



Climate Risks, Small Scale Farmers and Business: The Case of the Tanzanian Maize Sector

Simon Winter and Kyunghwa Rebecca Jang

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Written by Simon Winter and Kyunghwa Rebecca Jang

Designed by Alison Beanland

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Executive Summary	4
1. Overview of maize sector value chain in Tanzania	6
2. Climate change and implications for each player in the value chain	7
3. Current efforts to improve the maize sector and cope with climate risks	9
1) World Food Program's Farm to Market Alliance (FMA)	9
2) AGRA Inclusive Green Growth for Smallholder Agriculture in Southern Agricultural Growth Corridor of Tanzania (IGGSAS)	12
4. Opportunities to mitigate climate risks	13
A. Integrated platforms including end buyers	13
B. Mechanisms to share the climate risks across the value chain	16
5. Specific Case Example: Opportunities for Impact for AB InBev	19
6. Conclusion	20
Acknowledgements	21
Appendix 1. List of interviewees	21
Appendix 2. Cost and value analysis	22
Appendix 3. Additional revenue for each player	23
References	24
Endnotes	25

Executive Summary

The paper aims to assess climate risks along the maize value chain in Tanzania and to suggest potential solutions for businesses to address those risks. While there are previous studies about the impact of climate change on small scale farmers¹, few of them have focused specifically on how businesses that source from smallholders are likely to be affected or may need to change their practices accordingly. This literature is particularly thin when focusing on businesses that source indirectly from smallholders through intermediary aggregators, traders and processors, where the end buyers often have no visibility at all into who their producers are and what is happening in their lives.

Investigating business perspectives and helping business think about how to make decisions that will increase the reliability of smallholder supply chains is critical when discussing challenges and solutions to mitigate the potential impacts of climate risks in tiered supply chains. In the case under investigation, private sector players in the maize value chain include food and beverage processing companies, such as breweries, as the end buyers, animal feed manufacturers, millers both large and small, input companies, producers and their organizations, as well as financial organizations.² In addition, the government has a key role to play as a policy-maker and regulator that can incentivize and complement (or not) progressive engagement by the private sector, as well as being a buyer through the National Food Reserve Agency and other public institutions. Constructing a solution that addresses all stakeholder interests has to be based on an understanding of each player's incentives through the chain and how to align them for a broad solution set and positive impact.

To gather perspectives on climate risks of each player along the maize value chain, we conducted structured in-depth interviews with small-scale farmers, an intermediary milling company Kibaigwa Food Supplies (KFS), and the Tanzania Breweries Limited (TBL), an associated company of Anheuser-Busch InBev (AB InBev) in Tanzania during the early part of 2016. Given that maize is also a food security staple crop it was important to understand the interventions of the public sector to strengthen the maize sector. For this purpose, we interviewed and reviewed documents from the World Food Programme (WFP), Alliance for a Green Revolution Africa

(AGRA) and the International Institute of Tropical Agriculture (IITA)³. In addition to the interviews we reviewed and analyzed data from the 2016 season of the Farm to Market Alliance program in Tanzania, a WFP program that involves some private players and smallholder farmers, in early 2017.

While the case focuses on maize in Tanzania, and looks closely at the decisions that related businesses need to make, the intention is to document an approach that is more generally applicable to the role of business in the agricultural sector.

The paper is constructed as follows:

Section 1 provides an overview of the maize sector in Tanzania, exploring some of the challenges faced by the country's three and a half million smallholder farmers in increasing productivity;

Section 2 discusses climate risks for each player in the maize value chain, with a focus on smallholder farmers that face up to 10% yield losses by 2080 and significantly increased risks of harvest failure, which have significant implications for other businesses investing in the sector;

Section 3 provides an overview of two existing programs initiated by multilateral organizations, including WFP and AGRA, that deal with "climate smart" agriculture particularly in the maize sector in Tanzania and identifies potential areas of improvement in these programs;

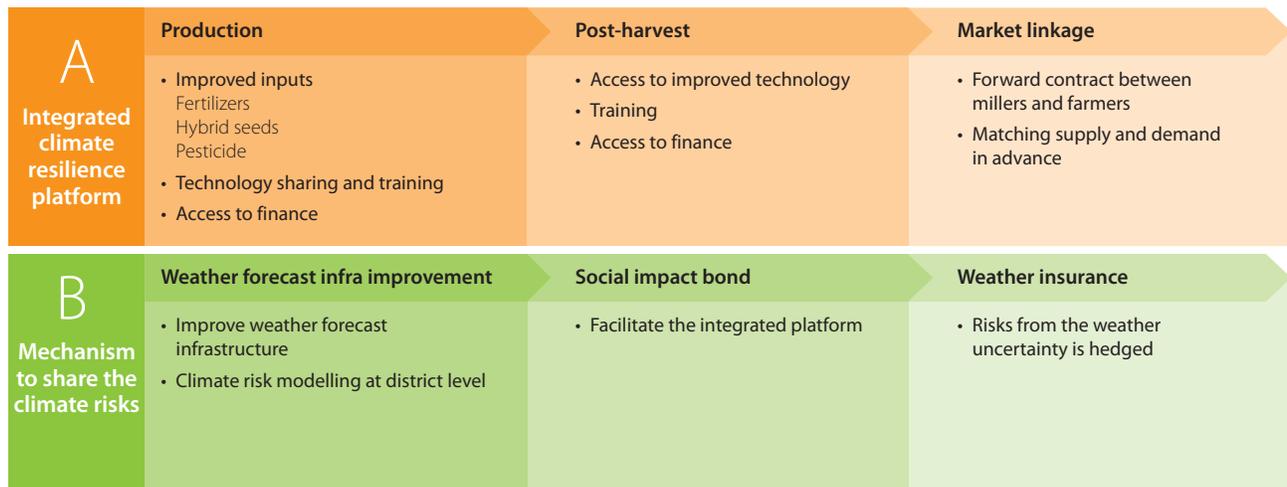
Section 4 suggests potential solutions to mitigate and share climate risks for the entire value chain rather than fragmented portions of the chain, with a focus on the creation of integrated multi-stakeholder platforms to support more climate resilient productivity, post-harvest management and market linkages and mechanisms to share climate risks, such as weather forecasting infrastructure, social [development] impact bonds and weather insurance; and,

Section 5 specifically discusses the case of one of the key companies in the maize sector, AB InBev focusing on decisions to be made to invest in climate resilience activities.

