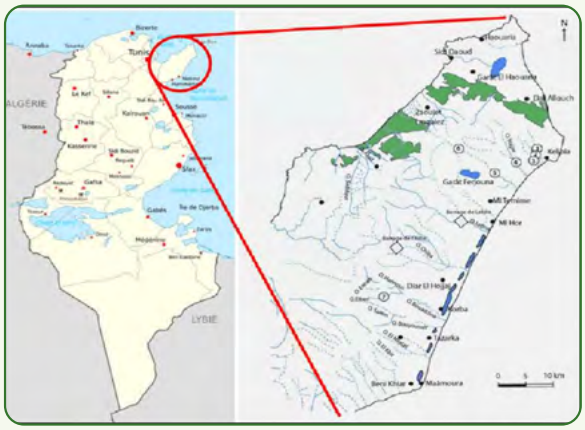

Figure 18. *Cap Bon region of Tunisia.*

127 Saussen S, Magsi H., Marri F, Rejeb H. 2013. Under What Management Practices and Mechanisms Water Resource Can Be Considered as a Public Good for Sustainable Development in the Developing Countries?. Journal of Water Sustainability. 3. 1-16.

The establishment of GDAF in 2016 was a critical step towards addressing these barriers and creating a space for women farmers to thrive. By fostering a sense of solidarity and offering opportunities for education and collaboration, GDAF provides women with the tools they need to become more resilient, both environmentally and economically. The network empowers its members by facilitating knowledge exchange, supporting sustainable farming practices, and providing platforms for income-generating activities. Through this initiative, GDAF is playing a pivotal role in transforming the local agricultural landscape and challenging patriarchal structures by giving women the agency to shape their own futures.

The group has a formalised organisational structure, with a chairperson, treasurer, and secretary (currently held by Rim Bensoud). Members contribute 5% of their earnings to the cooperative to support the organisation's operations. GDAF meets regularly, up to four times a week, and maintains an active WhatsApp group for easy information exchange. The group also provides valuable support to Tunisian women farmers through educational and training programmes.

Image. *Rim Bensoud (Image courtesy of Hivos[128])*

> ***"Promoting gender equality and addressing patriarchal attitudes will help women farmers take more control over their own businesses and decision-making"***
> – Rim Bensoud.

The focus of GDAF is two-fold:

Firstly, the group's interest lies in learning more around climate and agricultural resilience using sustainable farming methods, including the elimination of synthetic fertilisers and pesticides. The women farmers visit each other's farms as demonstration sites -including the farm of Rim Bensoud - to learn from one another about soil conservation, water efficiency practices and biodiversity management. They also act as a cooperative in terms of sharing resources, transport costs, helping each other with marketing and distribution etc. The group champions crop diversification, encouraging farmers to cultivate a variety of traditional and alternative crops. By supporting farmers in diversifying their produce and expanding their market reach, the group enhances both economic resilience and food security in the community.

Secondly, in addition to fresh produce, the group now creates and sells a range of high-quality, value-added products—including homemade cheese, harissa, couscous, citronella items, and spices—available locally and showcased at trade fairs. With a dedicated stall managed by GDAF, these products reach a wider audience, boosting income opportunities for farmers. The group is also pioneering new, innovative initiatives to foster entrepreneurial growth among members. A key example is a pilot programme to establish a chili pepper plantation circuit for harissa production. Visitors move from farm to farm to experience the varying tastes and to experience the techniques by which the farmers grow their produce. This is creating new pathways for local business development and market diversification.

128 VCA. N.d. Rim Bensoud: A woman farmer in Tunisia with initiative and solutions. Voices for Just Climate Action.

Starting with just 16 members, the group has now grown to over 170 women.[129] Members are committed to the network's growth and success. They are eager to scale up the network through partnerships with other local women's cooperatives, aiming to expand GDAF's impact and ensure its long-term sustainability. They are also seeking to partner with microfinance institutions to secure preferential loans for business operations.

Image. *Training on cheese production.*

> ***"We're at the front-lines of the battle against climate change, social injustice and a patriarchal society. Water shortage is a big threat to our livelihoods and incomes, because farming is all we've ever done since we were kids"***
>
> – Rim Bensoud.

Agri-tourism, climate-smart agriculture and local cuisine

In addition to her work with GDAF, Rim has developed an agri-tourism venture called **Taste of Takelsa**, which highlights the region's cultural heritage and traditional food and farming methods. In April 2024, she opened an ecological guest house and restaurant on her 2.5 ha farm in Cap Bon, offering guests an immersive experience in local farming and cuisine. The farm can accommodate up to six overnight guests and hosts day visitors, with up to 40 people dining on local, organic food prepared from on-site produce, including a variety of fruits, vegetables, and free-range poultry. This destination has quickly gained popularity among both local and foreign guests seeking authentic farm-to-table meals, thereby strengthening the connection between the community and regenerative agriculture.

Image. *GDAF's harissa circuit.*

129 Masters A. 2024. Agricultural Resilience: Support for Tunisian Farmers. The Borgen Project.

Image. *Rim Bensoud's ecological guest house.*

On her farm, Rim and her husband grow a wide range of food crops, including tomatoes, lettuces, chillies, peppers, onions, olives, watermelons, and lemons, with a focus on large-scale citrus production. Rim's farm strictly adheres to organic practices, avoiding chemical fertilisers and pesticides. Seeds for essential crops are saved seasonally to preserve local plant varieties, reducing dependency on imports. Her husband, a chemist, has also developed natural pest control solutions, such as fermented nettle for flies and clay-based sprays to manage Mediterranean fruit flies.

To address Tunisia's water scarcity, the farm employs several water-saving techniques. These include drip irrigation at night and experimenting with water-efficient crops like citronella, a resilient cash crop. The farm also uses porous clay pots, locally known as gollas, to efficiently deliver water directly to plant roots. These traditional unglazed clay pots are sourced locally and are known to conserve up to 70% more water compared to conventional methods. Buried near plant roots and filled periodically, the gollas minimise evaporation and runoff, preserving soil moisture, promoting healthy microbial activity, and reducing erosion. The use of gollas requires no energy-intensive infrastructure, thus lowering the carbon footprint of irrigation and making them ideal for arid regions facing water scarcity. By providing a steady water supply, they enhance resilience to erratic rainfall and drought, contributing to both food security and sustainable agriculture in the face of climate change.

Rim's farm is a model of climate-smart and regenerative methods, including no-tillage farming, minimal soil disturbance, and composting. These practices make the farm an exemplary model for sustainable agriculture in the community. Her peer farmers from the GDAF network, along with others, frequently visit the farm as a demonstration site to learn about new and best practices. The farm exemplifies the potential of CSA in Tunisia.

Image. *Women farmers using gollas, porous pots, for water conservation.*

Rim's Vision for Sustainability and Community Resilience

Rim's commitment to environmentally responsible practices ensures food security and conserves natural resources for future generations. By adopting techniques like chemical-free farming and water efficient mechanisms, she exemplifies the potential of CSA. Rim envisions incorporating new technologies in the future, especially with additional access to finance.

> ***"We're at the front lines of the battle against climate change, social injustice, and a patriarchal society. Water shortage is a big threat to our livelihoods and incomes because farming is all we've ever done since we were kids,"***
>
> – Rim Bensoud.

Image. *Taste of Takelsa.*

Products and services

GDAF stands as a prime example of community-driven climate resilience and sustainable agriculture in action. The network produces a diverse range of locally grown, homemade agricultural products, all cultivated using sustainable methods that are free from chemical pesticides and synthetic fertilisers. This commitment to organic and eco-friendly practices not only supports the health of the environment but also enhances the quality and safety of the food produced.

In addition to her work with GDAF, Rim personally manages an experiential tourism service that offers visitors the opportunity to enjoy meals prepared from fresh, organic ingredients directly sourced from her farm. This unique venture allows guests to experience the full spectrum of farm-to-table dining, connecting them to the land and the sustainable practices that support it.

Rim's farm also serves as a demonstration plot for fellow farmers. It showcases a variety of best farming practices, including innovative methods in soil conservation, water efficiency, and climate-smart agriculture. By opening her farm to others, Rim contributes to the spread of sustainable farming practices across the region, helping to build a more resilient agricultural community.

Environmental and climate focus

GDAF's farming practices are grounded in environmental sustainability, with a clear focus on protecting soil health and biodiversity. By avoiding chemical inputs, the group ensures that farming remains eco-friendly and that the land continues to thrive. Members use crop rotation and permaculture techniques to enrich soil fertility and maintain ecological balance, reducing the need for synthetic fertilisers and promoting long-term soil health.

