CIRCULAR FOOD SYSTEMS PROJECT LEAD FARMER CASE STUDIES FROM EAST AND SOUTHERN AFRICA

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Circular food system project lead farmer case studies from East and Southern Africa

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Photo

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ACIAR	Australian Centre for International Agricultural Research
AIPs	Agricultural Innovation Platforms
ANU	Australian National University
ARU	Ardhi University
BSF	Black Soldier Fly
CFS	Circular Food Systems
CITTAU	Centro de Transferência de Tecnologias Agrárias de Umbeluzi
FANRPAN	Food, Agriculture, Natural Resources Policy Analysis Network
GDP	Gross Domestic Product
GYSI	Gender, Youth, and Social Inclusion
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
INIR	National Institute for Irrigation
IP	Innovation Platform
IPM	Integrated Pest Management
SDAE	Serviço Distrital de Actividades Económicas
TISA	Transforming Irrigation in Southern Africa
ToT	Training of Trainers
UTS	Urea Treatment of Stover
UEM	Universidade Eduardo Mondlane

Overview of the Circular Food Systems in Africa (CFS) project

The Circular Food Systems (CFS) in Africa project (2023–26) addresses the critical challenge of nourishing a growing population within planetary boundaries. Operating across Tanzania, Zimbabwe, and Mozambique, the initiative aimed to transition food systems from traditional "take-make-waste" models toward a circular economy. By integrating irrigation, livestock, and rainfed farming, the project aimed to optimise water, carbon, and nutrient cycles to decouple economic development from resource depletion. Through participatory processes integrated by Agricultural Innovation Platforms (AIPs), the project used two main interventions to achieve this objective: small business development to value add to primary agricultural products; and working with lead farmers to introduce agroecological practices.

The CFS project has made major steps towards transforming smallholder farming communities into resilient, profitable ecosystems through:

- Socio-economic development: supporting small businesses that add value to produce and repurpose agricultural by-products (reported in Mujeyi et al. 2026[1]).
- Social inclusion: prioritising gender, youth, and social inclusion (GYSI) to empower underserved groups with leadership and economic agency (reported in Parry et al., forthcoming[2]).
- Environmental sustainability: supporting lead farmers to implement low-emission practices that enhance soil health and carbon sequestration.
- Policy and scaling: Developing a robust evidence base to facilitate the regional adoption of circular models.

The lead farmer intervention encompassed agroecological practices to close resource loops, reduce input costs, and improve soil fertility, yields and household livelihoods. The results of this intervention are the focus of this report.

[1] Mujeyi, A., Bjornlund, H., Parry, K., Dube, T., Dube, F., Moyo, M., Mdemu, M. V., Kimaro, E. G., Kissoly, L., Gabriel, G., Mutondo, J., Vilissa, D., Mutodi, K., Charachimwe, R. R., Mazive, E. T., Madal, A. P., Ubisse, N., van Rooyen, A., Ramshaw, P., Pittock, J., & Sinyangwe, S. (2026). Circular food system business case studies from East and Southern Africa (Technical Report). Circular Food Systems in Africa Project.

[2] Parry, K., Mujeyi, A., Gabriel, G., Mazive, E., Bjornlund, H., Sinyangwe, S., Dube. T. & Kinogo, I. (fortchcoming). Social inclusion in circular food systems interventions: using the 'Reach, Benefit, Empower, Transform' lens to identify outcomes and lessons learned. Journal of Rural Studies.

Executive summary

The Circular Food Systems (CFS) project in Tanzania, Mozambique, and Zimbabwe demonstrates how context-specific practices can increase resource efficiency, reduce input dependence, and strengthen resilience under climate variability and extreme climatic events such as droughts and flooding. Across all three countries, one of the key elements of the CFS approach was working with approximately 250 lead farmers, supported by demonstration plots and peer learning.

Implementation and incentives for participation

The following highlights important cross-country differences in lead farmer implementation:

- In Tanzania, engagement was with lead farmers involved in irrigation and rainfed production, with an implementation emphasis on crop-livestock integration, nutrient recycling, and utilisation of locally available biomass and agro-processing of by-products. Practices focused on stabilising household cash flow and reducing reliance on chemical fertilisers. Lead farmers illustrated pathways involving maize-dairy-poultry systems, fodder production, and irrigation-based crop rotations.
- In Mozambique, the project operated primarily within irrigation schemes, where water availability, input quality, and machinery access were binding constraints. Agroecological practices focused on composting, mulching, residue incorporation, and partial substitution of synthetic fertilisers. Integration with pig enterprises allowed valorisation of crop residues, though adoption remained gradual due to risk aversion and labour demands.
- In Zimbabwe, lead farmers operated across irrigated and rainfed systems, addressing high input costs and feed scarcity. Practices included urea-treated stover, protein lick blocks, black soldier fly (BSF) production, pit manure curing, intercropping, and thermal composting. Innovations aimed at creating closed nutrient loops, linking livestock, horticulture, and aquaculture. Demonstration plot outcomes and peer learning were particularly strong in promoting early adoption.

Several key lessons emerged regarding what made lead farmers accept the role and maintain engagement, and what created an incentive, in many cases, for immediate adoption, including the following benefits:

- the new practices directly linked to their challenges or objectives and were aligned with the agricultural calendar;
- opportunity for collaboration with extension officers and project staff and gaining early knowledge about the new practices;
- being part of a network of lead farmers sharing experiences and learning;

- use of a hands-on and multi-faceted experiential approach (practical demonstrations, look-and-learn tours, technical handholds and WhatsApp group chats);
- training sessions/demo plots took place in the lead farmers' fields;
- bringing new knowledge to their community, including to villages that often miss out due to their distant location; and
- enhancing their standing in the community.

The introduction and provision of training across the season, as practices were needed, proved attractive. Many lead farmers prioritised and adopted practices that addressed an immediate concern and expressed an intent to add on other practices when practicable. Quick uptake was not unexpected among the lead farmers as they were selected for being progressive, and adoption theory suggests that some farmers will adopt early while others will wait to see the outcomes. However, linking the introduction of agroecological practices to the season meant that we should expect that more widespread adoption would be delayed until the following season. Yet many other farmers also made changes, suggesting that these practices are highly relevant and the incentives for change were evident. Farmers are more likely to experiment when they can observe results under real conditions and engage directly with someone they know and trust.

Outcomes

Across the three contexts, the project generated tangible improvements in input efficiency, yield stability or improvement, and income diversification. Key results from across the lead farmers include:

- Fertiliser and feed costs were reduced by 25–60% through more efficient use of manure, composting and crop residues.
- Crop and livestock yields increased by 10–50% (depending on seasonal conditions) through improved soil health and moisture retention.
- Critical drought protection: Many farmers avoided cattle losses during the severe 2023/24 drought using low-cost feed alternatives (urea-treated stover, lick blocks, fodder), protecting vital household assets when neighbours faced mass mortality.
- Many have added more or new livestock into their farming system, realising the opportunity and benefits arising from integrating farming systems.

More detail on the drivers, challenges and benefits associated with adoption of the range of agroecological practices is summarised in Table 1, including a qualitative assessment of adoption patterns. Overall, the evidence indicates that agroecological practices can support more circular production systems while enhancing productivity, resilience, income diversification, and livelihoods across diverse agro-ecological contexts. The shift in mental models around resource use and the value of agroecological farming practices is a significant outcome and reflects a powerful leverage point for system change. Farming communities are visiting lead farmers to learn (and sometimes in considerable numbers), many have followed their lead and adopted new practices, extension officers are promoting the new practices, circularity features centrally in farming meetings, and new farming mantras are emerging:

"Emasimini akula lutho olulahlwayo, konke okusalayo kufanele kubuyela emhlabathini"

"From the fields there is nothing to be thrown away; everything coming from the field and not consumed by people must find its way back into the soil."

The interest among other farmers in adopting agroecological practices is evident with large number of farmers attending field days and demonstration plots and coming informally to the lead farmers to discuss the adoption of the promoted methods and their impact. While lead farmers have been generous with their time to share knowledge, this has compromised their labour availability and put a strain on their own operations. Further scaling would be assisted by strategies to improve lead farmers' mobility. Adoption of some practices was constrained by access to labour and capital, competition for biomass resources and input and climate variability. However, scaling efforts are gaining momentum through the development of local feed value chains, simplified tools like compost turners, and the distribution of training materials in local vernaculars.

Key lessons from cross-country case studies

The core intent of the lead farmer intervention was to introduce agroecological practices as part of creating a CFS in rural smallholder communities. Nine key lessons emerge from the case studies, which have underpinned the beneficial outcomes and support transitions to circularity:

1. **System-level circularity.** Circularity is the outcome of a system-level reorganisation of on-farm resources and the adoption of multiple agroecological farming practices. The intentional creation of multiple, reinforcing resource loops strengthens resilience. Integrated practice packages should be promoted rather than isolated interventions.
2. **Nutrient recycling.** Nutrient recycling (manure, compost, residues) consistently reduces synthetic fertiliser dependence while improving soil fertility and water holding capacity and increasing crop yields. Importantly, yield is not the only way to assess efficacy of new practices, with labour requirements also being a critical metric. Training is required on input preparation and quality control.

3. **Livestock integration.** Integration through feed valorisation, fodder production, and manure recycling, improves soil fertility and water holding capacitys, diversifies and increases household income, and, thereby, improves livelihoods and resilience.
4. **Adoption is gradual and shaped by resource constraints.** Farmers adopt practices incrementally, with uptake determined by exiting practices, immediate needs and available resources. Flexible and phased interventions that align with farmers' capacity and constraints are beneficial, including for resource-poor households at earlier stages of crop-livestock integration.
5. **Managing expectations.** Benefits are incremental and highly sensitive to timing and input quality. Farmers can misattribute inconsistent results to the practice, when failures are actually driven by poor-quality inputs—such as low-nutrient manure—or incomplete implementation. Hands-on training in the initial stages of adoption is vital to maintain confidence and prevent premature dis-adoption. Farmers need diagnostic support to distinguish between the inherent limitations of a technique and addressable errors in execution.
6. **Peer-led scaling.** The incentive for early adoption beyond lead farmers is facilitated by peer learning, timely introduction of the practices to coincide with seasonal work, and demonstration plots making outcomes visible. Farmer-led demonstrations have shifted mindsets. However, broader scaling requires investments in extension, irrigation infrastructure, labour efficiency, and access to quality organic inputs and machinery.
7. **Social empowerment.** Beneficial outcomes go beyond economic and environmental. Many lead farmers improved their household nutrition and gained confidence, recognition, respect, a strengthened voice in their community for sustainable approaches, and were empowered to manage stress and navigate adverse seasons.
8. **Context-specific strategies.** Local contexts determine feasibility and scaling pathways and uniform approaches should be avoided. Country-specific concerns—such as rainfall dependence in Tanzania, unreliable irrigation in Mozambique, and biomass constraints in Zimbabwe—highlight the importance of locally adapted circular strategies that address immediate needs.
9. **Multiple inter-connected benefits.** Agroecological practices—including intercropping, mulching, relay cropping, and improved varieties—are integral to circular systems, as they improve soil fertility and water-holding capacity while simultaneously reducing production costs and increasing resilience. These methods offer critical opportunities for resource-constrained farmers; specifically, manure shortages can be overcome through the heat composting of good quality or spoiled biomass, while feed shortages can be addressed using urea-improved stover and lick blocks at a significantly lower cost than commercial options.

Ultimately, these practices underscore that livestock survival and productivity do not have to depend on expensive, purchased feed.

The qualitative case studies in this report provide a structured foundation for subsequent quantitative validation. A follow-up survey covering the full set of lead farmers, alongside a broader sample of participating and non-participating farmers, would allow systematic estimation of adoption rates, intensity of practice bundles, and associated impacts on productivity, costs, and income. Such an approach would strengthen causal inference, enable comparison across agro-ecological and institutional contexts, and support more robust assessment of scalability and cost-effectiveness.

Table 1: Agroecological practices adopted: key drivers, constraints, benefits, and adoption patterns.

Practice	Key driver (problem addressed)	Implementation constraints	Observed benefits	Adoption pattern
Composting (M=Mozambique, T=Tanzania)	High fertiliser costs; low soil fertility	Limited biomass; labour-intensive; knowledge gaps on compost quality	20–40% fertiliser reduction; improved soil structure; moderate yield gains	Partial adoption; scaling gradually
Mulching (M, Z= Zimbabwe)	Soil moisture loss; declining fertility	Competing uses for residues; labour	Improved moisture retention; reduced input needs	Adopted on selected plots
Crop residue incorporation (M, Z)	Low soil organic matter	Labour; timing with land preparation	Improved soil fertility; reduced fertiliser needs	Combined with other practices
Relay cropping / intercropping (M, Z, T)	Risk of crop failure; low land productivity	Knowledge intensity; labour	Yield stability; better land use; diversification	Expanding through peer learning
Organic fertilization (manure use) (M, Z, T)	High cost of synthetic fertiliser	Transport; limited supply; handling	Reduced fertiliser costs; improved yields and soil fertility	Widely adopted where manure is available
Pig manure application (M, T)	Underutilised livestock waste; soil fertility decline	Disease risk; handling and application	Reduced input costs; improved crop performance	Moderate adoption
Integrated Pest Management (IPM) (M)	Pest pressures; cost of agrochemicals	Knowledge requirements; monitoring effort	Reduced chemical use; stable yields	Moderate adoption
Improved seed varieties (M)	Low yields; pest and climate stress	Access; cost	Modest yield gains; improved resilience	Combined with other practices
Urea-treated stover (Z)	Livestock feed shortages	Input access (urea); labour; correct preparation	Improved livestock condition; feed cost substitution	Early adoption at scale
Protein lick blocks (Z)	Poor livestock nutrition	Input availability; preparation knowledge	Improved feed efficiency; livestock productivity	Adopted in demonstration sites
Pit manure curing (Z)	Low-quality manure	Labour; time requirements	Enhanced manure quality; better nutrient availability	Growing adoption
Black soldier fly (BSF) production (Z)	High feed costs	Technical knowledge; initial setup	Alternative protein source; reduced feed costs	Limited but innovative uptake
Thermal composting (Z)	Biomass waste; low soil fertility	Labour; knowledge intensity	Faster composting; improved nutrient recycling	Demonstration-led adoption
Aquaculture integration (Z)	Income diversification needs	Water access; technical skills	Additional income; nutrient cycling	Limited adoption
Fodder production / fodder plots (T)	Feed scarcity	Land allocation; rainfall variability	Improved livestock nutrition; reduced feed costs	Gradual adoption
Use of agro-processing by-products (T)	High feed costs	Access; transport	Reduced feed costs; improved livestock condition	Early adoption
Crop–livestock integration (T)	Fragmented systems; input costs	Labour; coordination across activities	Nutrient cycling; diversified income	Expanding among lead farmers
Dairy–poultry–pig integration (T)	Income instability	Feed, disease management, labour	Stable cash flow; manure for crops; diversification	Early secondary adoption
Rice–bean rotation (T)	Soil fertility decline; low returns from monocropping	Biomass availability; grazing conflicts	Yield and income improvement; soil fertility gains	Small but targeted adoption

Introduction

Southern and East African agri-food systems are at a critical juncture, marked by growing exposure to climatic vulnerability, resource scarcity, rapidly growing populations and the need for inclusive job creation, especially for youth and women (IPCC, 2023[3]; Mueller & Thurlow, 2019[4]). To safeguard the long-term sustainability of smallholder economies, especially those built around vital irrigation infrastructure, there is an imperative to shift from a resource-inefficient linear economy model of take-make-dispose to a more sustainable model. Circularity and agroecology present regenerative and alternative development solutions that produce beneficial economic, environmental, and social outcomes (van Rooyen et al., 2025[5]).

The CFS project builds on a forerunner project—Transforming Irrigation in Southern Africa (TISA)—that worked with smallholder irrigation farmers to address wide-ranging challenges to profitability, including over-watering, declining soil fertility, high-cost and poor-quality inputs, market constraints, and much more. The TISA project enabled smallholder schemes and their farming households to become more productive and profitable by optimising water use through smart water scheduling tools and addressing critical barriers (Bjornlund et al., 2023)[6]. This created the foundation for the expansion of emerging small businesses and the adoption of agroecological farming practices; hence, making CFS and the integration of farming systems and value-adding business activities a viable next step. There are two key enablers of a transition to circularity: first, irrigation, rainfed, and livestock producers need to adopt agroecological farming practices; and second, there is a need for new small businesses that have local market penetration and deploy resource-efficient, contextually relevant, circular solutions to integrate farmers' principal products along short value chains.

The lead farmer intervention in the CFS project was designed to demonstrate context-specific practices that increase resource efficiency, reduce input dependence, and strengthen resilience under extreme climatic events and diminishing grazing land.

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[3] IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 35-115, doi: https://10.59327/IPCC/AR6-9789291691647

[4] Mueller, V., & Thurlow, J. (eds) (2019). Youth and Jobs in Rural Africa Beyond Stylized Facts. Oxford University Press, UK. https://doi.org/10.1093/oso/9780198848059.003.0001

[5] van Rooyen, A., Bjornlund, H., Moyo, M., Pittock, J., Parry, K., & Mujeyi, A. (2025). Agroecology and circular food systems: decoupling natural resource use from rural development in sub-Saharan Africa? International Journal of Water Resources Development, 41(2), 489–511. https://doi.org/10.1080/07900627.2024.2449224

[6] Bjornlund, H., van Rooyen, A., Pittock, J., Parry, K., Moyo, M., Mdemu, M., & de Sousa, W. (2023). Institutional innovation and smart water management technologies in small-scale irrigation schemes in southern Africa. In *Smart Water Management* (pp. 110-139). Routledge.

Lead Farmer Approach

In collaboration with community leaders and extensions agents, approximately 250 experienced, respected and motivated lead farmers engaged in irrigated and/or rainfed production, were carefully selected to test, adapt, and demonstrate agroecological farming practices under real production conditions. Selection processes were embedded within existing institutional and community structures, drawing on extension services, irrigation scheme leadership, and farmer networks. In Zimbabwe, lead farmers were identified that built on established AGRITEX and TISA models, with selection criteria including demonstrated performance, accessibility of plots, and willingness to support peer learning. In Tanzania, lead farmers were selected through AIPs, ensuring representation across communities and alignment with locally identified priorities. In Mozambique, selection was undertaken in collaboration with irrigation scheme management and cooperatives, focusing on farmers willing to experiment and share knowledge within their networks.

Participatory processes, including AIP visioning exercises (Tanzania), cooperative-based farmer consultation (Mozambique), and irrigation scheme consultations (Zimbabwe), ensured the selection of agroecological farming practices that were locally feasible and responsive to community priorities. These processes were complemented by key informant interviews and engagement with extension officers to ensure alignment with existing programmes and local production systems.

Farmers have a critical role in advancing CFS, generating income and food but also demonstrating how circularity can be practically embedded through: composting to generate organic fertilisers, local feed production, waste reuse, low-input systems, and decoupling farming from the use of expensive commercial input. Figure 1 illustrates the components of a circular food system using Zimbabwe as an example. It shows the circularity and resource loops generated within the farms and their circular links to the secondary and tertiary businesses. To assist with establishing or strengthening efficient resource flows, the lead farmers received training in agroecological practices, which were complemented by mentoring and follow-up support. Demonstration plots and peer learning were used to stimulate early adoption beyond lead farmers by providing visible evidence of practice performance under local conditions. These included individual farm-level demonstrations and, where land constraints existed, on shared plots at irrigation scheme level.

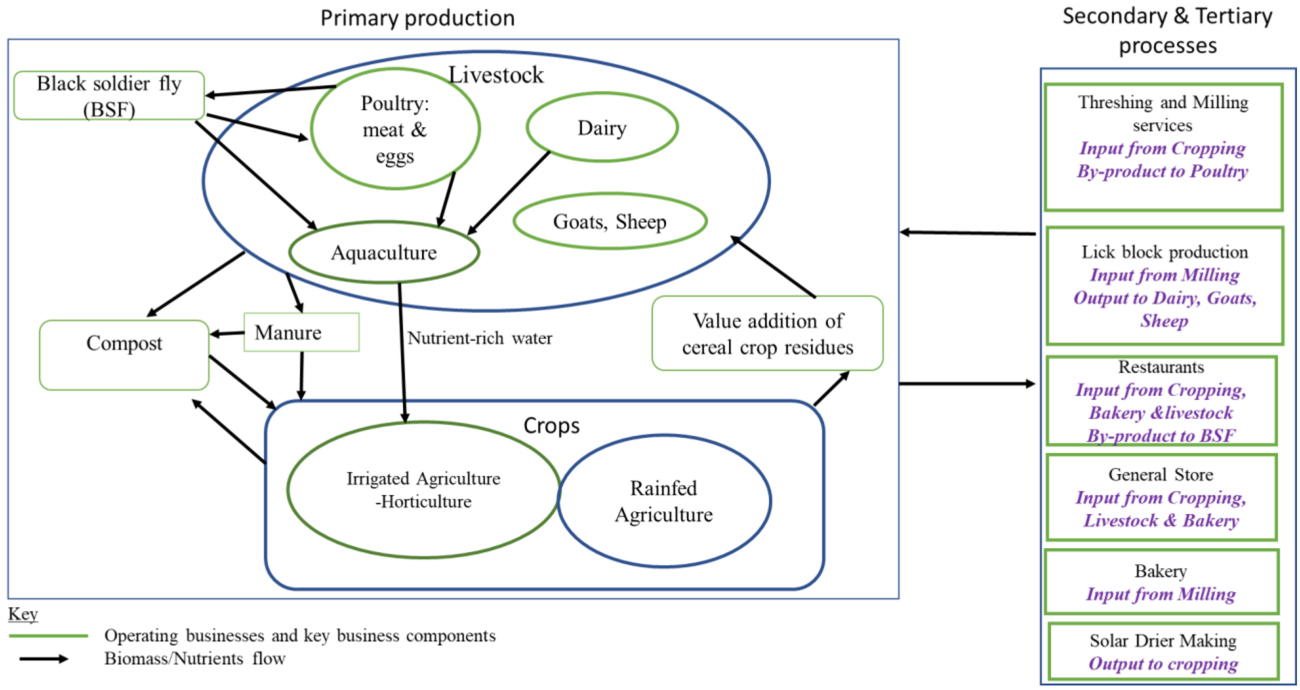

Figure 1: Circular food system linkages between production systems[7].

The collection of case studies that follows for each country capture the practical achievement of lead farmers introducing agroecological farming practices into the farming communities surrounding small irrigation schemes.

[7] Adapted from: Mujeyi, A., Bjornlund, H., Parry, K., Dube, T., Dube, F., Moyo, M., Mdemu, M. V., Kimaro, E. G., Kissoly, L., Gabriel, G., Mutondo, J., Vilissa, D., Mutodi, K., Charachimwe, R. R., Mazive, E. T., Madal, A. P., Ubisse, N., van Rooyen, A., Ramshaw, P., Pittock, J., & Sinyangwe, S. (2026). Circular food system business case studies from East and Southern Africa (Technical Report). Circular Food Systems in Africa Project.

Zimbabwe

Introduction

The CFS project initiated farm-level technologies during the mid-2023/24 summer cropping season, focusing on the irrigation communities of Hauke, Pollards, and Silalatshani in Zimbabwe. It addressed climate extremes and high input costs by promoting agroecological practices that repurpose "waste" into valuable resources, decoupling production from resources, and transitioning farming systems to circular systems. By integrating crop and livestock systems, the project aimed to improve productivity, food security, and household income through sustainable resource management. Key informant interviews, and AIP meetings were used to identify agroecological farming practices that the project could promote. Further discussions with AGRITEX extension officers explored appropriate approaches to introducing these practices in ways that complemented existing extension programmes in the area. Building on the TISA model, which successfully used lead farmers to influence changes in irrigation behaviour within the irrigation schemes through adoption of the learning from smart water monitoring tools, the project extended this approach to include rainfed farmers. Lead farmers were selected from established AGRITEX and TISA pools, using criteria such as early adoption, accessible plots, literacy, and interpersonal skills. Across three sites, 180 were chosen (68 female, 112 male), half irrigators and half rainfed, with >95% in mixed crop-livestock systems.

Following the identification of lead farmers, a participatory process was undertaken to identify practices relevant for promoting circularity within the mixed crop–livestock systems characteristic of the irrigation communities. The selected practices included improving the nutritive value of livestock feed from crop residues and by-products from crop processing such as milling, improved manure management, thermal composting, soil and moisture conservation, micro-dosing, protein lick blocks, urea treated stover and black soldier fly (BSF) farming. A Training of Trainers (ToT) workshop was conducted for 18 extension officers to strengthen their capacity to support lead farmers in implementing the identified practices. In addition, the project facilitated hands-on training sessions for lead farmers across all sites. Over 80% of lead farmers attended hands-on training by November 2024. Common adoptions included manure use, thermal composting, urea-treated stover, fodder, and intercropping; BSF was least adopted due to waste needs. Experience suggests that those who do not attend are able to access the information from their peers. The common practices that were adopted included improved manure use, thermal composting, urea treated stover, fodder production and intercropping. The least adopted practice was BSF farming, as this was largely piloted to selected farmers with the potential to generate enough waste for a viable unit. Female and male lead farmers showed comparable adoption patterns of agroecological practices promoted by the project.

During 2024, the initial focus was on improving the nutritive value of crop residues, particularly from irrigated production to address the livestock feed shortages due to the drought experienced during the 2023/24 season. This included practices such as urea treatment of stover and protein lick block production. In crop production, the promoted practices included thermal composting, improved manure management, minimum tillage, micro-dosing of organic and inorganic fertilisers, soil and water conservation, and intercropping. A total of 90 lead farmers were supported to establish rainfed crop demonstration plots to showcase the effects of manure or compost application and intercropping on crop yields. For irrigated production, similar demonstration plots were established at scheme level (one per scheme) rather than on individual farmer plots due to land constraints among irrigators.

Eight case studies of lead farmers engaged in irrigated, livestock, and rainfed production systems are presented, showing the project outcomes from a period of one and a half seasons, and demonstrating promising results regarding the effectiveness of agroecological practices in improving crop and livestock productivity within resilient, self-sustaining farming communities. The individual journeys, illustrate how the shift from viewing agricultural by-products as waste to recognising them as a valuable resource is contributing to more productive, integrated farming systems. The case studies also present evidence of the contribution of agroecological practices to agricultural productivity, food security, and household income. The report captures how agroecological practices adopted during the 2024/25 season have influenced farm performance. There is some evidence of adoption beyond lead farmers. However, the extent of this adoption has not been quantitatively assessed as the practices were introduced to link with the agricultural calendar. While uptake quickly followed among lead farmers, other farmers would not be able to adopt the practices until at least one season later. However, some field days have attracted significant interest beyond the lead farmers, which bodes well for future adoption. .

Case Study 1: Mrs. Thandanani Dube, Insiza District

Lead farmer profile and farming practices before CFS project

Mrs Thandanani Dube is a widow aged 62 years, farming in the Silalatshani area of Insiza District. Her household size is 5, made up of three other family members and one male youth employed on a full-time basis and residing in the household. She also employs three female employees on a part-time basis. She was among the first to be engaged as a lead farmer for the CFS Project. The project considered her a strong node due to the extensive links she had with other farmers. This was informed by the different roles she was playing to support adoption of improved agricultural practices in her community. One such role was as a focal person for the Ministry of Agriculture's "Agric4She" initiative, a programme supporting women in the agricultural sector. She also participated in the AIP meeting, sharing her experiences and contributing to shaping the approach adopted during the meeting to address some of the identified challenges in her community. During the meeting she demonstrated her suitability as a lead farmer through interaction with other farmers. Mrs Dube welcomed her selection as a CFS lead farmer, noting a strong alignment between the project's promoted practices and her previous experience with the TISA project.

Her farming system has always been a mixed crop-livestock system, which is among the most integrated farms in the area. Under crop production she has total arable land of 2.5 ha, 1.3 irrigated and 1.2 rainfed, with irrigated production primarily focused on income generation. Her irrigated land is made up of 0.5 ha in the Silalatshani irrigation scheme and 0.8 ha at her homestead, were she uses a drip system supplied with water from a river. The main irrigated crops she usually grows at the scheme are green maize, sugar beans, and wheat. While in the homestead plot, she mainly focuses on green maize, cabbages, onions, tomatoes, and leafy vegetables. She indicated that the crop choices in the two irrigated plots were based on the intensity of management required, with those that required more intensive management planted in the homestead plot. Her main rainfed crops sorghum, groundnuts and cowpeas, are mainly grown for subsistence. Her livestock include cattle, goats, poultry and fish. Initially poultry was mainly kept for household consumption but recently she transitioned to commercial production.

Mrs Dube's farming has faced significant and compounding challenges in recent years, foremost recurrent droughts have adversely impacted both crop and livestock production. While irrigated agriculture has historically served as a critical fall-back position for ensuring food, feed and income during drought years, the recent severe drought showed that under extreme weather events even irrigators are vulnerable; water shortages forced her to scale down irrigation. She also identified several entrenched challenges that amplified the climate risks, including severely depleted grazing areas, land degradation, chronic labour shortages, and the rising cost and limited availability of essential agricultural inputs.

Perspectives on introduction and adoption of agroecological practices in the first season

In 2024, Mrs Dube participated in several training sessions on circular agricultural practices, encompassing thermal composting, improved manure management, improving nutritional value of crop residues, fodder production, intercropping, BSF farming and soil and water conservation techniques. She indicated that the multi-faceted strategy, which combined practical demonstrations, look-and-learn tours, and technical handholds, was highly effective.

Training dispelled myths about compost complexity (Figure 2), leading to immediate 0.5-ha adoption. For instance, a hands-on session at her horticultural plot dispelled her prior assumption that establishing a thermal compost was technically difficult, revealing it instead as a manageable process that required good planning.

Figure 2: Setting up a thermal compost with other lead farmers.

The introduction of the CFS project coincided with Mrs Dube's expansion of her irrigated area at the homestead plot from 0.5ha to 0.8ha. According to her, this expansion increased manure demand, and her herd of 10 cattle was not producing enough. As someone who strongly believe in the role manure plays in improving soil fertility and structure, and quality of horticultural crops, particularly leafy vegetables, she resorted to buying manure from neighbouring farmers at a cost of USD15/tonne and USD23/tonne for cattle and goat manure, respectively. The training she attended on thermal composts came at an opportune time, and immediately thereafter she adopted this practice. In her first season, she produced sufficient compost to cover 0.5 hectares. She observed that the compost offered a viable solution to the challenge of manure shortage as it required locally available plant material and only a fraction of manure compared to using manure on its own.

Emerging from the severe 2023/24 drought, Mrs Dube faced a critical shortage of crop residues, and the quality and quantity of grass in the grazing area declined earlier than usual, threatening the survival of her livestock. Her adoption of urea treatment stover and homemade protein lick blocks proved to be a vital intervention, significantly improving cattle and goat nutrition, and, as a result, she did not experience any mortalities in 2024 due to malnutrition. By producing over 100 kg of protein blocks and a tonne of urea-treated maize crop residues from irrigated production, she estimated saving about USD 600. She also adopted BSF farming, which did not yield expected results at the first attempt, which was attributed to failing to create the right environmental conditions for the flies to breed. To address this, she has engaged another lead farmer, who has been successful, to assist her with setting up a successful BSF unit. Regarding the adoption of promoted agroecological practices, Mrs Dube indicated she has prioritised the ones that addresses her immediate challenges and expect to adopt others in the future.