This case study is primarily aimed at guiding staple crop value chain players as to how to think about addressing climate and weather risks in their activities, with the underlying hypothesis being that increased innovation,

investment and collaboration are needed to help improve the ability of value chain players to cope with increasing risk and volatility. In particular, while much attention has been given to how to develop more integrated platforms that can improve specific crop yields, food security, and associated farmer livelihoods, relatively little has been hitherto given as to how to complement such platforms with mechanisms that can mitigate climate risks in the target sectors. This paper highlights three such mechanisms that are worthy of further attention and development: weather forecasting and associated infrastructure; social impact bonds to align stakeholders' incentives; and, the use of weather index and associated insurance schemes.

Opportunities to create climate resilience and value added in the maize sector



1 Overview of maize sector value chain in Tanzania

Maize is the one of the most important crops in Tanzania, grown by 3.5 million farming households, or 60% of total farming households. While maize accounts for 40% of calorie consumption in Tanzania,⁴ the choice to grow maize, even in areas of insufficient rainfall, is driven by a strong dietary preference for maize over more drought-adapted traditional cereals such as sorghum and millet.⁵ Some 57% of maize production is consumed by farming households, while another 16% of the production is purchased by large and small millers for maize flour. Most of the 30,000 millers are very small and informal businesses. In addition, 12% of production is exported, 10% goes to the feed processing sector and the remaining 4-5% is saved for food security under National Food Reserve Agency (NFRA). The only downstream segment with larger players is feed processing, which is projected to grow to as much as 15% of demand by 2020, if the poultry sector continues to grow. Most larger millers have exited the sector, unable to compete effectively with the small informal players.⁶

With 8% average annual growth rate for the prior 10 years, maize production in Tanzania had grown to 6.7 million MT by 2014. Both imports and exports are limited to 10% of the domestic production respectively⁷, which demonstrates the maize sector in Tanzania is mainly for domestic consumption. Despite its growth, the yield level had only reached 60% of that of the average across East African countries by 2014.⁸ A recent study done by AGRA reported average yield⁹ at 668 kilograms per acre. Literature shows an attainable yield of 1814 kg/acre¹⁰ for rain fed maize in Sub-Saharan Africa under good agricultural practices. The low yields may stem from:

Limited input use: For instance, less than 34% of small scale farmers have used fertilizer¹¹ and 80% of seeds used are farm-produced open pollinated varieties, which are less productive.¹²

Crop loss due to pests and diseases: According to a 2015 AGRA study, on average, only 50% of the maize farmers used crop protection to fight pests and diseases. Those reporting the most use were in Kilimanjaro and Arusha and the least use was in Dodoma. In this study, farmers experienced pest and disease losses averaging 15%.¹³

Limited knowledge to improve soil health: Soils are depleted and untested. Farmers' tend to seek new land by cutting trees as the major way to find healthier soils.

Limited incentives: There are few incentives to encourage farmers to invest in the inputs that would improve yields given unstable markets, alongside limited access to finance for investment. Only 2.2% of all farmers access credit to pay for inputs.¹⁴

Lack of transformational leadership: The sector has few major galvanizing upstream or downstream investors looking at investing in sector-wide transformation with comprehensive packages of improved inputs and technologies. The sector has a history of failed outgrower and warehouse receipt / storage schemes.¹⁵

2 Climate change and implications for each player in the value chain

In addition to the low productivity, volatility of production and yields across years are other increasingly serious problems in the maize sector. As seen in the Figure 1, production and yields vary over the past decade. With most maize production in Tanzania being rain-fed, climate change and other weather challenges such as El Niño, as manifested in rising temperatures over time and irregular rains, are leading to increasing fluctuations of production and yield.

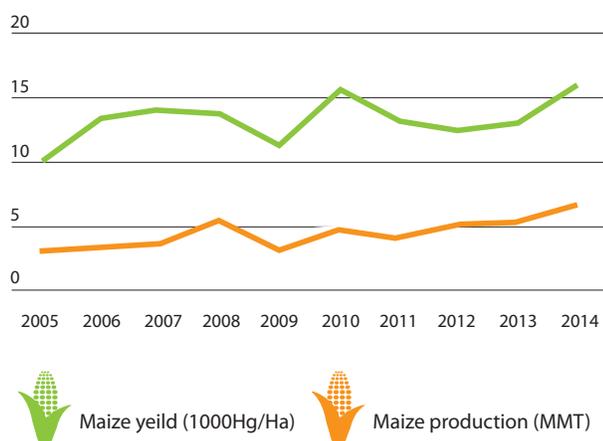
Research under the Climate Change, Agriculture and Food Security (CCAFS) program in 2016 projects that Tanzania will see 25-30% more short rains and increasing precipitation during the rainy season.¹⁶ By region, increases in precipitation early in the season are expected for Dar es Salaam and Arusha, and in the middle of the season for Dodoma.¹⁷

Farmers, who we interviewed, say that weather patterns have become increasingly unpredictable over the past 10 years. The distinction between rainy and dry seasons has become more and more blurred. In addition, rain is not equally distributed during the rainy season with sudden showers. Such weather uncertainty has influenced farmers' behaviors. Farmers have increasing difficulty deciding when to plant, weed, and harvest, which affects productivity.

Increasing uncertainty about the weather has led to less investment in farming by farmers, who are resource constrained and risk averse.¹⁸ The current provision of weather information is not helping producers reduce uncertainty or increase investment in farming. Although farmers can get weather information from the media, they find seasonal forecasts are not specific enough for them to predict in advance whether the year will bring drought or not. Short-run forecasts are only made three days out which is not long enough for them to decide when to plant, weed, apply fertilizers and/or harvest.