Water scarcity is a significant concern in Tunisia, and GDAF members address this challenge by using efficient irrigation methods, such as clay pots, which minimise water usage by delivering moisture directly to plant roots. These traditional methods help conserve water, a vital resource in arid regions, while ensuring plants receive consistent hydration.

In addition to these practices, GDAF is actively engaged in CSA. The group's members utilise diverse cropping strategies and water-efficient systems to mitigate the impacts of climate change. GDAF also serves as a valuable knowledge-sharing platform, where women farmers exchange climate adaptation strategies, empowering each other with the tools and knowledge necessary to strengthen local resilience and ensure sustainable agricultural practices for the future.

Community and gender inclusion

GDAF is pivotal in promoting gender equality within the agricultural sector, focusing on enhancing women's access to economic opportunities. By participating in GDAF, women farmers not only gain technical knowledge but also engage in valuable knowledge-sharing sessions, fostering a supportive network. Through the farming network/ cooperative, members are empowered to take part in national exhibitions, showcasing their products and skills, which strengthens their financial independence and autonomy. This collective approach not only benefits individual members but also drives broader social and economic transformation within the community.

Capacity building

GDAF places a strong emphasis on capacity building by providing women farmers with vital skills in CSA and water management. This training equips them with tools to address pressing environmental challenges, such as water scarcity and soil degradation. As a result, these women are better positioned to improve their farm productivity, adapt to climate change, and contribute to the long-term food security of their communities. Beyond individual growth, GDAF's efforts in capacity building also enhance overall community resilience, fostering a more sustainable and equitable agricultural system.

Contribution to the Sustainable Development Goals

GDAF, as well as Rim's farm operations, contribute to achieving the following SDGs:

Challenges

- **Funding and financial sustainability:** The network initially received seed funding from Tunisia's Social Solidarity and Sustainability (TSS) project, and a small amount of equipment was donated by GIZ. However, GDAF continues to face financial constraints and is actively seeking new funding avenues to sustain its operations. Securing consistent funding is crucial for maintaining and expanding capacity-building efforts, supporting day-to-day activities, and facilitating access to markets for members.
- **Access to markets:** Despite the high quality and diversity of GDAF's products, access to larger, more profitable markets remains a significant challenge. Many farmers in the network still rely on local markets, which often offer limited pricing and distribution options. Expanding their market reach would enable GDAF members to increase their incomes, but navigating the complexities of larger-scale production and distribution and marketing remains a hurdle.
- **Capacity building:** While GDAF offers vital training on CSA, water management, and other critical areas, there is still a need for more tailored training to address the varying skill levels of members. Expanding the scope of training to include advanced agricultural techniques, financial literacy, and leadership skills would help ensure the long-term sustainability of the network and its impact.
- **Climate and environmental pressures:** Despite the adoption of CSA practices, members of GDAF continue to face the challenges of climate change, such as erratic rainfall, prolonged droughts, and soil degradation. These environmental pressures, combined with Tunisia's water scarcity issues, make it difficult to maintain consistent crop yields. Continued investment in sustainable water management systems and climate adaptation strategies is essential.

- **Cultural barriers and patriarchal norms:** While GDAF has made significant strides in promoting gender equality, the group continues to work within a community where patriarchal norms often limit women's full participation in agriculture and business. Overcoming these cultural barriers and encouraging greater support for female leadership in agriculture remains a critical challenge.

Impact and future growth

- **Promotion of climate-smart and environmentally responsible practices:** Rim's efforts have significantly advanced environmentally responsible agricultural practices, ensuring both food security and the preservation of natural resources. By adopting sustainable agronomic techniques, such as chemical-free farming, Rim's farm serves as a model for local farmers. Additionally, the incorporation of efficient watering systems, including the use of porous clay pots, exemplifies the potential of climate-smart farming. These methods help conserve water, reduce soil erosion, and improve soil health, all of which contribute to the long-term sustainability of agricultural practices in the region.

- **Long-term vision and innovation:** Rim's long-term vision involves incorporating new technologies and establishing strategic partnerships with local cooperatives to ensure the sustainability of her initiatives. As GDAF continues to grow, these collaborations are key to expanding its impact and reaching more women farmers across Tunisia. Through innovation, including the introduction of agro-tourism and value-added products, GDAF is diversifying income sources for its members while showcasing the region's cultural heritage. Rim is committed to securing new resources and opportunities, ensuring that her cooperative thrives in an increasingly competitive and climate-challenged agricultural landscape.

- **Expansion and capacity building:** From its original 16 members, GDAF has grown into a network of over 170 women. This expansion is a testament to the group's success in building capacity and providing women with diverse income-generating opportunities. By offering training in CSA, water management, and entrepreneurial skills, GDAF empowers women to take control of their economic futures while enhancing community resilience. The network continues to support its members in scaling their businesses, improving their agricultural practices, and increasing their market access.

- **Future growth potential:** GDAF aims to further scale its impact by developing partnerships with microfinance institutions to secure preferential loans and enhance its financial stability. With the continued growth of its network and the expansion of its value-added product line, GDAF has the potential to become a model for other women's cooperatives in the region. By focusing on capacity-building, expanding market access, and fostering innovation, GDAF wishes to drive sustainable agricultural development and climate resilience for women farmers in Tunisia.

Lessons learnt

Empowerment through collective action: Forming a cooperative creates a supportive environment where women can collectively overcome gender-specific barriers. Also, working collaboratively, members are able to access shared resources, learn from each other, and enhance their economic opportunities, which improves their resilience and independence.

Knowledge sharing and capacity building as catalysts for resilience: Peer-to-peer knowledge sharing on climate resilience and sustainable practices fosters learning and adaptation. Regular meetings, training, and farm visits have enabled GDAF members to implement and experiment with new and alternative techniques. The cooperative's emphasis on skills transfer helps members improve productivity and sustainability while preparing them to better handle climate and environmental stresses.

Diversification enhances economic resilience: Diversifying crops and creating value-added products protects farmers from market volatility and climate risks, increasing both food security and income stability. GDAF's approach to growing a variety of crops and expanding marketable products allows women to tap into new income streams and strengthen local food systems.

Sustainable practices, both old and new, can respond to climate challenges: Adopting climate-smart and regenerative agricultural practices, including the use of gollas for water efficiency, shows how traditional knowledge can contribute to sustainable solutions.

Agri-tourism as a tool for community development: Developing tourism around agriculture can build awareness of local heritage and offer additional revenue. Takelsa has not only provided income for Rim's farm but has also created a platform for engaging the community and educating the public about sustainable agriculture, strengthening rural-urban connections and supporting the local economy.

Climate adaptation needs to be dynamic and continuous: Despite the adoption of CSA, GDAF members continue to face climate challenges like drought and erratic rainfall. This shows that climate adaptation, and the pursuit for supportive finance, is a continous process that requires adaptive strategies.

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Conclusion

Climate change is exerting intense pressure on agriculture worldwide, with African farmers facing disproportionate impacts due to extreme weather, deteriorating soil health, and increased pest and disease outbreaks. Smallholder farmers, particularly vulnerable due to limited resources, are urgently in need of resilient and sustainable adaptation methods. In response, locally driven, farmer-led initiatives are proving essential in building climate resilience across Africa.

This report, developed by the EAFF in partnership with the AICCRA, showcases ten outstanding case studies of farmer-led approaches to climate adaptation. These initiatives, which range from climate-smart farming techniques, integrated and sustainable natural resource management, cooperative models and value chain capacity building, are tailored to unique national and regional challenges and highlight the value of local knowledge and innovation. The purpose of this report is to promote knowledge exchange, inform policy-making, and attract financial support to scale up these successful strategies.

The key findings from the case studies illustrate the impact of these farmer-led efforts:

Diverse climate adaptation approaches: Each case study provides distinct solutions to local climate challenges.In Djibouti, DAPA, the national government and a number of other actors, implemented a diary goat cross-breeding programme to enhance resilience in arid conditions, thereby increasing food security through increasing milk yields. Similarly, ProSect Feed in Ghana is utilising black soldier fly technology to produce high-quality protein feed and organic fertiliser, supplying affordable animal feed, reducing waste and promoting a circular economy. In Rwanda, an innovative youth-led cooperative - UKC - is using modern, climate-smart hydroponic systems to produce nutrient-rich livestock fodder. These strategies, customised to local needs, collectively enhance resilience in diverse agricultural communities. In Rwanda, INGABO Syndicate has adapted a traditional CSA planting technique from West Africa – the zai pit – to enhance cassava production, as well as to increase water efficiency and reduce topsoil run off during extreme weather events. In South Africa, Donovale Farm is using land use design planning, strip planting and waterway techniques to reduce the impacts of flooding on its sugarcane.