Farm performance during the first season

Mrs Dube's strategic integration of organic and inorganic fertilisers during the 2024/25 season demonstrates the powerful economic case for circular agriculture. By adopting this blended approach, she successfully reduced her dependence on costly synthetic fertilisers by 30-40% across all crops. Crucially, this significant input reduction was achieved without compromising yield levels, validating the efficacy of her method.

A whole-farm budget analysis underscores this opportunity: with inorganic fertiliser constituting over 50% of crop production costs, and feed accounting for up to 80% of livestock expenses, these external inputs account for most farm expenditures. Further investment in agroecological practices, such as producing on-farm fertilisers and feed, presents the most direct pathway to enhancing profitability and building long-term resilience against input price volatility. Table 2 shows the diverse agricultural income streams of Mrs Dube during the 2024/25 season, with horticultural crops and green maize being the most profitable. She highlighted that the losses experienced in wheat production was due to low yields that resulted from water shortages at critical stages of production. She also indicated that the profit margin of fish production was lower than expectations and she attributed this to the poor quality of fingerlings supplied and the cost of commercial feed.

Table 2: Whole farm performance 2024/25 season.

	Green maize (1ha)	Wheat (0.5ha)	Sugar bean (0.3ha)	Cabbage (0.2ha)	Onions (0.05)	Broilers (1,200 birds)	Fish (25,00 fingerlings)
Gross Revenue (USD)							
Output (dozens/kgs/heads/birds)	2000	800	480	4200	2000	1080	300
Unit price (USD)	2	0.45	1.2	0.33	0.3	6	2.5
Revenue (USD)	**4000**	**360**	**576**	**1,386**	**600**	**6,480**	**750**
Variable Costs (USD)							
Seed /Day old chicks/fingerlings	140	80	180	10	36	1350	80
Basal fertiliser	320	100	60	120	100	0	0
Topdressing fertiliser/foliar fertiliser	240	120	40	60	20	0	0
Stock feed	0	0	0	0	0	2676	500
Pesticide	20	0	15	10	10	0	0
Veterinary input	0	0	0	0	0	120	0
Combine hire	0	45	0	0	0	0	0
Labour	120	30	40	20	50	400	50
Storage bags	0	15	5	0	0	0	0
Transport Cost	70	20	0	40	20	320	0
Total Variable Cost (USD)	**910**	**410**	**340**	**260**	**236**	**4,866**	**630**
Gross Margin (USD)	**3,090**	**(50)**	**236**	**1,126**	**364**	**1,614**	**120**
Gross Margin/ha (Crops) (USD)	**3,090**	**(100)**	**787**	**5,600**	**7,280**		
Return on investment	**3.4**	**-0.12**	**0.7**	**4.3**	**1.5**	**0.3**	**0.2**

Circularity and value chain integration

Mrs Dube operates a highly integrated farm, characterized by six interconnected subsystems: horticulture on a scheme and household plot, poultry, aquaculture, cattle, and goats on a rainfed plot and is currently learning to build up and integrate BSF. A fundamental circular flow within this system is the prioritization of livestock manure for improving soil fertility in irrigated and rainfed crop horticulture production, in response to market and own preferences. The homestead horticulture plot receives the bulk of this organic fertiliser, which includes water from the fishponds. Inorganic fertilisers remain in use, and are used in combination with organic fertilisers for heavy feeder crops such as cabbages, onion and tomatoes. She considers that the current scale and quality of organic fertilisers on their own will not be sufficient to meet the nutrient requirements of these heavy feeders for production of produce that can compete in the market. Only leafy vegetables such as spinach and kale are being produced under 100% organic fertiliser. This strategy has significantly reduced external input dependency, cutting fertiliser costs by more than 30%.

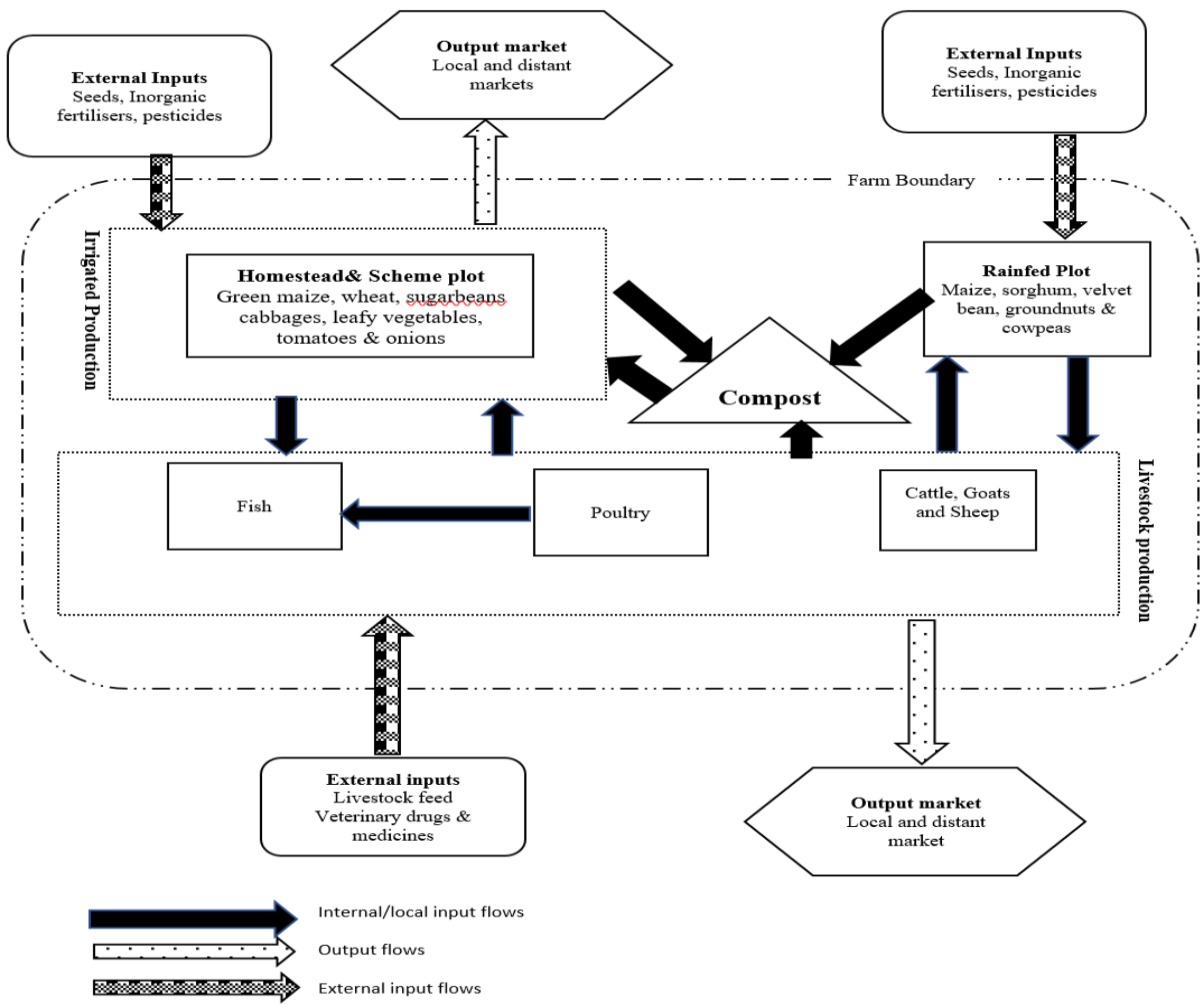

Figure 3: Circular flow of resources.

The farm's broiler unit, a 200-bird operation per cycle, remains reliant on external feed inputs; however, its waste streams are strategically used as an input in vegetable, fish and cattle production. Critically, all agricultural by-products are utilised; the chaff from shelled beans and the crop stover are collected and transported to the homestead to serve as vital feed for goats and cattle, ensuring no biomass is wasted. Figure 3 depicts the flow of biomass and organic waste in the farm, as well as external inputs and destination of the outputs.

At landscape level the farm is promoting the development of a manure market, as she buys from other farmers who have surplus. Horticultural produce is sold through local channels, including walk-in customers and direct sales at the Silalatshani business centre, under her Freshmark business name. Her market extends beyond Silalatshani to the district centre at Filabusi (Figure 4) and includes contractors, particularly for sugar beans, wheat and broilers.

Figure 4: Marketing products from the farm at an expo in Filabusi.

Personal and family impact of participation as a lead farmer in the project

On a personal level, she highlights that her role as a lead farmer has fundamentally changed how she views challenges on the farm. Before the project, a drought of the magnitude experienced in 2024 meant inevitable loss of assets. She now believes she is building a toolkit of affordable and sustainable solutions to evolving challenges. She indicated that learning to improve the value of crop residues, either in the form of compost or highly nutritious livestock feed, is deeply empowering.

Furthermore, the respect she continues to gain from teaching these practices to others has strengthened her role and voice within the community. The direct impact on her family has been both economic and nutritional. By adopting agroecological practices, they managed to save their cattle during the recent drought, a key asset for securing family wealth and a source of manure, at a reduced cost. She contends that these savings allow for further investment on the farm to make it more resilient to climate-induced stresses.

Flow-on impact on other farmers and the community

Mrs Dube highlighted that her farm has become a local reference point for transitioning to organic farming in the community, sparking crucial conversations and shifting mindsets. When other community members see a thriving horticultural plot and animals, they are keen to find out how she is doing it. As a result, her work has moved the discussion beyond theory and made agroecological practices a viable option for consideration by other farmers: specifically, two have adopted her intensive model. She reports that the dissemination of knowledge about agroecological practices is steadily occurring through multiple and complementary channels. These include walk-ins to her plot, field days and extension messages from local extension officers. She considers her farm a live demonstration site, regularly hosting and educating walk-in visitors. Central to her communication about agroecological practices, she articulates to fellow farmers that *"Emasimini akula lutho olulahlwayo, konke okusalayo kufanele kubuyela emhlabathini"*, which translates to, "From the fields there is nothing to be thrown away; everything coming from the field and not consumed by people must find its way back into the soil."

Outlook & lessons learned

Mrs Dube indicated that while she has significantly transitioned to circularity regarding crop production and livestock such as cattle and goats, the same could not be said for micro-livestock. For example, feed for fish and poultry remains largely external, due to the capacity and breed and requirement for specialised feeds for fast growth rate. She plans to further enhance her knowledge on BSF farming to be able to replace the external protein content of feed for both poultry and fish. She is currently producing a significant amount of chicken manure and horticultural waste and is conveniently situated close to the business centre where she can access restaurant waste; all are key inputs for BSF farming. She also plans to produce liquid top-dressing fertiliser in the form of chicken manure tea, a technology she was exposed to through the CFS project. She also plans to continue to intensify the practices already adopted. Regarding her farm, she is planning to improve her water storage capacity to ensure uninterrupted irrigation. Currently she relies on direct pumping from the river using solar energy, which she considered limiting as she cannot irrigate at night or when there is cloud covers.

Case Study 2: Ms. Lucy Nhliziyo, Insiza District.

Lead farmer profile and farming practices before CFS project

Ms. Lucy Nhliziyo, aged 48, a household head and single mother, was selected as a lead farmer at the project's inception based on her unique integrated farming model and her history of participation in extension-led farming programs at the Silalatshani scheme. Her household consists of 7 members, 4 of whom contribute family labour. She welcomed her selection as a lead farmer by her local extension officer, primarily for two reasons: she found the objectives of the project to align with the strategy she was pursuing and also felt that by accepting the role, she would bring the project to her village, which is further from the business centre and tend to miss out on projects.

Her farming operation has been a diversified enterprise for many years, integrating both irrigated and rainfed crop production with a mixed livestock portfolio including poultry, cattle, goats, and donkeys. Her arable land size is 3.5 ha, made up of a 0.5 ha irrigated plot, which is 15 km from her homestead, and a 3 ha rainfed plot. The main irrigated crops include maize, sugar beans, wheat, and a small-scale horticultural production such as tomatoes, leafy vegetables and onions. Under rainfed conditions, she focuses on drought-tolerant crops such as sorghum, pearl millet, cowpeas, groundnuts, and Bambara nuts. While she manages goats and cattle primarily for subsistence, the commercial focal point of the farm is a poultry enterprise that specialises in a solar powered hatchery and the sale of day-old chicks. Ms Nhliziyo emphasised that the poultry enterprise serves as the anchor of farm income, with all its grain requirements satisfied internally from maize, wheat, and sorghum production.

Ms Nhliziyo identifies climate change-induced extreme weather events, particularly drought, as the most significant threat to her livelihood. The severity of the 2023/24 season exemplifies this, as the drought was so extreme that it caused the failure of her historically reliable irrigation buffer. She further highlighted that the climate vulnerability is compounded by the poor sandy soils, characterised by low inherent fertility and poor water-holding capacity, which dominate her rainfed plot. Additional critical constraints that intensify these challenges include limited access to improved inputs, such as quality seed for small grains and legumes, as well as persistent labour shortages.

Perspectives on introduction and adoption of agroecological practices in the first season

Ms Nhliziyo indicated that the inception meeting, which introduced the objectives of the project, the involvement of lead farmers in selecting the practices and the training approach employed in the project, were key in influencing her decision to test the practices. In addition, she found the thrust of the project to resonate with her main farming objective, which is to run a fully crop and livestock integrated farming system. According to Ms Nhliziyo, the hands-on training approach, and aligning the training events to the agricultural calendar, was essential for her to decide to adopt the promoted agroecological practices. She managed to participate in training events that covered livestock feed related technologies such as the urea treatment of stover, protein lick blocks, BSF, thermal compost making, improved manure handling, fertiliser micro-dosing and intercropping. Following training on urea treatment of stover and the use of protein lick blocks, she immediately adopted these practices, managing to treat one tonne of maize stover from her irrigated plot (Figure 5) and making 150 kg of protein lick blocks . During a field day at her homestead, she explained that the high-quality feed she produced from crop waste and by-products of milling maize and wheat helped her avoid losing any animals from her herd of 15 cattle, despite the region experiencing high mortality rates due to emaciation and malnutrition caused by drought-related feed shortages.

Figure 5: Nhliziyo and follower farmers making urea treated stover.

Ms. Nhliziyo was also among the lead farmers that successfully hosted a demonstration plot during the 2024/25 season promoting the adoption of the application of improved manure and intercropping in the subsequent seasons. At a field day that Ms. Nhliziyo hosted, more than 200 farmers that included lead farmers and other farmers from the Silalatshani community attended. The highlights of the event included observations that showed that combining manure and intercropping had the most significant positive impact on crop performance compared to other practices such as using manure and inorganic fertilisers on their own or in combination. In addition, Ms Nhliziyo, explained that the benefits of intercropping went beyond soil moisture conservation and soil fertility, as they also included efficient use of land as the practice made it possible to harvest multiple crops from one piece of land at the same time.

The yield comparison across the treatments in the demonstration showed that combining manure/compost with intercropping and inorganic fertilisers at a micro-dosing rate produced the highest yield of 1700 kg/ha of all treatments followed by 1500 kg/ha from manure and inorganic fertilisers. A key observation from her demonstration plot was that the use of manure and intercropping only, without external input, doubled yields of the control, which showed the potential of agroecological practices in improving yields, particularly in the context of resource-constrained farmers. Her demonstration plot showed manure plus intercropping yielded 1700 kg/ha, doubling the control (Figure 6).

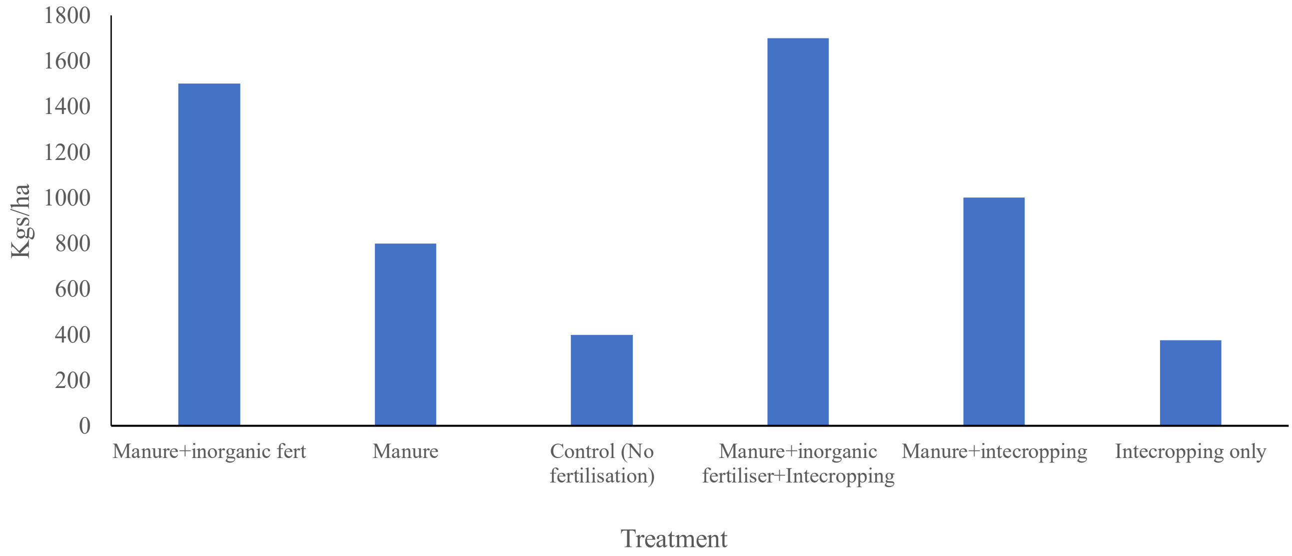

Figure 6: Demonstration plots yield levels.

She also adopted pit composting of cattle manure to improve its quality compared to simple heaping and production of chicken manure tea for top dressing inorganic fertiliser, which she intends to use on a 0.2-hectare homestead plot under drip irrigation she installed during the third quarter of 2025. Chicken manure tea is a liquid fertiliser made by steeping chicken manure in water to release its nutrients and the nutrient-rich liquid is further diluted before being applied to the crops. Leveraging her participation in a WhatsApp chat group of lead farmers, she was able to procure sunflower seeds for a 0.5 ha pilot plot. This initiative is part of a strategic, forward-looking plan to scale up production, retain seed, and ultimately invest in sunflower oil pressing. This intended value-addition would create a closed-loop system, producing cooking oil and generating sunflower cake as a protein-rich by-product for on-farm livestock feed mixes.

Farm performance during the first season

The 2024/25 season represented a marked improvement over the previous year in terms of rainfall, which translated into favourable biomass production that bolstered livestock feed reserves. The farm also was profitable as a result (Table 3). However, this overall improvement did not yield commensurate gains in rainfed grain production, as a prolonged dry spell during a critical crop development stage significantly curtailed yield. Compounding this climatic challenge, were high incidences of pests and diseases. In adherence to circular principles, the season's biomass was not wasted; all stover was harvested and preserved for supplemental livestock feeding, and the farm's wheat output was entirely retained for poultry feed. In retrospect, Ms. Nhliziyo noted that a more proactive approach to soil fertility management, specifically the earlier application of compost or manure to build soil organic matter and health, and crop rotation that included crops such as pearl millet ad velvet bean could have enhanced the crops' resilience to both moisture stress and eradicate troublesome parasitic weeds, such as “Witch” weed.

Table 3: Whole farm performance 2024/25 season.

	Wheat (0.5ha)	Sugar bean (0.3ha)	Layers Mixed Breeds 120
Gross Revenue (USD)			
Output (kgs/Chicks)	1000	950	1320
Unit price	0.45	1.2	2
Revenue	**450**	**1140**	**2640**
Variable Costs (USD)			
Seed	80	120	0
Basal fertiliser	100	80	0
Top dressing fertiliser	160	40	0
Stock feed*	0	0	435
Pesticide	0	15	0
Veterinary input	0	0	84
Combine hire	45	0	0
Labour	40	60	0
Storage bags	10	10	0
Total Variable Cost (USD)	**435**	**325**	**519**
Gross Margin (USD)	**15**	**815**	**2,121**
Gross Margin/ha (Crops) (USD)	**30**	**1900**	
Return on investment	**0.03**	**2.5**	**4.1**

**Wheat used as stockfeed*

Circularity and value chain integration

Ms Nhliziyo's farm demonstrates a foundational design for agricultural circularity, characterised by integrated biomass flows between its subsystems (Figure 7). Crop residues from both irrigated and rainfed plots are directed into livestock production, while organic waste, primarily in the form of manure, is returned to enrich the croplands. Historically, this system operated with minimal value addition, where low-grade maize, wheat, and sorghum grains were allocated to poultry, and both crop residues and manure were used with minimum improvements. The CFS project has served to enhance these pre-existing resource flows and introduce novel value-addition pathways for farm waste. A significant innovation is the channelling of poultry manure and kitchen waste into the production of black soldier flies. This process yields a high-quality protein source for poultry feed, while the resulting frass is repurposed as an organic fertiliser for the homestead garden. In the homestead garden she mainly relies on internal inputs such as indeterminate leafy vegetable varieties. Her first attempt with BSF was a success, albeit at a small-scale, laying a foundation for her to expand post the winter season when the larvae went dormant. Another innovation she adopted was the chicken manure tea, which she uses as a liquid top-dressing fertiliser for vegetables planted in her homestead garden, thereby closing another nutrient loop.

The substantial volume of biomass and organic waste generated on Ms Nhliziyo's farm represents a significant opportunity to enhance its circular integrity. However, the application of manure to the irrigated plot is constrained by the considerable distance between the homestead and the irrigated plot. In response to this logistical challenge, Ms Nhliziyo identified thermal composting, including the use of leaf litter and termitaria as viable strategies to enhance nutrient cycling, noting that these methods require a substantially smaller quantity of manure compared to direct manure application to the whole field. While the transition to full circularity remains her overarching goal, a state she considers nearly achieved in subsystems such as her poultry enterprise, she concedes that its realisation for crop production is a more protracted endeavour. She acknowledges that the current on-farm production of organic matter remains inadequate to fully meet the system's food and feed requirements, indicating that achieving complete circularity in this domain will require further time and increased biomass production.

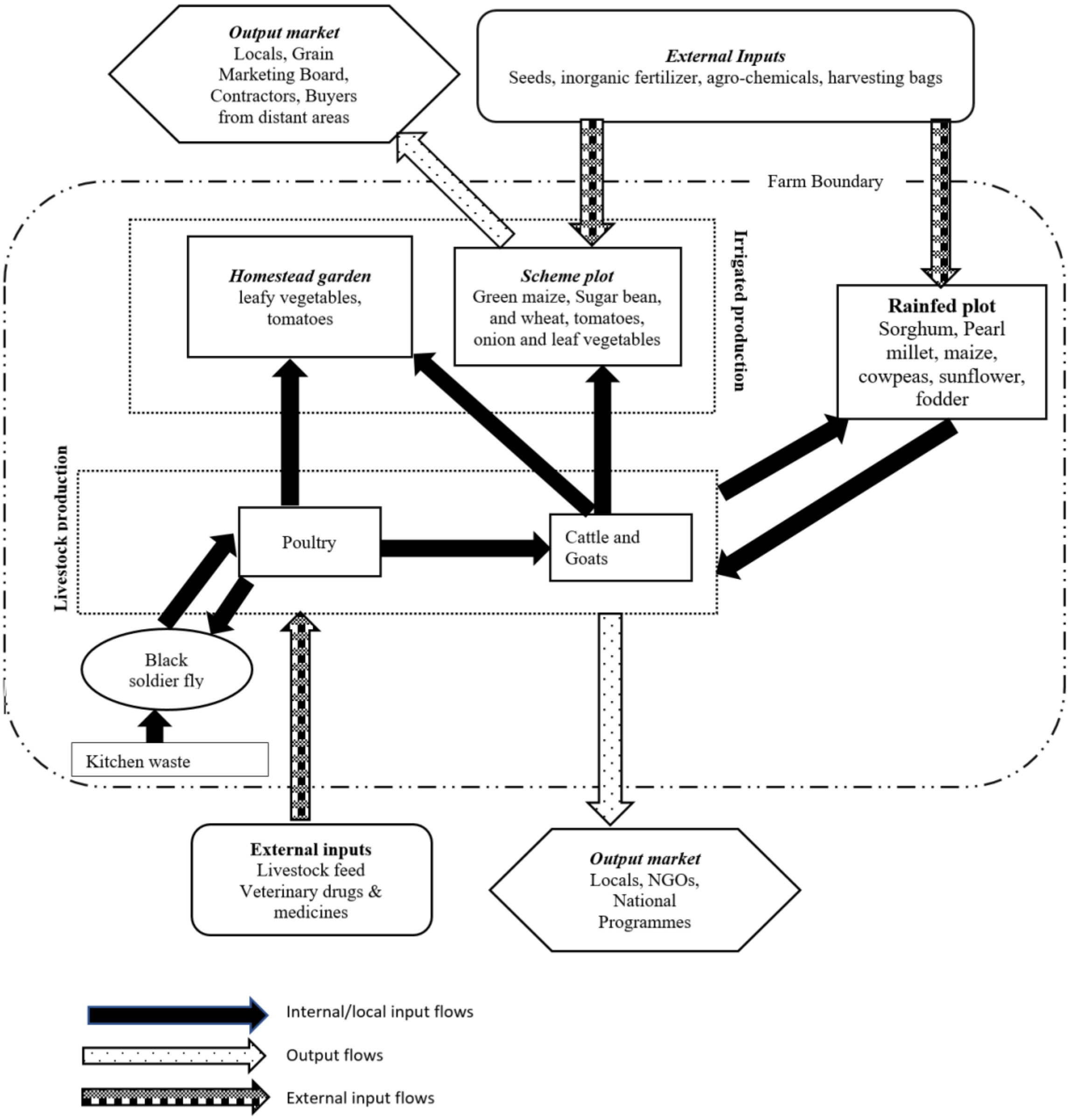

Figure 7: Nhliziyo farm circularity.

Personal and family impact of participation as a lead farmer in the project

On a personal level, Ms Nhliziyo perceives her role as a lead farmer to be empowering as it has increased access to improved sustainable agricultural practices, which she is integrating into her farming system. She indicated that previously, a poor season forecast would have been a source of significant anxiety and potential loss, but her experience in 2024 shifted her perspective as she managed to rely on internal resources to ensure survival of her cattle. In addition, the hosting of the demonstration plots and the field day that facilitated the sharing of knowledge elevated her standing in the community, creating a deep sense of fulfilment that she is contributing to building the resilience of the community to climate change and variability. According to Nhliziyo, the exposure to the agroecological practices through the project are helping her and fellow farmers to enhance their adaptive capacity. Furthermore, the diversification into sunflower production and the strategic plan to process the sunflower seed to oil and animal feed are potential new pathways for enhancing household income.

Flow-on impact on other farmers and the community

Ms Nhliziyo's visible success, particularly in saving her entire herd during a period of widespread livestock loss, created significant debate and discussion within the community about the agroecological practices she had adopted. Her farm became a local reference point, moving conversations beyond theory to tangible results. Fellow farmers began actively enquiring about the efficacy of practices like protein lick blocks and urea-treated stover, challenging long-held assumptions that livestock survival in a drought was largely a matter of chance or the ability to purchase expensive commercial feed. This shift in dialogue marked a crucial first step towards normalising circular approaches as viable risk-management strategies. As a lead farmer, Ms Nhliziyo actively shared her learning at a field day hosted at her farm that attracted over 200 farmers from across the ward, where compelling visual evidence was on display.

Outlook & lessons learned

Ms Nhliziyo highlighted that the most profound lesson from the project is that resilience can be built through intentional co-design that leverages internally and locally sourced inputs. Her outlook is one of consolidation and strategic expansion, with a firm commitment to continuing all adopted agroecological practices. About the farm, Nhliziyo’s vision is to transition the farm into a fully self-sustaining hub of value addition, centred on the planned acquisition of an oil press to process sunflower seed into cooking oil and protein-rich animal feed and drip irrigation within the homestead plot. The goal is a farm that not only withstands climatic and economic shocks but also thrives by generating its own fertiliser and feed, serving as a replicable model for sustainable agriculture in the community.

Case Study 3: Mrs. Nomuhle Mpofu, Bubi District

Lead farmer profile and farming practices before CFS project

Mrs Mpofu is a 60-year-old widow who heads a household of five members. She has, over the years, been managing a diversified farming system that includes both crops and livestock. Mrs Mpofu was already a lead farmer in the local conservation agriculture programme in her village when the CFS project began. When the project objectives were explained during an AIP meeting, and the approach to cascade agroecological practices was discussed, she expressed that her farm provided an ideal space for showcasing the practices. She emphasized that she saw a mutually beneficial relationship with the project, given her decision to transition to organic farming. On her part, she indicated that she was in the process of starting fish production, and her view was that the project was going to aid her in reducing the costs of production, given the high cost of inputs.

Her farm size measures 2.6 ha, comprising 0.6 ha under groundwater-fed drip irrigation at the homestead, and a 2 ha rainfed plot. Mrs Mpofu indicated she is now only practicing irrigated agriculture at the homestead plot as she surrendered her 0.3 ha irrigation plot at Pollards irrigation scheme to another family, as labour constraints prevented her from managing two irrigated plots. On her homestead irrigated plot, she focuses on intensive production of green maize, cabbages, and tomatoes for commercial purposes, while fodder crops are planted on the edges of the plot perimeter. Crops grown under rainfed conditions are primarily for food security, with maize grown on half the area, with a portion under conservation agriculture techniques, such as minimum tillage, mulching and crop rotation. Other crops include sorghum, pearl millet, groundnuts and cowpeas. Mrs Mpofu also rears a diverse range of livestock that include cattle, goats, sheep, pigs, poultry and fish. Despite this diversified setup, the farm's productivity is constrained by significant challenges, including recurrent droughts, pervasive low soil fertility, land degradation, cost of feed and a shortage of grazing land due to population pressure, which has resulted in development of settlements in areas previously set aside for livestock grazing. Mrs Mpofu identified high input costs and price volatility of fresh produce as significant obstacles to the viability and growth of her farm.

Perspectives on introduction and adoption of agroecological practices in the first season

As an operator of a highly mixed farming system, and like the two previous case studies, Mrs. Mpofu already exemplifies a more advanced degree of circularity than most of her peers. Her initial impression of the CFS project was that it presented a strategic opportunity to intensify these existing loops, particularly through improved waste valorisation. This motive was strongly driven by her concurrent plans to venture into aquaculture, creating a new demand for cost-effective fish feed. The project’s introduction of practices such as urea treatment of stover and on-farm protein lick blocks directly addressed her need to enhance the feed value of crop residues for livestock during critical periods. She adopted both during the first season of the project. Similarly, the focus on improved manure management, including the pit-curing method and thermal composting, was immediately relevant, as she recognized the potential of these practices to augment her soil fertility management and boost crop productivity.

