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Integrating Climate Smart Agriculture Capacity Development in Outgrower Schemes: Insights from Musoma Food Company Ltd and G2L Ltd in Tanzania

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Preface

This paper forms part of a set of five Climate Smart Agriculture (CSA) innovation model papers that are premised on the adoption and integration of various climate smart agricultural approaches to smallholder farming in East and Southern Africa (ESA). Funded by the United Kingdom's Department for International Development (DFID), the cases draw on pilot initiatives within the Agricultural Development portfolio of the Vuna programme. The pilot projects are country-specific with different project components that are based on CSA. The papers explore the experience of different models designed to strengthen the delivery and uptake of climate smart agricultural practices, inputs and partnerships among smallholder farmers. Notably, the implementation period of the Vuna innovation models was short, ranging between 9 and 12 months. Consequently, the findings contained herein are based on emerging insights and the potential of the innovation models supporting farmer resilience in a scalable and sustainable manner. The innovation model series of papers sought to assess and identify early lessons emerging from the innovation model's adoption, uptake and ownership by implementing partners.

The series of the *innovation model papers* include:

- Building Climate Resilience for Dairy Farmers, through Climate Smart Solutions: Insights from the Malawi Smallholder Dairy Sector;
- Integrating Climate Smart Agriculture in Pigeon Pea Production: Insights from Export Trading Group in Mozambique;
- Integrating Climate Smart Agriculture Capacity Development in Outgrower Schemes: Insights from Musoma Food Company Ltd and G2L Ltd in Tanzania (this paper);
- Integrating Climate Smart Agriculture into E-Voucher Farmer Input Subsidy Programme: Insights from Zambia; and,
- Building Inclusive Seed Systems for Semi-Arid Areas: Insights from Zimbabwe Super Seeds.

The research was conducted between October 2017 and February 2018, in three phases. First, available literature on CSA, climate change and agriculture in the focus country and within the region was reviewed. Second, desktop research of Vuna project documents (baseline reports, quarterly reports, grant application(s), and the Vuna project plan) was done. Third, field research was conducted to assess the extent to which the innovation model has been adopted and whether it is being adapted to enhance desirable outcomes for key value chain actors. Field research results were analysed to determine the potential for the sustainability of the interventions.

Acronyms

AMCOS	Agricultural Marketing Cooperative Society
BSC	Beula Seed Company
CIMMYT	International Maize and Wheat Improvement Center – Spanish acronym)
CSA	Climate Smart Agriculture
DAICO	District Agriculture, Irrigation and Livestock Cooperatives Office
DFID	United Kingdom's Department for International Development
EAGC	East Africa Grain Council
FAO	Food and Agriculture Organization of the United Nations
GAP	Good Agricultural Practices
G2L	G2L Company Ltd
ICRAF	World Agroforestry Centre
IITA	The International Institute of Tropical Agriculture
MFCL	Musoma Food Company Ltd
NERICA	New Rice for Africa
NGO	Non-governmental organisations
QDS	Quality Declared Seed
SBL	Serengeti Brewers
TADB	Tanzania Agricultural Development Bank
TBL	Tanzania Breweries Limited
ToT	Training of Trainers
WEMA	Water Efficient Maize for Africa
WFP	World Food Program

Executive summary

Declining rainfall and frequent droughts have resulted in reduced and inconsistent yields across many regions in Tanzania, but significant practice change among smallholder farmers has yet to be observed. The '*Tanzania Climate Smart Agriculture capacity development in outgrower schemes*' project seeks to address two interrelated problems: (i) limited knowledge and skills among smallholder farmers to adapt to increasing climate variation and climate shocks that is resulting in declining yields, marketed surplus and incomes; (ii) low volume, poor quality and inconsistent supply of crop commodities to food processing companies that has resulted in underutilisation of capacity, threatening the viability of processing companies. This problem is being addressed through a Climate Smart Agriculture (CSA) capacity development program that also improves access to markets through an outgrower partnership with two food processing companies - Musoma Food Company Ltd (MFCL) and G2L Company Ltd.

Working with smallholder farmers, government extension and other private sector partners in the maize, rice, soyabean, common bean and sorghum value chains, the intervention aims to increase yields, quality and security of supply to the food processors to enable greater business efficiencies. This is being achieved through; (i) capacity building of extension workers through a CSA training programme. The extension workers in turn transfer CSA knowledge to farmers and support them to adopt CSA practices; (ii) improving market opportunities for smallholder farmers through an outgrower scheme with food processing companies.

Better skilled and informed extension personnel is expected to provide more relevant and effective knowledge and skills development for smallholder farmers. The model also encourages food processing companies to work with and incentivise extension personnel in order to improve their capacity and productivity. Ultimately, better skilled and equipped farmers will be better able to respond and adapt to climate challenges, and deploy CSA techniques and practices to protect, stabilise and enhance yields, improve product quality and as a result increase the supply of crops to processing companies. Higher and more stable yields, as well as an assured market for crops is expected to boost farmers' incomes and incentivise adoption of good practices, while increasing the processing volumes, improving capacity utilization and reducing overhead costs for the processing companies.

The paper assesses whether this initiative has been successfully adopted by the food processing companies, farmers, government and private sector partners and whether the changes are sustainable and are starting to drive a process of resilience building for key value chain actors including farmers and the food processors.

> "...better skilled and equiped farmers will be better able to respond and adapt to climate challenges, and deploy CSA techniques and practices to protect, stabilise and enhance yields,

The findings suggest that the interventions have been successfully implemented with the leadership of the two food processing companies MFCL and G2L. In the Lake Zone, MFCL currently has established supply agreements for key crops including maize, rice, sorghum and chickpea with 30 farmer groups or close to 8000 farmers from four regions – Shinyanga, Tabora, Geita and Simiyu. The company is processing an average of 9000 tonnes of maize, 25-29000 tonnes of rice and 4000 tonnes of sorghum every year. Maize deliveries are expected to reach annual figures of 21000 tonnes by May 2018. The second private sector partner G2L is also on course with delivery of project objectives. Despite a short time, window for implementing the project, the company has successfully established structures for farmer capacity development in its seven districts of operation, targeting the soyabean and common beans value chain. During the 2016-17 season, G2L contracted 533 smallholder farmers in seven districts in Ruvuma, Iringa and Njombe regions. This figure is expected to rise to 3533 during the 2017-18 season, reaching 7000 farmers by the 2018-19 season.

Although it is too early to attribute any hint towards a process of resilience building to this initiative, interviews with farmers suggest signs of impact of the partnerships on incomes due to more consistent access to markets. Due to consistent access to markets and the resulting higher incomes, farmers have been able to expand their production

operations, invest in livestock and other capital assets, and access yield enhancing inputs such as fertilisers, agro-chemicals and suitable seed for their areas. Higher incomes have also enabled farmers to improve human capital elements, such as their living conditions through better housing, as well as better healthcare and improved access to education. Production systems are also diversifying beyond maize and rice, particularly to incorporate legumes such as common beans and soyabean.

The introduction of drought tolerant sorghum by MFCL in the drought prone central areas of the Lake Zone is expected to further diversify production systems resulting in more stable yields and incomes. In the Southern Highlands, the introduction of common beans by G2L is enabling farmers to do three cropping cycles in one year due to its short growing season. Bean production is also allowing farmers to diversify beyond maize, minimising risks associated with adverse weather patterns and market uncertainty.

> Due to consistent access to markets and the resluting higher incomes, farmers have been able to expand their production operations, invest in livestock and other capital assets, and access yield enhancing inputs such as fertiliser, agro-chemicals and suitable seed for the areas.