Locally led adaptation: Farmer-led adaptation initiatives empower local communities to devise climate solutions that align with their cultural, environmental, and socioeconomic realities. In Rwanda, the INGABO Syndicate has established a capacity and partnership-building network that strengthens the cassava value chain, opening new opportunities and access to research and finance for local farmers. Another example is Tunisia's Women's Agricultural Development Group, which is pioneering sustainable agricultural practices and creating diversified organic products, fostering community resilience and women's empowerment through additional income generation.

Economic viability and scalability: These case studies demonstrate that farmer-led models can become sustainable businesses, increasing income and food security while offering the potential for replication. For instance, the HIMACUL in Malawi supports smallholder farmers in creating a sustainable macadamia value chain that provides stable income and growth opportunities. Meanwhile, Donovale Farming Company in South Africa applies best management practices in sustainable sugarcane production, supporting soil health, water and biodiversity conservation and integrated pest management. Overtime, these sustainable practices have resulted in reduced costs for water use and increased yields and productivity. The economic success of these initiatives highlights their scalability across similar regions in Africa.

Alignment with broader development goals: The documented projects align with broader development objectives, including food security, gender equality, and biodiversity conservation. The Chomwedzi Apiculture project in Zimbabwe promotes forest conservation through sustainable honey production, supporting biodiversity and ecosystem services while providing a reliable income for farmers. In Uganda, AW Bamboo Enterprises Ltd focuses on sustainable bamboo production and community-led restoration, working with Uganda Wildlife Authority, Mount Elgon National Park officials and district authorities to reduce landslides stemming from extreme rainfall events and erosion caused by illegal deforestation. These projects not only build climate resilience but also contribute to social and environmental goals in line with sustainable development targets.

Need for increased financial support for adaptation: Despite their achievements, farmer-led adaptation initiatives face financial limitations, underscoring the need for increased investment. For example, GCAD in Sierra Leone is successfully promoting organic food and fertiliser production yet requires further funding to expand and maximise its benefits. All ten case studies expressed the challenges related to inadequate domestic and international financial support. Enhanced financial support would enable the broader adoption of climate-smart practices and amplify the impact of these successful models across African agricultural landscapes.

Through these examples, the report underscores the power of farmer-led initiatives to inspire further action, enhance knowledge-sharing, and mobilise resources to address the critical climate challenges facing African agriculture.

Appendix 1: All farmer-led applicants

Table 3. *Details of the farmer-led adaptation cases that were received after the call for cases was published.*

Country	Name	Key practices	Description	Contact details	Links to further information
Benin	Agro Bio Solutions (ABS)	Organic agricultural inputs to address land restoration and improve land health	Tidjani Abbas is from a farming community in Benin. He recognised the challenge of degradation of agricultural land in his community caused by climatic factors as well as the use of unapproved, synthetic chemical fertilisers. He started a business called Agro Bio Solutions (ABS) that specialises in the production and marketing of organic agricultural inputs. The company is dedicated to the research, development, and distribution of environmentally friendly agricultural products, with the aim of enhancing the quality and sustainability of agriculture. ABS develops a varied range of agricultural bio-inputs including: bio-fertilisers, bio-fungicides, bio-insecticides, biopesticides and biostimulants.	Tidjani Abbas Email: tidjaniabbass@gmail.com Tel: +22994748390	Article here
Cameroon	Mumita Holdings	Climate-smart Agriculture (CSA) for indigenous vegetable production	Mumita Holdings assists farmers in Cameroon to produce crops year-round using sustainable methods such as low-cost greenhouses and solar-powered irrigation. The agricultural startup managed by Ms. Nkenmayi uses greenhouse technologies and irrigation systems to support the year-round production of African indigenous vegetables. The company targets female farmers in rural areas engaged in producing indigenous vegetables. African indigenous vegetables are culturally important as well as highly nutritious, well adapted to the local climate, and a source of income for women in rural areas in Cameroon. Their cultivation can help improve food security while preserving traditional knowledge. Mumita Holdings proposes solutions to help adapt to climate change, including capacity building, consultancy services to improve yields, provision of high-quality seedlings, solar-powered irrigation systems, and low-cost greenhouses. Additionally, Mumita Holdings purchases vegetables from the farmers and dehydrates them to increase storage life.	Ms. Nkenmayi Tel: +237 6 80 10 29 71 Email: mumitaholdings@gmail.com	Article here Facebook page here
Cameroon	Brokering Innovation for Decentralised climate finance & Gender Equality (BRIDGE)	Finance	The BRIDGE project improves access by subnational stakeholders (municipalities and partners) to adequate finance for locally-led and gender-responsive climate change adaptation action in Cameroon, with learnings scaled to the central Africa region and beyond. This project aims to ensure that context- and community-appropriate adaptation interventions are implemented in ways that empower local stakeholders, including women. This is done by: • Strengthening the capacity of knowledge brokers working in Cameroon to enable inclusive planning, project development and financing for locally-led and gender-responsive adaptation action. • Identifying and enhancing the best-suited mechanism(s) to unlock finance for locally-led and gender-responsive adaptation in Cameroon. • Enhancing the capacity of knowledge brokers operating in central Africa to improve access and deployment of finance for locally-led and gender-responsive adaptation projects.	Blondel Silenou Professional Officer: Climate Change, Resilience and Research | ICLEI Africa Email: blondel.silenou@iclei.org Lucy Lavirotte Senior Specialist: Climate Change, Energy & Resilience | ICLEI Africa Email: lucy.lavirotte@iclei.org	Website here Brochure here

Country	Name	Key practices	Description	Contact details	Links to further information
Cameroon	CassVita	Biotechnology to increase cassava shelf-life	Pelkins Ajanoh grew up in a community of farmers. He founded CassVita, a social enterprise that uses technology to improve food security amongst smallholder farmers in West Africa. CassVita has invented new biotechnology which increases the shelf-life of cassava from 3 days to 18 months.	Email: info@cassvita.com Tel: US - +1 8172095199 Cameroon - +237 233-332-124 / + 237 675339559	Website here
Central African Republic	Initiative Noah for Africa	Climate smart market gardening, organic farming, Sexual and gender-based violence (SGBV) focus, Women and youth focused	Stéphanie Légie Mbombate is the founder of Initiative Noah for Africa, a social enterprise dedicated to promoting climate adaptation and improving agriculture in the Central African Republic. Through Initiative Noah, Stéphanie empowers her community, promotes organic food production and fights SGBV. Aware of climate-related challenges and farmers' and young persons' needs, Stéphanie aimed to improve life in her community in the prefecture of Kémo, Central African Republic. Climate change is affecting agricultural yields, and youth are faced with several challenges in terms of education and labour, especially in the agricultural sector. The initiative focuses on improved market gardening activities and cultivation through semi-mechanised methods. Through Initiative Noah, Stéphanie also runs educational talks on organic food production, entrepreneurial culture, and SGBV. The project contributes to job creation in rural areas, innovative agricultural production to enhance food insecurity, and combats SGBV in rural areas.	Stéphanie Légie Mbombate Tel: +236 72 75 43 37 Email: mbostephanie@inaafrica.org; info@inaafrica.org	Article here Facebook here
Democratic Republic of Congo (DRC)	Union of Women for Social Progress (UFPS)	Agroforestry and soil improvement practices	A women's association in the DRC is inspiring farmers to use drought-resilient farming techniques. The techniques which include agroforestry and soil health improvement, are being popularised by UFPS on the outskirts of Virunga National Park – to enhance livelihoods and protect biodiversity by discouraging land clearing in the park. Farmer members are educated on mulching techniques, row sowing, the use of organic fertiliser and agroforestry. Drought-resilient practices are essential as prolonged dry spells are becoming common.		Article here
DRC	ChemChemAgro	Sustainable honey production, Agroforestry, Livelihood diversification	ChemChemAgro is a beekeeping startup in North Kivu Territory, Lubero, that combines sustainability and advanced technology. The company works closely with local farmers to integrate beekeeping into their agricultural activities by providing hives and training, thereby diversifying their sources of income. The company offers accessible training on sustainable beekeeping practices to interested farmers inclusive of young people, women and vulnerable communities. To improve honey production the company promotes the planting of fruit trees or 'pollination nurseries'. This creates opportunities for farmers, including women, to engage in sustainable reforestation activities that enhance biodiversity and protect soils. The trees also increase the incomes of local families and contribute to food security. This diversification of income contributes to greater resilience of families in the face of climatic and economic hazards. In total, 40 families have been supported. The additional income has enabled 17 of the families to expand their farming operations to potatoes and other crops, increasing their cultivated areas from 0.5 ha to 2 ha. ChemChemAgro has also developed an app known as 'Api Connect'. The platform provides accurate weather advice to beekeepers, helping them plan their activities based on climatic conditions. It also recommends optimal nutritional practices for the bees, promoting their health and productivity. In addition, the app indicates optimal areas for the installation of hives, taking into account the available floral resources and identifying areas at risk of pesticides. This allows for sustainable and proactive management of apiaries.	Email: danniellavi@chemchemagro.com; chemchemagro@gmail.com Tel: +243 976 427 678	Website here App here