The introduction of BSF farming resonated powerfully with Mrs. Mpofu's farming system. The technology's requirement for organic waste, such as kitchen scraps, poultry, and pig manure, aligned perfectly with the substantial by-products already generated on her farm, offering a promising solution to manage fish feed costs. In 2024, she established two fishponds and adopted BSF farming, following training facilitated by the project. Mrs Mpofu was among a group of 10 farmers who were identified to pilot the BSF farming based on their diversity of livestock they were rearing and their interest (Figure 8). A start-up pack of 500 grams of larvae was provided by the project to each pilot farmer. Mrs Mpofu, through her own initiative and resources, procured an additional 1kg of BSF larvae to start at a scale she desired. The act of sourcing additional BSF larvae demonstrated that she quickly saw the value of BSF in her farming system. In comparison to other farmers, she quickly mastered the art of breeding the BFS, managing peak production of about 10kg of feed per month, in comparison to an average of 2kg for the group. This success with BSF is promising as it will help her sustain her nascent aquaculture project, through affordable feed generated from animal and kitchen waste and the frass used as fertiliser in her irrigated plot.

Figure 8: Black soldier fly unit.

Farm performance during the first season

The 2024/25 season yielded markedly better outcomes for Mrs. Mpofu compared to the previous 2023/24 drought season, with production increases realised across both irrigated and rainfed areas. A critical improvement was seen in rainfed cereal production, which rebounded from a total failure in 2023/24 to a yield of 1,200 kg/ha of maize. This was largely attributable to favourable rainfall, which also improved natural grazing and biomass production. Practices such as minimum tillage, in-field rainwater harvesting and precision application of manure and other inputs also contributed to improved yields. Overall, the whole farm was profitable (Table 4), with a loss only coming from fish production due to production challenges emanating from the quality of fingerlings supplied to the farmers. Mrs Mpofu contends that the losses could have been worse if she had relied 100% on purchased feed. The broiler enterprise profitability was marginal. Mrs. Mpofu cited the combination of the output price and the cost of feed as key factors for this development. She also expanded her fodder production to 0.5 hectares (0.1 ha irrigated, 0.4 ha rainfed) to further enhance the availability of high-quality feed for supplementary livestock feeding during the dry winter season.

Market volatility emerged as a critical constraint on profitability. The cabbage crop, a primary cash crop, suffered from a market glut, resulting in 25% post-harvest losses. In a demonstration of circularity, this waste was valorised within the system as feed for her pigs, recuperating some value. In retrospect, Mrs Mpofu identified that diversifying her winter horticultural portfolio beyond cabbage could have mitigated this market risk. Furthermore, she reflected that more rigorous pond management, including initial sex-segregation of fingerlings, would have been necessary to fully capitalise on the aquaculture investment. The season ultimately underscored that while favourable agro-ecological conditions are foundational, optimising gross margins is contingent upon proactive management of both biological and market risks. Table 4 shows the gross margin analysis of the Mrs Mpofu's key enterprises during the 2024/25 season. In addition, she also received significant income (USD 800) from the sale of 20 goats and sheep, which did not incur any significant cost to produce.

Table 4: Farm Performance for 2024/25.

	Green maize (0.6ha)	**Grain maize (1.2ha)**	**Cabbage (0.2ha)**	**Fish (2500 fingerlings)**	**Broilers**
Gross Revenue (USD)					
Output (dozens/kgs/heads/birds)	1800	1440	2400	100	400
Unit price	2	0.3	0.25	2.5	7
Revenue	**3600**	**432**	**600**	**250**	**2800**
Variable Costs (USD)					
Seed /fingerlings/chicks?	150	120	10	120	530
Basal fertiliser	0	0	100	0	0
Top dressing fertiliser/foliar fertiliser	240	80	50	0	0
Stock feed	0	0	0	350	1006.25
Pesticide	40	0	5	0	
Veterinary input	0	0	0	0	50
Labour	80	30	60	0	40
Storage bags	0	10	0	0	0
Transport Cost	30	0	50	0	0

	Green maize (0.6ha)	Grain maize (1.2ha)	Cabbage (0.2ha)	Fish (2500 fingerlings)	Broilers
Total Variable Cost (USD)	**540**	**240**	**275**	**470**	1626
Gross Margin (USD)	**3,060**	**192**	**325**	**-220**	1174
Gross Margin/ha (Crops) (USD)	**2,550**	**160**	**2,250**		
Return on investment	**5.7**	**0.8**	**1.2**	**-0.5**	**0.7**

Circularity and value chain integration

Since the project's inception, Mrs. Mpofu has significantly enhanced circularity within her diversified crop-livestock system (Figure 9). A key expansion was the venture into aquaculture, establishing two fishponds supplied by the same groundwater source that irrigates her horticulture plot. This addition created a new nexus for resource loops. Nutrient-rich water emptied from the fishponds is used to irrigate the plots. The core nutrient cycle involves the application of composted manure from her cattle, goats, sheep, pigs, and poultry to the crops, with priority given to the 0.6 ha horticulture plot; in the 2024/25 season, manure was applied to 1.5 ha of the 2.6 ha cultivated area. Manure has completely replaced inorganic basal fertilisers. In return, the crop residues from both irrigated and rainfed plots were improved through urea treatment for feeding cattle, goats and sheep. She used 3 tonnes of crop residues, mainly drawn from her irrigated plot to produce urea treated stover that was adequate to feed her livestock until the start of the rainy season, which coincided with improved grazing. While maize and sorghum grain were prioritized for human consumption and some was fed to free range poultry, spoiled grain was mainly fed to pigs.

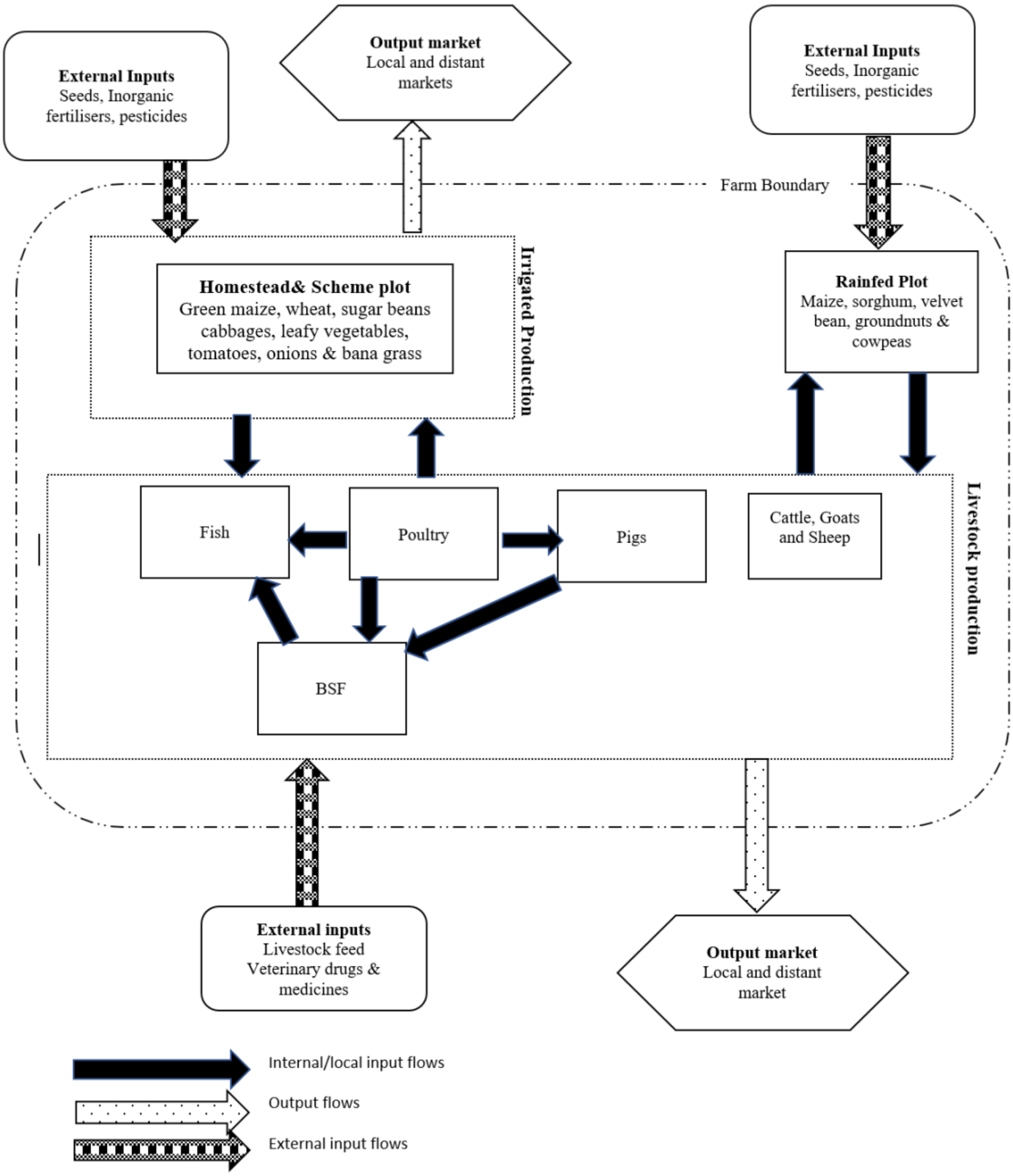

Figure 9:Circularity and market integration.

Furthermore, she uses maize bran mixed with locally sourced acacia pods to produce protein lick blocks (Figure 10) and pioneered BSF farming in her community, using own kitchen waste and poultry/pig manure as a growing medium. The successful scaling of BSF production positions her to substantially displace costly commercial feed for her new aquaculture and poultry enterprises, further closing the loop on organic waste and creating a more resilient and self-sufficient integrated value chain.

Figure 10: Making protein lick block.

Personal and family impact of participation as a lead farmer in the project

Mrs. Mpofu highlighted that being a lead farmer has profoundly elevated her standing within the community, transforming her farm into a recognized centre of excellence and herself into a key resource person. With the successful establishment of a BSF unit, she has become the primary reference farmer for this technology, regularly hosting and training visitors from her village and beyond. Additionally, she indicated that her role has extended beyond BSF, as the entire farm now serves as a live demonstration site for integrated agroecological practices, solidifying her reputation as an innovator and, in the process, strengthening her social networks.

Flow-on impact on other farmers and the community

Mrs. Mpofu has become a pivotal node in the dissemination of circular knowledge, actively fostering discussion and learning through multiple channels. She is a prominent member of several WhatsApp groups, where she regularly posts updates on her progress, such as scaling up her BSF larvae production, and fields questions from fellow farmers, offering practical advice based on her first-hand experience. This digital engagement has been complemented by a shift in local discourse; she reports that circularity now features centrally in formal farming meetings, a topic consistently promoted by the local extension officer, indicating its normalisation as a critical subject for community resilience.

Outlook & lessons learned

A key lesson from the 2024 season for Mrs. Mpofu was the critical importance of securing a consistent, high-quality feed supply in the face of climate variability and shrinking communal grazing land. This has directly shaped her outlook, leading to a strategic priority to expand on-farm fodder production. Her plan involves intensifying cultivation along two pathways: establishing Bana grass as a live fence around the irrigated plot to supplement the existing wire fence and doubling the area under rainfed forage legumes. She views this investment not only as a direct solution to livestock feed shortages but also as the foundational step to enhance the entire farm's circularity, as increased biomass will translate into higher quantities of quality manure and compost required to sustain the fertility of her productive irrigated horticulture plot.

Looking forward, Mrs Mpofu is committed to continue and deepen all adopted agroecological practices. Her long-term vision is to solidify her farm as a fully integrated, self-sustaining enterprise that is resilient to external shocks. The success of the BSF unit has validated the potential of internalising input production, and she now plans to explore other value-added processes, such as the small-scale processing of oilseeds for feed. The overarching lesson learnt is that resilience is built through the intentional creation of multiple, reinforcing resource loops. By strategically expanding fodder systems to better support both livestock and soil health, she is actively working towards a vision where the farm operates as a highly productive, closed-loop system, minimising external dependencies and maximising internal resource use.

Case Study 4: Mr. Richard Nyathi, Bubi District

Lead farmer profile and farming practices before CFS project

Mr Richard Nyathi (52 years old) is a community leader who describes himself as someone who leads from the front. As a result, he tends to be among the first farmers that test practices when they are introduced in the area. In the case of the CFS project, he indicated that he recognised that the objectives of the project sought to directly address the systemic constraints common to his area. The major challenges that have persistently affected farming in the community and directly affect Mr Nyathi's farm operations including low and unreliable rain, pests and diseases for both crops and livestock, low soil fertility, costs and availability of inputs, shrinking rangelands due to the expansion of the settlements into the grazing areas because of population growth. Mr Nyathi indicated that he welcomed his role as a lead farmer, as this placed him in a strategic position to gain knowledge and be able to be a reliable source of information in his community.

Mr Nyathi has managed an integrated crop-livestock system since the late 1990s, centred on a 0.3 ha plot in the Pollards irrigation scheme and 5 ha of rainfed land. In the irrigation scheme he used to grow horticultural crops, in addition to green maize and sugar beans. However, he stopped growing horticultural crops due to low prices following a glut in the local market as produce from the main agricultural produce market in Bulawayo found its way to the local vending stalls. Currently, Mr Nyathi focuses on green maize (grown twice annually) and sugar beans as his main cash crops, grown under irrigation. The utilisation of his rainfed plot has averaged 40% over the past few years, largely due to the risky nature of rainfed agriculture. The main crops grown under rainfed conditions are maize, sorghum, cowpeas, and groundnuts. He describes his farm as integrating crops and livestock, with the linkages relatively stronger between irrigated crops and livestock. This integration operated at a basic level, adding minimal value to the crop residues and manure before they were fed to livestock and crops, respectively.

Perspectives on introduction and adoption of agroecological practices in the first season

Mr Nyathi identified the project's participatory and context-sensitive introduction strategy as foundational to promoting adoption of agroecological practices. By aligning the awareness and training sessions of specific practices with immediate seasonal challenges confronting farmers, the project attracted high numbers of participants to its programmes beyond the targeted lead farmers. This approach of directly linking circular solutions to relevant problems at specific times was pivotal for Mr Nyathi to invest time and resources in the adoption of the practices. To date he has attended training sessions on urea stover treatment, improved manure management, thermal composting, intercropping, and protein lick blocks. As someone who had been using manure in the past cured through the heap method, despite the time needed, he adopted an improved manure curing method, the pit method, that produces better quality manure than the conventional method. Prior to the project, he indicated that the value added to crop residues collected from the irrigated plot was minimal, involving chopping and adding salt to increase uptake by cattle, while crop residues from rainfed production were grazed in situ. He found this method effective, as he had been using it for years. Following the adoption of urea-treated stover, he observed significant differences between the two practices. The cattle's condition recovered relatively quickly, and the entire herd's behaviour changed; now, the cattle are conditioned to late afternoon feeding, which has saved him herding labour because they voluntarily return to the homestead like clockwork. His main challenge with the adoption of urea treatment of stover was the concern of urea poisoning of cattle. He considered that the process of safely mixing urea solution for stover treatment required more skilled labour and time than his previous practice of direct residue feeding. Initial urea poisoning concern was eased by peer/extension advice.

Farm performance during the first season

The drought experienced in the 2023/24 season disrupted Mr Nyathi’s irrigation programme in the scheme due to low water levels in the Pollards dam throughout 2023/24. The dam also supplies the business centre increasing the competition for water and the need to share, the situation improved during the 2024/25 season. Within the irrigated plots, maize production normally tended to focus on the high-value green maize. However, a near total crop failure in this rainfed plots due to the drought in the preceding season, meant he was forced to shift to irrigated grain maize production to build his grain stocks in the 2024/25 season. Because of the improved 2024/25 rainfall season and a combination of good farming practices, such as minimum soil tillage, precision application of improved manure, and micro-dosing of fertilisers, his crop outputs improved considerable. Table 5 shows the crop outputs under different production systems realised in the 2024/25 season.

Table 5: Crop output performance 2024/25.

Crop	Area (ha)	Output (kgs)	Yield (kgs/ha)
Irrigated maize	0.2	450	2250
Rainfed maize	1	600	600
Rainfed sorghum	0.6	390	650
Rainfed cowpeas	0.1	80	800

Table 6 shows the gross margin analysis of the different crops that Mr Nyathi planted during the 2024/25 season. The most profitable crop, in terms of return on investment, was sorghum, followed by irrigated maize and the least being the rainfed maize. The shift to irrigated grain maize during the 2024/25 season from the usual green maize was necessitated by the need to build his stocks following the drought in the previous season.

Table 6: Gross margin analysis.

	Irrigated Grain Maize (0.2ha)	Rainfed Grain Maize (1.2ha)	Sorghum (0.6ha)	Cowpeas (0.1ha)
Gross Revenue (USD)	0.2	1.2	0.6	0.1
Output (kgs)	450	600	390	80
Unit price	0.4	0.4	0.5	0.6
Revenue	**180**	**240**	**195**	**48**
Variable Costs (USD)				
Seed	30	110	10	27
Basal fertiliser	0	60	0	0
Top dressing fertiliser	20	40	30	0
Pesticide	5	5	5	5
Labour	0	0	0	0
Storage bags	5	6	4	2
Transport Cost	0	0	0	0
Total Variable Cost (USD)	**60**	**221**	**49**	**34**
Gross Margin (USD)	**120**	**19**	**146**	**14**
Gross Margin/ha (Crops) (USD)	**600**	**16**	**243**	**140**
Return on investment	**2.0**	**0.1**	**3.0**	**2.4**

The improved performance from both irrigated and rainfed production over the previous year allowed Mr. Nyathi to gather crop residues for urea treatment to ensure the availability of highly nutritious livestock feed for supplementary feeding during the critical period of the year (Figure 11).

Figure 11: Making of the urea treated stover.

Circularity and value chain integration

According to Mr. Nyathi, his farm was already practicing low levels of circularity, where the value of crop residues and manure is measured in relation to their impact on agricultural productivity (Figure 12). Through the CFS project, Mr Nyathi indicated that he has identified the transformation of low-quality biomass into a high-value feed as a key innovation to enhance circularity on his farm through the following pathways. The ability to produce high-quality feed means that, with the same amount of crop residues he was able to feed his livestock for longer and due to the high nutritive value of urea treated stover his animals maintained a fair body condition during the dry season, where quality of the rangelands is poor. Nyathi, sees the adoption of urea treated stover as an important mean to increase his household income by substituting commercial stockfeed. An additional benefit of feeding at home is that it reduces herding labour by encouraging self-return. To enhance nutrient recycling in his farm Mr Nyathi indicated that adoption of improved manure management reduced nutrient losses and made more nutrients available for both the irrigated and rainfed crops.

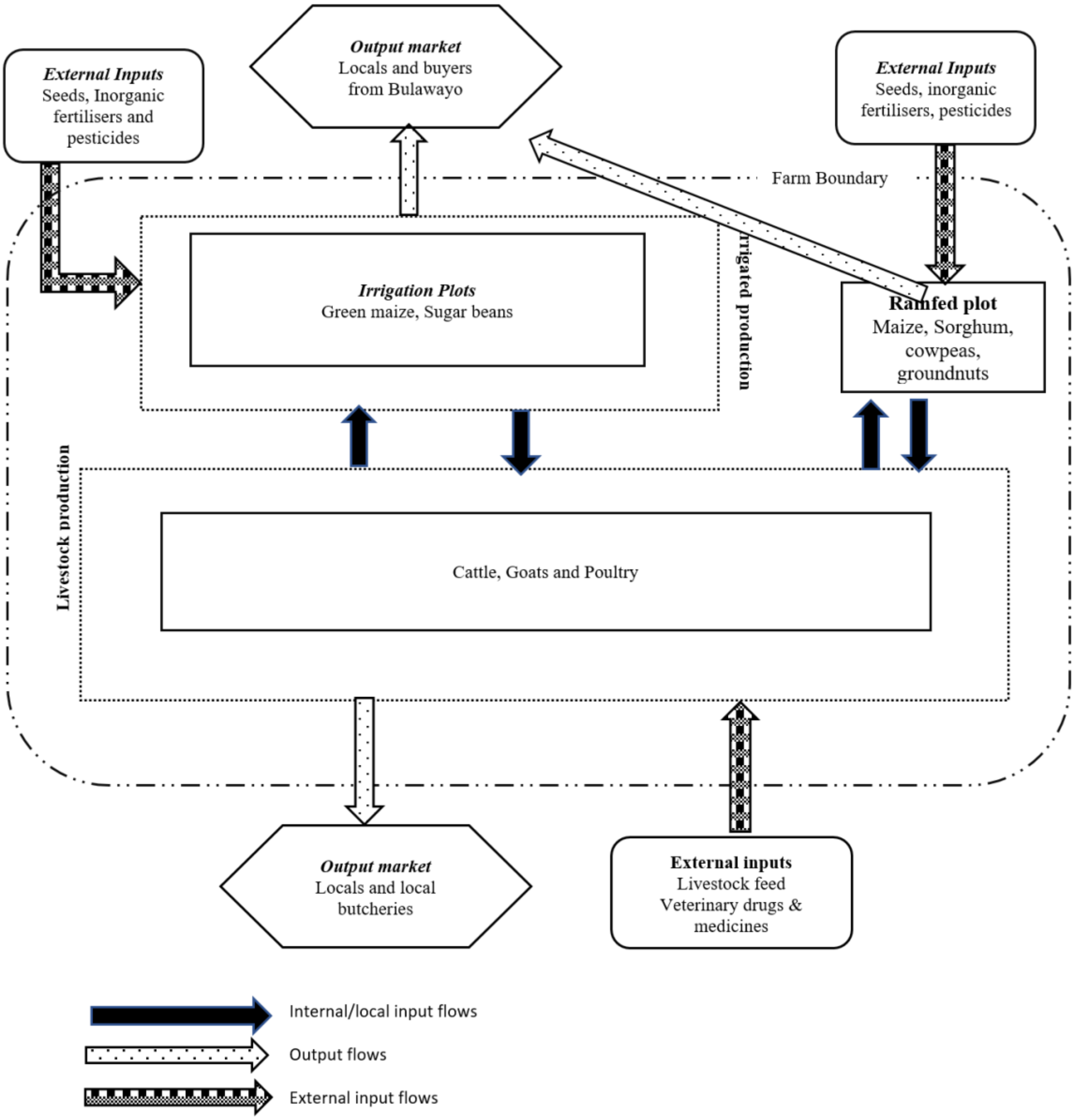

Figure 12:On-farm circularity.

Personal and family impact of participation as a lead farmer in the project

Mr Nyathi identified the major benefit of his role as a lead farmer was that it gave him access to knowledge through direct engagement with technical experts to refine his implementation of agroecological practices. He indicated that this arrangement has enhanced his confidence and competence, enabling him to progressively perfect techniques on his farm. As with other activities related to agriculture, Mr Nyathi indicated that he and his wife were the main actors, with other family members' participation being peripheral. He considers this a common challenge in many families in his area, as there currently is a disinterest in farming by the younger generation who are attracted to other livelihood activities that promise quick riches, such as artisanal mining. Mr Nyathi holds the opinion that interventions that enhance the profitability of agriculture and its resilience to climate change have the potential to attract young people.

Flow-on impact on other farmers and the community

Mr Nyathi has effectively leveraged his position as a lead farmer to disseminate information about agroecological practices to his existing networks of farmers. Together with his extension officer, he invited local farmers to a practical learning event on urea treatment of stover. He anticipates that through such engagements the uptake of practices will increase as it is common practice for farmers to observe and learn from peer success before committing to new practices. According to Mr Nyathi, the discussions about agroecological farming practices, that anchor circular food systems, are gaining traction in the community due to several factors such as cost and availability of inputs and scaling down of NGO activities, which over the years has become a source of free inputs for many households.

Outlook & lessons learned

Mr Nyathi's outlook is one of consolidation and expansion. He is committed to continue all his adopted agroecological practices that anchor circular food systems and plans to integrate new ones to further optimise his resource cycles, specifically thermal composting and protein lick block production. His immediate plan is a strategic focus on guaranteeing the production on his homestead plot to de-risk crop production from rainfall variability by establishing a 0.5 ha drip irrigation plot supplied by a newly drilled and potentially high-yielding borehole. Furthermore, his vision includes introducing a piggery enterprise, with the goal of producing all feed grains internally, and procuring a hammer mill to process both grain and crop residues. This integrated vision aims to transform his farm into a highly productive, self-sufficient, and commercially viable circular hub by minimising external input dependency and maximising value addition at every stage.

Case Study 5: Mr. Nkululeko Sibanda, Bubi District

Lead farmer profile and farming practices before CFS project

Mr Nkululeko Sibanda (62 years old), together with his wife, are active members of the Hauke irrigation scheme, where they have access to a plot slightly more than 0.2 ha. His household size is 5, with the other three members of school going age. They also produce crops under rainfed conditions on their 5 ha. plot. In this field, he has over the years maintained three small (16m by 39m) conservation agricultural maize plots, designed to ensure household food security. As a high-performing farmer in the area, who consistently participates in various extension programmes, an early adopter of technologies and socially well connected in the community, he was invited to participate as a lead farmer in the project during the project inception meeting. He indicates that his decision to participate in the project was driven by a need to address production challenges he was facing, which include declining soil fertility, the emergence of pests and diseases, feed availability, and labour shortages.

Due to labour shortages, he has only been able to use 3 ha, leaving 2 ha idle. The irrigated plot, however, is fully utilised to produced crops such as green maize, wheat and various horticultural crops such as tomatoes, peppers and leafy vegetables, mainly for household income. Mr Sibanda pointed out that he has observed an increase in the local demand for horticulture produce, cereals and poultry, which he attributes to the influx of artisanal miners. Mr Sibanda also indicated since the introduction of oil expressing machines in his community, which took place before the CFS project, he has taken up sunflower production to become self-sufficient in cooking oil. In addition to cooking oil, Mr Sibanda indicated that he was also getting sunflower cake from oil expressing, which he was using to improve the quality of livestock feed. He also indicated that he realises income from the sale of excess sunflower seed and cake to other farmers, particularly those that keep indigenous poultry, drawing multiple benefits from the sunflower crop.

Perspectives on introduction and adoption of agroecological practices in the first season

Mr Sibanda participated in the first project meeting in his area, in which he was engaged in the discussions that identified context-specific agroecological interventions, which he felt aligned with his priorities. This direct engagement was critical in creating a sense of ownership of the solutions the project was proposing. Among the main challenges, Mr Sibanda and other farmers identified were low soil fertility and poor-draining soils, particularly in the irrigation scheme. The challenges were worsened by poor access to inputs, such as inorganic fertiliser and his efforts to improve the soil structure and fertility using organic soil amendments were constrained by a shortage of manure (he only has a small herd of 6 cattle). Mr Sibanda was trained on thermal compost making, which was held within the irrigation scheme. He pointed out that this hands-on training was key to ensuring that he quickly grasped the agroecological practices. Having struggled with accessing cattle manure due low availability and lack of a scotch cart to transport manure 8 km from the homestead to his irrigated plot, he indicated that the adoption of the thermal compost has addressed the transport issue. He also attended training sessions for other agroecological practices, such as urea treatment of stover, protein lick blocks, and forage legume production, which followed the same hand-on training approach, adopted by the project to introduce the agroecological practices, Mr Sibanda successfully hosted a crop demonstration plot in his rainfed plot, which showcased the effect of combining agroecological practices (manure and intercropping) on yield levels.

Through the adoption of thermal composting, Mr Sibanda changed his practice of incorporating crop residues in the soil in his irrigated plot to improve soil structure. According to Mr Sibanda this change has the potential to increase the available crop residues for supplementary feed for his cattle. Mr Sibanda found that the compost he makes within the irrigation scheme is convenient for his system as it meant that he did not need to hire a scotch cart to transport manure from his homestead to the irrigated plot. During the 2024/25 season he managed to produce compost that was adequate to cover 0.2 ha. He also improved the nutritive value of crop residues by adopting urea treatment of stover, which he did at the irrigation scheme, taking advantage of the scheme’s chaff cutter (Figure 13). This arrangement meant that instead of carrying the bulky crop residues from the scheme to the homestead to feed his cattle, he was now transporting high- value and less bulky feed

Figure 13: Cutting crop residues at the scheme for urea treatment.

Farm performance during the first season

The 2024/25 season was characterised by above-normal rainfall, which was evenly distributed throughout the growing season, resulting in improved crop yields and grazing areas. The 2023/2024 season was marked by a severe drought that resulted in widespread crop failures and cattle deaths due to feed shortages. Mr Sibanda attributes the improved performance of his production to the improved rainfall and distribution during the season. He highlighted that he needs to implement the agroecological practices for several seasons to compare their influence across favourable, average, and adverse seasons. By setting up demonstration plots to compare sorghum crops grown with inorganic and organic fertilisers, he noticed that although the yield was higher with inorganic fertiliser, the benefits might balance out economically because the organic plot did not require external inputs and needed less labour, as intercropping helped reduce the amount of weeding needed. He also considered the long-term effect as it takes several seasons to build soil organic matter.

Mr Sibanda reported that his family had sufficient cereal and sunflower supplies to satisfy their annual needs and that his irrigated and rainfed plots yielded a satisfactory harvest. He was able to plant maize (0.2 ha) in the irrigated plot twice in a year. The first maize crop in the irrigation was a switch from the customary green maize to maize grain to address the deficit that arose from the low yields from the previous season. He indicated that he got 600 kg from the irrigated 0.2 ha plot, which translates to 3,000 kg/ha. During the season, he also put 0.1 ha of wheat under contract. During the winter of 2025, he also planted horticultural crops including tomatoes and leaf vegetables on 0.05 ha, which was absorbed by the local market. He planted sorghum on 1.8 ha in the rainfed field, where he produced 760 kg (420 kg/ha), and sunflower on 1 ha, where he got 430 kg. Other crops he planted under rainfed conditions were cowpeas and groundnuts that shared 0.1 ha and fodder crops (velvet bean and lab lab) on 0.1 ha. In mid-2025 he also set up a 50-broiler unit to diversify his income stream, from which he sold 80 birds from two cycles, grossing USD 560 in income. Table 7 shows the financial performance of the farm during the 2024/25 season.

Table 7: Whole farm performance.

	Green maize (0.1ha)	**Grain maize (0.2ha)**	**Wheat (0.1ha)**	**Sorghum (1.8ha)**	**Broilers (100 birds)**
Gross Revenue (USD)					
Output (kgs/dozens/birds)	180	600	250	760	80
Unit price (USD)	2.5	0.4	0.45	0.6	7
Revenue (USD)	**450**	**240**	**112.5**	**456**	**560**
Variable Costs (USD)					
Seed /Day old chicks	15	30	10	20	125
Basal fertiliser	40	60	15	0	0
Top dressing fertiliser	30	40	10	120	
Stock feed	0	0	0	0	220
Pesticide	5	5	0	10	
Veterinary input	0	0	0	0	10
Labour	20	0	30	0	0
Storage bags	0	10	5	12	0
Transport Cost	0		20	0	0
Total Variable Cost (USD)	**110**	**145**	**90**	**162**	**355**
Gross Margin (USD)	**340**	**95**	**23**	**294**	**205**
Gross Margin/ha (Crops) (USD)	**3,400**	**475**	**225**	**163**	
Return on investment	**3.09**	**0.66**	**0.25**	**1.81**	**0.58**

Circularity and value chain integration

Since the CFS project commenced, Mr Sibanda has been intensifying circularity on his farm by repurposing waste from crop and livestock production into high-value inputs. His closed-loop system is improving the quality of the soils and the feed value of crop residues to enhance crop and livestock productivity. The production of sunflower is supporting an emerging cooking oil value chain in the community, contributing to rural agro processing within the Hauke irrigation community. It costs him USD2 to press about 13 kg of sunflower seed into 4 litres of cooking oil and an additional USD 0.50 for collecting the sunflower cake by-product. These existing linkages are captured in the following diagram: soil nutrients from manure enhance crop growth, crop residues sustain livestock and the soil, livestock by-products enrich the soil, and the family is self-sufficient in terms of cooking oil. Figure 14 sketches the on-farm circularity in Mr Sibanda’s farm.