A number of lessons emerge from the Tanzania CSA capacity building in outgrower model that are relevant for the design and implementation of CSA and resilience building interventions in smallholder systems. These are summarised below:

- Initiatives designed to build smallholder resilience to climate change should prioritise market access and security issues as an integral part of any CSA innovation. This case reaffirms that CSA practices are necessary but not sufficient to ensure smallholder resilience to climate change. System-wide resilience building needs to be guided by both climate and market risk considerations. CSA practices and technologies, therefore, need to be framed and embedded within market imperatives and not just climate risk concerns.
- Rigorous partner selection is critical to model success and needs to consider the commercial capacity and corporate willingness to invest, long term in the proposed innovation. The different capacities of the two partner firms in this case have implications both for intervention support needs and model sustainability.
- The nature of project support for a partner is determined by their specific capacity needs and incentives. The level of that support nevertheless needs to be pitched carefully so as not to discourage or undermine the partner ownership and responsibility.
- Public-private collaboration on extension service provision is critical to its sustainability and outreach. Effective collaboration implies identifying appropriate and innovative models for joint delivery and offering incentives to government personnel.
- The use of formal contracts and agreements within outgrower schemes provides for clarity as to the responsibilities of each party but has limited utility in enforcing those responsibilities in practice. The effectiveness and sustainability of outgrower schemes lies in the establishment of mutual trust between parties over time.

> Initiatives designed to build smaller resilience to climate change should prioritise market access and security...

1 Introduction

Climate change is altering rainfall patterns and inducing more severe and frequent extreme weather events such as droughts and flooding in many parts of East and Southern Africa[1]. These changes threaten to deepen the challenges already being faced by millions of farming households. The situation is even more alarming in regions that are already semi-arid where climate risk is endemic. Unless decisive adaptation action is taken to build resilience of the agricultural sector, food insecurity and poverty are set to worsen. Effective response measures are urgently required to sustainably increase productivity, stabilise yields and diversify production systems while building the adaptive capacity and resilience of farming communities.

CSA is the most promising adaptation approach for the agricultural sector that has gained much traction among governments, non-governmental organisations (NGOs), private sector and donors. CSA has been formally defined by the Food and Agriculture Organization of the United Nations (FAO)[2] as consisting of three components: (i) sustainably increasing agricultural productivity and incomes; (ii) adapting and building resilience to climate change; (iii) reducing and/or removing greenhouse gases emissions. The concept of CSA has now been widely adopted at various levels. Significant levels of national and international funding are correspondingly being allocated to the development and promotion of CSA.

A key challenge is prioritising an extremely broad array of agricultural practices, technologies, institutional arrangements, and activities now being called "climate smart". Equally lacking is an understanding of both the effectiveness and sustainability of different models for rolling out CSA.

This paper assesses the climate smart agricultural practices implemented under Vuna's portfolio of projects in the sector, highlighting strengths and weaknesses in design and implementation and crafting recommendations for best practice. Specifically, the paper discusses how effectively the '*Tanzania CSA Capacity Development in Outgrower Schemes*' project has been adopted by key actors and its potential for driving sustainable outcomes for key actors in the face of a changing climate. The paper concludes by summarising key lessons and insights that are intended to inform decision making by key state and non-state actors, as well as the design and implementation of related interventions within East and Southern Africa where smallholder farmers and other value chain players continue to face similar challenges.

1.1 Local livelihoods system

Smallholder farmers in Tanzania are persistently grappling with low yields and poor quality for most major crops such as maize, rice, beans and soyabean. Yields of 1-1.2 tonnes/hectare for maize and 0.3 tonnes/hectare for sugar beans are typical, which are only a quarter of potential of Tanzanian farming systems. With a changing climate associated with lower and more erratic rainfall, yields are likely to decline even further unless production systems adapt. The impacts of poor productivity and the increasing climate risk threaten food security and incomes for farming households and reduce the consistency of volumes and quality of crop available to processing companies. Levels of awareness and technical appreciation of CSA practices and technologies remain low among farmers as well as extension staff whose services are regarded as 'extremely dated'.

1. IPCC, 2014
2. FAO, 2013; p. ix

Supported by Vuna, a United Kingdom's Department for International Development (DFID) funded CSA programme, the '*Tanzania CSA Capacity Development in Outgrower Schemes'* project was set up in 2016 to address this problem by training extension workers (and, in turn, farmers) to increase their understanding and use of CSA practices. The project is working with two food processing companies - Musoma Food Company Ltd (MFCL) and G2L Company Ltd (G2L) – through an outgrower model, to ensure there is a guaranteed off-take for the produce and to embed CSA within the practices and decision making of these private partners. The project is supporting maize, rice, soyabean and bean farmers to increase yields, increase incomes and increase the security of supply to the processors to enable greater business efficiencies.

The Vuna supported interventions are focused in two regions with contrasting agro-ecological potential. MFCL is based in Shinyanga, in the semi-arid central part of the Lake Zone, also with operations in Tabora Region in the Western Zone. Although the Sukuma-Nyamwezi people who dominate this region are originally pastoralists[3], production of maize and rice are now key agricultural activities. The other partner G2L, is based in the highly productive Southern Highlands Zone, which is regarded as the agricultural hub of the country. Key crops grown in this zone include maize, rice, common beans, soyabean and groundnuts. Horticulture, tea and timber plantations are also important economic activities in the region.

1.2 Climate risks and impacts

Tanzania's rainfall follows two regimes: a bi-modal pattern for the Northern Coast and Zanzibar, North Eastern Highlands and Lake Victoria basin, with short rains between October and December and long rains between March and May; and a uni-modal pattern for the Southern, Central and Western parts of the country, with the rain season between November and April. These seasonal patterns are changing due to climate change. The long rains used to come at the beginning of March but now only arrive at the end of March or in April. According to researchers at the Ukiriguru Agricultural Research Institute, even the bi-modal system of rainfall is now confusing[4]. The short rains are now more unpredictable with frequent dry spells that make it difficult for farmers and other players to plan their activities. The increased frequency of extreme events such as droughts and flooding is also a cause for concern and is receiving significant research attention[5]. A drought during the 2016-17 season in the central parts of the Lake Zone including Shinyanga is a typical example of this challenge. In the Southern Highlands were G2L operates, flooding is becoming a problem in some areas (Figure 1 and Annex 1).

Other climate change related challenges include increasing incidences of diseases such as fusarium wilt in very dry locations like Shinyanga, blight and aflatoxin in humid regions, and saltwater intrusion in the coastal regions[6]. Pests including stalk borer, cassava green mite, are also cited as a growing problem during dry periods[7].

At the national level, appreciation of climate change and its impacts is relatively high, particularly among ministerial, research and academic personnel, as well as within agribusiness. A climate change adaptation strategy for the agricultural sector has been developed by the Vuna supported Tanzania Climate Smart Alliance that is coordinated from the Environmental Management Unit of the Ministry of Agriculture, in partnership with national (e.g. University of Dar es Salaam) and international organisations such as The International Institute of Tropical Agriculture (IITA), FAO and World

3 Per Comm. With Dr Moses Kusiluka, Vuna Tanzania Country Representative
4 Insights shared at the CSA forum held with researchers at Ukiriguru Agricultural Research Institute
5 Per Comm. with Dr Emma Liwenga, Institute of Resource Assessment, University of Dar es Salaam.
6 Per Comm. with various researchers at Ukiriguru Agricultural Research Institute
7 Insights shared at the CSA forum held with researchers at Ukiriguru Agricultural Research Institute

Agroforestry Centre (ICRAF). Overall direction and coordination for climate change response has been elevated to the highest level, through the Climate Change Focal Person located in the Vice President's Office. National CSA Guidelines have also been finalised and are available to key stakeholders.