Country	Name	Key practices	Description	Contact details	Links to further information
DRC	ODRAPNA AFRICA	Land restoration, Reforestation, Good agricultural practices, Capacity development, Seed multiplication, Climate-smart varieties	ODRAPNA AFRICA, an agricultural research development and nature protection organisation, works to restore ecosystems and improve agricultural practices in the North Kivu Province of DRC. The organisation has undertaken the following activities: • Planted trees and restored 34 hectares of land near Virunga National Park. This action enhances local biodiversity and carbon sequestration. • Established four nursery sites to provide seedlings for the reforestation and restoration of degraded lands. • Introduced good agricultural practices to 100 beneficiaries including soil conservation, integrated pest and disease management, and other sustainable cultivation practices. • Conducted workshops and field demonstrations to provide farmers with the knowledge needed to apply the farming practices effectively. • Implemented an improved seed multiplication programme, cultivating varieties that are resistant to disease and drought. This improves the quality and quantity of harvests, thereby strengthening food security and farmers' incomes. • Launched an awareness campaign in Buzi Bulenga, reaching 3,500 farmers to inform them about banana wilt bacteria. Farmers were trained on recognising disease symptoms, prevention and management techniques, such as crop rotation, use of healthy plants, agricultural hygiene and water management. ODRAPNA-AFRICA promotes sexual and reproductive rights for women and young people, so that they can access sexual and reproductive health services, including voluntary family planning, maternal health care and comprehensive sexuality education.	Patrick Sawasawa Email: patricksawasawa@odrapnaafrrica.org Tel: +243 9717 66880 +243 8289 45827	Website here
DRC	Mukulima Soko	A web and mobile-based platform for smallholder farmers in DRC to promote agricultural trade, product grouping and joint sales, improved agricultural practices, and investment	Lapaque Mbumba founded Mukulima Soko to address limited financing options for smallholder farmers in Africa, particularly in the DRC. Buyers and farmers typically have no knowledge and experience of connected services. Internet tariffs are high and available bandwidth is very low resulting in many people remaining disconnected from the Internet. This limits their access to financial and other services, and markets. Additionally, poor road infrastructure makes the transportation of goods and services difficult for farmers and buyers. Mukulima Soko is a Civic and AgriTech platform for the engagement of agricultural stakeholders and promotes accountability and transparency in agricultural governance. Through the use of artificial intelligence (AI), Mukulima Soko offers personalised assistance with plant protection products, thereby reducing chemical risks and optimising yields. One of the platform's flagship tools is its AI-based plant diagnostic system which can provide accurate recommendations, enabling farmers to make informed decisions and build resilience in the face of climate change. Mukulima Soko has four components: • Mukulima Lab - facilitates knowledge exchange between smallholder farmers and agricultural experts. It encourages farmers to share their experiences and adopt proven practices. Farmers can thus make informed choices on the best ways to adapt to climate challenges, strengthening their resilience and that of their communities. • Mukulima Soko - facilitates group sales, eliminating traditional intermediaries. This approach guarantees fair prices to farmers, thereby increasing their income and purchasing power. By optimising supply chains, Mukulima Soko also helps reduce post-harvest losses and improves agricultural market efficiency. • Mukulima Invest - connects agricultural cooperatives with citizens wishing to invest in agriculture. This crowdfunding mechanism promotes agricultural and economic development by mobilising financial resources for local agricultural projects. • Physical agricultural mini-labs - that actively engage with local communities on sustainable and organic solutions. The mini-labs focus on the development and use of organic fertilisers and pesticides, thereby reducing dependence on imported chemical inputs. By using locally available resources and labour, Mukulima helps increase agricultural production while minimising costs and environmental impacts.	Lapaque Mbumba Email: mbumbalapaque@antarctik.net; admin@mukulimasoko.com; reportage@kilimotv.com Tel: +243 991 328 671	Website here Article here Linkedin here

Country	Name	Key practices	Description	Contact details	Links to further information
Ethiopia	Bamboo Labs	Sustainable transport	Bamboo Labs is a social enterprise that promotes affordable, accessible, and sustainable transport mobility by using renewable resources to create a positive environmental impact. Bamboo Labs started as an enterprise that produced wheelchairs framed entirely out of bamboo and has recently expanded its production to bamboo-made bikes.	Abel Hailegiorgis Email: abelhailegiorgisdaddy@gmail.com Tel: +251 9104 16023	Website here
Ghana	Sunkpa Shea Women's Cooperative	Non-timber forest products (NTFPs); Agroforestry; Farmer-managed natural regeneration (FMNR), Ecoenterprise or green business, Women empowerment	The Sunkpa Shea Women's Cooperative, founded in 2013, successfully integrated the organisation's organic shea and shea butter production into international supply chains, while financially empowering more than 800 Indigenous women. Formed from 12 smaller community associations, this Indigenous- and women-led cooperative has expanded its operations to over 120,000 ha of dryland forests. Women in the cooperative have produced organic shea butter for generations. The cooperative was established to sustainably expand production activities and join the organic shea butter value chain. The Cooperative operates within Community Resource Management Areas (CREMAs), which govern sustainable production practices. The Cooperative has helped to create no-take areas, nurseries, and buffer zones for sustainable harvesting to protect local ecosystems. This innovative community-based approach to resource management has allowed the Cooperative to scale up its organic shea nut and shea butter production, while restoring 600 ha of forest through native tree agroforestry and FMNR.	Memuna Braimah Email: memunabraimah483@gmail.com	Brief here Article here
Ghana	CCAFS Regional Agricultural Forecasting Toolbox (CRAFT)	Crop model-based yield forecasting	The CCAFS Regional Agricultural Forecasting Toolbox (CRAFT) project aims to address the challenges posed by changing climate patterns and increasing food demand in Ghana. The need for accurate and timely yield forecasting has become critical for effective climate risk management and the development of informed agricultural decision support systems. By using the CRAFT toolbox, crop yields can be forecast, enabling farmers to make informed decisions, manage risks, and meet the growing demands of the country.	Stephen Amankwah Email: stephen.amankwah@meteo.gov.gh	Weblink here
Kenya	Ziada Solutions	Green and sustainable solutions for the banana value chain	Ziada Solutions is a climate-smart, fully circular agri-processing business championing circular and sustainable practices along the banana supply chain. They promote a transformative approach to agri-waste while advancing sustainable development, supporting rural communities and contributing to a cleaner and greener future. Ziada Solutions collaborates with the Taita-Taveta Banana Cooperative Society to create added value for smallholder banana farmers. Banana stems, typically waste after harvest, are bought at above-market prices to produce natural fibres, enriched soil conditioners (biochar), and paper. In Taveta, the following has been established: • A decortication facility to extract fibre from banana stems. • A biogas system running on the pulp from the stems. • A hybrid solar drier running on the biogas produced. • A solar flour mill to offer gluten free four. • A weaving workshop currently training women and youth to make carpets, rugs and mats. Products currently include banana fibre, banana flour and organic bioslurry. A local weaving women's group is engaged to make a wide array of items and a fashion house in Nairobi is collaborating to making fabric from the fibre. Air pollution is mitigated through waste diversion and the facility uses clean renewable technologies. Workshops are held to train on CSA practices. Additionally, alternative livelihoods and diversified income sources are created to help communities cope effectively with droughts and empower women so that they can become their own agents of positive change.	Sam Thuo Mungai Email: ziadasolutionsltd@gmail.com Tel: 0722409108	Website here LinkedIn here Instagram here
Kenya	Dissemination of climate smart, consumer-demanded potato varieties	Improved potato varieties (drought and heat tolerant); Seed multiplication; Good Agricultural Practices (GAPs); Capacity building	This is a 3-year project in Samburu County aimed at diversifying food production and generating new income streams for the pastoral community. Syngenta supplied the technology -drought and heat-tolerant potato seeds. The local community were trained on multiplying the seedlings for a wider reach, with a focus on women farmers. Farmers were also trained on good agricultural practices (GAPs) such as post-harvest management losses, storage, marketing etc. Seed multiplication in Samburu could increase the supply of certified seed of climate-smart varieties to local farmers and potentially to farmers in neighbouring countries.	Lucy Kioko, Regional Director of Syngenta Foundation Email: lucy.kioko@syngenta.com Washington Kanyangi Email: w.kanyangi@arin-africa.org Tel: 0713843079; 0736447333	Outcome brief here