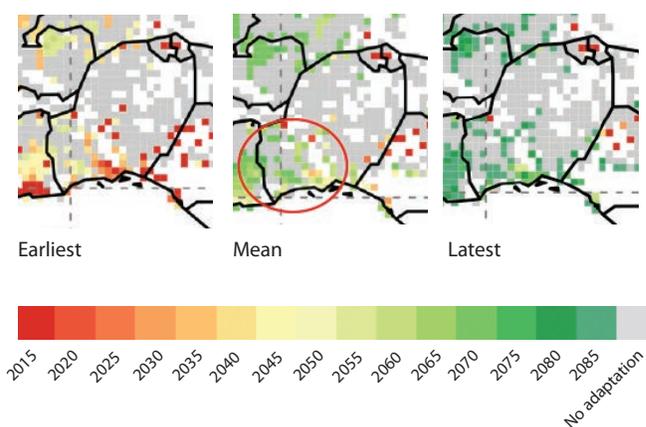
The CCAFS research projects that the target regions – Dodoma, Dar es Salaam and Arusha – would be warmer at least by 2°C by 2080s and have increased precipitation either early in the rainy season for Arusha and Dar es Salaam or the middle of the rainy season for Dodoma. The research also includes modelling of the impact of these expected weather changes on maize yields, which projects that the maize yields would be reduced by a relatively modest 9% across Tanzania while Dodoma region would expect larger reductions (9.2%) than other Dar es Salaam (6.6%) and Arusha (4.5%) by 2080. While this research shows longer term average yield declines, the average changes are not the real issue.

Figure 1. **Fluctuation of maize production and yields (2005-2014)**



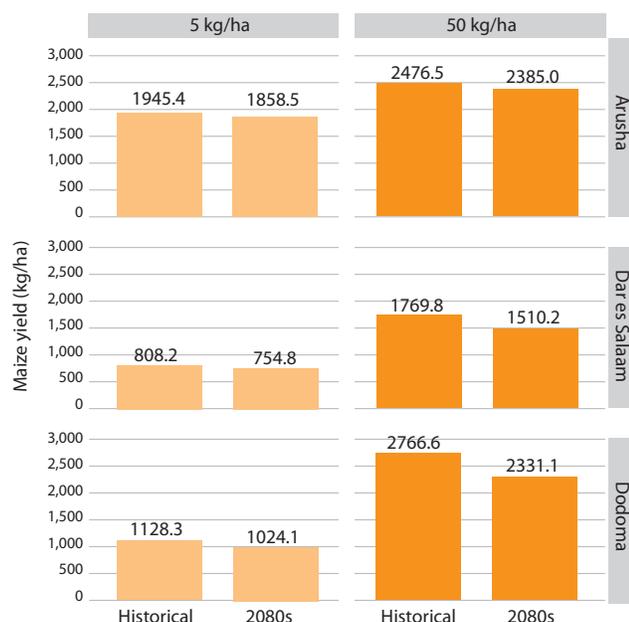
Source: FAOSTAT

Figure 2. **Expected timing of maize production transitions**



Source: CIAT, CCAFS, CGIAR, ILRI

Figure 3. **Climate change and maize yields**



Source: Thornton et al. (2009) Glob. Env. Change – updated with CMIP5

The bigger issues are that in any given year the risk of catastrophic loss is increasing. Risks are increasing of drought, storms, pests or diseases associated with more volatile weather. When these manifest with considerable severity for affected farmers, they will not just reduce their yields, but may wipe out substantial portions or even entire harvests. The climatic shifts mean that it is also more challenging to make progress on closing the huge gaps to regional best practice yields. While improved germplasm and input use may increase yields if all else remains the same, greater weather volatility may mean that the best solution last year, is not the best this year. Climate risks need to be tackled to support livelihood and food security improvements for smallholders.

Climate risks are not only a concern for small-scale farmers, but also for the commercial millers and brewery companies further down the chain. Commercial millers have contracts with end customers including brewery companies to provide a certain amount of flour per month. If the production drops in their region, millers need to source maize from other regions, which increases transportation costs. For instance, during 2014/15 a severe drought in the Dodoma region meant Kibaigwa Food Supplies (KFS) had to source maize from the southern part of Tanzania. KFS' costs increased two to three fold.

Several downstream players have local sourcing policies to support Tanzanian producers. They face increasing costs and more restricted amounts of maize produced locally during drought seasons. As uncertainty increases for these businesses, the attractiveness of increasing investment to expand local sourcing diminishes. Interventions that might reduce uncertainty across the value chain have potential to create value for each player.

The projections of climate risks and their impact on the maize sector for specific production regions of Tanzania needs ongoing research. The potential impacts in most research are for decadal changes. They need to be brought into the shorter-term that can be used to guide farm and business investment decisions over the coming few years. Per the above points about catastrophic risks increasing, the impacts of that volatility need also to be better understood in specific localities and for each planting cycle before farmers and their business partners make their planting decisions.

3 Current efforts to improve the maize sector and cope with climate risks

What is required in order to improve the way that value chain players cope with climate risks in the maize sector in Tanzania? This question can be divided into three sub-questions:

	Productivity with climate resilience: How can we improve yields and production with greater resilience to climate change?
	Market linkages: How do we improve the security of market access for farmers and sustainability of supply for millers and brewery companies?
	Climate risk sharing: How can risks be shared equitably among the value chain actors?

Keeping in mind these three questions, this section reviews major existing programs that deal with challenges in the maize sector in Tanzania. For the purpose of the paper, we focus on assessment of the programs from the perspective of climate risk management.

In addition, post-harvest management is critical for climate resilience to reduce post-harvest losses (PHL) caused by moisture level fluctuation under frequent weather changes. With adequate market demand and farmer aggregation

(pull approach) and access to improved post-harvest loss technologies, as well as training and finance to facilitate adoption of PHL technologies (push approach), farmers will be able to reduce their crop losses.

The two programs we examine are the WFP's Farm to Market Alliance and AGRA's Inclusive Green Growth for Smallholder Agriculture in Southern Agricultural Growth Corridor of Tanzania program.

1 World Food Program's Farm to Market Alliance (FMA)¹⁹

In 2014, World Food Program (WFP) created the Farm to Market Alliance (FMA), a multi-stakeholder platform that aims to create efficient value chains that enhance farmer incomes by guaranteeing market access founded on forward contracts between producers and commercial actors. Tanzania, Malawi, Rwanda, and Zambia were the countries targeted for implementation of the first iteration of the FMA. The first pilot in the maize sector in Tanzania had six off-takers, three of whom supply Anheuser-Busch InBev. These six off-takers purchase 22,000 tonnes of maize annually. During the 2015/16 season, the pilot worked with 22,000 farmers from 52 farmer groups.²⁰ Targets for post-pilot expansion include reaching 50,000 farmers by November 2016, and at least 75,000 by November 2017.²¹

The FMA facilitates contracts between farmer associations, millers (buyers), input providers, banks, and NGOs. Demand

aggregation also includes end-buyers that have committed part of their procurement needs to the FMA along with miller suppliers. The following account relates to the 2016 season.