At the local level, the impacts of climate are widely appreciated and farmers are actively working with other players such as researchers and academics to improve practices and technologies that respond to moisture stress, shorter growing seasons, salinity, higher temperatures, and emerging diseases and pests as well as flooding (Figure 1). Other adaptation needs for smallholder farmers relate to improving access to high quality, adaptable seed - particularly for legumes - and improving market access through better aggregation and connection with vibrant markets[8].

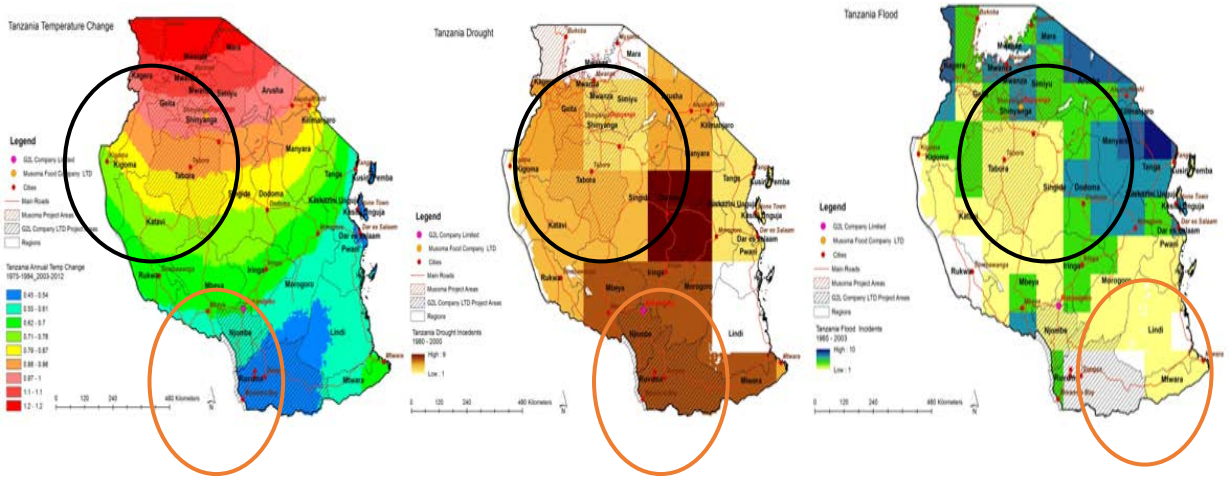

Figure 1: Temperature Change (left) Drought (middle) and Floods (right) in Tanzania. The project areas under Musoma are highlighted with the black circle and the areas under G2L by the orange circle

1.3 Structure of the market system

MFCL is based in Shinyanga and works with farmers in the Lake Zone and the Western zone sub-regions, which include Shinyanga, Mwanza, Kagera, Geita, Simiyu and Tabora. They are the largest distributor of maize flour in the region and focus on processing maize flour, rice and sorghum for brewing beer. They supply wholesalers, retailers, institutional buyers and individuals within the lake region, large corporate clients such as Tanzania Breweries Limited (TBL), Serengeti Breweries, and the World Food Program (WFP). G2L operations are centred in Makambako in the Southern Highlands and they work with farmers from seven districts in the Ruvuma, Iringa and Njombe regions.

Both food processing companies have highlighted climate variability and extreme events such as droughts and floods as key threats to their operations. These are worsening the challenges they already face due to current low yields. The result is underutilisation of processing and production assets, posing a major risk to the viability of their business models and further diminishing the prospects for involvement of smallholder farmers in commercial activity.

Weak supply of quality seeds for distribution to farmers, particularly for beans, is an ongoing challenge. Few seed companies (mostly small to medium-sized, recently established, e.g. Beula Seed Company) are multiplying and marketing certified bean seeds. These are perceived as less profitable for seed companies than other cash crops and maize,

8 Per Comm. with Dr Emma Liwenga, Institute of Resource Assessment, University of Dar es Salaam.

resulting in limited investment in legume seed production. A number of large fertiliser and agro-chemical suppliers such as Yara, Bayer and Syngenta are also present in the market, and are actively working with food processing companies in these outgrower partnerships with farmers.

From the government side, the main players include the Ukiriguru Agricultural Research Institute that focuses on research on major crops within the Lake Zone, Tumbi Agricultural Research Institute for Western Zone, as well as Uyole Agricultural Research Institute for the Southern Highlands. These institutes are key partners in the supply of climate resilient germplasm generated through their breeding programmes. They have been particularly successful in multiplying seed for drought tolerant, short season and disease resistant crop varieties through the New Rice for Africa (NERICA) and Water Efficient Maize for Africa (WEMA) programmes.

1.4 The nature of the problem facing Tanzanian smallholders

The problems being faced by Tanzanian smallholder farmers are threefold: Firstly, declining rainfall and frequent droughts have resulted in reduced and inconsistent yields, but significant practice change amongst smallholders has yet to be observed. The use of CSA technologies and practices is limited. Many smallholders lack access to relevant, up-to-date information and skills development in CSA practices and technologies. Secondly, access to extension information is limited. Government funded extension provision remains limited and out-of-date, whilst private actors have yet to step in to provide these services themselves. Third, the falling productivity and unstable yields amongst smallholders has resulted in inconsistencies in their ability to access commercial market opportunities. As smallholder production and productivity has fallen, buyers and processors are facing increasing challenges to sustain their businesses. The falling offtake amongst smallholders and the associated low capacity utilization of food processing plants directly threatens viability of firms, if left unaddressed, is likely to reduce further smallholder access to secure markets for their produce.

2 Innovation model description

2.1 Innovation model rationale

The innovation model addresses two interrelated problems: (i) a lack of knowledge and skills among smallholder farmers to adapt to climate variation and shocks resulting in declining yields, marketed surplus and incomes; (ii) inconsistent, low volume, and poor-quality supply of crop commodities to food processing companies resulting in underutilisation of capacity at around 40% and threatening the viability of those companies. These inefficiencies are driving up the cost of production for the companies, and if not addressed, would result in higher food prices for the basic staples as costs are likely to be passed on to the consumer. Even with higher prices, such low capacity utilisation puts the long term viability of processing companies at risk.

Most processing companies have sought to alleviate this by increasing the number of farmers in their outgrower networks and sourcing from further afield, increasing transportation costs. Little investment has gone into supporting farmers to increase yields or quality of their produce or to stabilise production in the face of climate change through the use of CSA technologies and agricultural practices.

Working with smallholder farmers in the maize, rice, soyabean, common bean and sorghum value chains, the intervention aims to increase yields, quality and increase the security of supply to the food processors to enable greater business efficiencies. This is being achieved through; (i) capacity building of extension workers through a CSA training programme. The extension workers in turn transfer CSA knowledge to farmers and support them to adopt CSA practices; (ii) improving market opportunities for smallholder farmers through an outgrower scheme with food processing companies.

2.2 The innovation model

This intervention uses an outgrower model, anchored around two food processing companies - MFCL and G2L Ltd. These companies contract smallholder farmer groups to supply crop commodities such as maize, rice, sorghum, soyabean and common beans that are processed for various local and regional markets. With support from Vuna, the two companies run a capacity development programme to integrate CSA best practices, tools and technologies into existing extension services, in collaboration with the government extension system, and other private sector value chain actors. The CSA capacity building target each crop type in the companies' value chain and is tailored to the local context. The capacity development programme was designed and rolled out through a train-the-trainer (the extension officers) followed by cascading of this training to farmers in each district of focus (See Boxes 1.1 and 1.2). The training materials draw from the latest and most relevant CSA knowledge, information services and technologies, to ensure the methods promoted are based on global best practice and are rooted in local requirements. Farmers are also supported to establish demonstration plots to encourage practical learning and to showcase best practices.