Country	Name	Key practices	Description	Contact details	Links to further information
Kenya	Tumal Orto Galdibe (self)	Climate resilient livestock practices such as interbreeding, herd diversification, and grazing management; Advocates for climate action and sustainable solutions	Tumal Orto Galdibe is a pastoralist from the village of Maikona ward in the Chalbi desert, Marsabit County, northern Kenya. He is an elder and community leader of the Indigenous Gabra people. Tumal's family has been rearing livestock for more than 300 years. However, in recent years climate change has led to a considerable loss of livestock in the area, impacting traditional livelihoods. Climate change has had a detrimental effect on Tumal's livestock production. Between 2020 and 2023 he lost 450 heads of livestock including 36 camels due to drought and 300 goats as a result of flash floods. Feed shortages, pests and diseases were particularly devastating. Other pastoralists in the area also experienced significant losses with the community realising a combined estimated loss of more 200,000 animals since 1997/2017. The loss of livestock does not solely have a financial impact but also an emotional one as pastoralism is a traditional livelihood and the animals are considered cultural capital. Tumal indicated that 2017 was a particularly bad year for drought, there was no water and pasture and so pastoralists were forced to feed their livestock portions of their own relief food. In times of drought, pastoralists are forced to trek up to 100 km to find shallow wells for their livestock, the weaker animals tend to die enroute. Further, annual crop failures mean less feed for the livestock and consequently lower productivity and incomes. Today Tumal has a small herd comprising 200 goats and sheep and 45 camels. He considers himself a resilient and adaptive farmer. He adapted by diversifying his herd and during good years with abundant resources he plans for the difficult times ahead such as by purchasing feed. He has a 14-point checklist that he uses to manage his livestock. He uses a free-range communal grazing system, with a camp for weaker animals that offers improved grazing. Tumal manages his livestock's breeding by separating the males and females during the dry months of June to October to prevent the herd from growing when resources are scarce. During the wetter months of April and May he reunites his herd and the majority of his livestock breed. The kids and lambs are separated from their mothers at six months of age to prevent inbreeding, this improves the resilience of his animals. Tumal also gives his young livestock milk replacement when required and builds underground water catchments in the grazing fields to capture water when it rains. Tumal rears his livestock using traditional pastoralism combined with new climate resilient livestock practices. He has spearheaded locally-led adaptation informed by Indigenous Knowledge. The pastoralists' Indigenous Knowledge is critical as it enables them to read the environment and plan routes based on the seasons, available vegetation and water and the composition and strength of the herd. Tumal educates and informs other pastoralists in Marsabit County of ways to enhance the resilience of their herds. Climate change has led to the migration of youth to urban areas as they no longer see a viable future in pastoralism due to the interlocked challenges of poverty and drought-aggravated conflict in the region. This leaves the elderly farmers in an even more vulnerable position. Tumal fears that traditional pastoralism could die out in Marsabit County and traditional pastoralists would likely struggle to find employment in urban areas forcing them to become climate refugees. Tumal believes that he and his fellow pastoralists should be recognised as victims of climate change. In this light, Tumal advocates for the rights of Indigenous pastoral peoples.	Tumal Orto Galdibe Email: tumalorto@yahoo.com Tel: +254 725 949 966	Article here Article here Article here

Country	Name	Key practices	Description	Contact details	Links to further information
Kenya	Paran Women Group	Reforestation, Land restoration, Agroforestry, Women empowerment, Environmental education	Paran Women Group is an Indigenous women's group that was formed as a community-based organisation in 2005. The group has a membership of 305 Indigenous women and youth. The group works to strengthen women's leadership and environmental governance through socio-economic empowerment initiatives, advocacy, capacity building, and training. Project activities include: • Reforestation; • Agroforestry (including tree nurseries); • Alternative income sources – beading and natural briquettes; and • Educating on women's rights, environmental conservation and sustainable land use practices. Since its formation, Paran women have planted a total of 120,500 tree seedlings in the Narok South sub-county across various primary schools, farms, and along riverbanks. Paran Women Group received a global conservation award at COP28 in Dubai.	Email: paranwomen2019@gmail.com Tel: +254 0721 462447	Website here Article here Article here Video here
Malawi	Mount Mulanje Conservation Trust (MMCT)	Microcredits	MMCT uses microcredits for sustainable community development. MMCT partners with microcredit agencies in Malawi to provide microcredits for community-based (revenue-generating) initiatives with positive conservation and community development impacts, such as beekeeping and smallholder tea farming ventures. While the microcredit agencies carry out the transactions with the borrowers, MMCT facilitates the process by matching the initiatives to suitable agencies and provides guarantees to mitigate default risk.	Email: info@mountmulanje.org.mw Tel: +265 (0) 1 466 179/282	Website here Report here
Malawi	Soils, Food and Healthy Communities (SFHC)	Agroecology, Participatory research	SFHC works to empower smallholder farmers in Malawi to build sustainable, healthy and resilient communities. Farmer-led, participatory research based on ecological approaches is the most important component of the approach. This includes strengthening local indigenous knowledge and democratic processes to address inequalities in Malawi. The programme consist of various activities to educate and empower farmers. Focus is placed on the role of women and youth. SFHC introduces a set of agroecological practices at the farm level, promotes local orange maize varieties and organises 'recipe days' to improve the diversity of diets and the role of men in their households. All the project activities focus on improving soil fertility, child nutrition and food security. For example, seed distribution and farmer training and annual field days are important elements to achieve these goals. The project has also integrated several activities to promote agricultural, nutritional and social practices, especially for the poor, HIV-infected and other marginalised groups. Farm level activities: • Planting legumes for natural nitrogen fixation. • Incorporating crop residues for improved soil fertility. • Improved food diversity and preparation, especially for young children.	Laifolo Dakishoni Email: sfhc@gmx.com Rachel Bezner Kerr Email: rbeznerkerr@cornell.edu Email: friendsofsfhc@gmx.com	Website here Article here Facebook page here Journal article here
Mali	Smart-Valley approach	Smart-Valley approach to rice production	This farmer-led and participatory approach for inland valley development, enhances resilience to drought, and flooding, and increases rice yields, diversification options, farmers' income, and food consumption score. In sub-Saharan Africa where inland valleys account for 190 million ha, the Smart-Valleys approach has great potential to contribute to climate resilience, food and nutrition security, and poverty reduction. The Smart-valleys approach follows a step-wise process focusing on design, lay-out and construction of low-cost water-control infrastructure to develop the bottoms of inland valleys for rice-based systems. The careful selection procedure pays attention to both socio-economic and biophysical factors and makes extensive use of farmers' knowledge. Major advantages mentioned by farmers are the increased water retention in their fields, less risk of fertiliser losses due to flooding and increased rice yields.	Elliott Dossou-Yovo CGIAR Email: e.dossou-yovo@cgiar.org	Weblink here

Country	Name	Key practices	Description	Contact details	Links to further information
Morocco	Fatima-Zohra (self)	Sheep, and goat rearing, Women's group, Honey and essential oil production	In Kandar Sidi Khiar, a rural village in the Sefrou province of northern Morocco access to land and finance limits women's opportunities to engage in the local economy. Knowing the women had a wealth of experience in rearing sheep and goats Fatima-Zohra founded a weaving cooperative with 22 members in 2013. Using wool from locally raised sheep, they wove first by traditional methods and then using modern equipment obtained through funding from the National Initiative for Human Development in 2014. Unfortunately, they were unable to compete with the cheaper alternatives on the market, and the cooperative closed two years later. Undeterred, Fatima-Zohra established another women's cooperative in 2017. This time, with support from IFAD she aimed to revitalise small-scale agriculture. Climate change and desertification had made traditional agricultural practices difficult and limited the incomes of small-scale producers. The new cooperative comprised 18 women with extensive experience in raising sheep and goats. They began with 108 ewes and 3 rams provided by IFAD (PDRZM programme), along with 20 beehives. Training was provided to the women on beekeeping, sheep rearing and accounting. By 2021, their flock had grown to 400 ewes, and they had 42 hives producing 126 l of honey annually. Selling the ewes and honey generated sufficient income for the women to improve their living conditions and those of their families, helping each of them become more financially independent. Fatima-Zohra knew the woodlands of Sefrou were rich in rosemary, lavender, and thyme, which have various uses in cosmetics, medicine, and food products. So in 2021 she founded the Economic Interest Group 'Arôme Agay', which now has 70 members, 56 of whom are women. Using a grant from PDRZM she created a workspace to extract, process and sell essential oils from the plants. She also obtained national food safety certification for the group, facilitating partnerships and expanding their market reach.		Article here Case in report here
Mozam-bique	ESA Saline Agri-culture Network	Saline agriculture, Knowledge sharing and networking, Participatory research	The ESA Saline Agriculture Network initiative brings together scientists, technicians and agricultural practitioners to exchange experiences and create synergies while working towards the sustainable use and management of salt-affected agricultural soil resources in Eastern and Southern Africa. This is achieved through the implementation of applied agricultural research projects, topical publications, along with continuous networking and awareness raising activities. The initiative promotes knowledge and action networks on the topic in the ESA region, specifically considering farmers' knowledge and practice. Farmer Field Schools are used to integrate local farmers in the experimental process and build knowledge on Saline Agricultural principals along with general good soil and water management practices in a participatory manner.	Jakob Herrmann Email: jakob@welt-weit.org Tel: +491 7434 71498 Bad Soden Email: info@welt-weit.org Tel: 061 9697 39515	Webpage here Flyer here
Multiple countries	Global Shea Alliance (GSA)	Shea value chain	The GSA is a non-profit association that aims to improve the livelihoods of rural African women. Through public-private partnerships, the GSA promotes industry sustainability, quality practices and standards, and demand for shea in food and cosmetics. It supports members to implement collaborative solutions to challenges, develop quality standards, share best practices, conduct research and advocacy, and open new markets for shea products. GSAs members are from 35 countries, including women's cooperative groups, brands and retailers, suppliers, and non-governmental organisations (NGOs). The GSA formalises shea gatherers into collectives, educates women's groups about their rights and strategies to improve their income, and provides training on business development and health and safety. It also improves their capacities to manage disaster and climate risks and impacts.	Email: info@globalshea.com Tel: +233 540 121 067 +233 243 600 749	Website here Report here Factsheet here