Productivity with climate resilience: The FMA helps farmers access improved inputs such as hybrid seeds, fertilizers and pesticides at 10-20% lower price than the market price. Since only few farmers used such improved inputs before the advent of the FMA, the FMA is an opportunity for input firms to expand their market, which justifies them offering 10-20% lower prices. For farmers to purchase such inputs, financial access is critical. By introducing a group loan for farmer associations offered by local banks, farmers can borrow up to 80% of input costs and pay them back after harvest. During 2015/16, 7,300 farmers (about 30% of those engaged and supplying) participated in the financing scheme. This was not higher as training and

sensitization was done close to the season and the down-payment by farmers had to be made at one time.²² With good results visible in the 2016 harvest, and some improvements planned for the scheme, the number of farmers participating in the financial scheme is expected to rise in the future as farmers get to appreciate the value of the program by seeing its impacts on their neighbors. In terms of technical knowledge, NGOs directly hired by WFP or input companies provide training to farmers on how to use such inputs.

The WFP FMA is also partnering with the Rockefeller Foundation and AGRA to integrate access to post-harvest loss training and technology for the maize producers to store grain post-harvest. Work with AGRA to date has focused on the distribution and use of PICS (Purdue Improved Crop Storage) bags.

Market linkages: The millers guaranteed to purchase a certain amount of maize after harvest at a minimum price of 330 Tsh per kg (US\$0.14), which is higher than the historical price at the worst time of the year (250 Tsh per kg – US\$0.11). If the market price is higher than the guaranteed minimum price, then the buyer purchases maize at the market price.²³ Thus, farmers have guaranteed market access with a secure minimum price, which provides increased incentives for farmers to invest in their farming.

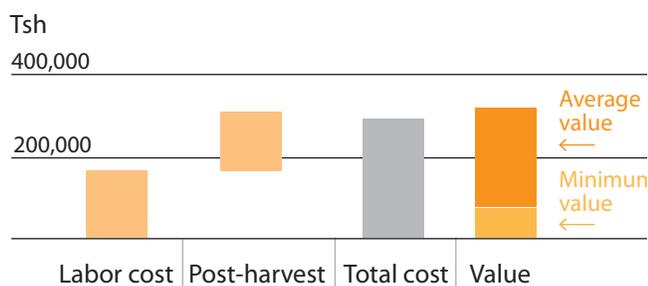


Climate risk sharing: In the 2016 season, WFP only partially addressed the risks caused by weather uncertainty. If farmers cannot pay back loans (most likely due to decreased production as a result of drought) WFP committed to fill the gap. Farmers are not made aware of this insurance, however, because project managers of WFP are concerned this would lead to less incentive to deliver on contracts. In order to address the climate risks more proactively, WFP has worked with a team based at Imperial College London to develop a sophisticated weather-index based insurance product tailored to the specific needs of the maize value chain in Tanzania, which was offered for producers participating in the 2017 season.²⁴ In addition, the FMA team also engaged with ACRE Africa to put insurance in place for the 2017 season. WFP has also engaged local banks as partners in the use of the insurance (which will insure loans financing inputs).

We examined the outcomes of FMA with the production data from three farmers groups, which supply to KFS in Dodoma area – Chawanako, Mkombozi Soko Kuu, and Muhangu. The difference across the groups being that Chawanako farmers did not use pesticides, while farmers from the other two groups used pesticides. Thanks to the platform, production increased to 1,600 kg per acre, on average across the three groups.²⁵ This is twice the yield in a typical good year and 8 times better than in a bad year (2014/15). The average hides a wider discrepancy between Chawanako producers (non-pesticide users), who produced 1,000kg per acre on average, and farmers from other two groups, who produced between 2,500 – 3,750 kg per acre. Additionally, the variation of production among farmers within each farmer association reduced significantly under the FMA, as participating farmers use upgraded inputs and have access to similar level of technology.²⁶

Before the FMA, farmers often had negative margins due to low yield levels particularly during the bad years (such as 2014/15), if farmers’ own labor costs were taken into account (see Figure 4).

Figure 4. **Cost and value of maize farming per acre before FMA**



Under the FMA, however, farmers should enjoy positive margins of up to 40-57% when using pesticides, while farmers who did not use pesticide still saw 0-23% of margins. Although the total costs of production would increase almost twice due to purchasing improved inputs such as fertilizers, hybrid seeds and pesticides, the production increase to 1600 kg per acre makes it possible to turn the margin from negative to positive under FMA.²⁷ The CCAFS research also confirms that if there is improved use and management of inputs, the production increase is expected to outweigh any reduced yields due to climate impacts.²⁸

While the FMA addresses both market linkages and the use of improved inputs and agronomic practices to improve productivity, the platform still has room for improvement in the way that it addresses climate risks.

First, the platform includes only intermediary suppliers (millers) as active partners. By including end buyers in ways that are more than just under-writing market commitments, there might be additional value addition to the scheme such as long-term coordination of supply and demand and traceability through the chain.

Secondly, in the pilot phase WFP has been financing all the investments in new aggregation infrastructure to improve market access and covering all weather risks. This cannot be sustained over the longer-term. As the program expands, the lack of industry player investment and risk sharing may eventually be noticed by producers, who may get concerned about the sustainability of a subsidized project versus a long-term market shift. This may reduce farmers incentives to increase production for the market if they believe the purchase commitment may go away. Insurance may reduce this performance risk, but additional transparency regarding the security of end-buyer commitments would assist further.

The FMA has great potential to serve as a platform that can reach farmers with additional services that can improve climate resilience. These include site specific weather information delivered via SMS, increasingly tailored insurance solutions, and enhanced farmer training that include a broader range of climate-smart agricultural practices including support for improved soil health and more diversified crop production.