- Development of CSA Training Modules and Messaging Material for Extension staff and lead farmer capacity building.
- Delivery of Training of Trainers (ToT) on CSA sessions
- Cascading of training to farmers
- Profiling potential existing producer groups to be engaged in soyabean and common bean contract farming and provision of training on contract farming
- Aggregation of demand for Inputs for each producer groups and mobilisation of inputs based on demand
- Establishment of CSA demonstration plots
- Management of aggregation centres.

Box 1.1: Main activities of G2L

- Conducting a climate smart assessment study
- Building capacity of targeted farmers and extension officers on climate smart agricultural practices
- Building capacity of farmers in agribusiness matters through Farmer Business Schools
- Setup a suitable agricultural inputs distribution approach to enable farmers access appropriate CSA inputs
- Setup a rural aggregation system to support contract farming with the smallholders.

Box 1.2: Main activities of MFCL

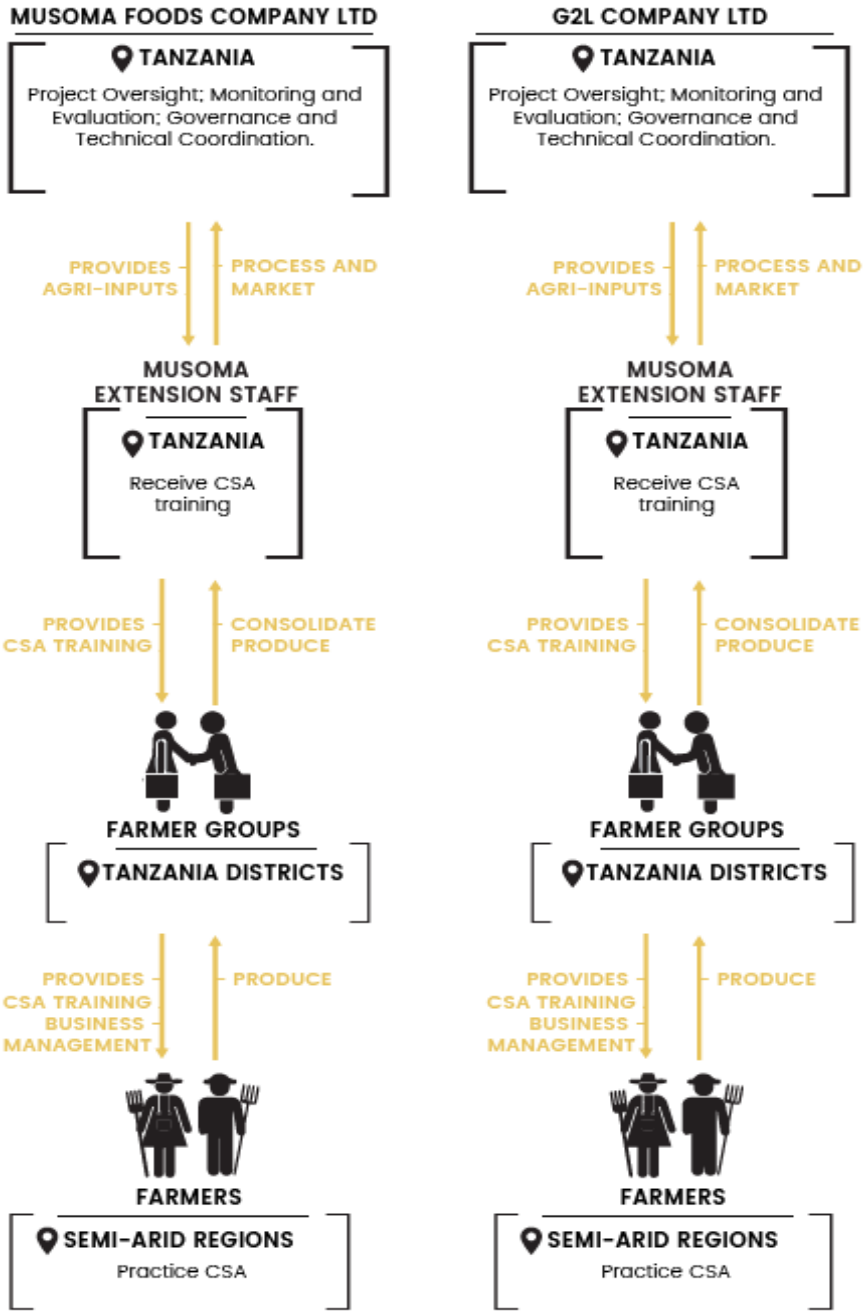

Figure 2: Structure of Tanzania outgrower business model

2.2.1 Key stakeholders and their roles

The MFCL and G2L models builds a partnership between a number of critical market players from private, public and non-governmental institutions. Table 1 below summarises the key stakeholders in the two business models and their roles.

Table 1: Stakeholders in MFCL and G2L business models

Company	Stakeholder	Type of organisation	Roles
G2L	• Syngenta Ltd • Bayer Agro-services • Yara Ltd • Agri-uyole • Beula Seeds	Input suppliers	• Supply of seed, fertilizers, and agro-chemicals to farmers • Partners in CSA extension and training, establishment of demonstration plots, field days
	• Mtewele General Traders • Rubuye Agro-business Co. Ltd, Lipambi Kayika Agrovet • Madaba agro-chemicals • Alfa Agro-chemicals	Agro-dealers	• Partners in supplying of inputs to farmers • Training and extension on CSA • Aggregation of produce
	IITA	CGIAR – International Research Institute	• Breeding and supply of climate resilient Early Generation Seed
	Uyole Agricultural Research Institute	National Research Institute	• Research on major crops within the Southern Highlands Zone
	Government extension workers (District Agriculture, Irrigation and Livestock Cooperatives Office - DAICO)	Government extension services	• Partners in CSA extension and training, establishment of demonstration plots, field days, day-to-day monitoring
	• Caritas • BRITEN • RUDI • Nafaka FtF	NGOs	• Training and extension on CSA
	NMB, Tanzania Agricultural Development Bank (TADB)	Financial Institutions	• Financial services to G2L
	East Africa Grain Council (EAGC)	Trading platform	• Regional trade facilitation
	Local wholesalers and retailers, consumers	End-market buyers	• Final demand for processed food products
MFCL	DAICO	Government extension services	• Partners in CSA extension and training, establishment of demonstration plots, field days, day-to-day monitoring • Aggregation of produce

Company	Stakeholder	Type of organisation	Roles
	NMB, Access Bank, and TADB	Financial Institutions	• Financial Institutions • Production finance for farmers
	EAGC	Trading platform	• Regional trade facilitation
	• Syngenta Ltd • Bayer Agro-services • Yara Ltd	Input suppliers	• Supply of seed, fertilizers, and agro-chemicals to farmers • Partners in CSA extension and training, establishment of demonstration plots, field days
	Ukiriguru Agricultural Research Institute & Tumbi Agricultural Research Institute	National Research Institute	• Research on major crops, CSA within the Lake Zone and Western Zone
	TBL, Serengeti Breweries, WFP, local wholesalers and retailers, consumers	End-market buyers	• Final demand for processed food products

2.2.2 Model theory of change/results chain

How the model is designed to build resilience

The intervention is designed to build resilience of both smallholder farmers, private food processing companies and other value chain actors within the market system. Working with both government and private sector partners, the programme aims to develop improved CSA extension materials and training programme through which to build the capacity of existing extension officer networks. Better skilled and informed extension personnel will then provide more relevant and effective knowledge and skills development for smallholder farmers. Importantly, the model seeks to encourage processors to work with and incentivise extension personnel to improve their capacity and productivity in terms of engagement and outreach.