Country	Name	Key practices	Description	Contact details	Links to further information
Multiple countries (Burkina Faso, Mali, Senegal)	Groundswell International	Agroecology, participatory research	Groundswell International and its partner organisations in West Africa implemented the 'Agroecology Plus Six' (AE+6) programme. The main goal is to improve small-scale farmers practices across the Sahel and create an enhanced enabling environment. At the field level this involves: • Transforming existing farming practices through training of agroecology practices: testing and adapting new practices. • Empowerment for social and gender equity. • Strengthening the institutional capacity of partners and local actors. • Developing a 'farmer to farmer' multiplier effect. • Undertaking 'action research' to integrate gender, nutrition, and risk reduction measures. • Documenting lessons learned and sharing it through improved communications and advocacy. • Networking and linkage with national and regional networks. The project process involves: 1) collectively defining problems and solutions; 2) community needs to experiment with several low-cost agroecological innovations, using farmer-to-farmer learning in the field; 3) integrating strategies to promote nutrition, equity and women's empowerment; 4) maintaining the strategies through strengthening governance and supportive policies at all levels.		Webpage here
Multiple countries (Burkina Faso, Mali, Senegal)	SYPROBIO	Innovation platforms, Agroecology, Co-development, Participatory research, Evidence informed policymaking	SYPROBIO aims to combine and strengthen the knowledge and creativity of researchers, technicians and local farmers to address problems related to food security and adaptation to climate change. They set up ten groups to find sustainable solutions to enhance resilience based on the principles of agroecology. Soil fertility, seed improvement, pest management, agronomy and socio-economics were the main targeted topics. Twenty-seven innovative practices for on-farm research were identified. Through these farmer-led innovation platforms new practices are tested and introduced and comparative research on the economic and agronomic differences is done. Some examples of the innovations include: • Pest resilient varieties; • Usage of bio pesticides and organic manure to reduce synthetic inputs; and • Intercropping using local varieties and trap plants to increase nutrient efficiency and reduce application of pesticides. The findings are intended for policy makers, and practitioners.	Gian Nicolay Email: gian.nicolay@fibl.org Tel: +41 (0)62 865-0454	Infonote here Paper here Webpage here
Namibia	Environmental Investment Fund (EIF)	National climate platforms delivering devolved grant programmes accessed through enhanced direct access (EDA); Ecosystem based adaptation; CSA, Conservation agriculture	The EIF is a national fund that finances equitable development and the sustainable management of natural resources in Namibia. The fund is capitalised by environmental taxes and levies from the national government, as well as through climate finance from international and bilateral donors. In 2016, the EIF became the first organisation to access finance from the Green Climate Fund (GCF) through its EDA financial modality for the Empower to Adapt project. The project provides finance to gazetted communal conservancies and community forests, which are community-based institutions that are self-governed, through representatives elected by local people. The EDA is different from traditional donor financing models as the national fund that accesses GCF money is not responsible for project implementation; that role is devolved to community conservancies. Relevant projects include: • Ecosystem-based adaptation project (EbA) - Building resilience of communities in 8 landscapes threatened by climate change through an ecosystem-based adaptation approach. • CBNRM project- Empowering rural communities of the Namibian CBNRM network to respond to climate change in terms of awareness, adaptive capacity and low-carbon development. • CRAVE project - Climate Resilient Agriculture in three of the Vulnerable Extreme northern crop-growing regions (CRAVE) project aims to reduce food insecurity by allowing beneficiaries to adopt conservation agriculture (CA) and CSA practices to produce food, as well as by providing them with access to renewable energy. The project scales up the adoption of adaptive measures such as CA and micro-drip irrigation.	Tel: +264 61 431 7700 +264 61 240 339	Report here Website here EbA project weblink here CRAVE project weblink here CBNRM EDA project weblink here Sunref project weblink here SAP001 project weblink here

Country	Name	Key practices	Description	Contact details	Links to further information
Namibia Cont	Environmental Investment Fund (EIF)	National climate platforms delivering devolved grant programmes accessed through enhanced direct access (EDA); Ecosystem based adaptation; CSA, Conservation agriculture	• The Sustainable Utilisation of Natural Resources and Energy Finance (SUNREF) programme facilitates access to affordable green technologies, thereby guaranteeing the development of a low carbon environmental footprint and contributing to the reduction of the causes of climate change and other environmental disturbances in Namibia. A target segment is sustainable agriculture. • SAPOO1 project - Improving rangeland and ecosystem management practices of smallholder farmers under conditions of climate change in Sesfontein, Fransfontein and Warmquelle areas. The project aims to reduce the vulnerability of smallholder farmers under climate change conditions by safeguarding natural capital and generating ecosystem services to sustain agricultural production systems.		
Rwanda	Farmer-led irrigation development (FLID)	Irrigation	Farmer-led irrigation development (FLID) is a process by which small-scale farmers or commercial farmers drive the establishment, improvement, and/or expansion of irrigated agriculture, often in collaboration with external actors. It involves entrepreneurial investments by farmers either alone or in groups. Farmer-led irrigation development depends on farmers driving the improvement in irrigated agriculture through knowledge production, technology use, investment patterns, market linkages, and improved governance of land and water. The enabling policy 'Fourth Strategic Plan for Agriculture Transformation (PSTA4)' allows smallholder farmers, to move from rainfed farming to irrigated agriculture to help them increase crop and land productivity and sustainable water use. Engagement with the private sector helps farmers with the maintenance of FLID equipment and accessories. Smallholder farmers who organise into cooperatives and irrigation water users' associations (IWUAs) pay water fees for maintenance of the equipment. Regarding FLID financing, the government has attempted to reform policies and increase access by smallholder farmers to financial services. As a result, different commercial banks (public and private), microfinance institutions and other financial service providers continue to expand their financial services to poor rural communities, especially smallholder farmers.		Report here
Rwanda	Rurangwa Sam (self)	CSA	Rurangwa Sam is a young agricultural engineer who started a passion fruit farm in Kayonza district in 2018. A grant from UNDP and MINAGRI enabled him to diversify his farm, invest in irrigation, and significantly increase his income and farm yields, benefiting his community and providing jobs, especially for women.		Article here Blog here
Rwanda	Bankunde Charlotte (self)	CSA	Bankunde Charlotte from Bugesera District runs a green bean farm and implements irrigation solutions, enhancing productivity and creating employment for over 500 individuals each season.		Article here Blog here
Senegal	Gender-Smart Accelerator Grant	CSA, Finance	In Senegal, the Gender-Smart Accelerator Grant programme has been addressing development and business challenges related to the scaling of CSA technologies in a gender-sensitive manner. The goal of the Grant is to develop a pipeline of gender responsive CSA business models that can be matched with private investor capital in Senegal. As a result grants have been awarded to: • FRUITY, a company specialising in the processing of fruits and vegetables into juices, soups and smoothies, and developing practices to reduce post-harvest losses. Owner: Habibatou Dieng • ACASEN, a company specialising in the production of cashew-based appetisers and snacks for large distributors. It is also active in the promotion of local products. Owner: Hermione Awounou (Senegal). • NUTRIVIE, which produces and markets vegetable meat made from cashew apples, thus limiting post-harvest losses. Latifah Diedhiou met with cashew farmers in the Casamance region who told her of the cashew apple waste and the need for a solution. She then connected with researchers and NGOs to develop the product. Owner: Latifah Diedhiou (Senegal).	Dakane Agro-cosmo Email: ndongdakane1@gmail.com Tel: +221 77 422 77 67	Article here Dakane Agro-cosmo facebook page here AT-TEEN website here AT-TEEN linkedin here Nutrivie linkedin here Nutrivie article here