Figure 5-1. **Cost and value of maize farming per acre under FMA (with All Climate resilient inputs)**

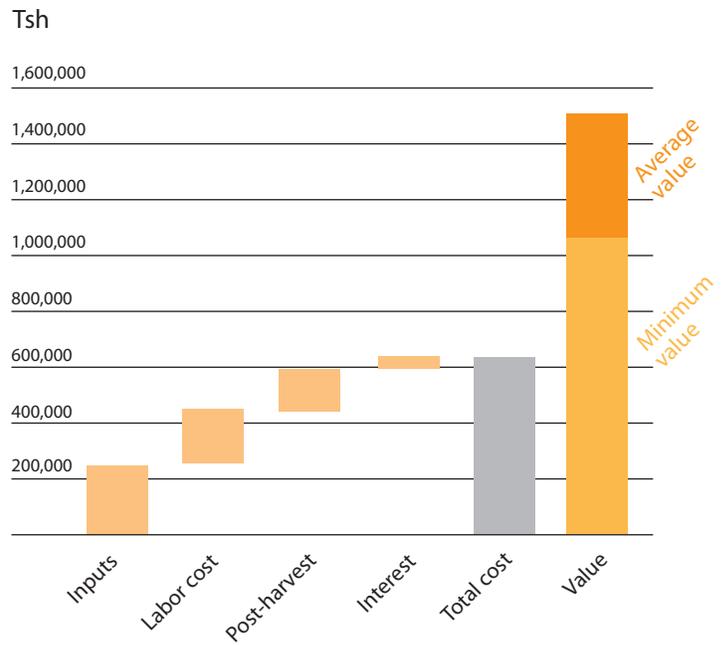
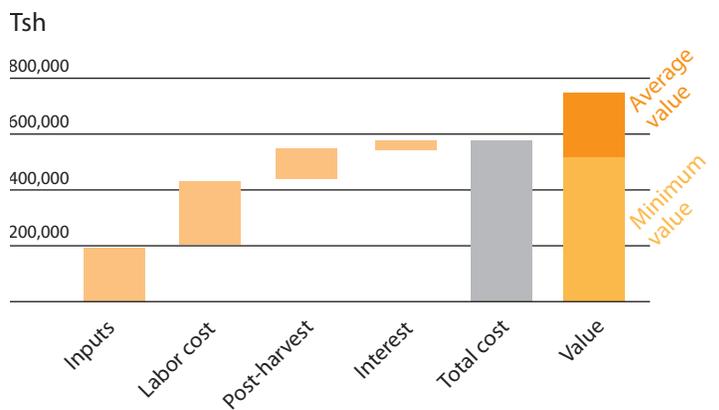


Figure 5-2. **Cost and value of maize farming per acre under FMA (without pesticides)**



2

AGRA Inclusive Green Growth for Smallholder Agriculture in Southern Agricultural Growth Corridor of Tanzania (IGGSAS)

In 2015, AGRA, in collaboration with Yara, developed a program on Inclusive Green Growth for Smallholder Agriculture (IGGSAS) in the Southern Agricultural Growth Corridor of Tanzania (SAGCOT), which aims to not only improve smallholder farmers' livelihoods but also enhance the efficiency and sustainability of the sector from the perspective of agribusiness in the country. The main program anchor crop is maize. Yara, a major international fertilizer corporation, has been a catalytic investor in the agriculture sector in Tanzania, with its leadership of SAGCOT and invest in port infrastructure to assist in the importation of fertilizers into the country.²⁹

The regional focus is on the southern highlands and the Mbeya region in particular. A baseline revealed that maize farmers get an average of 1.5MT per hectare and only 17% of smallholders are using improved varieties. They suffer 10.5% post-harvest losses and 97% are storing produce in their houses, with very little off-farm storage available.

The program includes the formulation of public private partnerships that include:



Productivity: Access to inputs, financing and technical advice to improve agronomic practices are critical part of the productivity improvement. Aspects that relate to climate risks include the use of conservation agriculture practices, and, advice on water management, woodland systems, soil fertility and post-harvesting handling.



Market linkages: To address challenges on smallholder farmers' market access, a public private partnership was created as a consortium that includes off-takers (millers, processors and other buyers) as well as input companies and farmers.

While the consortia helps small scale farmers gain easier access to markets, the efforts to improve productivity have focused on providing training in good agronomic practices that increase the use of fertilizers through more precise application methods, rotations of cereal crops with legumes, and improved weed control and integrated pest management. This includes the integration of "climate smart practices" such as:

- Promoting use of minimum tillage,
- Increasing crop diversification through greater intercropping and rotation,
- Increasing the use of high-yielding early-maturing, and drought tolerant crop varieties.

More limited support is provided for access to financial services. Although such technical support seeks to enhance productivity and mitigate the negative impact of climate change, farmers will still face risks of increasing weather uncertainty.



Climate risk sharing: The stated objective of the program is to "deliver inclusive green growth as a model for agricultural value chain interventions."³⁰ In practice, given the nascent stage of the program, there has been relatively little focus on climate risk sharing. Yara has promoted lower emissions fertilizer packages as one component.

The program only concluded its inception phase on April 30, 2017. Unfortunately, AGRA was unsuccessful in confirming funding for a follow-on implementation phase and the project officially closed at the end of August 2017.

With vertical integration linking farmers with private players, lessons learned from both the FMA and AGRA programs could be used to help enhance long-term improvements in market access and productivity in the Tanzania maize sector. Particularly, FMA demonstrated an ability to boost productivity by 2-8 times on average. However, at this stage,

climate risks are not shared or adequately addressed by all players across the maize supply chain including end buyers (e.g., consumer-facing millers and brewery companies). Opportunities should be pursued to align further incentives of stakeholders across the sector to improve how they are understanding and addressing climate risks.

4 Opportunities to mitigate climate risks

There are several opportunities to improve the ability of the Tanzania maize sector to deliver improved value in the face of climate risks, which are summarized in Figure 6. We observe that efforts have been made to tackle some of the opportunities that we lay out including WFP’s FMA and AGRA’s IGGAS. However, the platforms do not yet include end buyers as investors, and have not been focused on ensuring that major players in the value chain share the climate risks. Thus, we suggest strengthening of “integrated platforms”, by which we mean multistakeholder approaches that include all major players along the value chain including end buyers, and implementing mechanisms for “climate risk sharing”.