Ultimately, better skilled and equipped farmers will be better able to respond and adapt to climate challenges, and deploy CSA techniques and practices to protect, stabilise and enhance yields, product quality and supply to processing companies.

Stable demand for raw materials by the processing companies is expected to further incentivise farmers to adopt good practices, resulting in further yield improvements, higher incomes and improved food and nutrition security. Higher incomes will also boost farmers' buying power and demand for CSA technologies and other yield enhancing inputs. The income effect is also expected to drive investments in other forms of capital assets as well as into diversifying the production system in a manner that spreads both climate and market-related risks.

Higher and more reliable yields will strengthen the supply chain of the processing companies, increasing their processing volumes, improving the levels of utilisation of current plant assets and reducing overhead costs. Improving efficiencies of processing companies will reduce production costs, boost profits and also result in lower prices for consumers. Strengthened processing companies will also create more economic opportunities locally, create employment and more demand for crop produce from local farmers.

How the model is designed for sustainability and scalability

The potential for sustainability of the model is anchored on the converging interests of key value chain players such as farmers, food processors, input suppliers and other stakeholders. While farmers are interested in a stable and rewarding market for their produce, the food processing companies are equally keen to secure a consistent market for good quality raw materials for their processing plants and to meet the demand of their clients. With the intensity and cost of capacity development likely to decline after the first and second year, the private sector partners should be in a position to take over the full cost of farmer support beyond the Vuna supported projects. The demonstration effect of this partnership is also expected to drive a mindset shift within participating and non-participating private firms in a manner that will lead to replication of the model.

The strong commercial incentives received by key players are also expected to drive scaling up of the initiative along five main dimensions: (i) current contracted farmers expanding their operations to produce more crops to take advantage of rising productivity and improved marketing opportunities; (ii) motivated by experience of participating farmers, new farmers forming new supplier groups or joining existing ones to supply their crops to the food processors; (iii) participating food processors expanding their capacity by either expanding current processing plants or establishing new one in new areas, and, (iv) new firms replicating similar models.

Although government related institutions do not have direct commercial interests, they are equally interested in supporting the growth of prosperous farming communities, particularly smallholders whose livelihood depends on agriculture. Private sector partners are developing stronger and more innovative relationships with government extension personnel designed to incentivise them to keep up with latest technologies and practices in order to better support farmers to improve productivity and to maintain and increase their outreach. Training and other capacity development initiatives that are part of this intervention go a long way in meeting these needs. Working with the government extension service also enables the new knowledge on CSA technologies and practice to be shared with farmers beyond those contracted to supply commodities to participating food processors.

3 Assessing the success of the innovation model adoption

3.1 Model success in delivering intended support services

The capacity building initiative for outgrower schemes in Tanzania was successfully implemented with the leadership of the two food processing companies MFCL and G2L. In the Lake Zone, MFCL is currently working with 30 farmer groups or close to 8000 farmers from four regions – Shinyanga, Tabora, Geita and Simiyu. Supply agreements have been established for key crops including maize, rice, sorghum and chickpea. A key parameter in the contracts is quality, moisture content, minimum standards for aflatoxin and absence of foreign materials. Crops are rejected if they fall short of these requirements. The prevailing market price at the time of delivery is used to pay farmers. Contracts stipulate that farmers will sell at least 50% of produce to the company. A contractual relationship aims to help the firm estimate of volumes to be expected during the selling season. These are now used to unlock finance from financial institutions.

MFCL is processing an average of 9000 tonnes of maize, 25-29000 tonnes of rice and 4000 tonnes of sorghum every year. However, adequacy of supply is affected by seasonal variations. Due to the drought during the 2016-17 season, they only processed 1900 tonnes of maize, well below the average of 9000 tonnes. They are confident some of the interventions facilitated by the Vuna funded project will minimise these large fluctuations. During the current buying season, MFCL is projecting increases in maize deliveries, reaching annual figures of 21000 tonnes by May 2018. For sorghum, they expect to clean and package around 4000 tonnes by December 2017.

It was noted that whilst MFCL has contracts with the farmers, these are not very strictly enforced and thus do not appear to be binding, particularly if default is due to climate related causes such as was the case with the drought in the 2016-17 season. This is meant to protect relations with farmers and acknowledged the realities that enforcement is both legally and reputationally problematic. Whilst cases of side selling remain, this does not appear to be a major problem for the company as close relations with farmers prevent these.

The second private sector partner G2L is also on course with delivery of project objectives. Despite the short implementation timeframe for this project, the company has successfully established structures for farmer capacity development in its seven districts of operation. In each district, they have recruited field officers and are working with government extension officers in each ward. They conduct joint farmer trainings, establish demonstration plots and host field days to showcase CSA practices.

CSA training include, zero tillage practices, improved use of fertilisers and other agro-chemicals, herbicide use, selection of appropriate seed. Trainings target lead farmers and local agro-dealers. G2L is cooperating with input companies such as Syngenta, Bayer, and BASF to establish at least one demonstration plot per 30 farmers, each on a quarter acre plot. Each partner provides the necessary inputs. So far 71 demonstration plots have been established in the last two seasons, with 40 planned for the next season.

Box 2: Partnership for CSA training, demonstrations by G2L Farmers Individual farmers are, however, required to sign in for themselves when they receive inputs.

They are focusing on two commodities, soyabean and common beans for this project but they also buy and process rice. Their major market is directly to major cities Tanzania such as Dar es salaam, Dodoma, Arusha, and Zanzibar. They are also now members of the East African Grain Council through its Esoko platform. Through this partnership, they hope to access the East African market.

Under the Vuna supported initiative, G2L contracts smallholder farmers in seven districts in Ruvuma, Iringa and Njombe regions. They contracted 533 farmers in the and partnersfor the 2018-19 season has since been revised from 5000 to 7000 farmers. This rapid expansion has been facilitated by Vuna support. are contracted as groups, with the leader of each group signing the contract document.

All groups are registered with the government office and the village executive officer also signs as a witness on the contracts. This has been a key factor in preventing side selling. Contracts stipulate the amount of seed to be supplied to farmers, expected volumes to be delivered to G2L, quality parameters (e.g. colour, foreign materials). The price is not stipulated as it will depend on the market prices at the time of buying but G2L guarantees a basic price that covers production costs and a profit for the farmers. During the buying season, G2L prioritises contracted farmers before they buy from any other farmers.

The company provides farmers with an inputs package (seed, fertiliser fungicide, pesticides, and herbicides) for the production of soyabean and common beans. Farmers pay 20% of the cost of seed and the remaining 80% is deducted at selling. The company also works with other private partners such Yara who supply fertilisers. Their seed is procured from Uyole Agricultural Research Institute as well as smaller, emerging seed companies such as Beula Seed Company (BSC), particularly in the case of common beans. In some years they are forced to buy 'quality declared seed (QDS) due to the shortage of certified seed in the market.

3. Signs of model impact on sensitivity and adaptive capacity of farmers and other market players

3.2.1 Changes in level of sensitivity of current production/market systems

"I have a family of 12 and have a 6-acre plot for rice and 8 acres for maize. Recently, I was introduced to sorghum by MFCL so I planted a quarter of an acre as a demonstration. Now, I plan to plant 20 acres of sorghum as the cost of production is much lower than maize and other crops. The productivity of sorghum is good in this area, its very drought tolerant even with a severe drought like last year I still harvested six bags. I could not get even a single bag of rice due to the drought but the previous year I had 48 bags. During a good year, I can get between 12 and 18 bags of sorghum per acre especially the variety known as Masia. Many other farmers are motivated to grow sorghum after my experience, both for sale and for own consumption. We sell to Musoma at TS550/kg. Musoma has been very good to us. Since their arrival, prices of commodities have gone up as they offer decent prices. They also pay cash instantly. From just farming, I managed to purchase 20 cows and a power tiller (valued at about $5000) over two seasons. Because of this implement, I have significantly reduced the time needed to plough the fields to only about 20% of time required when using ox-drawn implements. Sorghum is my new favourite crop and I plan to expand.