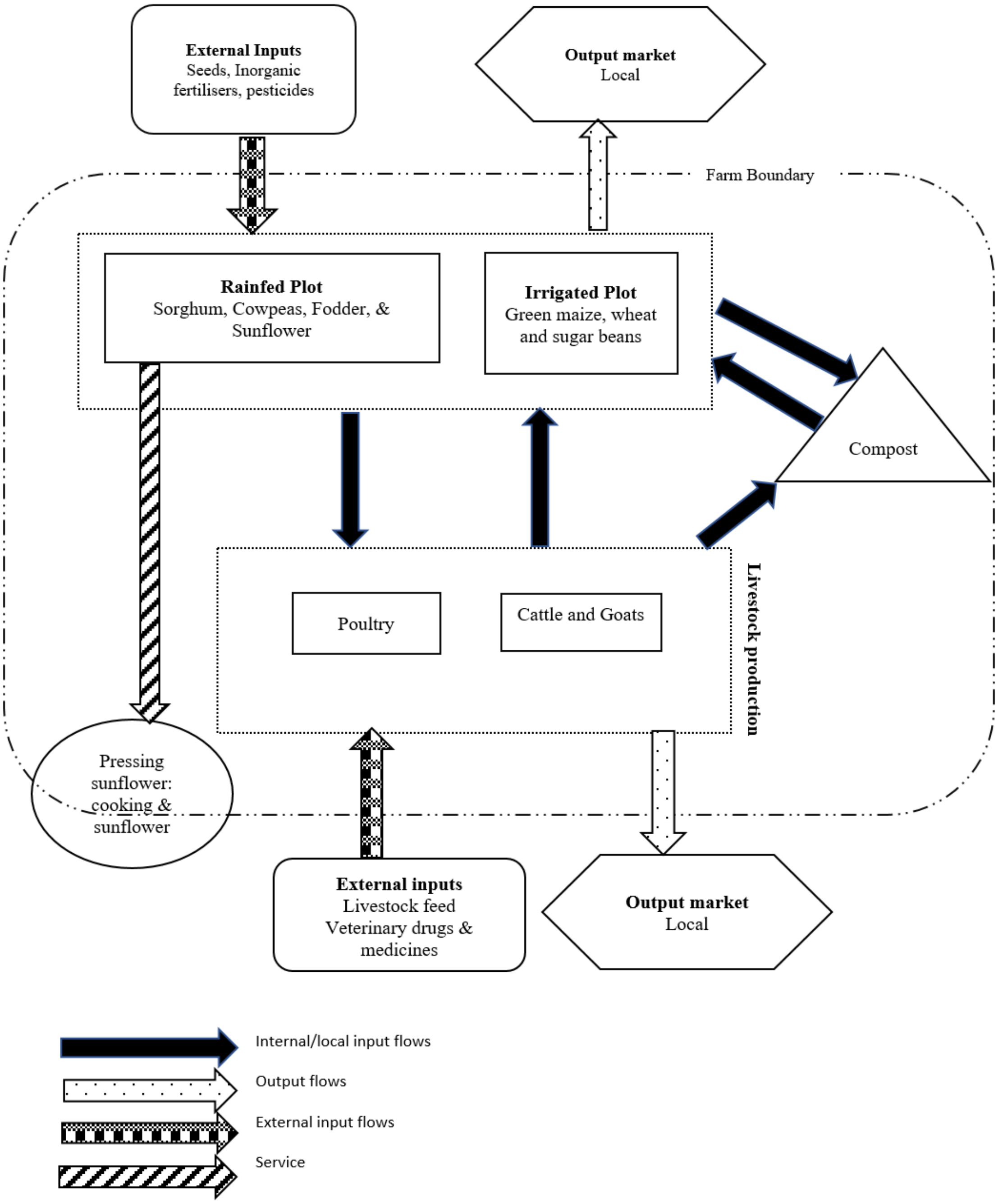

Figure 14: On-farm circularity.

Personal and family impact of participation as a lead farmer in the project

According to Mr Sibanda, his participation in the project as a lead farmer has yielded significant personal benefits. It allowed him to directly engage with project activities, enabling him to critically assess and prioritise which agroecological practices he should adopt based on his needs. The hosting of training events at his homestead has substantially enhanced his standing in the community and expanded his social networks. He also indicated that, because of being a lead farmer, he gained an in-depth understanding of the characteristics of his soils, as they were analysed through the project.

While Mr Sibanda is the registered lead farmer in the project, he indicated he jointly makes adoption decisions with his wife. Mrs Sibanda also attends the training and, as a result, is also well versed with the practices promoted in the project.

Flow-on impact on other farmers and the community

Mr Sibanda highlighted that the project demonstration plot at his homestead field during the 2024/25 season became a pivotal knowledge hub, fostering significant knowledge transfer and community-wide discourse on circular agriculture. He added that through a field day that attracted 86 farmers, the awareness about circularity reached farmers other than the lead farmers. This activity was complemented by the establishment of a dedicated farmer's field school at his homestead, where neighbouring farmers regularly convene to discuss agricultural challenges, with agroecological practices frequently dominating conversations. According to Mr Sibanda, the local extension officer encourages farmers to adopt agroecological practices at almost every farmer meeting, highlighting that it’s a viable solution to the challenges common in the area.

Outlook & lessons learned

Mr Sibanda plans to continue using compost and intends to increase the amount he produces to be able to apply it to all his fields. He indicated that the use of compost will increase the amount of crop residues available for livestock feed, as he will not any longer incorporate crop residues into the soil While he has been curing manure using the conventional method of heaping manure, he intends to switch to curing manure in pit composting, which improves the quality of manure. He also intends to increase the share of legumes in his system for effectively implementing crop rotation, to improve soil fertility and control pests without resorting to pesticides. He intends to increase his scale of irrigation through expanding the area under irrigation by investing in a private drip system supported by a borehole at his homestead.

Case Study 6: Mr. Bhekisiwe Ndlovu, Bubi District

Lead farmer profile and farming practices before CFS project

Mr Bhekisiwe Ndlovu (49) was identified for the role of lead farmer by the extension team due to his history of active participation in similar programmes. Though not a member of the Hauke Irrigation Scheme, he rents plots in the scheme. Drawing on this experience, Mr Ndlovu articulated that his primary motivation for participating was driven by a strategic vision to transition to a more organic farming system, as the cost and availability of inputs are increasingly becoming unfavourable. With the CFS project adopting a landscape approach, he sought to spearhead efforts that would enhance the benefits from the interaction between irrigation and rainfed systems, an area he believed held significant, yet untapped, potential for the broader community.

Mr Ndlovu manages a diversified agricultural enterprise that integrates both irrigated and rainfed production with livestock management to support his ten-member household. Within the irrigation scheme, he cultivates high-value crops, including maize for the green maize market, sugar beans, wheat, and horticultural produce like tomatoes and leafy vegetables on 0.3 ha. His arable rainfed area measures 4 ha, and he usually grows maize, sorghum, groundnuts, and cowpeas and recently added sunflowers. A notable feature of this rainfed system is his dedicated 0.24 ha conservation agriculture demonstration plot, which is subdivided into four 0.06 ha plots for sorghum, cowpeas, groundnuts, and sunflowers. This structured approach reflects a government-promoted conservation agriculture strategy for enhancing household food security, which Mr Ndlovu has actively adopted on his farm.

He indicated that his integrated operation faces multiple systemic challenges. Incessant rains in the area render the poorly drained soils within the irrigation scheme unworkable for extended periods, which negatively affect farm operations leading to low productivity. Mr Ndlovu highlights that the vulnerability of the community to drought is worsened by limited livelihood options in the area, poor road infrastructure, poor access to inputs, land degradation, low soil fertility, and dependency on rainfed production by a large proportion of farmers.

Perspectives on introduction and adoption of agroecological practices in the first season

As a lead farmer, Mr Ndlovu attended CFS project-facilitated participatory events to co-select priority agroecological practices for his area. The practices included: compost making, improved manure management, urea treatment of stover (UTS), protein lick block processing, soil and water conservation (minimum tillage, contour ridges and mulching) and intercropping. In addition, he was provided with a farmer field book to record inputs use during the season and farm operations, crop yields and livestock dynamics. According to Ndlovu, the project approach used to raise the awareness about the agroecological practices, which involved learning by-doing, made it easy for him to try out the practices that included composting and urea treatment of crop residues for feed. In the 2024/25 summer season, Mr Ndlovu was among the lead farmers that successfully hosted demonstration plots of agroecological practices that showcased minimum tillage and intercropping to other farmers within his community (Figure 15). Mr Ndlovu highlighted that the way the training sessions were sequenced kept him and his neighbours engaged in the project as they aligned with the calendar of activities in his farm: for example, practices related to livestock feed were implemented during the dry winter period when there was a shortage of feed from the rangelands; and the demonstration plots to showcase the agroecological practices were established during the rainy season.

Figure 15: Mr Ndlovu’s demonstration plot.

The demonstration plots allowed Mr Ndlovu to compare the impact of different combinations of cattle manure, inorganic fertilisers and legume intercropping on sorghum yields. He observed that combining manure with intercropping without inorganic fertiliser, more than doubled yield compared to plots without any soil fertility amendment. According to Mr Ndlovu, while the yields from plots that included inorganic fertiliser were much higher than plots without, the agroecological practices (manure and intercropping) offered a viable option for resource-poor farmers. While the yield of cowpeas used for intercropping was not recorded, Mr Ndlovu indicated that the added benefits of intercropping with leafy vegetables and pulses enhanced household dietary diversity. Figure 16 shows the yield levels by soil amendment treatment.

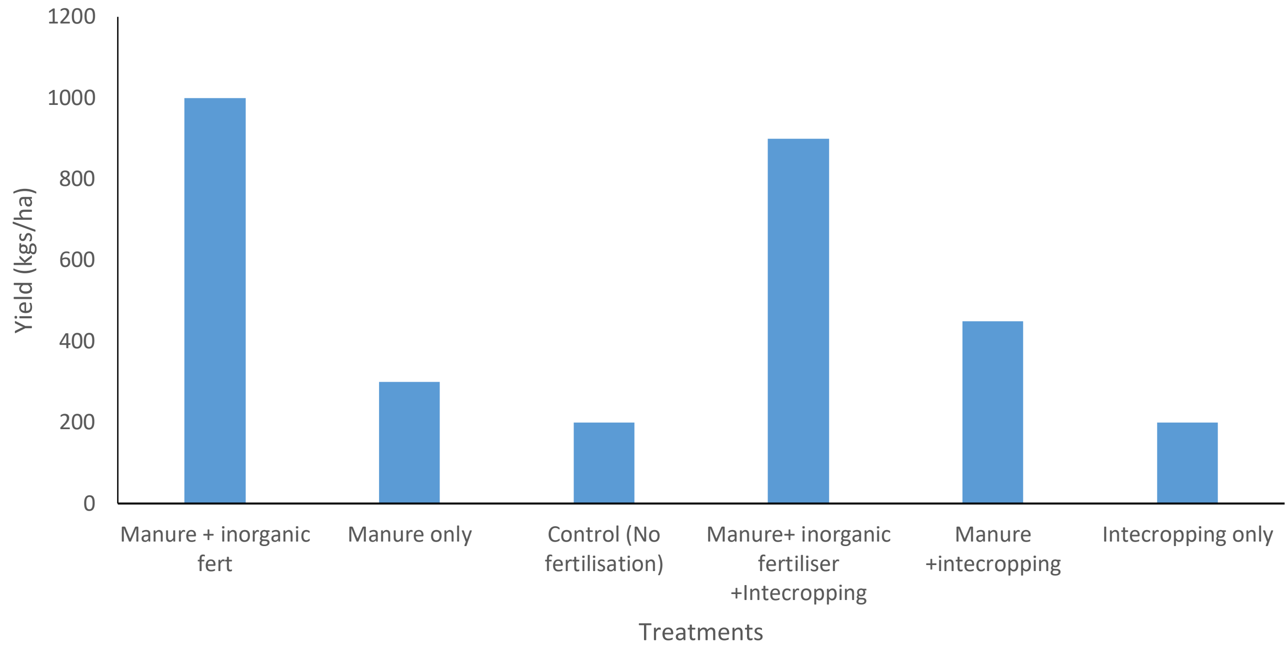

Figure 16: Demonstration plot yield under different treatments.

Facing a critical shortage of manure, Mr Ndlovu identified thermal composting as a key practice to address soil fertility gaps within the irrigation scheme. He recognised an opportunity to produce compost from the abundant crop residues, which were previously unused and left to decompose along the scheme's fences. Mobilising a collaborative effort, he partnered with two other farmers to establish a compost heap that provided sufficient compost to cover 0.5 ha during the 2024/25 season. Beyond improving soil fertility, Mr Ndlovu foresees that the application of compost will, in addition to complementing animal manure, also help ameliorate poor soil drainage.

On the livestock enterprise, Mr Ndlovu was confronted by a severe and unexpected feed shortage during 2024 when rainfall ceased three months prematurely, causing the rangelands to deteriorate much earlier. The financial strain of purchasing commercial stockfeed prompted him to seek an alternative. Using the training he had received from the project, he was able to convert 500kg low quality crop residues to high-value feed through urea treatment, which successfully served as a substitute for commercial feed. This intervention was critical, allowing him to sustain his herd of 12 cattle until the onset of the 2024/25 rainy season. From this experience, Mr Ndlovu indicated that he was going to embrace the practice and mainstream it in his system.

Farm performance during the first season

For Mr Ndlovu, irrigated production serves as the primary engine of on-farm income, with green maize, grown at least twice annually, being the largest contributor. In contrast, rainfed crop production is largely dedicated to household food security. However, this dynamic needs to be fluid to responds to climate shocks; that is, when severe droughts cause low productivity or complete rainfed crop failure, the role of irrigation pivots to prioritise household food security above all else.

During the 2024/25 season, Mr Ndlovu cultivated a diverse range of crops within the irrigation scheme, including green maize, wheat, tomatoes, and leafy vegetables. His horticultural produce, particularly leafy vegetables, is now being grown exclusively using manure in response to the preference for organically grown vegetables. Mr Ndlovu reported that scaling his horticultural operations is constrained by the size of the local market and prospects for exploring distant markets are constrained by the poor road network linking Hauke and Bulawayo.

A financial analysis of the season revealed a clear hierarchy in profitability. Green maize was the standout performer, accounting for over 70% of the net income from his irrigated crops and delivering the highest return on investment. Soybeans also proved to be a financially sound venture, ranking second in profitability. In contrast, wheat was the least profitable crop, but Mr Ndlovu considered it to be a key food security crop, that contributed minimally to his overall income and highlighted the importance of crop selection in optimising financial returns (Table 8).

Table 8: Financial performance of the farm 2024/25 season.

	Green maize (0.4ha)	Wheat (0.2ha)	Sugar beans (0.2ha)
Gross Revenue (USD)			
Output (dozen/kgs)	420	360	300
Unit price (USD)	2	0.4	1
Revenue	**840**	**144**	**300**
Variable Costs (USD)			
Seed	48	36	50
Basal fertiliser	140	50	30
Top dressing fertiliser	60	30	
Pesticide	10	0	5
Labour			
Storage bags	0	10	5
Total Variable Cost (TVC) (USD)	**258**	**126**	**85**
Gross Margin (USD)	**582**	**18**	**215**
Gross Margin/ha (Crops) (USD)	**1,455**	**90**	**1075**
Return per $ invested	**2.3**	**0.1**	**2.5**

Circularity and value chain integration

Mr Ndlovu is intensifying circularity on his farm to increase income and reduce reliance on external inputs (Figure 17). He processes crop residues from rainfed and irrigated plots, converting them into high-quality resources: some for thermal composting to create organic fertiliser and others undergo urea treatment to produce superior livestock feed for his cattle and goats. This internal recycling loop enhances both soil fertility and animal nutrition, boosting the productivity of his crop and livestock enterprises. Mr Ndlovu's market is mostly local, within his and the nearby wards. In the case of horticultural commodities, which are not bulky but are perishable, they are sold at local business centres and door-to door. Green mealies and sugar beans are sold mainly in the local market, while part of the wheat output is sold to the GMB and part is consumed in the household.

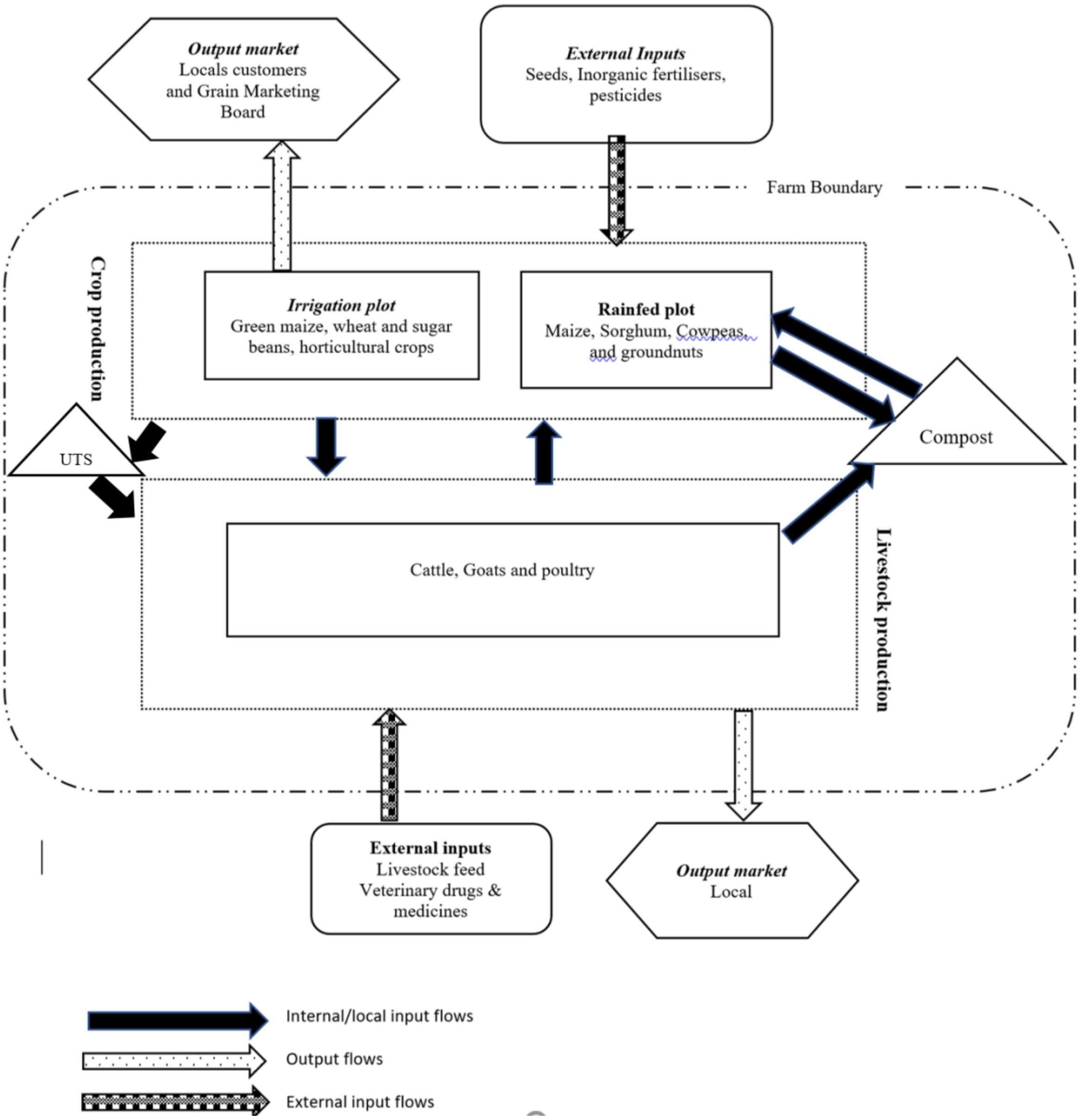

Figure 17: On-farm circularity.

Personal and family impact of participation as a lead farmer in the project

According to Mr Ndlovu, his role as a lead farmer has served as a pivotal mechanism for improving his farm's resilience to climate shocks through agroecological practices. His position has increased his contact and direct engagement with agricultural extension officers and project specialists, resulting in the continuous, transfer of specialised knowledge and technical skills. Crucially, the practice of hosting training sessions at the homestead has created a unique, convenient learning environment that extends benefits beyond Mr Ndlovu to his entire family and the community. During the year, three training sessions were held, each attracting around 50 participants. His role has facilitated intra-household knowledge assimilation and discussion, which is particularly vital for minimising errors in complex preparatory techniques, such as the meticulous process required for urea treatment of crop residue used for livestock feed.

Being a lead farmer comes with challenges. Mr Ndlovu indicated that there was a substantial time commitment required for both training and peer-to-peer farmer support, which must be carefully mitigated to prevent it from negatively impacting existing family commitments and the efficiency of his personal farming operations. He notes that effective scheduling and delegation are essential management practices required to sustain the positive impact of his role without compromising the farm's productivity.

Flow-on impact on other farmers and the community

Ndlovu highlighted that since the inaugural project meeting at Nkosikazi Primary School, a discernible shift in community discourse has occurred, with circular principles now dominating local farmer discussions. This has been crystallised by the widespread adoption of a powerful local maxim: *"Akula okuphuma emasimini okulahlwayo, konke kuyasebenza"* meaning "nothing from the fields is waste; everything is valuable for production." This recurring messaging has evolved into a functional slogan, fundamentally reframing perceptions of agricultural by-products and actively discouraging the burning or discarding of organic materials.

Outlook & lessons learned

Mr. Ndlovu's future strategy centres on deepening circularity on his farm through a deliberate focus on the use of his own internal resources and adopting new practices that can provide additional income streams, like making stock feeds. He intends to expand the area under intercropping, production of compost and explore strategies to expand his market access. He views this approach as more aligned with his role as a lead farmer, believing that sourcing manure externally would contradict his advocacy for self-sufficient circular systems, though he remains open to future exchanges if other farmers have a demonstrable surplus. Concurrently, his long-term vision includes a significant infrastructure investment: he plans to drill a borehole at his homestead to establish a solar-powered drip irrigation scheme within his yard.

Case Study 7: Ms. Nothani Ngwenya, Bubi District

Lead farmer profile and farming practices before CFS project

At the start of the CFS project, Ms Nothani Ngwenya (49 years old) was the chairperson of the Hauke irrigation scheme. She had overseen the introduction of a dairy unit within the scheme at the tail end of the TISA project, and her leadership was considered key to fostering the adoption of agroecological practices in the scheme and at the community level. She also exhibited traits of an innovator, with a reputation of being willing to try new practices. Unlike most farmers in the project area, she only has small livestock such as poultry and goats but has linkages with cattle farmers through trading her crop residues. After learning about the thrust of the CFS project, she indicated that she wanted to play a key role in assessing the efficacy of the practices from both a personal and a scheme perspective. On a personal level she was establishing a horticulture garden where she intended to employ only organic farming techniques, in response to market preferences.

Ms Ngwenya is the head of her two-person household. She is involved in both irrigated and rainfed production. Under irrigation, she has access to a 0.3 ha plot within the scheme where she grows green maize, sugar beans, and wheat, mainly for household income. She also cultivates horticultural crops such as bell peppers, butternut squash, tomatoes, and leafy vegetables, which she sells locally (Figure 18). She indicated that tomatoes accounted for more than half of the area under horticultural crops. In her horticultural production system, she currently practises organic farming, with some inputs, such as externally sourced liquid organic foliar fertiliser and goat and cattle manure sourced from other farmers. Under rainfed conditions she produces maize, sorghum, and cowpeas, mainly for food security. Ms Ngwenya faces several challenges, including the cost and availability of inputs, a lack of draught power and labour, and poor soil. Her lack of livestock represents a fundamental barrier to circularity on her farm, as she sells her crop residues to other farmers with livestock.

Figure 18: Ms Ngwenya marketing her produce at a local expo.

Perspectives on introduction and adoption of agroecological practices in the first season

Ms. Ngwenya found immediate resonance with the core principle of circular agriculture: minimising external inputs by repurposing waste within farming systems, as it directly addressed her resource constraints. The project's approach, emphasising behavioural change, rather than introducing entirely foreign concepts, through demonstration plots and practical sessions, effectively builds confidence and facilitates identification of feasible practices. From the various techniques introduced she identified thermal composting as a priority as it is aligned with her capacity and needs. During 2024/25 she made thermal compost, which she applied to her 0.3 ha plot. She found that the use of compost was a solution to the perennial challenge of accessing adequate manure for her plot. She also managed to set up, and successfully manage, a demonstration plot, where she compared sorghum crop performance, including yield, when grown using organic farming practices (intercropping and compost) versus using conventional practices and inorganic fertilisers. She observed that the yield differences between the two plots were small, making intercropping in combination with the use of compost more profitable, as she the cost of inorganic fertiliser.

Farm performance during the first season

According to Ms Ngwenya, the performance of her farm in the 2024/25 season was an improvement compared to the 2023/24 drought season, which adversely affected the otherwise reliable irrigation. While she could not quantify the contribution of the new practices she implemented, she indicated that it solved her challenge of accessing manure, as she only has a small flock of 10 goats. During the season she was able to plant green maize, sugar beans, wheat, and various horticultural crops (butternut, bell peppers, and tomatoes). She indicated that all production in the irrigation scheme was done using her resources, with wheat grown under contract with the Grain Marketing Board (GMB). On the rainfed land, she was able to plant maize, sorghum, and cowpeas using inputs from the drought relief program. Table 9 shows the output of the main crop in the 2024/25 season.

Table 9: Crop output 2024/25 season.

Crop	Area (ha)	Outputs (kgs)	Yield (kgs/ha)
Green mealies (in dozens not kg)	0.2	380	1,900
Wheat	0.2	440	2,200
Tomatoes	0.05	1,600	32,000
Maize grain	1	540	450
Sorghum	0.3	160	533
Cowpeas	0.1	40	400

Ms Ngwenya realised most income from selling green maize and tomatoes. The other crops such as bell pepper are promising and she planted a small area to learn about the crop while also testing the demand in the market. Table 10 shows the gross margin of the irrigated crops from which she derived the most income.

Table 10: Gross margin analysis.

	Green maize (0.2ha)	Wheat (0.2ha)	Tomatoes (0.05ha)
Gross Revenue (USD)	0.2	0.2	0.05
Output (kgs/dozens)	380	440	1600
Unit price (USD)	2	0.45	0.3
Revenue (USD)	**760**	**198**	**480**
Variable Costs (USD)			
Seed /Seedlings	35	20	90
Basal fertiliser	60	40	
Top dressing fertiliser/foliar fertiliser	30	20	10
Pesticide	5	0	5
Labour	20	30	0
Storage bags	0	5	0
Transport Cost		20	
Total Variable Cost (USD)	**150**	**135**	**105**

	Green maize (0.2ha)	Wheat (0.2ha)	Tomatoes (0.05ha)
Gross Margin (USD)	**610**	**63**	**375**
Gross Margin/ha (Crops) (USD)	**3,050**	**315**	**7,500**
Return on investment	**4.1**	**0.47**	**3.6**

Circularity and value chain integration

Ms Ngwenya has established a circular model centred on the thermal composting of crop residues, effectively closing the nutrient loop on her farm (Figure 19). Her system now redirects biomass that was previously sold to other farmers into a valuable resource for improving crop production under both irrigated and rainfed conditions. The key linkage in this system connects crop waste management directly to soil health, generating significant benefits including reduced expenditure on commercial fertilisers and improved resilience to dry spells. This approach presents a clear pathway to full circularity for farmers without cattle or large numbers of livestock, demonstrating how to build soil organic matter and create production stability. Furthermore, this model opens potential value chain developments in producing and marketing organic compost to other farmers, transforming what was a low-value waste product (sold for $5 per scotch cart) into a premium soil amendment, thereby creating new economic opportunities while advancing ecological sustainability.

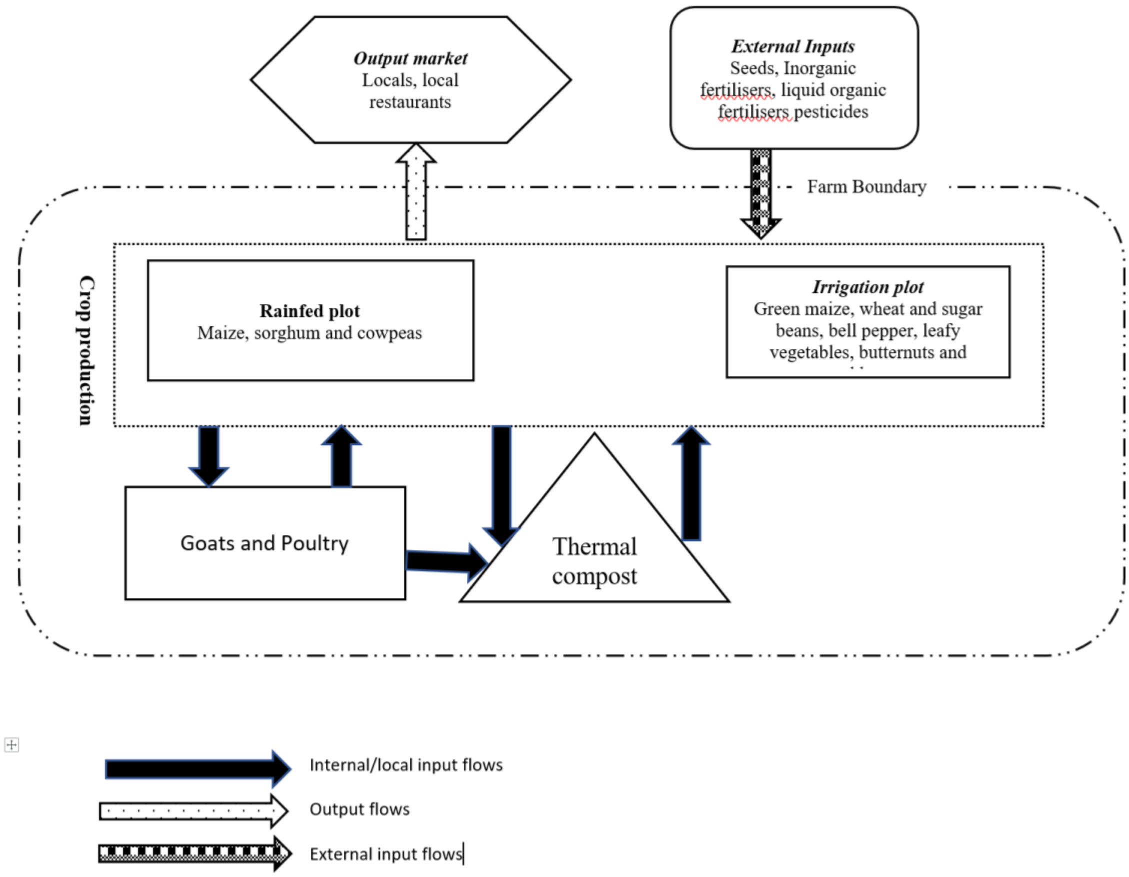

Figure 19: On farm circularity.