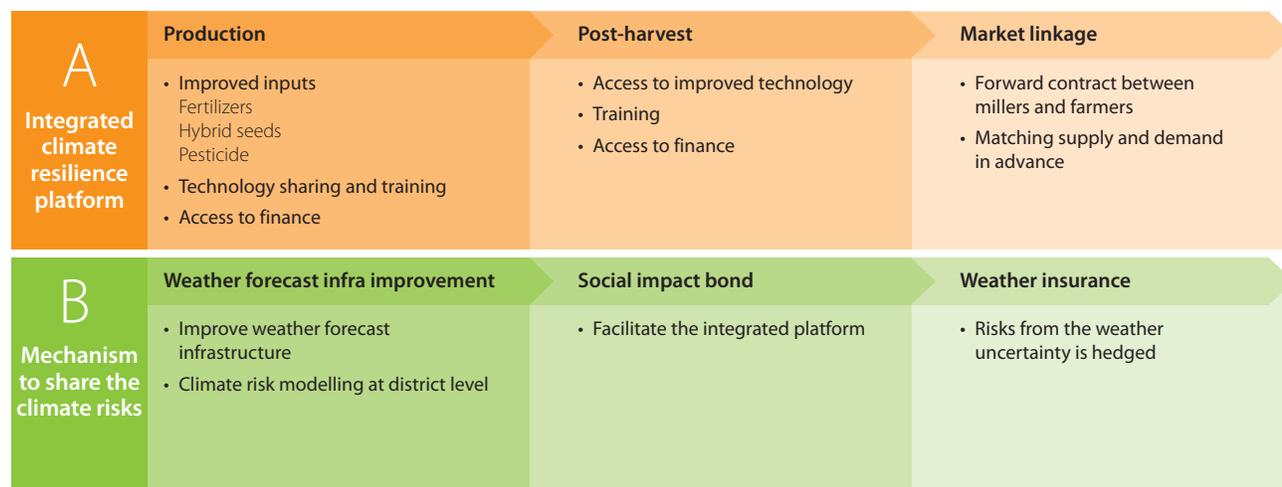
While this paper focuses on actions of and implications for the private sector and producers, we need to recognize there are critical enabling roles for the local public sector to incentivize such private sector participation through favourable tax and regulatory policies to support local capacity building and extension, and, to maintain a stable and predictable policy environment in place. International donors, including the increasing array of climate financing mechanisms, should look to invest catalytic grants and support for blended finance solutions that can help build capacity and skills across the value chain and underpin the risks facing the private sector and producers seeking to invest in new approaches, inputs and technologies.

A Integrated platforms including end buyers

By integrated platforms we mean multi-stakeholder platforms that include all major players from input suppliers, producers (farmers), off-takers such as millers, and end buyers in the commercial value chain, such as food and beverage companies manufacturing consumer products. The integrated platforms could be extended forms of existing platforms building on initiatives such as FMA or IGGAS, for example. One of the most critical factors that will determine success or otherwise of such platforms in the commercial maize market, will be the extent to which incentives are aligned of each player in the value chain. For example, if support at the production level is going to increase the reliability of local supply, downstream players should not be pleading to policy-makers to make imports easier to bring in every time there is a suggestion of a possible supply reduction in the coming harvest.

Any such extension to an existing platform needs to include three components: i) Enhancing productivity through improvement in access to and use of climate resilient inputs, technology and financial services; ii) Improving post-harvest management; iii) Strengthening market linkages and transparency of information across the entire value chain including the end buyers.

Figure 6. **Opportunities to create climate resilience and value added in the maize sector**



i) Productivity with climate resilience:

Productivity improvement through input and technology upgrading would be a primary lever for climate smart adaptation. As seen in Figure 4 and 5, the productivity (yield) enhancement will increase farmers' revenue from 332,000 TSH (US\$150) per acre to more than 1,500,000 TSH (US\$660) per acre in a good year. If involving 3,125 farmers³¹ in the program, additional revenues for farmers would amount to 3.65 billion TSH (US\$1.6million).

From the program, the input companies can expand their market to smallholder farmers. Having 3,125 new farmers in the market means additional values of about 828 million TSH (US\$360,000)³². Banks, which provide loans to 3,125 farmers, will earn interest income of approximately 138 million TSH (US\$61,000).

There are hidden benefits for millers from such an approach. When production is low in drought year, millers may need to source from other regions to meet the needs of the end buyers, and if they cannot, then end-buyers will have to import from outside their normal sourcing footprint. Due to high transportation costs, sourcing from other regions is a heavy burden for the millers. For instance, the sourcing cost for KFS, which is located in Dodoma, the central part of the country, doubled due to high transportation costs from southern Tanzania during 2014/15 when there was a severe drought.

Adoption of climate resilient approaches to productivity improvement would build on many of the good achievements of the current programs, while paying attention to adoption of not just improved seeds, but climate smart use of inputs. The latter might include a wide variety of seeds appropriate to context, addition of lime, precision fertilizer application, reduced but more consistent and appropriate use of chemicals, improved water management and adoption of conservation agriculture agronomic practices such as minimum tillage, mulching, composting and use of rotational crops. Such practices need to be evaluated in each different context for the cost effectiveness of their use by farmers both individually as well as together under a broader program.

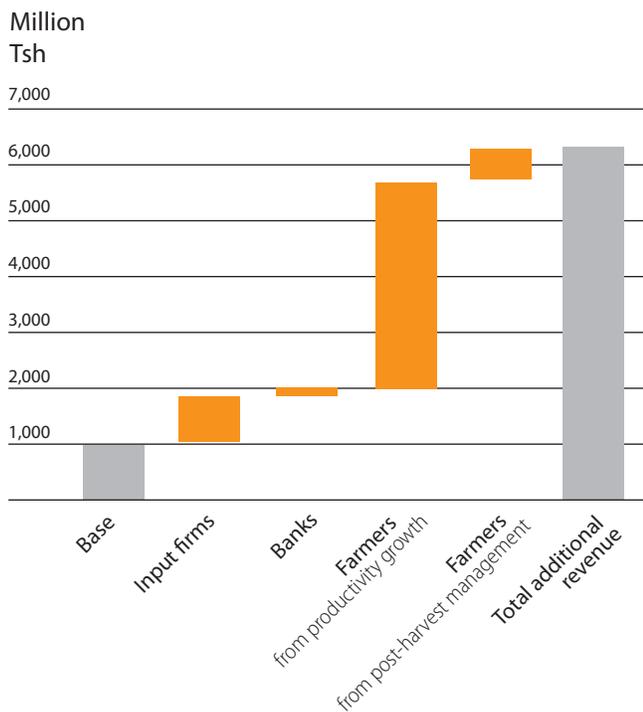
ii) Improving post-harvest management:

Good post-harvest management can increase the amount of maize farmers can sell and consume, and reduce income volatility. The key levers for decreasing maize loss are as follows:

- **Post-harvest technology distribution:** the procurement platforms and agro-dealer networks can liaise to ensure that PHL solutions are accessible. They can
 - Set up a warehouse receipt system so that volume and value of maize in stores creates a bond opportunity for a farmer³³
 - Improve access to improved threshing, drying and storage technology
- **Farmer aggregation & training for all supply chain players:** main aggregation centers/hubs can be developed by off-takers and source from near-farm aggregation stores; the latter in turn can utilize post-harvest technologies and train farmers in post-harvest management. Training is required for all supply chain players in relevant topics such as storage technologies and management, market intelligence, warehouse receipt systems, and, access to finance.
- **Financing mechanisms:** similar to productivity enhancement components, with market risks reduced due to more limited post-harvest losses, financial institutions will be more likely to provide financing and credit to farmers, farmer organizations and local manufacturers/fabricators of technology to increase access and affordability. By liaising with banks, micro financing institutions and supply chain actors can provide farmers access to affordable credit and cushion them from moneylenders and other financial institutions that charge high interest rates.

As an example of the potential, Figure 7 summarizes the value-added through the integrated platform for farmers, input firms and banks for the 3,125 farmers, which supply maize to Kibaiwiga Food Supplies. While there is cost saved for the miller due to reduced uncertainty on sourcing and potential saving on transportation caused by sourcing from other regions, this benefit for a miller is not included in the Figure 7 as it is hard to quantify.

Figure 7. **Additional revenue through the integrated platform**
(Including 3,125 farmers supplying one miller)



iii) Market linkages:

Forward contracts promise a certain amount of maize to be procured in advance between farmers and millers. Through the forward contract, as FMA is doing now, farmers can secure market access, while buyers can have a reliable supply base (assuming low production risk). Ideally the contracts would be extended up to three to five years in the future, to reduce the risks for producers of increasing their investment in yield and quality improvements. In addition to contracting, better matching of supply and demand in advance between end buyers such as brewery companies and millers tightens coordination, which reduces risk for other players across the chain. When the demand is lower than expected, supply chain players such as millers may face increased storage costs. If the supply of the crop is less than the end-user companies' need, the firms would not be able to meet their business plan through local sourcing and may have to resort to imports that may be more expensive and/or of lower quality.

Market linkages and greater transparency through the season are critical even though it is hard to quantify the value-added they create. They provide strong incentives for millers and end buyers to work with smallholder farmers. Millers and end buyers can manage their expectations in terms of quantity and quality of the products.

Regardless of increased trust within the chain, there may still be times when local supply is constrained (eg due to poor harvests induced by adverse weather) where imports are available at prices below those on the local market. At such times, it will be essential that the government is ready to provide complementary incentives such as reducing excise taxes to maintain local sourcing, while not directly intervening in regulating trade flows.

B Mechanisms to share the climate risks across the value chain

i) Weather forecast infrastructure and climate risk modeling

In order to reduce the climate risks, a key improvement is to improve collection and sharing of weather information, so that farmers can decide the optimal timing of their planting and harvesting activities, farmers and other value chain players can more accurately risk-assess their potential investments, and millers as well as end buyers can manage their expectations about the supply of maize before and during the season. Currently, the weather forecast infrastructure is poor in Tanzania: although the weather data is collected at the district level, it is unknown how well the data is analyzed or used. In addition, the weather projections that farmers get are limited to forecasts for three days in advance. Accurate longer-term forecasting would enable better planting decisions to increase germination and survival rates (for example, it would be good to know if the rains will be likely to continue for ten days after planting or not). However, this would take considerable investment in improved local skills and use of terrestrial and satellite data. Based on improved weather information, more could be done to understand what the impact of the weather would be for each crop including maize, so that there can be more preemptive actions to mitigate the negative impact. Additional investment in weather infrastructure and forecasting, as well as climate risk modeling, can improve the management of climate risks by improving the abilities of relevant players to prepare for such risks in advance.

ii) Social Impact Bond

Beyond improving weather forecasting and developing and offering an attractive weather index insurance scheme (see next sub-section), a partnership between companies, donors, non-profits and government could put in place a new financing vehicle to invest in both climate resilience and yield enhancement that would equitably share in the risks and rewards of improving support services for maize growers. Ideally, the solution would not only *finance* the development of extension services for maize growers to facilitate yield improvement and climate-smart practice adoption, but also *coordinate* incentives of private sector value chain players, such as breweries and millers, and the local public sector to optimize climate-smart extension programs. Along the

way, the results of this program would need to be measured and verified by an independent third party, ensuring that credible, viable solutions could spread across growing regions.

Such a financing vehicle could use the design features of a social impact bond to directly fund farmer enrolment in programs that offer risk reduction and yield improvement. It would also pay returns to investors based on achieving targeted results that span both sets of objectives.

Leading private sector players in the value chain, as well as interested financial institutions, could be co-investors into such a bond structure ear-marked for climate-smart extension programs for maize growers. The Tanzanian government, in conjunction with international public donor agencies or foundations, such as those supporting the WFP's FMA, would issue this 'bond'. Essentially, these sponsoring organizations would promise a financial reward if the social or development initiative (in this case adoption of climate smart maize inputs and practices) were to produce the results they desired, including increased production in the face of climate risks, while managing some of the risks on the downside. Private sector players' financial returns on the bond would thus be contingent on the program in which they are a co-investor achieving the desired results. If the program achieves its targets, participating companies might receive a 5% premium, for example, on their initial investment; if it does not, they might lose 20-30% of the principal invested. An independent party would need to be contracted to verify the results of this program.

A financing arrangement structured like a social impact bond could provide multiple incentives to lock in enhanced coordination and cooperation during program delivery:

- **Sharing risk and reward:** A pay-for-success vehicle would encourage leading private value chain players to invest in climate-smart extension programs, but share the risk and reward of investment with other interested partners. Instead of assuming full liability if the intervention fails. Financial and any reputational losses are shared with other value chains players, as well as the government and/or development financiers that issue and underwrite the bond. If success occurs, the private sectors' gains

from less volatile returns from the maize supply chain are complemented by an additional financial reward.