Box 3. Interview with Mr Christo Shigela – Igunga district, Tabora Region

With the initiative only one season into its implementation, it is tenuous to already report significant changes in sensitivity to climate and market risks of either the production system or the supply side for private firms.

Interviews with farmers suggest signs of impact of the partnerships on incomes due to more consistent access to markets (See box 3). As a result of higher incomes, farmers have been able to expand their production operations supported by the purchase of better implements (e.g. power tillers) or investment in livestock. Access to quality inputs has also improved with more consistent access to markets, enabling farmers to select suitable seed for their areas, and also invest in yield enhancing inputs such as fertilisers and agro-chemicals. Higher incomes have enabled farmers to also improve human capital elements such as their living conditions through better housing, as well as better healthcare and improved access to education.

3.2.2 Impact on level and diversity of income profiles

Anecdotal evidence gathered during interviews with farmers suggest that yields are rising, production systems are diversifying beyond maize and rice, particularly to incorporate legumes such as common beans and soyabean (Box 4). The introduction of drought tolerant sorghum by MFCL is also expected to further diversify production systems in the more drought prone central areas of the Lake Zone region. Soyabean introduced by G2L in the flood prone Southern Highlands was also reported to be more tolerant to excessive rains than maize.

The introduction of common beans with its short growing season (three months) is further enabling farmers to grow up to three harvests in one year in many areas of the Southern Highlands (Box 4). This smoothens cash flow for farmers and the food processors, and also enables farmers to access higher prices during the period of low supply from December to March.

The 2017-18 season was good for maize in most parts of the country, leading to a bumper harvest. Ironically, this has negatively affected farmers, particularly in the highly productive Southern Highlands as the NFRA, the government agency that buys maize, does not have enough funds to buy all their maize. With export bans on agricultural commodities, this excess production could not be sold to regional markets. Due to this glut, even private buyers are offering lower prices. As a result, many farmers are stuck with their maize. The introduction of bean production has

helped farmers working with G2L as they can still receive income from beans, enabling them to hold onto their maize until market conditions improve. As such, many of the farmers interviewed are planning to increase their hectarage for beans in the coming seasons to hedge themselves against market risk (Box 4).

Mavanga Agricultural Marketing Cooperative Society (AMCOS), Mavanga ward, Ludewa district, Njombe region

"Mavanga AMCOS started in 1984 but we were not doing well until 2015 when things started improving due to encouragement from development partners who insisted on better organisation. Now, the group bring farmers together for training, input procurement and marketing to lower transaction costs and share storage facilities. The AMCOS has 130 members and of these, 49 are women. Many now recognise the benefits of being in AMCOS. This season we had a very good harvest for maize. So far, we have sold 600 tonnes of maize to the government owned National Food Reserve Agency (NFRA), which is the only large buyer. Each season, the NFRA gives us a quota for maize. Unfortunately, this season we have already exceeded our quota of 400 tonnes even though farmers still have a lot of maize in stock. We will keep scouting for other buyers and continue to negotiate with NFRA to buy more maize as we understand they received more money for buying maize from central government. There are not many buyers for maize as there is an export ban on agricultural commodities.

Since the 2016-17 season, more than 50% of our members started planting beans under the G2L partnership. Some of the bean producers are not members of AMCOS. This partnership has come to the rescue of many farmers who are struggling to sell their maize. We only plant two varieties but it is working very well. We are planning to add soyabean but currently we are only planting beans. G2L is providing training on good agricultural practices (GAPs), they provide inputs loans that enable us to pay 20% on receiving inputs and the rest after selling. They have assured us of a market and the price is good. One of the challenges is availability of bean seed as few companies are selling it. We hope we can start multiplying bean seed locally in partnership with seed companies to improve supplies. The other challenge includes insect attacks and availability of the inoculant we use for beans.

Beans are far better than maize because maize takes five to six months, while beans take a maximum of three months. In this area we can harvest three times a year. The profits per acre are higher than maize. We are also paid on delivery in cash for beans and there are no middlemen. Beans are also less expensive to produce compared to maize, although the seed is more expensive. Maize require more labour, (e.g. you need three cycles of weeding compared to only once in beans). Beans also bring healthy diversity to our production system as they do well when rains are poor while maize does better in a season with higher rainfall.

Most of our members only planted two acres during the past season, but many are planning to increase hectarage to 10 acres. For example, one member harvested 800 kg of the Uyole red variety from 2 acres and sold 700kgs. Now he is planning to double area under beans. Another farmer harvested 4000kgs from 10 acres and sold 3600 kg. He is now planning to plant on 20 acres.

We are very positive that beans are having a significant impact on our livelihood. Although we have just begun, we see a very bright future. Higher incomes from beans are supporting education. We are better organised and this partnership has overcome our marketing problems. We have also improved productivity, quality and consistency of our crop as we are using the same improved varieties. The company has worked very well with us. They use standard measurements when buying crops and we feel the partnership is transparent."

Box 4: Testimonials from farmers in the G2L outgrower partnership

Madaba district - Ruvuma region, Southern Highlands

We are members of three different groups in Madaba district: Vicoba has 120 members and the majority of members (95) are women. Paprica has 14 members and four are women, while Muungano has 28 members and 11 are women. Each group is registered at the district office. Vicoba is also registered at the national level. There are many other farmer groups. A group is supposed to have a minimum of five farmers to ensure effective peer monitoring.

Currently, we grow beans and sell to G2L. We are also planning to grow soyabean. We work with three bean production seasons, from December to March, March to June, and then July to December. Contracts with G2L are signed by group leaders and village leaders but individuals sign against the inputs received. We have very good relations with G2L. They encourage farmers to be organised, they provide capacity development, and provide inputs on credit, with only a down payment of 20% on delivery and the balance when we sell our crops. They have been educating and advising us and their prices are good.

Mrs Agnes Mlelwa – "*I planted 1 acre of bean and I harvested 300kgs and sold 250 kgs to G2L. My neighbour harvested 835kgs from just 1 acre. Yields for the December – March crop are lowered by the excessive rains. Although the March-June season is the best for bean production, prices are very low, averaging Tsh1000*[1] *per kilogram due to oversupply. In September-October prices go up to about Tsh3500 to Tsh3800 per kilogram because this is a difficult season to grow beans due to reduced moisture. I am planning to plant 1 acre for the December – March crop, and 2 acres for March – June crop. Bean production is less input intensive compared to crops like maize and it fertilises our fields. The payback period for beans is shorter compared to maize and the partnership with G2L guarantees a market for our crop. Most farmers are planning to increase area planted to beans".*

Side selling is not a problem here. So far, only seven cases of default have occurred. Even some farmers that are not on contract also got inputs because they were interested and they still delivered the crop. Through G2L we have managed to get access to better seed and the training and technical assistance have improved productivity. We have a continuous training programme with those trained cascading this capacity development to others. Groups meet every week and every month we have inter-group meetings. Some meetings are purely for training but others are for planning.