Personal and family impact of participation as a lead farmer in the project

Through her participation in the project as a lead farmer, Ms. Ngwenya indicated that she had benefited immensely from the training sessions and the look-and-learn tour she attended. Through these activities, she shared experiences with other farmers, which enriched her knowledge in various areas related to compost making and provided ideas for establishing a small business to derive more value from her output. In addition to these direct benefits, Ms. Ngwenya indicated that she benefited from being part of a social group that chats regularly about ideas to enhance farm circularity through the WhatsApp platform. Through this interaction, for example, she learnt about producing organic topdressing fertiliser, chicken manure tea, a liquid fertiliser made by steeping chicken manure in water to extract nutrients, creating an organic fertiliser rich in nitrogen. This practice further reduced the cost of production, as she was relying on liquid organic fertiliser bought from Bulawayo some 130 kilometres from her homestead.

Demands on the lead farmer become particularly acute during pre-season periods when training sessions and meetings intensify, creating occasional feelings of being overwhelmed as she manoeuvred the complicated intersection of community leadership, economic entrepreneurship, and family responsibilities, pointing out the importance of effective time management strategies for farmers serving in multiple capacities.

Flow-on impact on other farmers and the community

Since the project was introduced, as a result of the contact she has had with the farmers, both in the irrigation scheme and outside, Ms Ngwenya highlighted that 'circularity' has become a buzzword and, a virtual part of almost every farmer meeting, where not only extension officers raise it but also other farmers bring out what they are doing and the results they are observing. According to her observation, most of the agroecological practices being promoted are still confined within the group of lead farmers. She indicates that this is understandable given that the practices have only been implemented for one full season. She opined that other farmers tend to come on board once they observe benefits of the practices from other farmers. With the project timing its activities to align with the agricultural calendar, the earliest the diffusion of the practices to other farmers can be observed is in the next season.

Outlook & lessons learned

She plans to continue using thermal compost and intends to venture into the production of liquid organic fertiliser using chicken manure, which is readily available at her farm and from neighbouring farmers. Although she does not own cattle, she plans to produce high-quality feed, including fodder crops and urea-treated crop residues, for sale to cattle owners. Currently she is using water from a communal borehole to support a small garden close to her homestead. She is planning to drill a borehole in her yard and set up drip irrigation focusing on the production of high-value horticultural crops, such as bell pepper, onions, and cabbages as well as expanding the area under tomatoes. She considers having a second plot as a strategic development, as it will allow more autonomy in crop choices, and she intends to use it as a vehicle to accumulate assets, such as cattle, which she considers important in her context.

Case Study 8: Mr. Mark Khabo, Bubi District

Lead farmer profile and farming practices before CFS project

Mr Khabo (59 years) is a well-known leader in his community, with a long history of advocating for social issues, including women's empowerment and disability rights. Prior to the CFS project, he had already demonstrated leadership in agriculture through his role as a lead farmer in a local extension conservation agriculture programme. Hence, Mr Khabo had established credibility and an extensive network and was therefore identified as an ideal candidate to be a CFS lead farmer, a role he accepted as it presented an opportunity for him to test the efficacy of circular agricultural practices in addressing his context-specific challenges.

Mr. Khabo's 2.3 ha rainfed crop production operation, is split across two locations: a 0.3 ha homestead plot, where he has been practicing conservation agriculture (minimum tillage, mulching and crop rotation) and a larger, 2 ha plot located 5 km away. Historically, his cropping was dominated by maize, which accounted for over 80% of his cropped area. However, repeated drought-induced crop failures forced a strategic shift to sorghum, a more drought-tolerant cereal he had not previously cultivated. This shift has resulted in a more resilient and diversified crop mix: 50% maize, 40% sorghum, and 10% legumes. In addition to crop production, Mr Khabo sources crop residues from irrigators for supplementary feed for his cattle, linking his rainfed system to the irrigation scheme.

Mr Khabo's situation underscores the acute vulnerabilities faced by rain-dependent farmers in the region. He identifies the increased frequency and severity of droughts as his major challenge. This core threat is compounded by a constellation of other stressors that heighten his overall vulnerability. These include population growth leading to encroachment on traditional grazing lands, declining soil fertility, the high cost of agricultural inputs, and persistent pests and diseases. His attempts to adapt are often hindered by the very problems he seeks to solve. For instance, to address poor soil fertility, Mr Khabo turns to manure as an affordable solution. However, the effectiveness of this practice is severely undermined by a shortage of manure itself. The shrinking grazing areas forces livestock to spend more time grazing and relatively less time than typically in communal areas where penning tend to take place at sunset to morning. As a result, he was not producing enough manure from his animals. This creates a cyclical dilemma where one challenge intensifies another, trapping him in a cycle of diminishing resilience.

Perspectives on introduction and adoption of agroecological practices in the first season

As part of the CFS project, Mr Khabo was trained on several agroecological practices that included thermal compost making, improving manure curing and nutritive value of crop residues through UTS and transforming crop by-products into high-value livestock feed, such as protein blocks. In addition, he hosted a demonstration plot to showcase the impact of intercropping and manure application on crop productivity. He notes that the approach of hands-on training and using practical demonstrations was effective. Through the experiential learning model used by the project, he was able to answer the questions of feasibility in the context of his labour challenges, a common phenomenon in his community due to outmigration of young people for mining in other parts of the district. Adding to that, the timing of the training aligned with his calendar of activities, which made it easy for him to adopt practices such as thermal composting and urea treatment of stover.

Figure 20: Thermal compost making.

After learning about the thermal compost (Figure 20), Mr Khabo set an experiment to compare effect of compost and manure on maize yield on his 0.3 ha homestead plot. He observed that crops with compost performed better during the dry spells compared to those planted using manure. While the experiment was only for one season, Mr Khabo believes that compost is a potential solution to the weakness of manure, which he said tended to draw moisture away from the crop, causing the crop to wilt, during the mid-season dry spells common in his area. Following his training on UTS, Mr Khabo was able to immediately mobilise 1.5 tonnes of crop residues, of which a third was sourced from friends in the irrigation scheme. According to Mr Khabo the drought experienced in 2024, which worsened an already precarious situation in the grazing area, was a good test for the effectiveness or urea treated stover as a solution to feed shortages. Generating 1.5-tonnes of high-quality supplementary feed, enabled him to sustain his herd of ten cattle for a critical 60-day period early in the project. Mr Khabo indicated that this made it attractive to mainstream the UTS treatment in his farming system.

Mr Khabo was among the lead farmers that successfully established a 0.12 ha demonstration plot on his rainfed field during the 2024/25 season to showcase a suite of sustainable practices rooted in circular principles, including the application of cattle manure, fertiliser micro-dosing, and intercropping. A key insight from the single-season observation was that integrating manure and intercropping showed a positive impact on yields, compared to the control plot that had no soil fertility amendment (Figure 21).

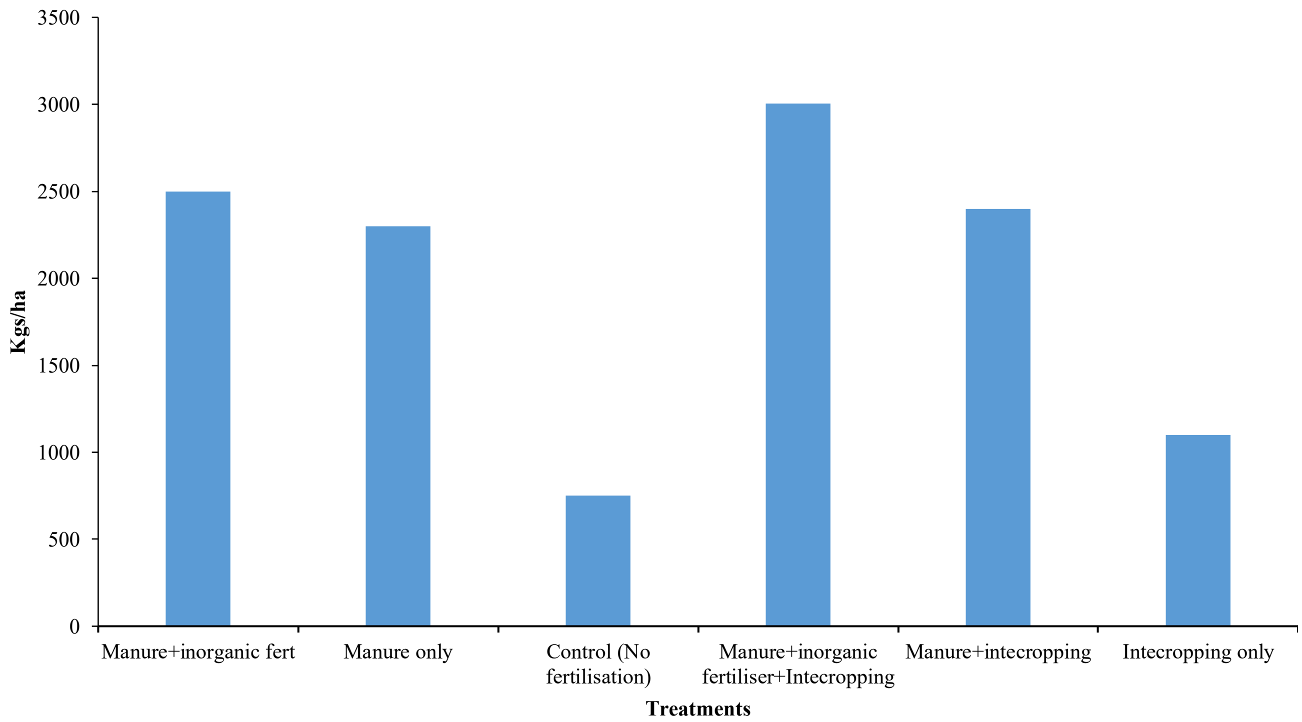

Figure 21: Comparison of yield across treatments.

According to Mr Khabo, the demonstration plot model used in the project had profound value by allowing him and other farmers to not only compare yield levels across the treatments, but also to observe vital agronomic indicators such as plant stand, crop vigour, weed pressure, and pest incidence (Figure 22). The other farmers in Mr Khabo’s neighbourhood were also able to observe the performance of the different combination of agroecological practices, which he believes will play a key role influencing their adoption decisions in the forthcoming season.

Figure 22: Demonstration plot.

Farm performance during the first season

The 2024/25 season represented a significant recovery for Mr Khabo's farm, with maize yields rebounding to about 1200 kg/ha and sorghum to 860 kg/ha, a stark improvement over the previous draught season, where maize was a total failure and sorghum output was less than 100 kg. He attributes it to a combination of improved practices adopted and favourable seasonal conditions. Despite the season's success, Mr Khabo reflected that high pest pressure remained a challenge that adversely affected yields. An economic assessment revealed that while both crops were profitable, sorghum delivered a notably higher return on investment, yielding three times that of maize (Table 11). Mr Khabo indicated that half of the harvest was sold, and the balance was retained for household consumption. Meanwhile, legumes, cultivated under a low-input system, were primarily reserved for home consumption, with sales being opportunistic. The crop residues from the harvest and the by-products from the post-harvest process were used as livestock feed after UTS.

Table 11: Whole farm performance.

	Maize (1.1ha)	Sorghum (0.7ha)
Gross Revenue (USD)		
Output (kgs)	1,300	600
Unit price	0.4	0.5
Revenue	**520**	**300**
Variable Costs (USD)		
Seed	90	5
Basal fertiliser	80	0
Top dressing fertiliser	40	40
Pesticide	5	5
Labour	20	15
Storage bags	15	5
Transport Cost		
Total Variable Cost (USD)	**250**	**65**
Gross Margin (USD)	**270**	**235**
Gross Margin/ha (Crops) (USD)	**245**	**336**
Return on investment	**1.1**	**3.6**

Circularity and value chain integration

Mr. Khabo’s farm serves as a compelling model for how circularity can significantly bolster a household's resilience to climate change when extended to the landscape level. His approach operates on multiple fronts. Internally, he intensifies on-farm circularity by improving the value of his own crop residues to create high-value compost and livestock feed. Externally, his system is strategically linked to broader resource flows at community level, notably from the nearby Pollards irrigation scheme, despite not farming within it himself (Figure 23). Mr. Khabo leverages personal networks to access crop residues from the scheme, often at no cost, while also having the option to purchase wheat residues from surrounding commercial farms during drought-induced shortages. For his produce, he utilises mobile phone platforms to advertise and sell primarily to local families, ensuring a reliable local market outlet. He rarely sells cattle, but when he does it is often within the local market to individual households or local butcheries. To anchor his household's food security, Mr. Khabo employs a forward-looking strategy of retaining a two-year supply of grain, mitigating the risk of consecutive poor seasons. He further safeguards this vital reserve by using chemical grain protectants to minimise post-harvest losses, demonstrating a comprehensive and multi-layered approach to risk management.

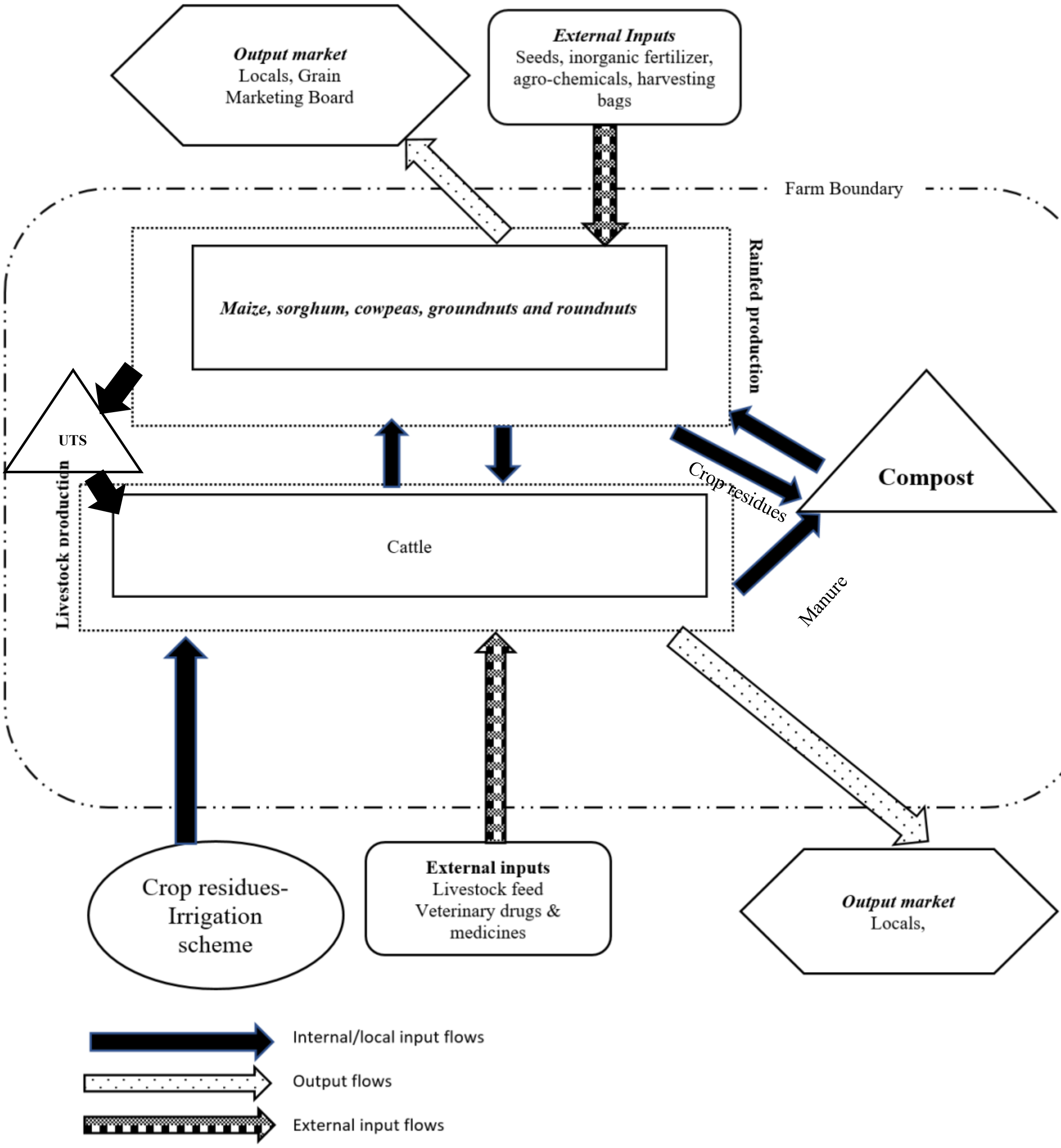

Figure 23: On-farm circularity.

Personal and family impact of participation as a lead farmer in the project

As an early adopter of the agroecological practices, Mr Khabo demonstrated his willingness to cascade his knowledge to other farmers by readily making himself available to train other farmers in the ward during both the project and extension officer-facilitated training sessions. He personally welcomes this added responsibility, which builds upon his existing reputation as a champion for social issues. However, Mr Khabo also acknowledges the challenges of the position, which demands considerable time for hosting demonstrations and can strain family labour. He notes that his effectiveness could be further enhanced with access to Information, Education, and Communication

(IEC) materials in vernacular and with less text and more images for distribution to farmers and logistical support such as a bicycle, which would enable him to assist other farmers directly when extension officers are unavailable.

Flow-on impact on other farmers and the community

Mr. Khabo strategically located his 0.12 ha demonstration plot in an area with high pedestrian and vehicle traffic. As a result, 30 farmers visited his plot and enquired about the techniques he used to have successful crops, and he highlighted the agroecological practices during their visit. Mr. Khabo's observation is that the subject of intensifying circular agricultural practices is gaining traction in farmer meetings, either organised by extension officers or by farmers. According to him, the major driver of the discourse is the cost and availability of inputs over the years and the emergence of farmers that are successfully implementing the agroecological practices in the community.

Outlook & lessons learned

A central insight for Mr Khabo has been that resilience within his rainfed system is fundamentally built through proactively enhancing soil resource quality and conserving moisture through adoption of circular agricultural practices such as use of composts. This understanding now shapes his forward-looking strategy, which is defined by a dual focus on intensification and diversification. He plans to not only continue but expand the agroecological practices he has adopted, particularly composting and the urea treatment of stover. Furthermore, he is exploring ways to add value to his surplus grain by repurposing it as poultry feed. Informed by knowledge-sharing with other farmers, he also intends to experiment with alternative methods for improving feed value, such as replacing urea with chicken manure to create a fully organic supplement mainly for his cattle. Ultimately, recognising the growing unpredictability of rainfall, his most significant planned investment is the establishment of a drip-irrigation system supplied through a groundwater source for his homestead plot. This intervention represents the cornerstone of his strategy, designed to shield his core production from drought, guarantee a consistent biomass supply for his livestock, and realise his vision of a highly productive, water-efficient, and self-sustaining circular farm.

Tanzania

Introduction

The CFS project was implemented in Kiwere and Magozi in Iringa District, Tanzania. Both communities face similar structurally related constraints: declining soil fertility, high and volatile fertiliser prices, low and variable crop productivity, and acute livestock feed shortages during the dry season (August–December). These challenges are compounded by rainfall variability, increasing pressure on shared grazing resources, and limited access to affordable capital. In this context, production systems have become increasingly vulnerable, with rising input costs and stagnating returns.

To respond to these constraints, the project adopted a participatory approach to identify and test locally appropriate agroecological practices. Through AIP visioning exercises conducted in April 2024, farmers, extension officers, and other local stakeholders identified practices that would build on existing resource flows within the communities. The emphasis was on strengthening linkages between crop and livestock enterprises and improving the reuse of locally available biomass and by-products. The selected practices included manure application for soil fertility improvement; use of crop residues and agro-processing by-products (rice bran, maize bran, sunflower cake) for livestock feed; urea-molasses treatment and mineral lick blocks; fodder production (including Super Napier grass); crop rotation with legumes; and black soldier fly production. While urea-molasses treatment of stover and mineral lick blocks were included in training, early adoption prioritised manure use, fodder production, crop residues, and legume rotations due to local biomass and cropping fit.

To accelerate learning and diffusion, the project worked through a lead farmer model. Sixty lead farmers (30 per community) were selected and trained by ward- and district-level extension officers. Training covered group formation and management, financial literacy, business planning, and agroecological practices. Each lead farmer developed an implementation plan tailored to their farm conditions. Follow-up mentoring was provided during implementation, with particular attention to addressing operational constraints such as limited capital, transport costs for manure, labour bottlenecks, and access to planting materials. In several cases, farmers adopted a phased strategy, which included starting with lower-capital practices and reinvesting profits into practices that required more capital.

Evidence from the documented cases suggests that agroecological practices can alter both cost structures and productivity when appropriately adapted to local conditions. In Kiwere, integration of livestock manure into rainfed maize systems was associated with substantial yield increases relative to prior seasons, alongside partial reductions in mineral fertiliser use. While rainfall variation across seasons influenced outcomes, gross margins improved where manure substituted purchased inputs and family labour replaced hired services. In Magozi, crop rotation with common beans following irrigated rice enabled farmers to intensify land use, diversify income streams, and reduce fertiliser expenditure through manure application. In livestock systems, fodder cultivation and treatment of rice residues addressed feed shortages that previously constrained weight gain and extended holding periods before sale. These changes reflect shifts from reliance on open-access grazing and external inputs toward more internally integrated production systems.

Across cases, farmers report reductions in chemical fertiliser expenditure of approximately 25% where manure was applied consistently, alongside yield increases of up to 50% in favourable rainfall conditions. Livestock keepers adopting fodder supplementation report lower dry-season losses and improved body condition. While these figures reflect early-stage results and remain context-specific, they indicate the potential of agroecological practices to improve resource-use efficiency and strengthen resilience under climatic and market uncertainty.

Beyond farm-level production effects, the lead farmer approach has contributed to knowledge diffusion within the communities. Farmers have begun to replicate manure application, bean rotation, pig integration, and fodder production after observing early adopters. At the same time, adoption remains gradual and constrained by capital limitations, labour demands, disease risk in livestock, and competition for biomass resources. As more households adopt manure use and fodder production, resource scarcity and price adjustments may emerge, underscoring the need for complementary soil fertility and feed strategies.

Overall, the CFS experience in Kiwere and Magozi demonstrates that circularity is not a single technology but is created by a set of agroecological practices that reorganize existing resource flows within farms and communities. The early results are promising, but scaling these practices will require sustained extension support, access to finance, and attention to emerging trade-offs in biomass use and labour allocation. Continued investment in farmer-led experimentation and structured learning platforms will be critical to expand impact within and beyond the two communities.

Case Study 1: Mr. Hussein Kiangi, Mgera Village, Kiwere – Iringa District

Lead farmer & farm profile

Hussein Kiangi, a 34-year-old maize farmer from Mgera village, is married with two children. He holds a degree in education. Since engaging with the CFS project in 2023, together with his wife, he has expanded his livelihood activities to include poultry and dairy production, positioning their household as an emerging example of integrated farming in the community. He owns a 1 ha rainfed plot and during the 2023/24 season he leased 1 ha and a further 1.4 ha during the season of 2024/25. His wife is mainly involved in the egg production business feeding, collecting, sorting, and packaging eggs in trays for sale. His main source of income before the CFS project was a tri-cycle business, transporting small cargoes. He stopped the business in February 2024 after he broke his leg in an accident, which made him realize he needed a business that does not require a lot of movement.

Before the project: Farmer's journey and motivation

Since 2021, Mr. Hussein has produced maize from the two leased rainfed plots in Mgera village. His farming methods relied heavily on chemical fertiliser as a main source of nutrients for his crops. He started to experience low yields due to low rainfall, poor soil fertility and pests. He then planted tomatoes for the first time, but his crops were affected by low rainfall during the rainy season. Mr Hussein heard about agroecological practices from Kiwere's irrigation farmers during TISA. He continued to take an interest in agroecological practices from the likes of Anatalia Kilienyi and Pewa Ndelwa, who started dairy projects in the scheme in 2020. In 2023, Mr Hussein was invited to participate in the AIP visioning exercise and was asked to be among the lead farmers as he showed great interest in circularity, such as manure application, and dairy and poultry farming. In 2023 he decided to start a dairy project and bought a semi-improved breed heifer at a cost of 700,000 Tsh (USD300), which he earned from selling maize. He later added another heifer, which he bought from a farmer in Kiwere village. Unfortunately, that heifer became ill after it was dehorned during the rainy season. He sold it and decided to remain with his first heifer, which calved in 2024 (calf died) and calved with a second female calf in early September 2025. He realized that dairy did not produce quick cash. Hence, he ventured into egg production in June 2024, investing money from selling milk and maize. He started with 400 layers and added 400 in 2025, using income from his first layers and his maize crop. He attributes this progress in his enterprise to participation in the various activities of the CFS project, starting from the early stages of visioning through AIPs, receiving periodic mentoring, and gaining subsequent linkages to feed suppliers through the network.

First season (2023/24) experience

The first season of 2023/24 was the season for learning dairy cattle keeping and management, laying the foundation for dairy production. A key lesson in this season was the need for another income source that provides income within a short period of time, as a dairy business takes time to build.

Hence, he started an egg production business, which has a shorter income return time. Mr Hussein has been doing most of the dairy activities himself, collecting maize stover for feeding and taking care of the cattle (cleanliness, dipping). His biggest challenges in this season included: unreliable rains, weeds and pests in crop production; loss of a calf due to premature birth; and the loss of 100 birds in the egg business (Table 12).

Evidence of adoption & impact first season

Table 12: Agroecological practices.

Circular practice	Area (Ha/acres)	Farmer feedback	
		Benefits experienced	**Any Challenges Faced**
Manure application	0.4 ha	• Increased yield, reduced chemical fertiliser from 150 Kg per acre to 100 kg per acre	• Insufficient manure to apply the whole plot
Dairy farming	1 cow with 2 calves (Figure 24)	• Manure (Figure 25). crop residues, and by-products from maize processing machines used as feed	• Inexperienced in cattle management, longer waiting period to realize profit • Lost a calf because of pre-mature birth
Poultry farming	1,000 layers (Figure 26 and 27)	• Poultry manure (Figure 28), daily income from egg and manure sales	• 50 birds were burnt by a charcoal burner used for heating during brooding period • 30 birds died due to loss of power supply for lighting and heating, and 20 birds died from chicken diseases because of delayed vaccination
Intercropping	0	• Has not initiated intercropping as maize production is more a priority	• Need to use herbicides for controlling weeds makes introducing intercropping more complex.

Figure 24: Newborn calf on the farm.

Figure 25: Cattle manure collected from the farm.

Figure 26: First batch of layers which gives eight trays per day.

Figure 27: Second batch of layers in the farm.

Figure 28: Poultry manure collected and ready to be taken to the farm and sold.

Data from Mr. Hussein's field book reveals that rainfall and the number of rainy days were greater in the 2023/24 season compared with the 2024/25 season (Table 13). Manure was applied only in 2023/24. Although the cultivated area expanded in the 2024/25 season, Mr. Hussein recorded lower yields and incurred a loss of TSH 447,000. This season proved unsuccessful largely due to untimely fertiliser application—a consequence of inadequate rainfall.

Table 13: Gross margin analysis table for grain maize.

Input Type/Activities	Rainfed	Rainfed
Planting season	2023/24 -Maize	2024/25-Maize
Seed varieties	Tembo 719	Tembo 719
Area in that crop (ha.)	1.42	1.42
Fertiliser regime	(DAP-2, UREA-6, CAN 3),	(DAP-2, UREA-8, CAN 4),
Expenses (Tshs.)		
Farm preparation	122,500	122,500
Manure application	300,000	did not apply
Seeds	196,000	270,000
Ploughing	175,000	175,000
Planting	175,000	175,000
Weeding	175,000	175,000
Fertiliser	306,000	1,100,000
Pesticides	85,000	268,500
Fertiliser application	70,000	70,000
Pesticides application	105,000	105,000
Harvesting	140,000	140,000

Input Type/Activities	Rainfed	Rainfed
Planting season	2023/24 -Maize	2024/25-Maize
Other costs (ploughing, renting plot)	142,500	500,000
Postharvest management cost-Chemical used	48,000	16,000
Transport	60,000	90000
Shelling	45,000	80,000
Packaging	35,000	40,000
Total cost	2,180,000	3,327,000
Income (add up from fieldwork table)	3,080,000	2,880,000
Profit (Income less total cost)	900,000	-447,000
Yield (ton per ha.)	7,200	3,840
Quantity sold (Kg)	6,600	3,240
Gross margin (profit/area)	257,143	-81,273

Table 14: Gross margins: maize, eggs, dairy (2023 to 25).

	Dairy business		**Egg production**	
Activity/Season	**2023/24**	**2024/25**	**2023/24**	**2024/25**
Feeding	1,440,000	2,160,000	10,800,000	36,000,000
Sheds	500,000	140,000	4,000,000	4,500,000
Vaccination	120,000	200,000	320,000	486,000
Transport	240,000	150,000	150,000	430,000
Total cost	**2,300,000**	**2,650,000**	**15,270,000**	**41,416,000**
Income	3,240,000	3,960,000	21,600,000	48,600,000
Profit (Income –Total cost)	940,000	1,310,000	6,330,000	7,184,000

Use of by-products/value addition

Mr Hussein uses crop residues to feed his dairy cattle (Figures 29 and 30) and relies on by-products from maize milling (Figure 31) and oil pressing to mix feed for his layers. Maize bran is also used for local brewing, so demand in the community is higher than supply, and he sources most of it from outside the area. Even with this constraint, preparing his own mixed feed (Figure 32) has reduced feed costs by about half (Table 14). At present, he feeds maize stover to his cattle without improving its nutritional value, for example through urea treatment, which suggests there is still scope to strengthen feed quality.

Figure 29: Collected maize stalks and grasses for feeding dairy cattle.

Figure 30: Heifer grazing on the maize stover from neighbour's plot.

Figure 31: Solar drying of maize bran before mixing with other ingredients.

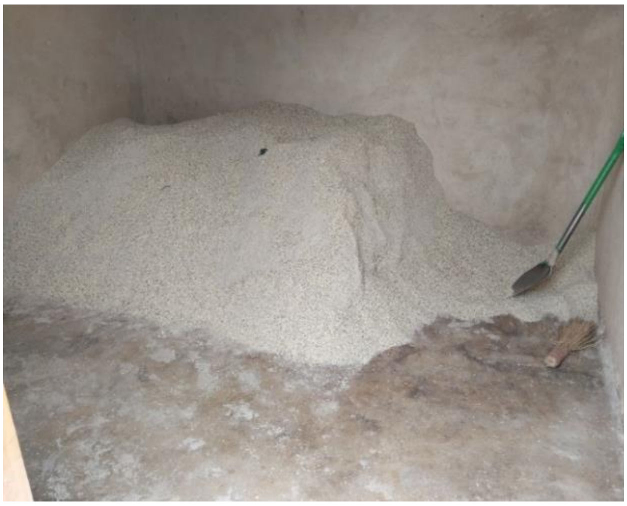

Figure 32: Feed mix for the layers.