Country	Name	Key practices	Description	Contact details	Links to further information
Senegal Cont.	Gender-Smart Accelerator Grant	CSA, Finance	• AT-TEEN Groupe, which specialises in the packaging of medicinal plants into herbal teas and oily macerates, encouraging the empowerment of women. Owner: Ramata Sidibe (Senegal). • DAKANE AGRO COSMO, a company specialising in the transformation of mangoes into cosmetic and food products, which fights against waste while integrating people with disabilities. Owner: Ndeye Khadiome Ndong (Senegal). • FERME LA BARAKAH, an agro-ecological farm, which produces and markets organic fruits and vegetables, and promotes local consumption. Owner: Ndeye Thiam (Senegal).		
South Africa	Nutrisek	Black soldier fly (BSF) technology, Food waste upcycling, Feed production, Fertiliser production	Nutrisek has 40-years of experience in BSFs. BSFs provide a solution to organic food waste by converting it into high-value sustainable agri-cultural inputs. BSF larvae consume the organic waste transforming it into insect biomass which is then converted into high-protein animal feed, lipids and insect frass. The insect-based protein feed is targeted to aquaculture famers as the alternative fish-based oil and meal sources are in high demand, expensive and finite. The feed is also beneficial to poultry and pig farmers. The insect frass (excrement and exoskeletons) are used to make a chitin compost which is sold as a regenerative input to crop farmers. Chitin is used directly as a fertiliser to enhance crop growth; it has a high nitrogen content and a low carbon: nitrogen ratio. The addition of chitin to soils also improves microbial communities in both population size and structure. Lipids are also extracted from the BSF larvae which can be used as biofuel. Additionally, Nutrisek has developed and sell their technology used for on-site bioconversion of organic waste streams. The individual biore-actors process 25 tonnes of organic feedstock per day and have an 800m2 footprint, this makes waste bioconversion a profitable service at the medium scale. Environmental component: Insect-based protein is one of the most sustainable sources of animal protein, it uses only a fraction of the land and water needed for rearing other farmed animals. Further, for every tonne of insect meal produced, valuable nutrients are recycled back into the food chain that would otherwise be wasted, generating a positive net return to the environment. Climate component: Every bioreactor (HIVE 20) in operation saves 3,000 tonnes of carbon per year with potential for carbon credit generation.	Cobus Kotze Email: Cobus@nutrisek.com Tel:+27 83 395 1860	Website here
Tanzania	Food Security and Livelihood Project	Women adaptation initiative – CSA, market linkages, farmers-to-farmers learning (model farmers approach), social behaviour change (SBC), Village Savings and Loan Associations (VSLAs)	The Food Security and Livelihood Project (2018-2023) in Dodoma, Morogoro, Iringa, and Rukwa regions in Tanzania. The project focuses on climate adaptation interventions specifically irrigation water management, soil nutrient improvement, improved/drought tolerant crop varieties, and pest/disease management practices. A key focal area is empowering women in climate adaptation interventions in agriculture. The project involves training and capacity building of farmer groups, participation in local government programmes, VSLA, support to marginalised groups, and devolved decision-making.	Dr Arun Khatri-Chhetri Email: akhatrichhetri@savechildren.org	

Country	Name	Key practices	Description	Contact details	Links to further information
Tanzania	Tanzania Tree Growers Association Union (TTGAU)	CSA, Wetland restoration	Two projects: First is on linkage of livestock keeping, biogas production, farming and climate change adaptation. TTGAU through the Forest and Farm Facility (FFF) demonstrated the relationship between cattle rearing, biogas production for energy, improved crop production, and environmental protection to group members of UWAMINYO at Nyombo village. The demonstration involved engagement of women in cattle rearing for improved household income and wellbeing. The project minimises land degradation as biogas requires cattle to be zero grazed as opposed to the common free grazing. Gas cook stoves motivated many women members to adopt indoor cattle rearing and reduces deforestation for charcoal production. The collected cow dung and slurry is used as fertiliser. Second project is the Women Baskets Value Chain. Basket weaving is a common activity carried out by women members of UWAMINYO. Reeds are the main raw material. Women in UWAMINYO have been sourcing reeds from wetlands within and outside the village. In the past, they made baskets mainly for household use and the local market. With technical support the women have managed to add value to the baskets and secure markets beyond the village increasing their income. To ensure sustainable availability of the reeds, the Nyombo village government council has set aside two valleys for restoration by both natural and assisted restoration. This will not only contribute to the sustainable availability of reeds but also promotes the conservation of wetland areas and biodiversity.	Joshua Ngalomba, Forest Extension Officer, TTGAU Email: 1995joshuangalomba@gmail.com Kastory Timbula (CEO) Email: kmtimbula@gmail.com Marry Uswege (Project officer) Email: maryuswege77@gmail.com Aileen Mekenzi (Sociologist) Email: aymickenz@gmail.com	Website here
Tanzania	Chololo Ecovillage	Agroecology; Improved livestock breeds; Water conservation; Knowledge transfer	The main goal of Chololo Ecovillage is to address climate vulnerabilities and create a model of good practice in climate adaptation, based on testing, evaluating and rolling out over 20 ecological 'technologies' in agriculture, livestock, water, energy, and forestry. It also focuses on planning climate change strategies with local and national authorities. Building on local knowledge, traditional practices and natural resources, it provides a package of agroecological practices or 'technologies', aimed at making the most of the limited rainfall, improving soil fertility, reducing farmers' workload, and improving the quality of local seeds. The project adopts a participatory approach from the assessment of climate vulnerability to knowledge generation and dissemination. Farm level activities include: • Package of agroecological practices, including manure-based increase of soil fertility and optimal planting schedules. • Introduction of improved breeds of cattle, goats and chickens and use of crop residues to feed livestock. • Improvements to water conservation features, such as contour ridges, grass strips and gully healing to capture rainwater and prevent soil erosion, sustainable forestry and agroforestry and water management. • Creation of 'technology groups' for knowledge transfer and farmer-to-farmer outreach.	Dr Francis Njau Email: frabe59@gmail.com Tel: +255 762 926 426	Webpage here Article here Project report here
Tanzania	Njombe Agricultural Development Organisation (NADO)	CA, Agroforestry, GAPs, Income/ livelihood diversification – home gardens, beekeeping, livestock, nursery and tree plantation	NADO works with smallholder farmers on the production of various crops (maize, beans, sunflower, tomato, cabbage, Irish potato, sweet potato, soybean, vegetables and fruits). NADO improves the climate resilience of its members by promoting more sustainable means of production and maintains and expands access to markets. The overall objective is to improve living conditions for the rural population in the project areas. NADO establishes farmer groups and conducts farm-led research in soil fertility, agroforestry, nurseries and tree plantation. Together with different stakeholders including farmers, NADO identified climate change risks and hazards and developed adaptation strategies which farmers are currently applying. NADO focuses on inclusion (women, youth and disabled). NADO builds farmer capacity to improve productivity and increase incomes. NADO also has advocacy goals for improving women's rights to land, as well as agricultural subsidies that make competition conditions unfavourable for subsistence farmers.	Ernest (Tizo) Ng'umbi NADO Agricultural Advisor Email: tizongumbi@yahoo.com Tel: +255763204364	Facebook page here Article here Blog here