Mrs Oswaldina Mlelwa – "Money from growing beans on contract with G2L has helped me to keep my son in university. There is no way I could have afforded the fees. At some point, my son was on the verge of withdrawing from his studies as we just could not raise the required fees. Now, he is in his second year and from my bean production business we can easily pay off his fees. Beans business has also contributed to food security as they are an important part of our diet. Recently, I also managed to start a poultry business and it is growing. My family is very happy with this business and we look forward to a long term relationship with G2L."

3.2.3 Changes in market integration

The intervention is changing the way farmers interact with markets. Both firms have demonstrated the benefits and feasibility of commercial marketing arrangements with smallholders. Consistent access to markets is driving a mindset shift towards commercial oriented planning and production. Group based contractual arrangements are also enabling participation of individual farmers who would otherwise struggle to comprehend and manage commercial agreements and relationship on their own. The impacts of better market are largely seen through a trend to increase production and rising propensity to invest in yield enhancing inputs and implements.

From an inputs perspective, the investments of the partner firms is leading to improved interaction between farmers and inputs suppliers. Through joint demonstrations, these input suppliers are showcasing their products and farmers have more opportunities to observe the benefits of high quality inputs. Although it is still too early to attribute any changes to this intervention, there is potential that this exposure will encourage more farmers to adopt the use of improved inputs.

3.3 Local sentiment and perspectives on the success of the innovation model

Key stakeholders are positive about the prospects for its success. Despite its implementation having essentially started just a year ago, the positive impacts on farmers' production and marketing opportunities were said to be already apparent. The effect on incomes was also reported to be significant, resulting in meaningful investments that improve both productivity and scale of operation (See boxes 3 and 4). The CSA capacity development intervention was described by farmers as vital to a transformation of production systems given climate changes. Many of the farmers that have not been able to benefit from current partnerships have expressed interest in joining participating farmer groups as they perceive the benefits to be significant.

For the private sector partners, the benefits have been on the improved relations with farmers which is resulting in improved quality and reducing side selling or other forms of defaults. Both G2L and MFCL indicated that they now consider farmers as part of their business. The initiative has also brought them closer to other value chain actors such as government, inputs suppliers and financial institutions, with whom they now work very closely.

4 Assessing model adaptation and potential sustainability

4.1 Extent of model adaptation

Whilst there are some signs of potential sustainability of the model, these are not universal. Improved relationships and trust particularly between farmers and processors but also with government extension personnel, are emerging. Both private firms working with farmers have reported significant benefits from capacity development of farmers and planning to sustain this partnership.

MFCL in particular, appears to have considerable ownership of the model (Box 5). The company has recently introduced sorghum into their crop mix, largely due to rising demand from their beer-brewing customers, TBL and Serengeti Breweries. They are largely sourcing from Songwe region but have also introduced the crop in Shinyanga where farmers are set to benefit from the crop's drought tolerance. In the 2017-18 season, MFCL plans to distribute 20 tonnes of sorghum seed to farmers and provide the necessary capacity development at their own cost, to expand the production of the crop.

For G2L however, because of its smaller size and lower levels of integration with upstream customers, it is apparent they will struggle to absorb the costs of capacity development activities (Box 6). Partnerships with other private sector players such as inputs suppliers and financial institutions are part of their strategy for a sustainable model for capacity development of farmers.

"The company is committed to working with smallholder farmers even without development support. We have not seen any significant weaknesses with this kind of partnership. We are already negotiating with inputs suppliers and banks to finance our farmers on the back of contracts they have with us. The banks have been very positive about such arrangements, for example NMB, Access Bank, and TADB - all have indicated willingness to pursue this arrangement with us. We plan to start during the 2018-19 season. Negotiations are at an advance stage. MFCL will pay for extension support and any other support services needed by farmers. For example, Access Bank only work with farmers who are within a 100km radius of their branches. To facilitate this partnership MFCL will open an agency for Access Bank to ensure farmers in some areas that currently do not have branches such as Igunga, can qualify for such financial support."

Mr Saidi Makilagi, Director, MFCL

Box 5: MFCL perspectives on sustainability of partnership

"We have seen the benefits of working directly with farmers and we have no intention of stopping after the project. As we are still growing, we may not be able to maintain all current aspects of farmer capacity development, but through partnerships with government and others with commercial interests such as inputs suppliers, we should be able to maintain all key functions. We are already expanding our operations by building new processing plants in new locations, and also vertically integrating our operations to increase our absorption capacity. We are adding value to our soyabeans by going into feed production as well as pig production. We are also looking to bring on board financial institutions as partners to fund farmers with their production contracts as collateral. We are particularly hopeful about the new TADB that should lend at lower interest rates. Other banking institutions such as NMB have also indicated interest to work with us so we are very positive about our prospects for the future."

Mr Lusajo Telatela, Director, G2L

Box 6: G2L plans beyond the project.

4.2 Changes in market system triggered by model innovations

The intervention is triggering a new culture of cooperation between private sector, farmers and government. The innovative partnership with the government extension system is not only reducing costs for the private partners but also demonstrating that the state system can be equally effective when adequately supported. This partnership is expected to encourage similar arrangements in other parts of the country. The improved marketing arrangements for legumes and associated capacity development is driving various changes in the market system.

The emergence of small to medium size seed companies such as Beula Seed Company - that have a strong focus on multiplying bean seed is improving availability of certified seed. The demand is currently surpassing supply and more seed companies are expected to enter the market. Increasing demand is also encouraging partnerships for local seed multiplication with smallholders. This will not only improve access to seed but will also open new commercial opportunities for smallholders to enter the lucrative seed value chain.

4.3 Expansion and wider adoption and benefits

The positive sentiments and level of benefits for MFCL are reflected in their plans to expand their operations based on the current model. The company plans to maintain and extend the extension model and partnerships and is also investing in a 2000 tonne warehouse and a processing plant with capacity for handling 200 tonnes per day in Songwe region. The plant was expected to start operating in November 2017. In Shinyanga, MFCL is also building another 2000 tonne warehouse and was expected to have been completed by December 2017 to increase the handling capacity of their current plant.

G2L's plans with regards to model expansion are less clear, although they too are planning to increase investment in warehousing and other processing capacity in the Mbeya region.

5 Key lessons and recommendations for model improvement

Although much of the implementation of the Tanzania outgrower model has only been underway for just over a year, important signals are beginning to emerge in terms of what might drive resilience building and how the investment could provide sustainable solutions for the key stakeholders. Below is a summary of some of the observations, insights, experiences and lessons from the review of this model.

- **A holistic view of resilience:** This case reaffirms that CSA practices are necessary but not sufficient to ensure smallholder resilience to climate change. System-wide resilience building needs to be guided by both climate and market risk considerations. The outgrower partnership demonstrates the importance of the market both in terms of resilience, but also incentives and thus the sustainability of farmer behaviour change. The prospect of consistent access to a market for produce is a key driver of cooperation, uptake of new practices and technology and more significant than climate risk concerns. CSA practices and technologies, therefore, need to be framed and embedded within market imperatives and not just climate risk concerns.

  Lesson: Initiatives designed to build smallholder resilience to climate change should prioritise market access and security issues as an integral part of any CSA innovation.

> "The prospect of consistent access to a market for produce is a key driver of cooperation, uptake of new practices and technology and more significant than climate risk concerns. CSA practices and technologies, therefore, need to be framed and embedded within market imperatives and not just climate risk concerns.

- **Partner selection and capacity needs**: The different capacities of the two partner firms in this case have implications both for intervention support needs and model sustainability. It is apparent that, as a larger and better networked business, MFCL has required less support to adopt and adapt the model. G2L, on the other hand, as a more emergent firm has required more substantive support and its path to expansion is likely to be slower. It is noteworthy nonetheless, that G2L's reticence to invest in the extension model contrasts with its warehouse investment plans. Evidently, its decision not to invest in the model is a commercial choice and suggests need to assess carefully partner willingness to invest and may also indicate the additional support to G2L may have undermined their ownership compared to MFCL.