Circularity and value chain integration

Mr Hussein links with different business in and outside the community (Figure 33). He sells his maize directly to the National Food Reserve Agency at their Iringa branch. He supplies milk to a local restaurant and sells about 8 litres of milk per day to the ASAS dairy company located in Iringa town and receives 1,100 Tsh. The poultry business is supplying eggs at a wholesale price of 7,500 Tsh per tray: 22 trays/week to an Iringa buyer; 3 trays daily to a local retail shop (Figure 34); 1 tray per day to Chips Kiosk; and 3 trays weekly for other retail shops in the neighbouring villages. Neighbours buy at least 4 fractured eggs per day. With the integration of other businesses in and outside the community, the farmer is assured a reliable market for his products. Selling in the community also helps him minimize the transportation cost. He sells large quantities of poultry manure to five irrigators from the Kiwere irrigation scheme and provides manure in kind to neighbours, who produce vegetable for their household consumption.

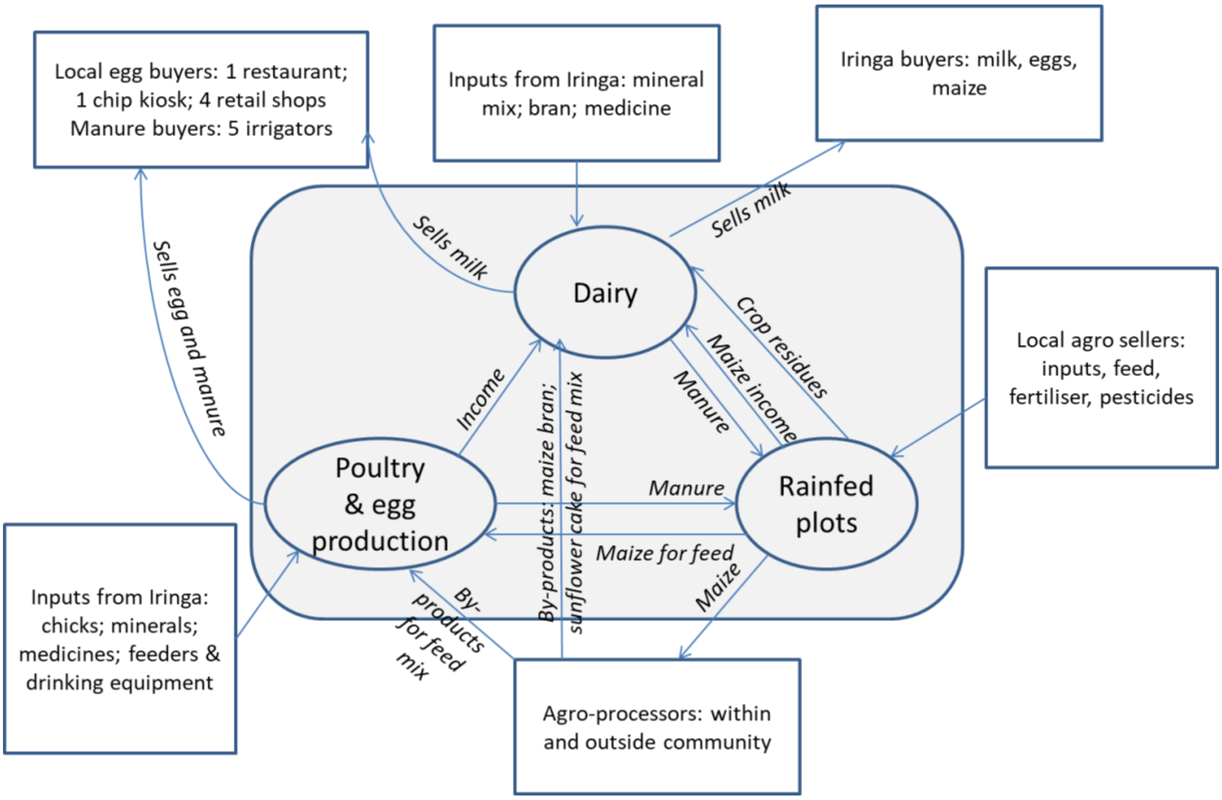

Figure 33: Value chain integration of Mr. Hussein businesses.

Figure 34: Eggs being sold in one of the retail shops in the community.

Lead farmer and community outcomes

Mr Hussein Kiangi said that “working as a lead farmer has enabled him to learn new practices, which enabled him to improve his businesses”. Socially “my fellow villagers are valuing and adopting the practices, which I am applying in my farm”. Four women and four men have adopted milk production after seeing Hussein making money selling milk daily. Three women and two males are from Mgera, and the others are from nearby Kitapilimwa village. The three women from Mgera are a nurse, a teacher and a farmer, while the two males are farmers. Four women (1 from Mgera and 3 from Kiwere village) have adopted the egg production business after seeing Mr Hussein’s success. After seeing his products for sale in the local shops or hearing from relatives buying his eggs, they asked him to train them on the construction of poultry sheds, feeding, vaccination and linking them with chick suppliers, and some visited his farm for learning purposes. Regarding maize farming, about 20 youth in the community have visited him for farming advice, such as manure application and seed varieties.

Outlook & lessons learned

Mr. Hussein has a plan to increase the area for maize production from 5.5 to 10 acres. He will also double the area where he applies manure i.e. from 1 to 2 acres. In response to increasingly unreliable and shorter rainfall periods, Mr. Hussein intends to shift to a short-maturing maize variety such as Dekalb (DK 80-31), which takes 90 days to mature. This will replace the Tembo (SC 717) variety, which takes 141-150 days to maturity. Looking ahead, he also plans to purchase a water pump to supplement his rainfed maize plot near the Little Ruaha River, enabling more reliable and potentially year-round production.

Mr Hussein's long-term plan for poultry is to have 2,000 chickens and to acquire additional land to expand the enterprise. He also aims to increase his herd to eight dairy cows and to irrigate three acres for tomatoes, watermelon, and green maize. As part of strengthening his on-farm logistics, he plans to obtain a truck to support his activities and hire additional labour as the enterprise grows. He has learned that poultry need to be fed with maize to improve egg production efficiency; hence, he intends to produce maize specifically to supply his poultry unit. Hussein believes it is important to start small and grow when starting a project. He also emphasises the value of maintaining alternative income streams and avoiding withdrawals from a business while it is still at an early, vulnerable stage.

Case Study 2: Mr. Sadro Midule, Mgera Village, Kiwere – Iringa District

Lead farmer & farm profile

Sadro Mdule is a 45-year-old male farmer in Kiwere and a father of 7 children (4 male. 3 female). His children (Figure 35) provide labour for most of the farm activities, including grazing and ploughing. He owns a 1.75-acre plot in Kiwere irrigation scheme, and he has been renting an additional 1-acre irrigated plot for the past three years. His main crop in the scheme is green maize. He also owns a 3.75 acre rainfed plot where he normally grows grain maize. Mt Sadro also keeps livestock: 27 cattle (14 bulls, 9 cows and 4 calves), goats and chickens. Ten of his bulls are trained for draught power, which he uses to offer ploughing services to other farmers in the community at a fee of 40,000 Tsh per acre.

Figure 35: Mr. Sadro's son closing the cattle pen opening

Farmer's journey and motivation

For years, Mr Sadro used chemical fertiliser in his maize farming, but he was obtaining low yields of less than one ton per acre. He used to sell manure from his cattle to other farmers within and outside the community, at a price of 50,000 Tsh per 4-ton truck. After realizing the importance of manure, and observing its benefits on neighbouring farms, he switched to using the manure on his farm. In the 2023 /24 season, he was selected to serve as a lead farmer under the CFS project. With guidance from the project officer and the extension officer, he started applying manure in his own farm and applied about 4 four-ton trucks of manure paying 70,000 Tsh per truck load for transportation to the farm. The 2023/24 season was the first season he applied manure, and he also applied thirteen 50 kg bags of fertiliser (DAP- 3, UREA- 7, CAN- 3). He had a yield of 4 tons per ha. of maize from the DK 90-89 Pioneer maize varieties. This is almost double the yield compared to the previous season, and he attributes the increase to the introduction of manure, higher fertiliser application, and better rains. In the 2024/25 season, he planted DK 90-89 and DK 80-31 maize varieties and applied nine 50 kg bags of fertiliser (DAP-2, UREA- 7). He used his own oxcart to carry approximately 40 carts (equivalent to about six 4-ton trucks). He therefore applied 24 tons of manure using labour provided by three family members. Hence, he had no manure cost during that season and harvested 3.6 tons per ha. In the 2024/25 season, most farmers experienced very low yields due to inadequate rainfall. The rainfall in 2024/25 was 571.44 mm, compared to 713.06 mm in 2022/23 and 963.52 mm in 2023/24

Evidence of adoption & impact first season

Mr Sadro adopted manure application in his rain-fed plot to increase soil health and minimize the use of chemical fertiliser. With the combination of manure and a smaller quantity of chemical fertiliser he has managed to increase both yield (1.68 ton/acre) and income. He also introduced dairy and chicken, which increased cashflow and overall income (Table 15). Taken together, Mr Sadro experienced significant increases in the gross margin (Table 16). As a result, he was able to build a three-bedroom house with burnt bricks and roofed with corrugated iron sheets, between 2023 and 2025.

Table 15: Adopted practices.

Circular practice	Area (Ha/acres)	Farmer feedback	
		Benefits experienced	Any challenges faced
Manure application	2.5 acre	Increased yield from less than a ton per acre to 1.68 ton/acre	Need to apply herbicide to manage heavy weed infestation.
Chicken rearing		Good source of protein for the family	Loss of chicks due to lack of vaccination
Livestock keeping	27 cattle	Provide manure for maize production Income from ploughing activities Milk for family consumption and source of income	Foot and mouth disease in 2024/25 season led to loss of two cattle. Shortage of pasture in dry season. Poor cattle shed leaves cattle sleeping in deep mud in the rainy season.

Table 16 provides a breakdown of the cost and return for three maize seasons. The 2022/23 was without manure application and in the 2023/24 and 2024/25 seasons manure was applied. Though the cost of production did not change much, yield and profit increased significantly.

Table 16: Gross margin analysis for rainfed grain maize with and without manure application.

Activities			
Planting season	**2022/2023**	**2023/2024**	**2024/2025**
Varieties	DK 90-89 and Pioneer	DK 90-89 and Pioneer	DK 90-89 and DK 80-31
Plot size (ha)	1.5	1.5	1.5
Fertiliser regime	Did not apply manure. Fertiliser: 9 x 50kg bags of fertiliser (DAP- 2, UREA- 5, CAN- 2)	16 tons of manure and 13 x 50kg bags of fertiliser (DAP- 3, UREA- 7, CAN- 3)	24 tons of manure and 9 x 50kg bags of fertiliser (DAP- 2, UREA- 7)
Expenses (Tshs)			
Farm preparation	90,000	90,000	90,000
Manure application	0	280,000	Used family labour
Seeds	240,000	240,000	240,000
Ploughing	Used own cattle	Used own cattle	Used own cattle
Planting	70,000	70,000	70,000
Weeding: 1st and 2nd (labour)	240,000	240,000	~~0~~
Fertiliser (2 times)	910,000	910,000	630,000
Pesticides	50,000	50,000	164,000
Fertiliser application	50,000	50,000	50,000
Pesticides application	Family labour	Family labour	Family labour
Harvesting	60,000	80,000	70,000
Transport	80,000	100,000	100,000
Shelling	70,000	120,000	110,000
Packaging	25,000	50,000	45,000
Total Cost	**1,885,000**	**2,280,000**	**1,569,000**
Yield (ton per ha.)	2	4	3.6
Income	2,000,000	3,600,000	3,150,000
Gross Margin	**115,000**	**1,320,000**	**1,581,000**

Circularity and value chain integration

The farm is linked with other businesses in and outside the community. The farmer buys inputs for his crop production locally and purchases medicines for his cattle from Iringa town, which is about 22 km from the farm. Milk is sold to a restaurant and families in the community. Maize is processed by the local miller for home consumption. He feeds his cattle the maize stover from both his rainfed and irrigation plots. Cattle are grazed in the rainfed plot and stover are brought home by donkey cart (Figure 36) and fed to cattle without chopping or urea enrichment. He uses maize bran from local millers to feed his dogs and chickens. He sells most of his maize unprocessed. The farm is also linked to markets that purchase produce from the farm: grain, green maize and cattle for slaughter. Mr Sadro benefits from these integrations by getting information on farm inputs from local agro shops, services such as milling, markets for his produce, and by establishing and maintaining social relations.

Figure 36: Cattle fed with maize stover from the irrigation scheme.

Lead farmer and community outcomes

Recognition of Mr. Sadro's work as a lead farmer has strengthened his position within the community, and his example has inspired other farmers to adopt agroecological practices. About 15 farmers in the community report learning from him how to make better use of on-farm resources, including recycling maize stover from both rainfed and irrigated plots as cattle feed, integrating livestock manure into crop fields to improve soil fertility, and linking crop residues with livestock feeding schedules to reduce waste. After observing these practices and the associated benefits, particularly improved yields and reduced input costs, other farmers in the community are increasingly applying these approaches in their own farms (Figure 37 and 38). In terms of benefits for his family, Mr. Sadro reports that beyond housing improvement, which is at the core of the benefits accruing from the proceeds of his farming, he notes that the improvements he has made on his farm have enabled him to increase yields, leading to higher income, which he spends on family nutrition, children's education, and other needs.

Figure 37: Pile of manure to other farmers plot in the community.

Figure 38: Farmer applying poultry manure to his tomato in Kiwere irrigation scheme.

Outlook & lessons learned

The case study provides a valuable lesson to farmers of the benefits of manure application in their plots. Major benefits observed are significant increases in crop yield and reductions in the use of chemical fertiliser. These benefits enable farmers to increase net income, which can be used to improve household welfare such as improving housing conditions. The CFS project provides a platform for Mr Sadro and other farmers to learn different technologies. The adoption of these technologies is slow, mainly because farmers face practical resource constraints including limited cash for buying inputs, shortage of labour at critical stages, and lack of basic tools needed to handle and apply manure properly. These everyday limitations make it difficult for many farmers to shift away from the familiar practices they have relied on for years, even when those practices are no longer profitable. As more households begin using manure, its availability will likely decline and prices will rise. Hence, Mr. Sadro and other farmers will need support to learn alternative soil-fertility options, especially composting and crop rotation, so they are not fully dependent on purchased manure.

Case Study 3: Mr. Shedrack Nzala, Magozi Village, Magozi – Iringa District

Lead farmer & farm profile

Mr Shedrack Nzala is a 42-year-old livestock keeper in Magozi village, Iringa district, Tanzania. In his farm he has 270 Zebu cattle. He grazes his livestock free range, in bush lands or in Magozi irrigation scheme after farmers harvest rice in June. Mr Shedrack is among the 126 Livestock keepers in Magozi community, which has a total of 3175 cattle, 2700 goats, and 1836 sheep. The community receives rainfall of 600mm per year, mean temperature of 25°C, which is favourable for livestock keeping. Some livestock keepers from neighbouring communities bring their cattle to graze in the Magozi scheme as the rules are very relaxed. With the large number of livestock grazing in the community, feeds and water are becoming insufficient. Because of this the area experience conflicts between livestock keepers and farmers over resource use. This challenge will increase when the rehabilitation of the Magozi scheme is completed as livestock keepers won't be allowed to graze their livestock in the scheme. That is a wakeup call for livestock keeper like Mr Shedrack, who for many years have enjoyed grazing in the scheme.

Farmer's journey and motivation

Mr Shedrack is facing the problem of poor growth and weight (Figure 39); hence, he had to keep cattle for about three years before taking them taken to the market. The prices he receives for the cattle is low considering the time it takes for them to be ready for sale. With the imminent loss of grazing in the scheme, fierce competition from other livestock keepers, and the increasing effects of climate change, feed options for his livestock are diminishing. Additionally, the area received sparse rainfall, which and therefore cannot produce sufficient feed throughout the year. Through the CFS project Mr. Shedrack learned new practices of improving nutritional value of rice stover by adding molasses and then feeding it to his livestock after one month. He also learned how to grow Super Napier grass to supplement crop residues, which were currently not sufficient to feed his animals in the dry season.

Figure 39: Cattle in poor condition at auction.

First season (2024/25) experience:

The first season of 2024/25 Mr. Shedrack was very reluctant to join the program. However, by observing the demonstration plot and experiencing persistent feed challenges he decided to join the program to save his cattle. By then it was late and the rain was about to stop. Another challenge was inability to access sufficient cuttings of Super Napier for planting. To overcome these challenges, he decided to plant earlier in the second season 2025/26. To access sufficient cuttings, the CFS project linked him with a CFS project super Napier demonstration plot in Kiwere (Figure 40). He managed to establish a 0.8 ha of super Napier in his rainfed plot, which can feed his cattle when fodders are scarce. He further established a one-acre plot near a water source (little Ruaha river), which can be irrigated and produce feed throughout the year. Within two years Mr. Shedrack wants to produce sufficient feed for his animals.

Figure 40: Loading of super Napier cuttings from Kiwere to Magozi.

Evidence of adoption & impact first season

Mr Shedrack has adapted four agroecological practices (Table 17) which are the use of crop residues for feeding livestock, use of manure for fertilization of fodder crops, use of by products for feed mix, and fodder production (super Napier).

Table 17: Practices adopted.

		Farmer feedback	
Circular practice	**Area (Ha/acres)**	**Benefits experienced**	**Any Challenges Faced**
Use of crop residue for feeding of livestock		Increased body weight of livestock Reduce burning of crop residue	Incur cost in transporting crop residue to feeding area
Use of manure for fertilization		Minimized fertilization cost by half -Increased fodder yield	High transportation cost to the fields
Fodder production	0.8 Ha of rainfed plot	Reduced mortality rate Improved animal health Improved livestock food security	Low rainfall which makes difficult to use rainfed plots for fodder production
Use of by-products for feed mix		Weight gain Decrease mortality of calves	Insufficient maize bran in the community

Use of by-products/value addition:

The farm uses by products and crop residue to feed the cattle, goats and sheep (Figure 41). By products which are available locally are maize bran, rice bran and sunflower cake. A large percentage of crop residues comes from rice, which is the main crop in Magozi irrigation scheme. Other crop residues include beans and maize stover. About 40% of Mr Shedrack's livestock feed now comes from crop residues, which sustain them from late June to November.

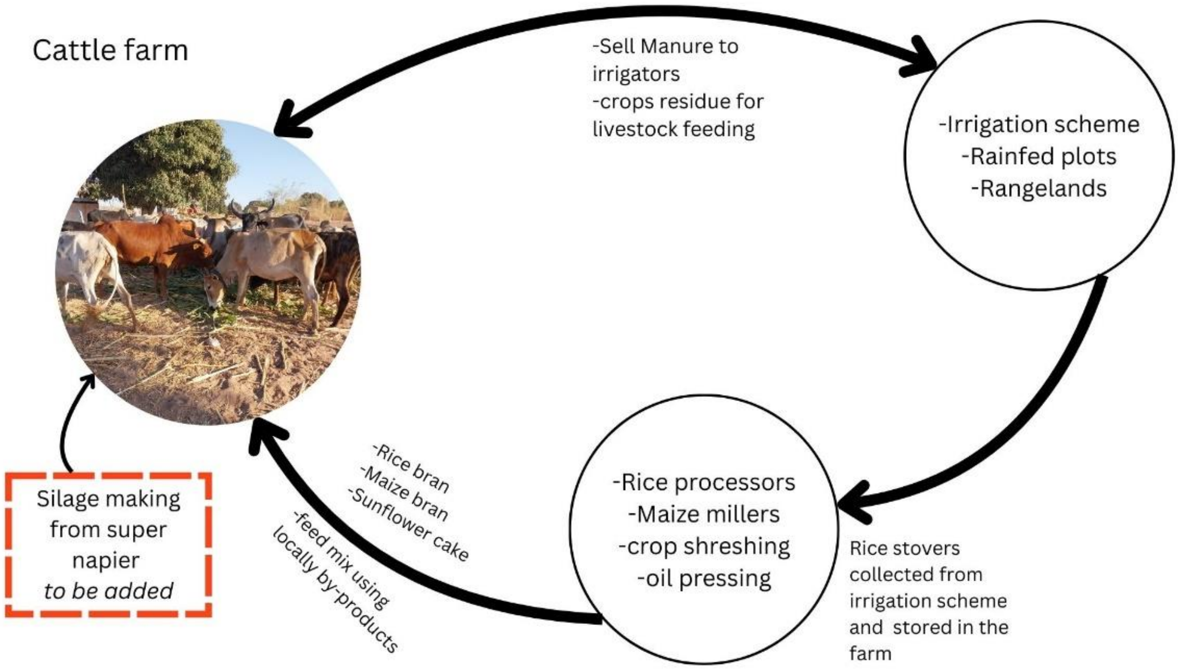

Figure 41: Circularity at the farm level.

Circularity and value chain integration

The Mr Shedrack's business integrates with other small businesses in the community (Figure 42). His farm supplies milk to 2 local restaurants daily and he links with local livestock auction where he sells at least 2 cattle and 3 goats per month. Buyers in these auctions use transporters to transport livestock to the end-users within and outside Iringa. The linkage with other businesses helps him to easily access markets for his products. Mr Shedrack is also linked with other stakeholders in the livestock value chain through the AIPs, where they share best practices, challenges and solutions.

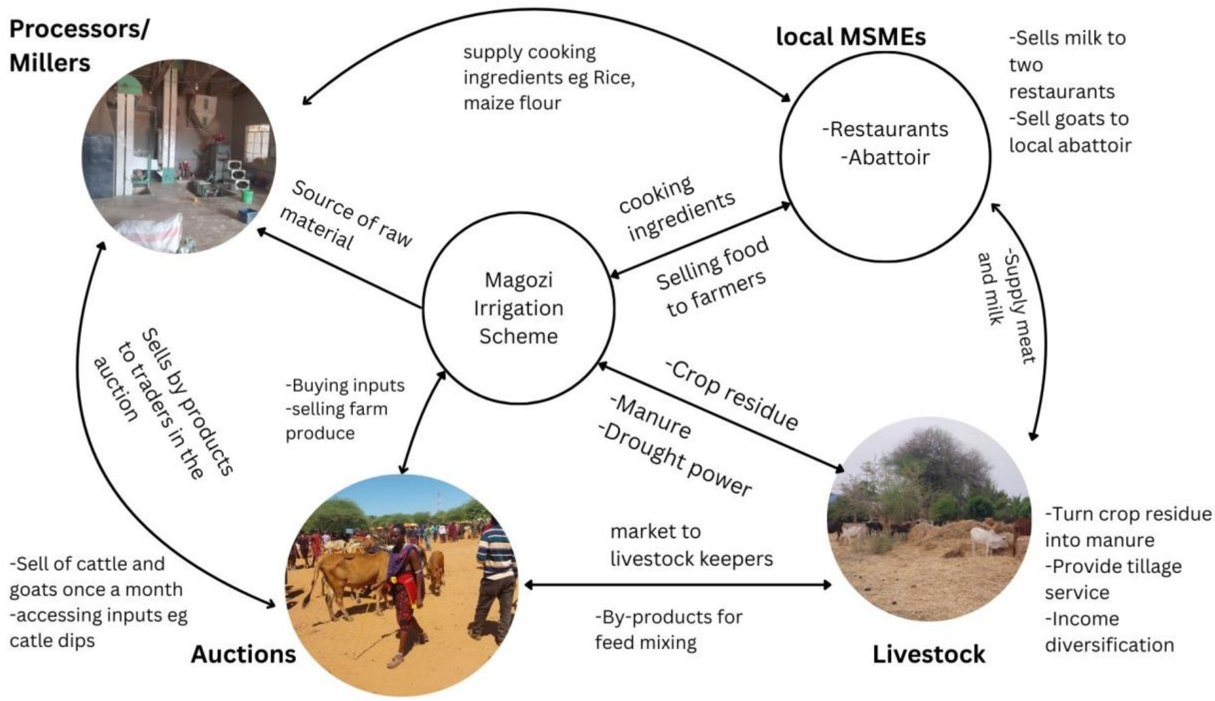

Figure 42: Circularity at the community level.

Lead farmer and community impact

Other livestock keepers in Magozi are learning from Mr. Shedrack and are beginning to adopt fodder production themselves. This shift is driven by a growing realization of the importance of dedicated feed cultivation, as pressure on shared crop residues intensifies. So far, three keepers have adopted the practice. The process is gradual, as many are accustomed to years of relying on freely available feed.

Outlook & lessons learned

Mr. Shedrack's long-term plan is to produce sufficient feed for his entire herd. He aims to reduce the distance his livestock travel for forage and intends to establish a fattening program before bringing animals to market. He believes that by ensuring his animals are healthy, he will secure better prices and a more assured market.

Changing mindsets requires time and patience. Demonstration plots have proven to be a powerful tool for inspiring this shift among farmers. Given the ongoing effects of climate change, it is increasingly important for livestock keepers to move beyond traditional practices and adopt climate-smart alternatives.

Case Study 4: Ms. Kalista Degela, Magozi Village, Magozi – Iringa District

Lead farmer & farm profile

Ms. Kalista Degela is a 45-year-old divorced woman with three children living in Magozi village. She owns a 1 ha irrigation plot within the Magozi irrigation scheme and a 0.8 ha rainfed plot. She uses the irrigation plot to grow rice and common beans, while maize and groundnuts are grown on the rainfed plot. She normally leases out 0.4 ha of the irrigation plot. Farming is her major source of income, contributing about 90% of household earnings. She expressed strong interest in learning new farming ideas, which motivated her to accept the role of lead farmer when the extension officer offered her the opportunity in late 2023.

Farmer's journey and motivation

Before the project, Ms. Degela grew rice only on 0.6 ha of her irrigation plot and did not cultivate crops on the rainfed plot in all seasons due to unreliable rainfall. Irrigation is the major source of crop production in the area; without irrigation, households previously depended on government food handouts. The main challenges she faced in farming included high production costs, low yields, low income, and high level of water use associated with rice production. Her engagement with climate-friendly farming practices began at the start of the 2023/24 farming season. She learned that residual soil moisture after the rice harvest could be used to grow common beans, thereby improving soil fertility while generating additional income within a short period. She selected common beans because they are a staple food in the community, making them easy to sell. With support from a peer farmer (Mr. Safari Mdindile), she learned how to grow common bean. The first season (2023/24) was challenging, as cattle frequently grazed on the farm, requiring her to spend most of her time in the field protecting the crops.

Evidence of adoption & impact first season

From the 2023/24 season, Ms. Degela adopted crop rotation, livestock integration, and manure application as new agroecological practices (Table 18). She initially practiced crop rotation on 0.4 ha of her irrigation plot, planting common beans in July 2024 after harvesting rice in late May 2024. During the 2023/24 season, she applied 100 kg of chemical fertiliser and harvested 0.8 t/acre. In the 2024/25 season, she applied manure, reduced chemical fertiliser use to 50 kg, and harvested 1.1 t/acre (Table 19). In both seasons, she used 50 kg of seed, with a spacing of 15 cm between plants and 50 cm between rows. Weeding was carried out once in both seasons, while fertiliser application was done twice during the 2024/25 season and once during the 2023/24 season. Pesticides applied included 0.5 litres of Profenofos 720 g/L EC and 1 kg of Mancozeb 80 WP as a fungicide. The crop booster used was 1 litre of NPK (10:10:40).

Table 18: Circular food system practices adopted 2023/24 farming season.

		Farmer feedback	
Circular practice	**Area (Ha/acres)**	**Benefits experienced**	**Any Challenges Faced**
Rice value addition	Milled 3.4 tons of paddy from 0.6 Ha and got 2 tons of rice	-More income -Rice bran for mixing pig feed	
Crop rotation -introduced common beans after rice crop (Figure 43)	0.4 Ha	-Increase of income from selling beans -Managed to get some money by selling beans residues to livestock keepers	-Grazing of cattle in the scheme area
Manure application	0.4 Ha 7 tons of manure was used	-Reduced fertilization cost by half -Good yield	-High transportation cost of manure due to distance from kraal to irrigation scheme
Livestock integration (started keeping pigs)	Started with 4 piglets (3 female, 1 male)	-Diversification of income -Collect manure for improving soil fertility	-high feeding cost -Poor bread which takes long time to mature

Figure 43: Irrigation plot growing common beans.

Table 19: Gross margin analysis for rice and common beans.

Input type	Irrigation 2023/24 -Rice	2023/24 - Beans	Irrigation 2024/25-Rice	2024/25-Beans
variety	Faya Dume	Uyole Njano	Faya Dume	Uyole Njano
Planting Date	10/01/2024	05/07/2024	05/01/2025	15/07/2025
Harvest Date	30/05/2024	30/09/2024	02/06/2025	03/10/2025
Expenses				
Seeds	12,000	150,000	12,000	150,000
Fertiliser	75,000	140,000	75,000	75,000
Chemicals	14,000	57,000	14,000	60,000
Manure application	0	0	0	150,000
Other costs (Water pump, fuel, water fee)	130,000	410,000	130,000	410,000
Labour (ploughing, farm preparation, weeding, harvesting etc.	900,000	500,000	960,000	540,000
Postharvest management cost- Chemical used	50,000	0	50,000	40,000
Transport/packaging	**185,000**	**30,000**	**185,000**	**40,000**
Total cost	**1,366,000**	**1,287,000**	**1,426,000**	**1,465,000**
Income (add up from fieldwork table)	**2,220,000**	**2,100,000**	**2,400,000**	**2,800,000**
Profit (Income less total cost)	**854,000**	**813,000**	**974,000**	**1,335,000**
Area in that crop (acres)	**1.5**	**1**	**1.5**	**1**
Yield (Kg)	**3,367**	**840**	**3,640**	**1,120**
Quantity sold (Kg)	**3,000**	**800**	**3,200**	**1,020**
Gross margin (profit/area)	**569,333**	**813,000**	**649,333**	**1,335,000**
Total number of household labour	**1**	**1**	**1**	**1**

The rice produced by Ms. Degela is processed locally (Figure 44), which enables her to obtain a better price and provides easier access to buy rice bran. She currently uses rice bran, maize bran, and sunflower cake to formulate feed for her new pig enterprise (Figure 45). By mixing her own feed, she has managed to reduce feed costs by approximately 50%. Maize bran and sunflower cake are purchased locally from maize milling and oil pressing machines in a nearby village. At present, she has not fully achieved circularity on her farm. Crop residues are sold to livestock keepers in the community, as she does not own cattle or goats to utilise rice straw or bean residues as feed.

Figure 44: Circularity at farm level.

Figure 45: Four piglets which Kalista started with in 2024.