Country	Name	Key practices	Description	Contact details	Links to further information
Tanzania	Zanzibar Seaweed Cluster Initiative (ZaSci)	Seaweed farming, Value addition	Seaweed is an important aquaculture sub-sector in Tanzania, particularly in Zanzibar where it employs nearly 26,000 people (of which almost 80% are women). The commonly farmed cotton variety began to die off in certain areas of Zanzibar due to climate change - increased water temperatures and stronger ocean waves. Many farmers lost their livelihoods. In 2006, a network of academics, government officials, and farmers came together to form the Zanzibar Seaweed Cluster Initiative (ZaSci). The main objectives of ZaSci were to develop innovative farming techniques to increase production; and to add value to farmed seaweed by promoting the production of quality seaweed products for national and international markets. ZaSci introduced a new farming technique of using deep-water floating rafts to reduce the problem of cotton die-off. Farmers were trained on monitoring production and environmental health. They were also trained to construct floating rafts to grow the seaweed on, and provided essential gear, including boats. A higher value kikarafuu variety of seaweed was introduced. Farmers were also trained in value addition - seaweed soap and dessert-like treats. New farming techniques led to higher production rates and attracted new growers.	Email: info@seaweedcluster.or.tz Tel: +255 762 022 356	Website here Article in report here
The Gambia	Cash for Work - Local Climate Adaptive Living (LoCAL) Facility	Inclusivity, Climate resilience	Cash for Work project by the Local Climate Adaptive Living (LoCAL) Facility. The project supports the creation of vegetable and fruit gardens, mainly bananas, irrigated by solar irrigation systems. Community members create the gardens, receiving a competitive daily wage and the profits from selling the fruits and vegetables once the gardens are productive. The programme focuses on jobs, skills and finance for women and youth. The programme adopts locally-led adaptation to address the impacts of climate change and broader social needs, including job creation, skills development, and financial inclusivity, for a 'whole of society' approach to tackling the climate crisis. LoCAL's approach, of working through local authorities, is increasingly seen as key in building resilience to climate change at the local level. Decision-making factors in the findings of Climate Risk Vulnerability Assessments, help prioritise activities that contribute to climate resilience-building. The process prioritises decision-making by the community, and the effective and inclusive participation of the local population, including vulnerable groups.		Article in report here
Uganda	Rootical	Regenerative agriculture, Agri-business accelerator	Rootical equips entrepreneurs in Uganda with the tools, skills, networks and capital needed to build transformative food-related businesses. Rootical enables entrepreneurs to build and own regenerative agri-food companies. Together with the agri-preneurs, Rootical builds commercially viable and purpose-driven enterprises to accelerate the transition to a fair, inclusive and regenerative food system. It involves: • Extensive training on business development skills. • Critical knowledge and insights on regenerative food systems. • Crash course on food systems practice and leadership. • Partners with food systems transformation minded founders and investors.	Email: info@rootical.org Tel: (+256) 0758 620 905	Website here
Uganda	Neycha Accelerator and Fund	Agroecology; Agri-business accelerator	The Neycha Accelerator and Fund blends capacity building and finance for agroecological enterprises. The enterprises can improve their business-related skills, including impact measurement, agroecological practices, human resources management and approaches to gender sensitivity. This support strengthens them and enables them to scale up. Furthermore, they are connected to other agroecological enterprises, markets and investors. Neycha provides key inputs to farmers practicing agroecology, including agroecological knowledge, seeds, organic pesticides, etc. Agroecology encourages equal sharing and valuing of local resources and knowledge. Furthermore, it also actively addresses gender inequality by empowering women through access to resources, knowledge, and active participation in decision-making processes. Agroecology addresses the challenges of climate change by adopting practices that sequester carbon and reduce greenhouse gas emissions. By promoting organic farming methods, agroecology helps build soil organic matter. It also encourages agroforestry systems that sequester carbon in trees and perennial crops.	Email: neycha@shona.co Tel: +256(0) 783 130 800	Website here Article here Facebook page here Instagram here

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Uganda	Eden Seeds	Indigenous seed, Regenerative agriculture	Emmanuel Luwemba grew up on a farm which fuelled his passion for regenerative agriculture. Emmanuel worked as an extension officer for 6 years. A smallholder farmer himself, he established a demonstration farm where he trained farmers on regenerative agriculture such as vermiculture, biogas, organic fertiliser, biopesticides, seed multiplication and soil and water conservation. Emmanuel established Eden Seeds, an agri-business that links farmers to indigenous seeds. Eden Seeds is a decentralised network and farmer-owned seed brand that partners with existing seed producers and community seed banks to multiply and market Indigenous seeds. Smallholder farmers are co-founders and key decision makers at Eden Seeds. This motivates and empowers them to ensure quality and consistency in the production, distribution and marketing of Eden Seeds. In addition, 5% of the profits generated by Eden Seeds is allocated to corporate social responsibility engagements like reafforestation and waste management projects for the betterment of local communities. By reaching smallholder farmers, promoting agroecological farming practices and championing Indigenous seeds, Emmanuel seeks to revolutionise regenerative agriculture in Uganda.		Linkedin here Article here YouTube video here
Uganda	Garden Fresh	Post harvest loss, Organic farming	Roselyn Ilemuyat, a groundnut business owner, is driven by a desire to empower women farmers and create a healthier food system in Uganda. She realised that smallholder farmers in Uganda are heavily reliant on harmful agrochemicals so she co-founded Garden Fresh, a business dedicated to extending the shelf life of fruits and vegetables using natural and organic solutions.		Article here Linkedin here
Zambia	Sylvia Banda (self)	Promotion and sale of traditional foods	Sylvia Banda partners with smallholder farmers to produce nutritious traditional food. She links the farmers with markets, connects them with the private sector and secures finances from NGOs, multiple business streams and international financial institutions. She provides post-harvest training to limit losses and improve food safety. She makes solar dryers accessible to smallholders. She encourages organic production with a focus on soil health and biodiversity. She also promotes a gender sensitive approach.		Article in report here
Zambia	Community Markets for Conservation (COMACO)	Organic farming, CSA, CA, Agroforestry	COMACO helps establish community-run cooperatives in three provinces of Zambia. The cooperatives provide vital support services to thousands of small-scale farmer members. The cooperatives house high-quality community seed banks and provide farmer trainings, crop-purchasing events and payments. Each cooperative runs a community depot, which serves as a central hub for farmers and allows individuals to store their seeds, crops and equipment safely. To maximise learning and facilitate knowledge sharing, famers are organised into small producer groups of 15-20 members, each mentored by a peer-selected lead farmer. Lead farmers report to a network of senior and principal lead farmers. Half of all cooperative leadership positions are held by women. Farmers are trained in organic farming – they practice crop rotation and plant *Gliricidia sepium* trees, a nitrogen-fixing plants. To address drought, farmers are taught minimal tillage. The dedicated gender programme runs 182 VSLAs for women, teaching small-business skills and supporting women in their entrepreneurial ventures. Energy-efficient cookstoves, fuelled by dried twigs from the *Gliricidia* trees greatly reduces women's workload. COMACO's commitment to purchase directly from communities allows women the opportunity to sell crops directly to COMACO and manage all their family's finances themselves. Women and children of COMACO families are half as likely to be underweight than their non-COMACO neighbours.	Email: social@itswild.org Tel: +260 97 158 3282	Website here

Country	Name	Key practices	Description	Contact details	Links to further information
Zambia	Multiple small- and medium-sized enterprises (SMEs)	CSA, Innovative finance, Business accelerator	**First accelerator cohort** AICCRA and partners have worked closely with an initial cohort of 14 Zambian agribusinesses. They were grouped into five innovation 'bundles', each focused on different value chains or challenges specific to Zambia's agriculture. The Accelerator's approach combined partnerships and innovations, creating synergies that increase impact and foster sustainable development. This method not only accelerates the adoption of proven solutions but also strengthens collaborative networks and enhances the scalability of innovations while improving inclusivity and supporting environmental sustainability. **Second accelerator cohort** AICCRA Zambia in partnership with national incubators and the private sector have nurtured innovations through the provision of accelerator grants for SME's working in CIS delivery and CSA technology scaling to de-risk scaling innovations and to enhance climate resilience of value chains, social inclusion, and sustainable use of land and water. It has identified gender and youth vulnerability within the food system. Subsequently, AICCRA Zambia is targeting SME partnerships to scale bundles of CSA innovations (digital innovations, finance innovations, social innovations, technological innovations, services etc). Activities ensure use of such innovations while improving gender and youth inclusivity and support environmental sustainability. The enterprises will: • Partner to co-implement and scale market-system based solutions in CSA; • Implement, scale, and refine sustainable finance mechanism(s); • Integrate digital innovations; • Contribute to capacity development of food producers, women, youth and other marginalised groups; and • Implement a series of activities directly addressing the needs of women and youth.	Email: iwmi-aiccrazambia@cgiar.org Tel: +260 963 828438	Webpage here Webpage here
Zambia	Kanyama Women's Federation	Organic farming, Organic manure, Biogas, Liquid fertiliser, Vegetable production	Kanyama Women's Federation in partnership with Voices for Just Climate Action (VCA) is co-producing climate solutions based on grassroots knowledge and experience. Women are leading the way in sack gardening, organic manure making, liquid fertiliser production and initiatives such as savings groups among other green innovative and sustainable climate change solutions aimed at empowering women with the skills and knowledge to respond to food insecurity and malnutrition. The Federation, which started with only 35 members, has grown to about 365 members, including those living with disabilities. Members have been divided into various sizeable groups to ensure effective management. The group produces organic manure, biogas and liquid fertiliser. The group is also engaged in vegetable production which they sell to the community for income. The activities cover the costs for schooling their children and food for their families.		Article here

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