  Lesson: Rigorous partner selection is critical to model success and needs to consider the commercial capacity and corporate willingness to invest, long term, in the proposed innovation.

Lesson: The nature of project support for a partner is determined by their specific capacity needs and incentives. The level of that support nevertheless needs to be pitched carefully so as not to discourage or undermine the partner ownership and responsibility.

- **Multi-player solutions:** The case demonstrates clearly the reality of a multi-player or pluralistic solution to critical system functions such as extension provision. Experience indicates that neither government nor private processing parties can sustain adequate CSA extension and information services by themselves. Nevertheless, collaboration on extension provision is not well-established. Sustainable provision of these critical services to smallholders requires innovative public-private partnerships and investment.

  Lesson: Public-private collaboration on extension service provision is critical to its sustainability and outreach. Effective collaboration implies identifying appropriate and innovative models for joint delivery and incentivisation of government personnel.

- **Trust building underpins effective outgrower schemes:** The experience of both MFCL and G2L confirms the difficulties in establishing and enforcing legally binding contracts with large numbers of smallholder farmers. MFCL and G2L have used contracts as planning tools rather than as an instrument for recourse in the event of default. Practical enforcement is provided through peer monitoring and group accountability.

  Lesson: The use of formal contracts and agreements within outgrower schemes provides for clarity as to the responsibilities of each party but has limited utility in enforcing those responsibilities in practice. The effectiveness and sustainability of outgrower schemes lies in the establishment, overtime, of mutual trust between parties.

ANNEX 1:

Tanzania – Climate risks for agriculture

Extreme weather events

Drought prevalence in Tanzania analysed over a 20-year period (1980-2000) illustrates widespread drought incidences especially in the central region of Dodoma with a prevalence of nine, followed by prevalence of between seven to eight events in the central and southern region including Ruvuma where some of the Outgrowers Scheme projects are located (Figure 1, centre). In terms of flooding, (Figure 1, right) the prevalence of flooding events ranges from ten to one, with high prevalence recorded in the north eastern regions of the country. The areas were the outgrowers projects are located have low prevalence or no data, especially around Ruvuma in the south of the country.

Observed changes in temperature over the past 37-year period highlight the highest increases in the northern areas (Figure 1, left) up to 1.1 to 1.2 ºC. The degrees of change reduce as we move further south with the smallest degree change of 0.45 to 0.54 ºC around Ruvuma[9]. Further, observed trends highlight significant increases in both minimum and maximum temperatures, with the minimum rising more than the maximum annual temperature[10]. In terms of rainfall, there is a decline in the amount of rainfall received across the country, however the decrease is not very significant in some areas.

9. Jack, NDC
10. URT, 2014

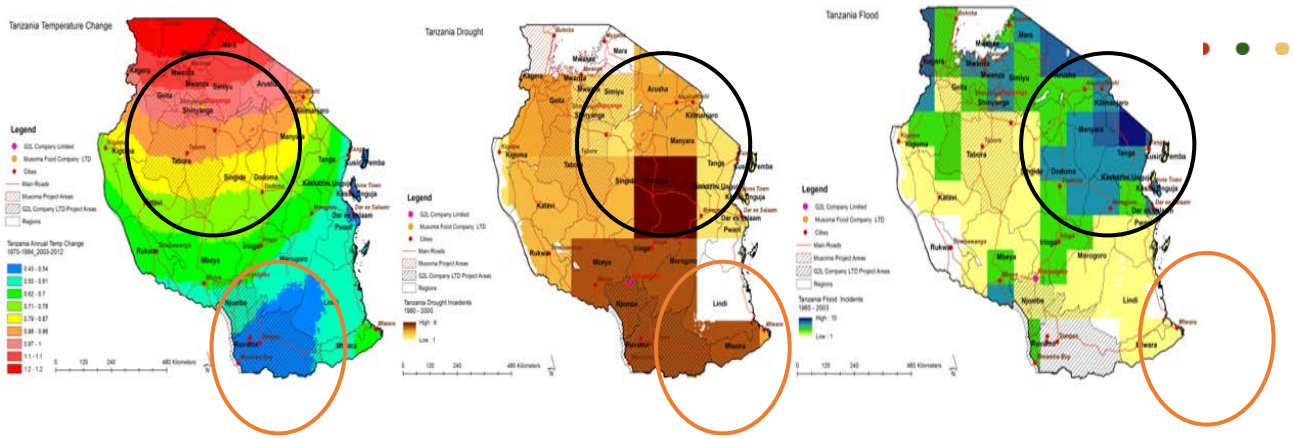

Figure 3: Temperature Change (left) Drought (middle) and Floods (right) in Tanzania. The project areas under Musoma are highlighted with the black circle and the areas under G2L by the orange circle. Impacts of rainfall changes on agriculture and Outgrower schemes

Impacts the rainfall changes on pigeon pea production

Rainfall variability will likely be detrimental to agricultural production, and reduced rainfall will lead to crop failure. However, the predicted increases in rainfall will be good for agriculture, especially in areas around Lake Victoria basin. This projection is contested in other models that illustrate decreases in rainfall in the same areas during the same period. Other projections predict continuous reduction in seasonal rainfall which is essential for agriculture[11].

Impacts of temperature changes on agriculture and outgrowers Scheme

Temperature trends across the country have been dramatically increasing, and this will likely result in increased evapo-transpiration in the soil leading to crop failure, due to crops failing to reach maturity as a result of lack soil moisture.

Impacts of extreme weather events changes on agriculture and Outgrowers Scheme[12]

The negative impacts of climate change, including extreme weather events will have significant impacts on agriculture sectors. The impacts will likely include reduced crop yields as a result of drought and floods and reduced water availability[2].

11. Kent *et al*., 2015, URT, 2014
12. World Bank, 2012

Maize, soyabean and beans production are promoted for CSA capacity development in the Outgrowers Scheme, with the objective to increase yields, incomes and security of supply, through agricultural extension training[13]. Given that the CSA innovative project focuses on agriculture extension and capacity building, understanding the impacts of the climate change especially on the focus crops such as maize, soyabean and common beans will assist in the design of new modules and training materials, as well as equip the extension officers with the right knowledge on how to adapt to climate change for the affected farmers

Quick facts:

Climate Change Trends in Tanzania

Rainfall

- The rainfall projections indicate that both increases and decreases in different parts of the country are probable.
- The areas around Lake Victoria basin and the Northern-Eastern highlands, where some of the Outgrowers Schemes are located, will experience increases in mean annual rainfall of approximately 18 to 28% by 2100.
- Seasonal rainfall is decreasing dramatically from season to season. Agriculture is Tanzania is dependent on seasonal rainfall.

Temperature

- Mean seasonal annual temperatures will increase by 3 to 4 ºC in the western areas and less than 1.76ºC by 2050 and 3.28ºC by 2100 in the northern coast of the country by 2100[2].
- The north-eastern highland regions, will face increases in excess of 1.77ºC by 2050 and 3.3ºC by 2100 in areas around the Lake Victoria and central zones of Tanzania
- Temperature changes over 1.39ºC for 2050 and 3.18ºC for 2100 are projected for the southern coast regions[2].

Extreme Weather Events

- Despite the difference in the models on rainfall variability, there is high confidence that the extremes of wet and dry conditions will intensify. These will likely result in flooding and drought incidents.
- In East Africa Tanzania will suffer the worst incidents of flooding.

13. Levira 2009; World Bank, 2012

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