Circularity and value chain integration

Ms. Degela's farm supplies raw materials which contributes to enhancing circularity at the community level (Figure 46) and sells beans and rice to two local restaurants (Figure 47), two retail shops (Figure 48), and one buyer from outside the community. The farm provides employment opportunities to four youth who are engaged in activities such as tilling, planting, weeding, fertiliser application, and pesticide spraying. Local businesses support the farm by providing reliable markets for produce and access to agricultural inputs, including fertilisers and pesticides. In turn, the farm contributes to the local economy, as hired labourers purchase food from local restaurants, with youth operating motorcycles and power tillers to transport fertiliser and manure to the farm.

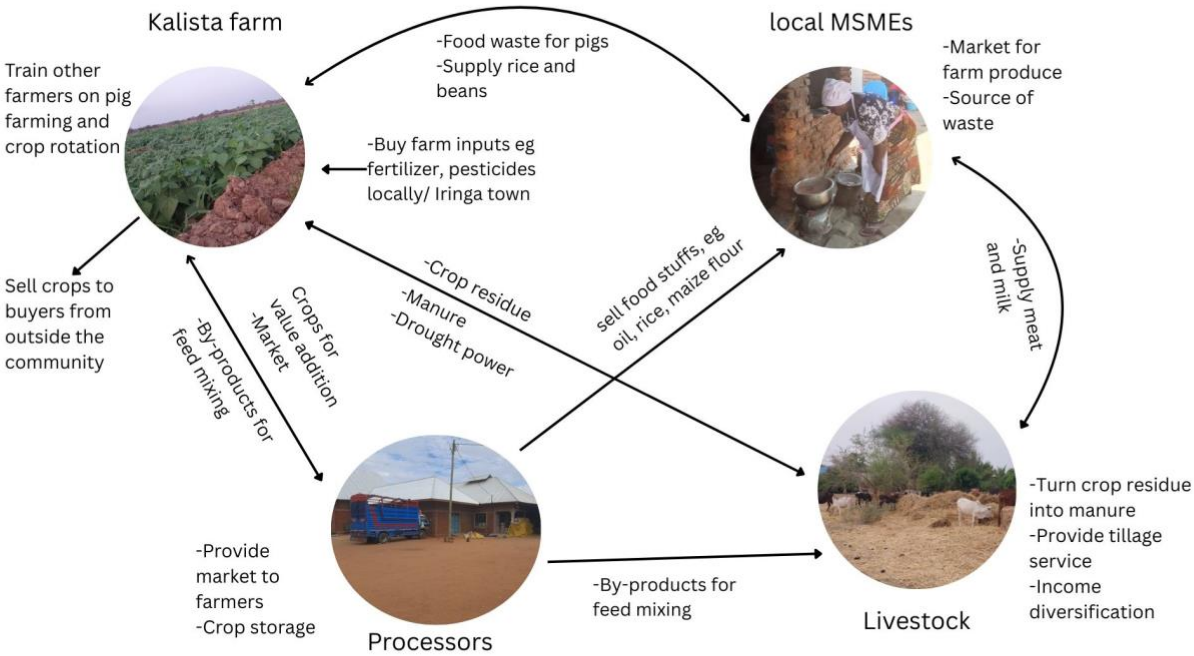

Figure 46: Circularity and value chain integration.

Figure 47: A woman cooking beans in a restaurant in Magozi community.

Figure 48: Common beans sold in a retail shop in Magozi community.

Lead farmer and community impact

Ms. Degela plans to ensure sufficient food production for her household while selling surplus produce within and outside the community to generate income for other household needs. In the 2025/26 season, she plans to apply manure from her pigs and to purchase additional manure from livestock keepers. Cultivating beans has demonstrated to her that higher income can be generated within a shorter period compared to rice, which requires more time and resources. Other farmers, particularly women, have begun visiting her farm to learn from her practices. Four women have adopted bean farming, and two have adopted pig farming after learning from her. One female farmer in the community, Ms. Mlaga, stated that "by learning from Kalista's farming practices, I have also decided to adopt bean farming for crop rotation and to improve fertility of my soil."

Outlook & lessons learned

Ms. Degela's long-term vision is to establish a well-functioning farm that integrates agroecological practices and maximizes the use of all farm outputs. She aims, for example, to apply manure consistently to reduce fertiliser costs. The case study provides lessons for other farmers seeking to diversify income sources or address soil fertility challenges. The use of legumes can contribute to household protein supply, generate income, and enable capital accumulation.

Mozambique

Introduction

Mozambique's agricultural sector plays a central role in rural livelihoods, food security, and national development. Agriculture contributes about 20–25% to GDP and remains the country's main source of income. It is dominated by family farms, which account for an estimated 95% of the cultivated area. Smallholder farmers drive production but face persistent challenges such as limited access to inputs, irrigation breakdowns, poor market infrastructure, and vulnerability to climate variability. These constraints have undermined productivity and household resilience, leaving communities dependent on costly synthetic inputs and exposed to environmental degradation.

The CFS Project was introduced as a timely intervention to promote sustainable practices that reduce costs, improve soil fertility, and strengthen food security. Although implementation began later than expected in 2024, the project started with a series of AIP meetings that emphasized the importance of nutrient recycling. Farmers were encouraged to incorporate crop residues into their fields and to avoid the practice of burning this valuable resource. During these meetings, participants were exposed to practical examples of circularity, which helped them understand the benefits of sustainable approaches.

To reinforce these outcomes, formal training sessions were conducted over a four-month period from August to November 2025. The training focused on biochar production, vermicomposting, and simple composting techniques, building on the foundation laid during the earlier AIP meetings. The project targeted lead farmers in two irrigation schemes 25 de Setembro (20 lead farmers) and Manguiza (20 lead farmers) as well as two lead farmers engaged in rainfed farming from communities near 25 de Setembro. However, engaging the farmers near Manguiza proved more challenging, as many participants came from diverse zones and distant communities, making coordination difficult.

Lead farmers are a critical part of the CFS strategy, particularly within the 25 de Setembro Cooperative and the Manguiza Irrigation Scheme in Boane District. The project accelerates adoption of sustainable practices through local leadership and peer learning. Lead farmers were selected in collaboration with irrigation management, targeting individuals who are committed, willing to take risks, and capable of motivating others by sharing knowledge and demonstrating new techniques.

The fields of the selected lead farmers served as demonstration sites, showcasing agroecological practices such as composting, mulching, crop residue incorporation, organic fertilization, integrated pest management, and intercropping. The lead farmers' role was not only to test and refine these practices but also to cascade knowledge to other farmers and the wider community. This approach embeds innovations within existing social and institutional structures, increasing the likelihood of widespread uptake.

The case studies show that lead farmers are beginning to integrate agroecological farming practices to transition their farmers into circular systems. In the schemes, farmers face unreliable water, poor input quality, limited machinery, and labour shortages. Agroecology addresses these via composting, mulching, and residue use. These practices also diversify production and create new income streams through by-product reuse. Their experiences highlight both the opportunities and constraints of transitioning toward more sustainable farming systems, offering lessons for broader scaling strategies.

Having lead farmers central to the CFS approach, has created a multiplier effect, tested and refined practices at the pilot level, which have been disseminated across irrigation schemes, strengthening resilience, increasing household incomes and improving livelihoods. With irrigation serving as an engine of growth, these improvements also enhance food security. The cascading model ensures that innovations spread through cooperative networks, ultimately contributing to more inclusive and sustainable rural development.

Case Study 1: Mr. Sérgio António Mulhanga, Manguiza, Boane District

Lead farmer & farm profile

Mr. Sérgio António Mulhanga, 45 years old, is married and the father of three school-age children. He initially joined the Manguiza Irrigators Association as an irrigator but later became a full member of the association. Today he is one of the lead farmers in the CFS project. His recognition as a lead farmer stems from his good relations with other association members and his strong commitment, dedication, and active participation in field activities, which has been acknowledged by the extension officers. Within the Manguiza Irrigation Association, Mr. Sérgio cultivates a 0.24 ha plot, primarily growing potatoes, maize, and green beans (Figure 49). He has practiced agriculture since his youth, accumulating about 25 years of experience. Currently, he dedicates most of his time to farming, working alongside his wife. His deepened involvement in farming followed his return from South Africa, where he had been employed in an agricultural company. This experience, and participating in conservation agriculture training, has provided him with solid technical knowledge and practical skills in land management.

Figure 49: Mr. Sérgio working alongside his wife.

Pre-CFS practices

Before joining the CFS project, Mr. Sérgio managed his farm using practices common in the region, such as burning harvest residues and relying on synthetic fertilisers, practices that are detrimental to soil bio-fauna. His agricultural activity was constrained by several challenges, particularly the high cost and limited accessibility of essential inputs such as fertilisers, seeds, and pesticide, frequently requiring negotiations with suppliers to arrange transport to the association, further increasing production costs. The challenges he experiences also affect the productivity, income and livelihoods of most smallholders. Another major constraint was inadequate availability of transport to move produce to markets and poor road conditions. As a result, farmers often relied on buyers purchasing directly from the fields who offered low prices.

Farmers in the region also faced frequent livestock theft, a challenge that discouraged local producers and undermined their role in circular food systems, thereby hindering the adoption of sustainable practices within the community. In addition, the irrigation system was unreliable due to recurring breakdowns of the motor pump, limiting the regular supply of water to farmers. Despite these obstacles, Mr. Sérgio consistently demonstrated curiosity and a willingness to learn.

Key practices adopted

The first year of implementation of the CFS project (2024/2025 season), represented an important phase of learning and reflection for Mr. Sérgio on CFS concepts. Although the term CFS was new to him, the associated principles, particularly the reuse and reduction of organic waste, were quickly assimilated, as they had already been promoted by other programmes and training courses he had attended. Thus, the project provided an opportunity to put previously acquired knowledge into practice.

After the harvest, Mr. Sérgio began adopting new agroecological practices (Table 20). He produced compost using organic waste (Figure 50). He constructed an open-air compost pile, though in a basic and somewhat precarious manner, leaving it directly exposed to solar radiation. This highlighted the need for technical monitoring and continuous training to improve the process. He also started using mulch to reduce water evaporation from the soil, conserve moisture, and suppress weed growth (Figure 51). He expected this technique to lower the frequency of weeding and watering. In addition, he implemented relay cropping between maize and green beans. This technique involved sowing green beans first, a nitrogen-fixing crop, and then introducing maize after the beans had produced two leaves. Since maize is more nutrient-demanding, this practice can promote a better nutritional balance in the soil, enhancing productivity and sustainability.

Table 20: Agroecological practices.

Circular Practice	Area (ha)	benefits	Challenges	Possible solutions
Composting	0.24 ha	-improves soil fertility and structure; -reduces reliance on synthetic fertilisers	-compost is insufficient to cover the entire cultivated area	-can scale up compost production by integrating crop residues, livestock manure, and community organic waste; -explore vermicomposting to accelerate decomposition
Mulching	0.09 ha	-reduces soil water evaporation, conserves moisture, and suppresses weed growth	-provided a habitat for pests such as Maria-café, which attacked crops and caused damage	-Can combine mulching with integrated pest management (IPM) practices
Relay Cropping (maize and green beans)	0.09 ha	-enhances crop diversification; green beans fix nitrogen in the soil, supporting maize growth and improving overall soil fertility	-limited scale of implementation reduced the full benefits of nutrient enrichment and diversification	-Can expand relay cropping to larger plots; rotate with other legumes (e.g., cowpeas, soybeans) to maximize nitrogen fixation and soil health

Figure 50: Compost pile made by Mr. Sérgio.

Figure 51: Weeding residues reused as mulch.

Farm performance

During the 2024/25 rainy season, Boane district experienced moderate to normal rainfall. Despite this, Mr. Sérgio relied on furrow irrigation, supplied through taps and hydrants located in the sub-blocks of the irrigation system, to meet crop water requirements. In this season, he cultivated maize, green beans, and potatoes. The yields obtained were 270 kg of maize, 250 kg of potatoes, and 130 kg of green beans. Maize was sold directly in the field as green mealies at 25 Meticais/kg, potatoes at 300 Meticais per 10 kg bag, and green beans at 40 Meticais/kg. Table 21 outlines the production expenses for the 2024/2025. The purchase of synthetic fertilisers represented the largest share of production costs across all three crops. These findings highlight the urgent need to adopt more sustainable and environmentally responsible practices that can reduce input costs, enhance profitability, and secure financial returns for smallholder farmers.

Table 21: Financial performance of farmer in the 2024/2025 and 2025/2026 season.

Item	2024/25			Projected 2025/2026		
	Maize (0.9 ha)	Sweet potato (0.09 ha)	Green beans (0.06 ha)	Maize (0.9 ha)	Sweet potato (0.09 ha)	Green beans (0.06 ha)
Soil Preparation						
Ploughing	337.5	337.5	200	300	300	180
Harrowing	337.5	337.5	200	300	300	180
Subsoiling	337.5	337.5	200	300	300	180
Seeds	550	5,250	650	550	5,250	650
Fertilisers						
NPK	2,200	2,200	1,000	1,000	1,000	700
Urea	1,250	1,250	500	600	600	400
Pig manure	0	0	0	500	500	300
Pesticides						
Abamectina	850	0	0	600	0	0
Mancozeb Metalaxyl	0	475	0	0	350	0
Belt	1,100	0	0	800	0	0
Cypermethrin	0	0	450	0	0	400
Amistar Top	0	550	0	0	400	0
Labour	300	250	200	200	150	100
Sowing	150	150	150	150	150	150
Irrigation (Rega)	1,700	1,700	1,500	1,500	1,500	1,500
Ash	0	250	200	0	200	200
Harvest	0	0	0	0	0	0
Total Production Cost (MZN)	**9,112**	**13,087**	**5,250**	**6,800**	**11,000**	**4,940**
Yield (kg)	**1,800**	**1,500**	**160**	**2000**	**1,800**	**170**
per/kg	**25**	**30**	**40**	**25**	**30**	**40**
Revenue (MZN)	**45,000**	**45,000**	**6,400**	**50,000**	**54,000**	**6,800**
Net Profit (MZN)	**35,887**	**31,912**	**1,150**	**43,200**	**43,000**	**1,860**

Circularity and integration in the value chain

Mr. Sérgio has adopted agroecological practices aimed at reducing production costs and maximizing economic returns on his farm (Figure 52). At present, he reuses organic waste left in the field after harvest to produce compost, thereby improving soil fertility and structure. He also incorporates pig manure into the soil as an additional source of nutrients, which is collected from pigsties in the region, Despite cultivating crops with strong market potential, Mr. Sérgio has not yet engaged in value-adding activities. For instance, maize is sold directly in the field in the form of green mealies, which dealers later resell boiled or roasted in local markets or along the roadside. With access to financing, he has expressed interest in packaging green beans, producing *piri-piri achar*, and processing tomatoes into paste. Currently, tomato production is constrained by limited transportation, leading to significant post-harvest losses. Transforming tomatoes into puree would reduce waste and improve overall yields.

Previously, Mr. Sérgio engaged in pig farming but abandoned the activity due to frequent thefts. He now relies on other farmers for manure. With adequate financial support, he intends to strengthen pigsty security and resume pig production, using agricultural waste and by-products as feed while reusing manure for soil fertilization. Such measures would reinforce the circularity of his production system, reduce dependence on external inputs, and enhance both the economic viability and environmental sustainability of his farming enterprise.

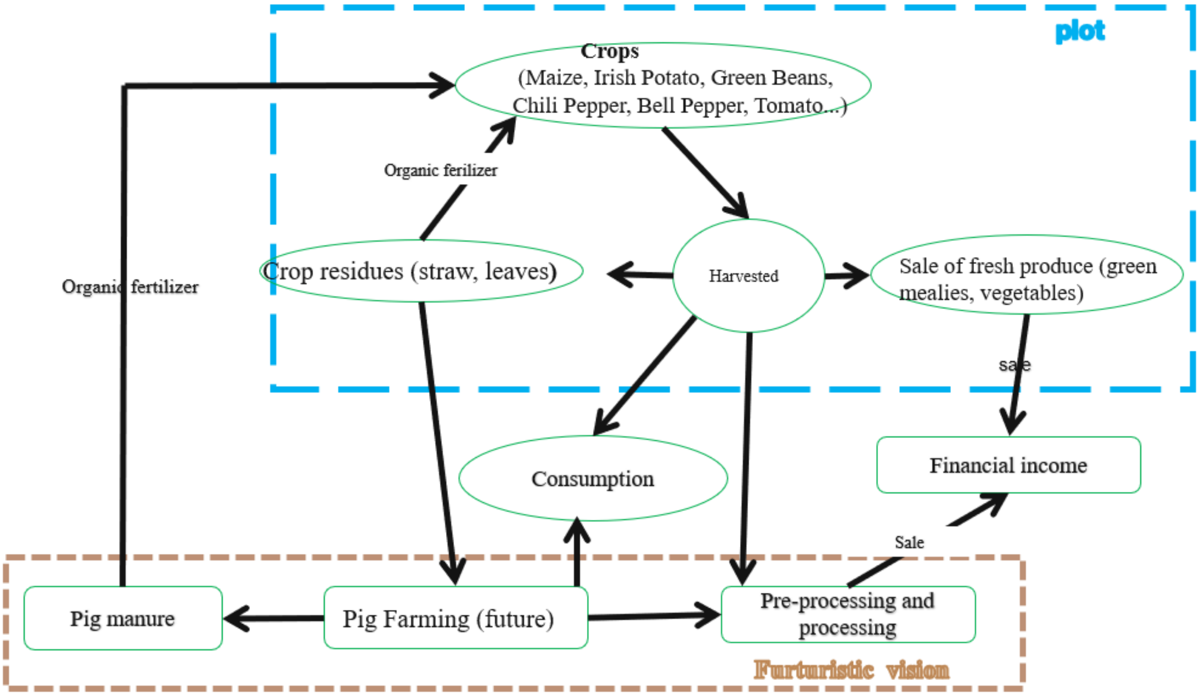

Figure 52: Diagram of Mr. Sérgio current and future food circulation.

Personal and family impacts of participating as a lead farmer in the CFS project

Since the introduction of the CFS project in the 2024/2025 season, Mr. Sérgio's household has already begun to experience tangible short-term benefits. Encouraged by the training and other activities of the project, household members have started reusing organic waste and participating more actively in farm activities, reflecting early behavioural changes promoted by the project. This is because the introduction of the CFS concept generated a lot of interest and high expectations given its effect on input cost reduction. These immediate improvements enhance daily living conditions and lay the foundation for longer-term impacts anticipated in subsequent seasons, such as stable income, and sustained food security.

At the community level, his involvement as a lead farmer has earned him respect and recognition. Other association members seek his advice, exchange experiences, and consult him on techniques introduced by the project. Such recognition has boosted his self-esteem and sense of responsibility, reinforcing his role as a leader. He expects to participate more actively in meetings, speak with greater confidence, and exert stronger influence in association decision-making processes.

Outlook

Based on the experience gained during the 2024/25 season, Mr. Sérgio's aim is to strongly focus on diversification and sustainability in 2025/26 season. In the rainy season, he intends to cultivate maize, *piri-piri*, and peppers, applying agroecological principles that have already demonstrated positive results in improving soil fertility through organic compost and in promoting the efficient use of water. He believes these crops are well-suited to summer conditions and require relatively low levels of irrigation. Looking ahead, Mr. Sérgio envisions his farm and the wider community becoming more resilient, productive, and sustainable, capable of generating income while improving household food security. He sees the CFS project as a key driver in achieving this vision by encouraging the reuse of organic waste, reducing production costs, and protecting the environment. To expand the adoption of these practices within the community, he emphasizes the importance of continuous training, field demonstrations, and awareness-raising activities among farmers.

Case Study 2: Mr. Hélio Samuel Herculano, Manguiza , Boane District

Lead farmer and farm profile

Mr. Hélio Samuel Herculano is a 65-year-old married father of six children, and a dedicated smallholder farmer whose life reflects resilience, commitment, and a deep connection to agriculture. His engagement in farming began 10 years back during his years as a civil servant, where agriculture served as both a livelihood support and a long-term investment in household food security. Following his retirement, farming became his primary full-time occupation and source of daily income and sustenance.

Mr. Hélio is an active member of the Manguiza Irrigation Association, where he cultivates approximately 0.75 hectares of irrigated land, including a greenhouse facility (Figure 53). Using irrigation, he can produce crops beyond the rain-fed season, contributing to stable household nutrition and reduced vulnerability to climate variability. In addition to crop production, Mr. Hélio practices integrated farming by raising rabbits, chickens, ducks, and pigs on a small scale. Although this livestock production is mainly for household consumption, it plays a critical role in improving dietary diversity, recycling farm by-products, and strengthening overall farm resilience.

Figure 53: Mr. Hélio next to his greenhouse.

Pre-CFS practices

Before joining the CFS project, Mr. Hélio's vegetable production was mainly focused on cultivating cabbage (0.08 ha), onion (0.01 ha), dry beans (0.01 ha), green beans (0.01 ha), and potatoes (0.27 ha). He commonly burned plant residues left in the field after harvesting and relied primarily on synthetic fertilisers for soil fertilisation. The use of organic fertilisers, such as compost and animal manure, was rare, mainly due to his fear of adding to his pest control challenges by introducing and spreading more pests in the field. Although he recognized the environmental benefits of organic fertilization, he opted for synthetic fertilisers, considering them safer under the prevailing pest pressure.

Coffee mite was among the major challenges faced by Mr. Hélio, which is a key pest that causes significant yield losses and negatively affects crop yield. In addition, his farming activities were constrained by the irregular supply of irrigation water due to pump breakdowns. He depends on a collective irrigation system, water access is strictly rotational, meaning he can only irrigate during his assigned time slot. As a result, even when crops experience acute water stress, he may be unable to irrigate at the most critical times, which limited production planning and reduced crop performance during critical growth stages. Market access also remained a major challenge due to the poor condition of rural roads. As a result, Mr. Hélio often had to join a large group of farmers to collectively rent transportation to reach the market. When collective vehicle renting was not possible, would be compelled to sell his produce directly at the farm gate, often at substantially lower prices, which reduced his income and undermined the profitability of his farming enterprise.

His main motivation for joining the CFS project as a lead farmer was the need to find sustainable alternatives that would reduce production costs, improve soil fertility, and strengthen his ability to cope with pests and other production constraints. Additionally, Mr. Hélio saw the project as an opportunity to acquire new knowledge, serve as a role model for other farmers in the association, and contribute to promoting more sustainable and resilient agricultural practices in the Manguiza community.

Key practices adopted

The first time Mr. Hélio was introduced to the CFS practices it was through the school-farm established by SDAE (Serviço Distrital de Actividades Económicas) and CITTAU (Centro de Transferência de Tecnologias Agrárias de Umbeluzi) in 2024/2025 season. He reacted positively upon observing satisfactory results in the crops. The practice that Mr. Hélio found interesting at the school-farm was the use of biopesticide. However, due to the volume of fresh material required and the need for a shredding machine to make biopesticide, it was not possible to apply the technique. The agroecological practices he adopted (Table 22) are being implemented simultaneously on different size of land. The main objective of their adoption is to reduce production costs and improve income.

Table 22: Agroecological practices introduced 2024/2025.

Practice	Area (ha)	Benefits	Challenges	Possible solutions
Mulching	0.75	-reduces water loss (20%); -lowers irrigation frequency (15%); -suppresses weeds (30%).	-labour intensive; -shortage of material; -delayed results.	-promote use of locally available organic waste. -encourage collective labour -sharing groups.
Pig Manure	0.08	-reduces synthetic fertiliser use (40%); -lowers costs (30%); -increases yield (+10%); -improves soil quality.	-pest risk (coffee mite); -manure handling difficulties; -limited supply; -dosage uncertainty.	-provide training on safe manure handling and application. -Explore alternative organic inputs to supplement supply.
Crop Residues (e.g. Cabbage, maize)	0.04	-enables full waste reuse (100%); -reduces fertiliser use (2.5%); -lowers costs (20%); -increases soil organic matter (+0.3%); -improves moisture retention (+10%).	-slow decomposition; -high labour demand; -pest risk if poorly managed; -delayed benefits.	-introduce composting techniques to speed decomposition. -Offer farmer training on safe residue management.

Note: All percentages are subjective estimates reported by farmers, not standardized scientific measurements.

Farm performance

During the 2024/2025 agricultural season, Mr. Hélio began to partially utilise agricultural by-products generated on his farm. Crop residues were sold to local pig farmers at a price of 100 meticais (MZN) per 50 kg bag, representing an initial form of direct economic valorisation of by-products. The residues that were not sold were incorporated into the soil to contribute to improved organic matter and soil fertility, in line with the circularity principles promoted by the CFS project.

Regarding land use and cover, no significant changes were recorded in the total cultivated area; however, a positive shift in management practices is anticipated, with a reduction in the burning of plant residues and an increase in their incorporation into the soil. This change is expected to contribute to better soil cover, greater moisture conservation, and a gradual improvement in soil structure, particularly in horticultural plots. However, the impacts of livestock manure and crop residues will be expected in the 2025/2026 season Mr. Hélio expects that, through the adoption of circular farming practices, his crop yields will increase. This anticipated improvement in productivity is expected to strengthen his confidence in the new techniques and encourage their continued application.

The main challenges he anticipates include rising and unstable production factor costs, limited labour during critical periods of the agricultural cycle, and technical and biological constraints. Furthermore, the farm is vulnerable to pest infestations, particularly coffee mites affecting potatoes, as well as rats and birds damaging maize fields. These challenges are expected to cause crop damage, reduce yields, increase vulnerability, and heighten production losses, undermining both farm productivity and household income. Table 23 below show 2024/25 performance and 2025/26 projections show compost cuts costs 25%.

Table 23: Farmer's financial performance in 2024/2025 and projections for 2025/2026.

	2024/2025 Price (MZN)				Projected 2025/2026 Price (MZN)			
Items	Potato (0.2)	Piri-piri (0.06 ha)	Pepper (0.05 ha)	Corn (0.125 ha)	Potato (0.2)	Piri-piri (0.06 ha)	Pepper (0.05 ha)	Corn (0.125 ha)
Land preparation								
Ploughing	2,500	250	200	500	2,500	250	200	500
Ridging	1,000	250	200	500	1,000	250	200	500
Planting	1,000	250	200	500	1,000	250	200	500
Seeds	32,000	-	765	900	32,000	-	765	900
Fertilisers								
NPK	4,000	2,250	800	1,500	3,000	1,500	400	1,000
Urea	1,000	1,350	900	1,700	500	900	350	600
Pig manure		-	-	-	-	500	300	500
Chicken manure		-	-	-	2,000	500	300	500
Pesticides								
Tamarom	-	750	-	-	-	500	-	-
Belt	400	-	-	1,100	200	-	-	500
Amistar	-	-	1,243	-	-	-	750	-
Copper	500	-	-	-	250	-	-	-
Malathion	600	-	-	-	300	-	-	-
Redomil Gold	500	-	1,061	-	250	-	700	-
Labour								
Permanent workers	4,600	4,600	4,600	4,600	4,600	4,600	460	4,600
Total Production Cost (MZN)	48,100	9,700	9,969	11,300	47,600	9,250	4,625	10,100
Yield	1,750	500	750	375	2,000	700	900	500
Corn Residue (100 MZN/50kg)	-	-	-	2,000	-	-	-	2,500
Price per kg (MZN)	40	300	279	35	40	40	300	279
Gross Revenue (MZN)	**70,000**	**150,000**	**209,250**	**15,125**	**80,000**	**28,000**	**270,000**	**142,000**
Net Revenue (MZN)	**21,900**	**140,300**	**199,281**	**3,825**	**32,400**	**18,750**	**265,375**	**131,900**

Circularity

Mr. Hélio's production is integrated into the local value chain through the sale of crop residues to pig farmers in the community, who use it as animal feed, and through the direct sale of his agricultural products in the local market (Figure 54). For Mr. Hélio, this connection allows him to generate additional income, reduce waste, and pollution through burning, while pig farmers benefit from a more accessible feed source. Incorporating unsold waste into the soil reinforces circularity by returning nutrients to the production system. Despite these advances, some by-products, such as crop residues from other crops, are not yet fully valued, representing an opportunity to further strengthen the integration of the value chain in the future

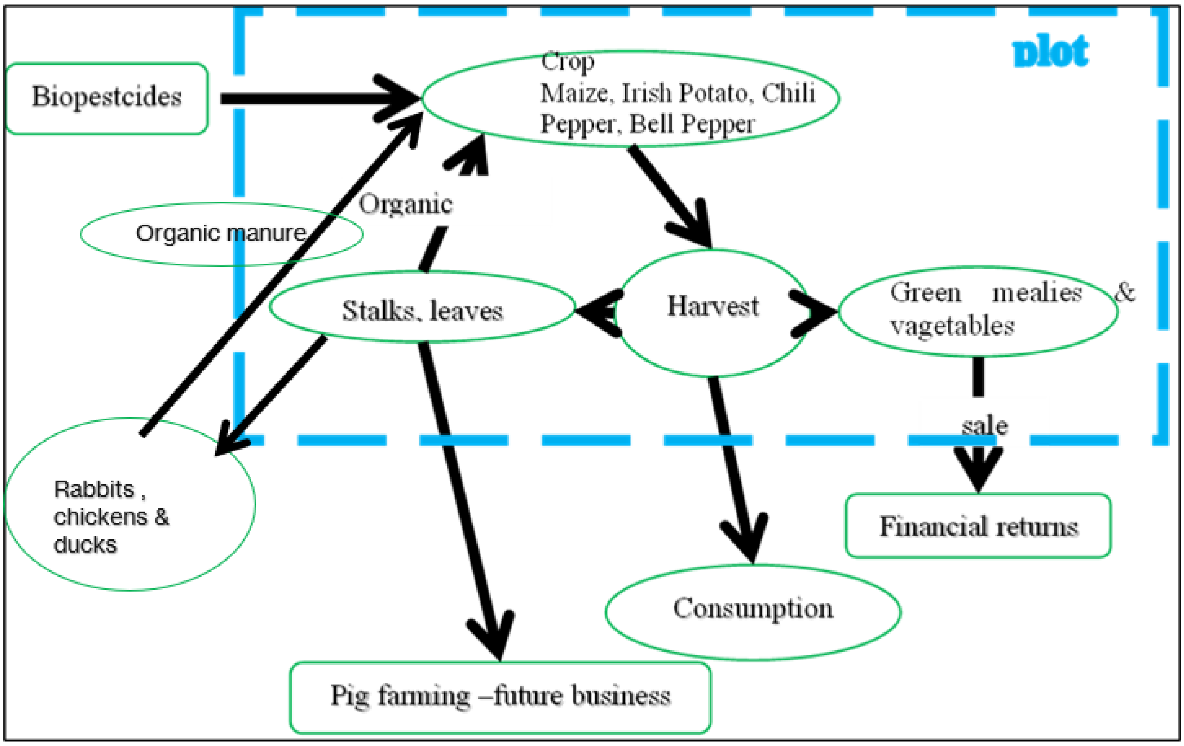

Figure 54: Diagram of the current and future situation of food circulation at Mr. Hélio's.

Personal and family impacts of participating as a lead farmer in the CFS project

Mr. Hélio's participation as a lead farmer in the CFS project is expected to bring positive benefits both personally and within his family. From an economic standpoint, the adoption of circular farming practices allows for a reduction in production costs. The reuse of agricultural waste and reduction in the use of synthetic fertilisers is particularly important and can contribute to greater stability in family income. Socially, his involvement as a lead farmer reinforced recognition and respect from the community and other farmers, increasing his self-esteem, sense of leadership, and his role as a local reference in sustainable agricultural practices. These factors have a positive impact on family well-being, promoting greater confidence in the future of agricultural activity.

To date, neither Mr. Hélio nor other family members have started a new business directly because of their participation in the CFS project. However, the valorisation of agricultural by-products and the knowledge acquired have opened prospects for future initiatives, such as expanding the sale of agricultural waste, producing compost, or processing products, should the technical and financial conditions allow.

The main challenges faced by Mr. Hélio in assuming the role of lead farmer included an increased workload, the need to balance his productive activities with demonstrations and knowledge sharing, as well as the high expectations of other farmers for immediate results. Additionally, he faced technical challenges associated with the initial adoption of circular farming practices, such as pest management, limitations in access to irrigation water, and the need for continuous technical support.

Outlook

Based on experiences from the first season, Mr. Hélio plans to produce corn and chili peppers in the summer and potatoes and bell peppers in the winter for the 2025/26 season, prioritizing the most profitable crops. He intends to continue and reinforce the use of agroecological practices such mulching, manure application and use of crop residues, especially in corn and chili peppers, while progressively increasing the use of organic fertilization. His vision for the farm is to make it more productive, sustainable, and less dependent on external inputs, also serving as an example for other farmers in the community. For the community, he aims for greater adoption of circular farming practices, cost reduction, and improved agricultural yields. Mr. Hélio believes that CFS practices contribute to this vision by improving soil fertility, reducing waste, and strengthening farmers' autonomy. To increase the adoption of CFS, more technical support, access to water, equipment, and collective organization are needed.

The main lesson learned is that the transition to circular farming practices requires patience, as the benefits are progressive but bring lasting gains for the farmer and the community. In addition, Mr. Hélio acknowledged that the application of composting may also bring new challenges, such as inadequate residues for composting, high labour requirements, pest threats, and difficulties in manure handling.

Case Study 3: Mr. José Francisco Davale, 25 de Setembro, Boane District

Lead farmer and farm profile

Mr. José Francisco Davale, 46 years old, is married and the father of ten children. He has been a member of the 25 de Setembro Cooperative for more than 20 years. From an early age, he learned to farm by working with in the family's fields. After completing high school, he joined an agricultural company in the Namaacha district, where he consolidated his practical experience. Driven by curiosity and a strong interest in exploring agriculture more intensively, Mr. José acquired skills in tractor operation, becoming a qualified professional in this field. Within the 25 de Setembro Cooperative, he was allocated one hectare of arable land, which he cultivates using a furrow irrigation system (Figure 55). Currently, he serves as the cooperative's main tractor driver, responsible for preparing the soil in the fields of other members who request his services.

Figure 55: Mr. José working in his one-hectare field.

Pre-CFS practices

Before joining the CFS project, Mr. José combined cropping with pig rearing. He received technical assistance and support from the cooperative. On his farm, Mr. José primarily cultivated maize, cabbage, and piri-piri using conventional production methods. For soil fertilization, he relied mainly on synthetic fertilisers because of their rapid nutrient release and immediate impact on crop growth. Despite these practices, he faced several challenges. The high cost and limited availability of synthetic fertilisers posed a major constraint. Frequent pest and disease outbreaks also required intensive use of synthetic pesticides, which were costly and had harmful effects on the environment, biodiversity, and farmers' health. Climate change further compounded these difficulties, with increasingly frequent extreme events such as floods and droughts threatening agricultural production and investment. In addition, limited access to finance for small-scale farmers restricted the adoption of new technologies and the implementation of value-adding initiatives.

Key practices adopted

Mr. José's initial reaction to the practices promoted by the CFS project was positive, largely because of the rapid soil recovery through composting. His main motivation for adoption was the expectation of higher crop yields. However, full implementation was constrained by the limited availability of organic fertilisers, particularly compost and pig manure, which required him to supplement with synthetic fertilisers. Despite these limitations, his overall experience was excellent, as he recognized significant potential for increased crop yields and improved income. The main challenges he encountered included the scarcity of good quality organic inputs, and high prices. These constraints made it difficult to maintain consistent production and profitability. To address these challenges, Mr. José has aligned his production strategy with market demand, prioritizing crops that are both profitable and easier to market, while integrating CFS practices. This approach enables him to reduce risks, manage costs more efficiently, and optimize his investments. Table 24 presents agroecological practices and expected benefits for Mr José.

Table 24: Agroecological Practices adopted by Mr. José.

Practice	Area (ha)	Benefits	Challenges	Possible solutions
Composting	0.125	-lower use of synthetic fertilisers - reduced fertilisation costs - improved soil organic matter	-availability of good quality organic materials -costly and labour-intensive -requires technical monitoring -benefits slow to appear	-promote use of locally available organic waste -provide farmer training on low-cost composting methods
Mulching	0.125	-reduced soil evaporation and irrigation frequency -lower weed growth -elimination of waste burning	- irregular supply of cover material -higher labour demand -gradual benefits	-encourage collective mulching initiatives -explore alternative cover materials
Organic fertilization (e.g. pig manure)	0.25	-reduced chemical fertiliser use - lower production costs	-risk of pests -limited access to quality manure	-training on safe manure handling

Practice	Area (ha)	Benefits	Challenges	Possible solutions
		-improved soil structure and water retention	-need for correct dosage	-support farmer cooperatives for sourcing
Organic fertilization (crop residues)	0.5	-full reuse of residues -reduced fertiliser use -gradual soil fertility improvement	-slow decomposition -risk of pests if poorly incorporated -medium-term benefits	-introduce composting/biochar techniques -offer extension support on residue incorporation
New maize varieties (PAN 53, DK 777)	—	-higher income -uniform production -better market acceptance	-high seed cost -dependence on imports -greater management demand	-provide subsidies/credit schemes -strengthen local seed distribution networks

Farm performance

In the 2024/2025 agricultural season, Mr. José's production relied mainly on synthetic fertilisers (Table 25). The largest share of his expenses was the acquisition of inputs such as fertilisers and chemical pesticides, followed by soil preparation operations, which he considers a key factor for successful agricultural production. During this season, he produced both maize and cabbage, selling the maize directly at the farm gate and the cabbage at the Zimpeto Wholesale Market. These sales generated substantial revenues, with net income reflecting the balance between high input costs and strong market demand. Looking ahead to the 2025/2026 season, the introduction of agroecological practices is expected to reduce production costs while increasing productivity. This shift is projected to improve both gross and net revenues, strengthening Mr. José's income base. Thus, the forecasted increase in net revenue margins between the two seasons is expected to boost household income, with positive implications for the well-being and economic security of his family.

Table 25: Farmer's financial performance in 2024/2025 and the projected for 2025/2026.

Items	2024/2025		Projected 2025/2026	
	Maize (1.0 ha)	Cabbage (1.0 ha)	Maize (1.0 ha)	Cabbage (1.0 ha)
Soil Preparation				
Harrowing (1)	1,350	1,350	1,350	1,350
Farming	2,700	2,700	2,700	2,700
Harrowing (2)	1,350	1,350	1,350	1,350
Grooving	1,800	1,800	1,800	1,800
Seeds				
Seeds	2,700	900	2,700	900
Fertilisers				
NPK	3,800	7,600	2,850	5,700
Urea	2,650	5,300	1,987.5	3,975
Pig manure	–	–	–	–
Compound	–	–	–	–
Pesticides				
Belt	–	2,400	–	2,400
Pyriproxyfen	3,000	6,000	3,000	6,000
Ampligo	–	1,400	–	1,400

Items	2024/2025		Projected 2025/2026	
	Maize (1.0 ha)	Cabbage (1.0 ha)	Maize (1.0 ha)	Cabbage (1.0 ha)
Bandit	–	3,000	–	3,000
Transport				
Car Rental	–	1,300	–	1,300
Labour				
Preparation of grooves	1,300	1,300	1,300	1,300
Sowing	1,300	2,600	1,300	2,600
Fertilization	3,900	3,900	2,925	2,925
Watering	5,028	15,084	4,274	12,821
weeding	2,600	3,900	2,080	3,120
Harvest	0	0	0	0
Market Price Meticais/kg)	35	12	35	12
Total Production Cost (Meticais)	33,478	61,184	29,616	54,641
Gross Revenues (Meticais)	210,000	528,000	241,500	607,200
Net Revenues (Meticais)	176,522	466,116	211,884	552,558

Circularity

Mr. José markets his produce through two main channels: cabbage is sold at the wholesale market, while maize is sold directly at the farm gate. In addition, he supplies part of his harvest to institutions such as schools with school lunch programs, student boarding schools, hospitals, and orphanages. These institutional buyers value his products not only for their quality and immediate availability but also for the reliability of bulk purchases and guaranteed payments, which provide greater stability in marketing. Beyond sales, Mr. José integrates agroecological practices into his production system. He reuses most of the plant residues left in the field after harvest. A portion of these residues is used as feed for his pig farm and compost, while the remainder is incorporated into the soil. This dual use of agricultural waste reduces external input dependence, improves soil fertility, and strengthens the sustainability of his farming system. Figure 56 shows the integration of circularity in the value chain of maize and cabbage for Mr. José

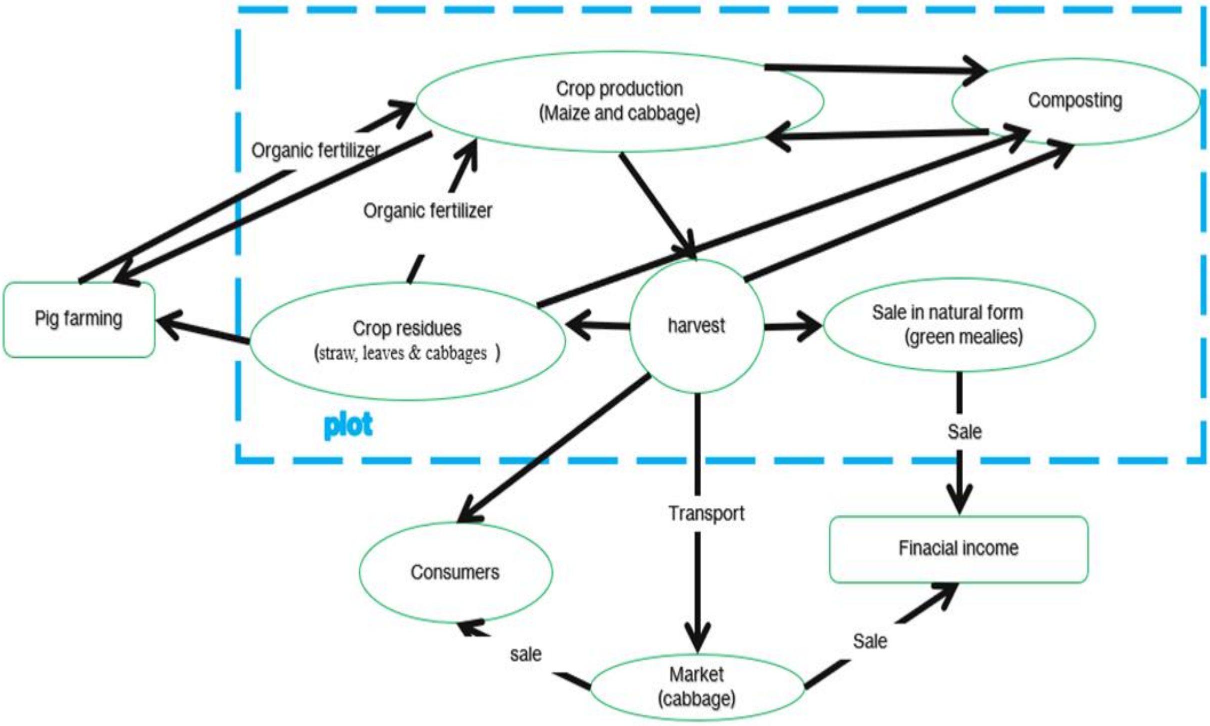

Figure 56: Diagram illustrating the current food circulation within Mr. José's enterprise.

Personal and family impacts of participating as a lead farmer in the CFS project

Mr. José's participation as a lead farmer in the CFS project has already generated positive impacts at the personal, family, and community levels during the 2024/2025 season. By disseminating agroecological and economically sustainable practices, he has strengthened respect, collaboration, and recognition among colleagues in the 25 de Setembro Cooperative Association. Looking ahead, the strong results expected on his farm will enable him to diversify his activities further, including expanding his pig project, which has the potential to enhance his family's economic security in the 2025/2026 season. His leadership role presents challenges, particularly due to the limited sharing of personal assets and equipment within the group. To address these constraints, Mr. José has encouraged colleagues to participate in community savings groups. This strategy mobilizes financial resources, allowing each farmer to acquire their own materials and inputs, thereby promoting greater autonomy and long-term sustainability.

Outlook

For the 2025/2026 agricultural season, Mr. José intends to continue cultivating maize and cabbage, which he considers the flagship crops of his farm. His production strategy is based on the implementation and consolidation of agroecological practices, including composting, the use of pig manure from his own livestock, and the reuse of plant residues generated after harvest. These residues are either incorporated into the soil or used as pig feed and to produce organic compost. Mr. José believes that the consistent adoption of these practices will improve soil quality, reduce production costs associated with external inputs, and result in higher-quality agricultural products. In his view, strengthening and expanding the use of circular systems within the community requires access to appropriate equipment. This includes machines for shredding excess straw after harvest, as well as tractors equipped with ploughs, harrows, and furrowers to ensure the proper distribution and incorporation of shredded plant waste into the soil. The main lesson learned by Mr. José is that quality production depends on quality inputs, such as seeds, fertilisers, and pesticides. To achieve efficient production while adopting agroecological practices, it is essential to guarantee the quality of inputs available on the market. He therefore argues that the government should strengthen supervision of the agricultural input market. Without such oversight, some producers may wrongly attribute poor results to agroecological practices, when in fact the problems arise from the low quality of inputs being used.

Case Study 4: Mr. Victor Francisco Magaia, Manguiza, Boane District

Lead farmer and farm profile

Mr. Victor Francisco Magaia is 38 years old, married, and the father of four children. He has been a member of the 25th of September Cooperative Association, for over ten years. He currently serves as the Vice-President of the cooperative. As part of his agricultural activities, he owns one hectare of arable land, which he irrigates (Figure 57).

Figure 57: Mr. Victor on his 1.0 ha plot of land.

Pre-CFS practices

Prior to his participation in the CFS project, Mr. Victor participated in the TISA project and benefited from technical support, in coordination with SDAE, as well as funding for the acquisition and installation of a motor pump for the association's use. He mainly produced maize, carrying out all soil preparation using the cooperative's tractor and adopting management practices based on the use of synthetic fertilisers, namely NPK and urea. The main challenges included the scarcity, high prices and poor quality of agricultural inputs, lack of transportation to get produce to market, and the absence of equipment for processing and adding value to agricultural products. Due to his openness to innovation and his leadership role, the local extension agent identified Mr. Victor as a lead farmer for the CFS project.

Key practices adopted

When the agroecological practices (Table 26) were introduced to Mr. Victor, his initial reaction was positive, as he anticipated improvements in soil condition, yields, and income. His main motivation for adopting these practices was to reduce production costs, increase productivity, and consequently improve family income and revenue. Mr. Victor has since adopted mulching, crop residue incorporation with pig manure, integrated pest management, new varieties, and intercropping. These practices are expected to improve soil health, reduce input costs, diversify production, and raise incomes, although challenges such as limited materials, odour management, technical skills, and seed access remain. Through intercropping cowpeas and pumpkins, Mr. Victor has successfully diversified his production. His experience has been positive, with crops showing good development while safeguarding biodiversity and the environment. The main challenge he faced during the season was limited availability of quality agricultural inputs on the local market. Despite this constraint, Mr. Victor continues to implement all the practices promoted under the CFS project, adopting them in a phased manner.

Table 26: Agroecological practices.

Practice	Area (ha)	Benefits	Challenges	Possible solutions
Mulching	1.0	Reduces soil evaporation (~30%); lowers watering frequency (~2.5%); decreases weed emergence (~30%).	Limited mulching material; labour intensive process.	- Promote use of locally available organic waste (e.g., grass clippings). -Encourage community labour-sharing groups to reduce workload.
Incorporation of Crop Residues & Organic fertilisers (pig manure)	1.0	Improves soil structure; reduces synthetic fertiliser use (~20%); increases maize yield (~10%).	Slow residue decomposition; requires technical knowledge on timing; odour and handling difficulties.	- Training on residue management and composting. - Introduce low-cost protective gear and odour-control techniques.
Integrated Pest Management	1.0	Cut pesticide use (~40%); lowers pest control costs (~30%).	Limited skills in pest identification; delayed visible results.	- Training on pest recognition. -Use demonstration plots to show gradual results.
New Varieties	1.0	Raise average income (~15%); better adaptation to local conditions.	Restricted access to improved seeds; higher initial seed costs.	-Strengthen seed distribution through cooperatives. -Provide subsidies or credit schemes for initial seed purchase.
Crop Intercropping	0.5	Enhances soil use; reduces pests (~20%); diversifies production.	Complex spacing/calendar planning; greater need for technical support.	-Develop simple intercropping guides with visuals. -Facilitate extension support visits during planting seasons.

Farm performance

During the 2024/2025 agricultural season, Mr. Victor's production costs for both maize and cabbage were substantial, yet his yields provided solid returns. On a 1.5 ha he produced approximately 2,800 cobs per tonne and 4 tonnes of cabbage, selling them at competitive market prices. These sales generated significant gross revenues, with net revenues reflecting a healthy margin (Table 27). Looking ahead to the 2025/2026 season, a notable reduction in production costs is anticipated for both crops due to the use of organic fertilisers. At the same time, productivity is expected to increase, with projected yields slightly higher than the previous season. As a result, gross revenues are forecasted to rise, and gross margins are expected to improve considerably.

Table 27: Farmer's financial performance in the 24/25 and 25/26 campaigns.

Items	2024/2025 Season		Projected for the 2025/2026 Season	
	Maize (1.0 ha)	Cabbage (0.5ha)	Maize (1.0 ha)	Cabbage (0.5ha)
Soil preparation	Price (MZN)	Price (MZN)	Price (MZN)	Price (MZN)
Grading (1)	2,700	1,800	2,700	1,800
Farming	3,600	2,250	3,600	2,250
Grading (2)	2,700	1,800	2,700	1,800
Furrowing	2,250	1,350	2,250	1,350
Seeds	2,700	900	2,700	900
Fertilisers				
NPK	14,000	7,000	11,200	5,600
Urea	10,000	5,000	8,000	4,000
Pig manure	0	0	0	0
Compound	0	0	0	0
Pesticides				
Belt	0	1,500	0	900
Pyriproxyfen	2,030	0	1,218	0
Transport				
Car Rental	0	1,300	0	1,300
Labour				
Preparation of the furrows	2,400	1,200	2,400	1,200
Sowing/Transplanting	2,400	2,400	2,400	2,400
Fertilizing	2,400	1,200	2,400	1,200
Irrigation	10,680	8,010	8,010	6,008
Weeding	8,000	8,000	5,600	5,600
Harvest	0	0	0	0
Total Production Cost (MZN)	65,860	43,710	55,178	36,307
Total Revenue (MZN)	210,000	55,000	231,000	60,500
Gross Margin (MZN)	144,140	11,290	175,822	24,192

Mr. Victor has not started working on value addition, but he is currently practicing the reuse of crop residues to improve soil fertility. His production is mainly marketed unprocessed, being sold to purchasing companies such as Mica, which reduces the potential for added income along the value chain. Despite this, Mr. Victor does not intend to replace the crops currently grown in the short term, opting instead to consolidate and improve existing production systems. The main challenges he faces include the scarcity of agricultural inputs in the local market, the low quality of some of these inputs, high prices, and the limited availability of agricultural machinery and equipment.

To mitigate these constraints, and strengthen the circularity of the production system in the community, he recommends that the competent authorities: i) strengthen the monitoring of the quality of agricultural seeds and pesticides, to guarantee their conformity and effectiveness; ii) create accessible financing mechanisms that allow farmers to acquire machinery and equipment; and iii) improve access roads.

Circularity

Mr. Victor's farming system operates on a circular model, where outputs from one activity feed back into another, creating a closed loop of resources. At the centre of the plot, maize and cabbage are produced using compost and organic fertiliser. Crop residues such as straw, leaves, and cabbage waste are recycled into compost, which enriches the soil and sustains crop growth. A distinctive feature of this model is the integration with neighbouring farmers. They use crop residues to feed pigs and, in return, provide Mr. Victor with pig manure free of charge. This manure is applied as organic fertiliser, reducing production costs and strengthening soil fertility. The exchange indicates how community cooperation enhances sustainability and resilience.

Harvested maize is partly sold in natural form as green mealies, generating immediate income, while cabbage is transported to markets and sold to consumers. This creates a flow of resources and earnings that supports household livelihoods. Figure 58 below illustrates this circular and integrated value chain, showing how farming activities, livestock, and markets are interconnected in a sustainable cycle

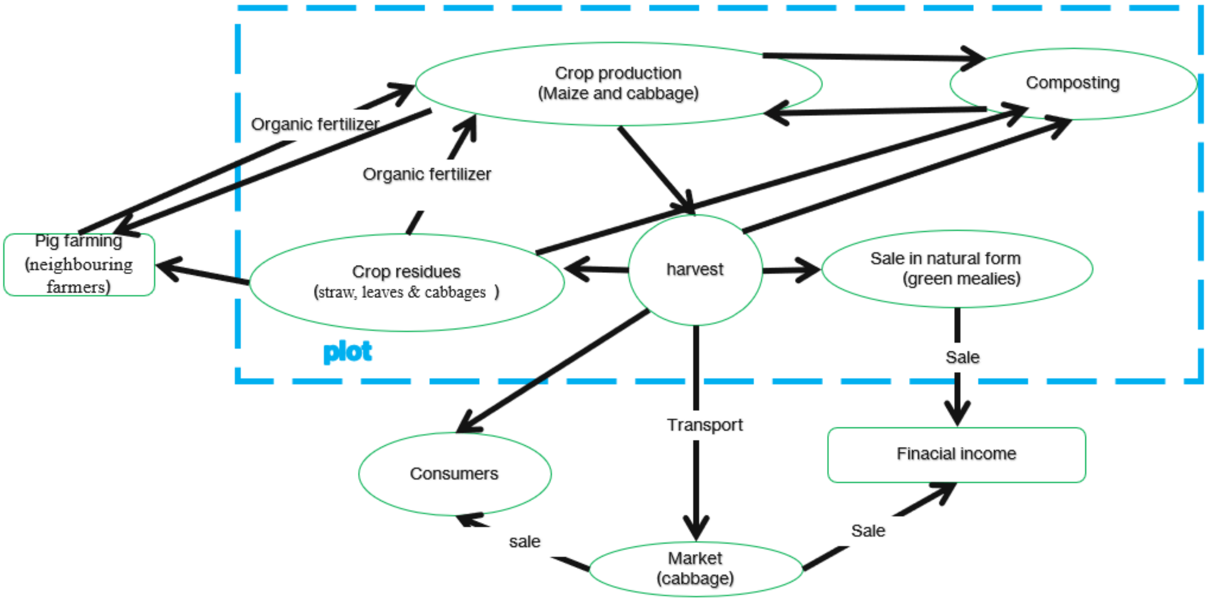

Figure 58: Diagram illustrating the current food circulation system at Mr. Victor's plot.

Personal and family impact of participating as a lead farmer in the CFS project

Mr. Victor's participation as a lead farmer in the CFS project has had significant positive impacts on the personal, family, and community levels. From an economic perspective, the adoption of agroecological farming practices has contributed to reduced production costs and greater stability in agricultural production, positively impacting family income. At a social level, his involvement as a lead farmer has strengthened his leadership position and increased recognition and respect from community members, who now see him as a role model for adopting sustainable agricultural practices. In terms of well-being, the diversification of production has improved food security for the household.

Within the family, one of the main benefits was the children's involvement in learning about food production. The family became interested in helping to spread crop residues and apply mulching in the field after learning that these practices can preserve moisture and enrich the soil. Participation in farm activities contributed to the children's training in agricultural practices, promoting the appreciation of agricultural work and the development of basic skills related to food production. However, neither Mr. Victor nor other family members started a new business directly because of their participation in the CFS project, maintaining their focus on consolidating existing agricultural activities.

Outlook

In the future, Mr. Victor intends to explore and intensify the use of organic fertilisers, especially cattle manure. This is because cattle manure has the capacity to cover a larger area compared to the small amounts of pig manure he receives for free from neighbouring farmers. And this can substantially improve soil fertility and reduce dependence on synthetic fertilisers. For circular food system or agroecological practices to become established and expanded within the community, it is essential to acquire agricultural machinery capable of performing most operations throughout the entire production cycle. This is because it will save on household labour and then channelled to picking crop residues and making compost. Additionally, strengthening the monitoring of the quality of agricultural inputs available on the market is fundamental to ensuring the effectiveness of the adopted practices and the sustainability of the production system. One important lesson learned is that increased family involvement in agroecology-linked farming is achieved when there is a clear explanation of the importance of adopting CFS practices

Conclusion

The 16 cases demonstrate how agroecological practices can transform smallholder systems across differing contexts, with lead farmers often hosting more than a hundred interested farmers at demonstration plots and inspiring mantras like '*Emasimini akula lutho olulahlwayo*' (nothing from fields wasted). The studies show that shifting towards more circular food systems is feasible and relevant in smallholder contexts, but it is not a one-off intervention. It is a gradual process of learning, adaptation, and system reorganisation. Across Tanzania, Mozambique, and Zimbabwe, lead farmers have demonstrated that combining agroecological practices such as nutrient recycling, crop–livestock integration, and feed valorisation can reduce dependence on external inputs, stabilise production, and diversify income. At the same time, outcomes depend on how well these practices are implemented, the quality of available inputs, and the broader constraints farmers face, particularly labour, capital, and climate variability.

The case studies show that adoption is strongest where practices are locally relevant and aligned with farmers' priorities. Many farmers began with practices that addressed immediate challenges and expanded gradually as they gained experience. However, persistent constraints, including access to labour, finance, organic inputs, irrigation, and appropriate equipment, continue to influence what can be adopted and sustained. Addressing these constraints will be important for translating early gains into broader system change. This highlights the need for continued investment in extension services, improved access to inputs, labour-saving options, workable finance, and reliable irrigation.

Across the three countries, there is also evidence of a shift in how farmers view their production systems, with materials previously treated as waste increasingly reused as productive inputs. This change in perspective underpins the adoption and adaptation of agroecological practices and supports longer-term system change. During the 2023/24 drought, farmers in Zimbabwe and Tanzania successfully preserved their livestock assets and livestock condition using low-cost interventions like urea-stover treatment, lick blocks, and fodder, effectively avoiding the mass cattle deaths seen in neighbouring communities without relying on expensive commercial feed. This success was driven by a gradual adoption model where progressive lead farmers first addressed immediate feed scarcity before soil fertility, while women played a pivotal role in leading demonstrations and gaining significant community influence. Although full implementation remains hindered by labour demands, biomass competition, and limited machinery, scaling efforts are gaining momentum through the development of local feed value chains, simplified tools like compost turners, and the distribution of training materials in local vernaculars. The key cross-country lessons emerging from these case studies are summarised in Table 28, which highlights the main drivers of adoption, observed outcomes, and their strategic implications for scaling circular food systems.

Table 28: Key Lessons from Lead Farmer implementation of Circular Food Systems.

Lesson	Evidence from the field	Strategic impact
1] Circularity is achieved through integrated systems, not single practices	Lead farmers combined composting, residue use, livestock integration, and intercropping, resulting in 25–60% input cost reductions and 10–50% yield improvements where practices were bundled.	Promote integrated practice packages rather than isolated interventions.
2] Nutrient recycling is a primary entry point for reducing input dependence	Composting, manure use, and residue incorporation reduced fertiliser use and improved soil structure and moisture retention, though results depended on input quality and correct application.	Strengthen soil fertility management through training on input preparation and quality control.
3] Livestock integration enhances income and resource efficiency	Crop–livestock systems enabled manure recycling, feed substitution (e.g., urea-treated stover), and more stable income streams across Tanzania and Zimbabwe.	Support integrated systems to improve resilience and diversify income sources.
4] Peer learning and demonstration drive adoption beyond direct beneficiaries	High attendance at demonstration plots and informal farmer visits led to early adoption beyond lead farmers in all three countries.	Scale farmer-to-farmer extension and demonstration-based learning models.
5] Adoption is gradual and shaped by resource constraints	Farmers adopted practices incrementally, prioritising those addressing immediate needs, with uptake limited by labour, biomass availability, and climate variability.	Design flexible, phased interventions aligned with farmer capacity and constraints.
6] Timing and seasonality influence uptake	Training aligned with agricultural cycles increased participation, while off-cycle introduction delayed adoption to subsequent seasons.	Align extension delivery with seasonal calendars to improve uptake.
7] Local context determines feasibility and scaling pathways	Tanzania focused on biomass and integration, Mozambique on irrigation constraints, and Zimbabwe on feed and nutrient innovations.	Tailor interventions to agro-ecological and institutional conditions; avoid uniform approaches.
8] Scaling requires complementary institutional and infrastructure support	Adoption was constrained by limited access to irrigation, machinery, labour, and organic inputs, particularly in Mozambique and Zimbabwe.	Combine farm-level practices with investments in infrastructure, input systems, and extension services.
9] Drought resilience	Zimbabwe and Tanzania farmers preserved livestock assets through 2023/24 drought using urea-stover, lick blocks, and fodder.	Feed substitution prevents asset loss, builds household confidence for climate shocks
10] Farmer-led scaling	Seen in all three countries; farmer-led demonstrations shifted mindsets	Field visits, extension uptake, community mantras show powerful leverage if infrastructure supports.

A consistent lesson is that the value of the lead farmer model lies not only in testing and adapting practices that have immediate value, but also in enabling peer learning and building trust within communities. Farmers are more likely to experiment when they can observe results under real conditions and engage directly with someone they know and trust. This has generated strong interest among surrounding farmers, with large numbers attending demonstration plots, visiting lead farmers, and some early adoption beyond the initial group. Uptake is gradual and uneven, reflecting the time needed for farmers to test practices in their own conditions, build up required inputs such as manure, and prioritise practices based on their resources and immediate needs. Managing expectations is part of this process. Benefits are often incremental, and early results can be mixed, especially where inputs are not well prepared or where practices are not applied correctly. Continued training, follow-up, and practical support are therefore important to sustain confidence and support adaptation over time.

While the qualitative evidence provides detailed insights into farmer experiences and adoption pathways, there is scope to strengthen the evidence base through more systematic quantitative analysis. A broader survey of lead farmers and other farmers in the same communities would allow clearer measurement of adoption patterns, economic returns, and the conditions under which these practices perform best. Overall, the findings indicate that circular food systems offer a practical pathway for improving resilience, reducing input dependence, and strengthening livelihoods, particularly when supported by continued learning, peer exchange, and appropriate institutional support. Farmer-led circularity offers proven pathway from input dependence to resilient, profitable systems. Paired with targeted extension/infrastructure, it scales rapidly through existing social proof.