- **Embedding sectoral coordination:** This structure would give leading companies an incentive to put “skin in the game”, rewarding them financially for offering to coordinate effectively with other players along the maize value chain alongside an umbrella platform, such as the FMA or IGGASAS.
- **Providing rigorous evidence of impact:** With such pay-for-success contracts being typically monitored by a neutral third party evaluator, trust is built in benefits of the program. The monitoring provides independent confirmation of impact, while clarifying the ways that all stakeholders would benefit from the program over the long-term.

Constructing a social impact bond offers the potential to align incentives across all players in the value chain. As noted above, the government and supporting donors/foundations would be the primary underwriters of the bond, connected to participating companies through the financing mechanism. WFP and/or AGRA as lead program implementer(s), would

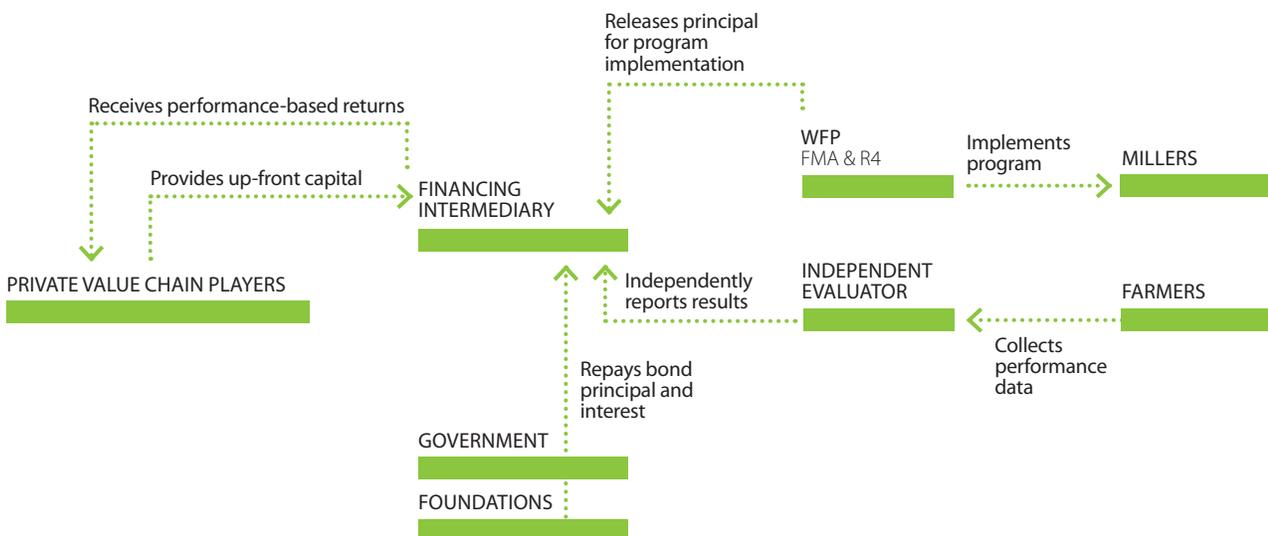
be funded through the financing mechanism. Private sector players will benefit from the program as returns to farmers on the ground are verified.

iii) Weather Insurance

Even if productivity, post-harvest management and market access improve, the weather uncertainty will not be fully hedged. The negative impact of drought on production could be reduced, but the losses from the drought are not covered. Weather-index and related types of insurance can directly tackle risks of weather uncertainty. Those insured would pay a regular premium. In a bad year, the insurance companies would compensate for weather related losses in line with the index, saving individual farm level loss verification.

The initiative with the widest smallholder coverage across East Africa to date is ACRE Africa supported by Syngenta Foundation for Sustainable Agriculture. It currently focuses its product development efforts on reducing risks to smallholders from purchasing improved inputs.³⁴ They and other similar schemes focus on insuring the costs of inputs and loans taken to purchase them, but do not fully insure the farmers from the opportunity loss of a poor or failed harvest

Figure 8. **Implementing FMA through a Social Impact Bond Structure**



(ie farmers get no compensation for their production efforts and loss of potential income).

With few available weather insurance options in the region and limitations as noted above, the World Food Program in collaboration with Imperial College, London has been developing the WINnERS model for weather-index insurance linked to the FMA with different scenarios for payers, premium, coverage and any upfront investment in actions to reduce risks. This model holds much promise given the level of refinement of the indices being constructed and the ability of it to take into account differential farm improvements being applied, that make the insurance cheaper for farms that are less exposed to risk, having adopted improved inputs and practices. It should be carefully tracked and assessed for its commercial viability and any need for ongoing subsidy.³⁵

WFP has also developed a program that is oriented toward reducing farmers' risks. Initiated in 2011 through a strategic partnership between Oxfam America and the World Food Programme, R4 aims to provide an integrated risk management strategy combining improved resource management (risk reduction), insurance (risk transfer), livelihoods diversification and micro-credit development (prudent risk taking), and small-scale savings (risk reserves).³⁶ R4 was designed to insure the poorest farmers who were deemed to be uninsurable due to poor market access and liquidity constraints. The program allows farmers to pay for insurance premiums through its Insurance-for-Work (IFW) program. In Ethiopia, this program is directly integrated into the country's PSNP (Productive Safety Net Programme). In other countries, it is built into WFP's food-for-assets program. Through the program, farmers participate in a variety of labor projects that improve resilience, such as conservation agriculture, in return for subsidized premiums.

The program has shown a variety of benefits through linkages with other products. Not only did farmers increase their borrowing and invest in productive technologies (oxen), but they also managed to increase savings by 123% relative to the uninsured.

R4 seems to be ripe for scale-up. In recent years, R4 has expanded from its original country of focus, Ethiopia, to Senegal. Pilots have also begun in Malawi and Zambia. Investments to establish the R4 platform by end buyers, might help to accelerate program development in Tanzania, while also providing strong linkages to capacity development initiatives such as the FMA, if the efforts were pursued in tandem. Such contributions would also support the development of a market-based mechanism for sustainably funding a program that is currently proceeding primarily through non-profit donations. To date, WFP has not moved to introduce R4 in Tanzania, preferring to focus on developing the new insurance product mentioned above.

Finally, the spread of mobile and digital financial services creates opportunities to ensure that such efforts explore and embrace opportunities to reduce delivery costs, promote unique customer identification and improve transaction security. For example, integrated service menus delivered over mobile platforms could allow smallholders and their business partners to agree supply chain financing of inputs combined with insurance and guaranteed sales that could reduce market risks for all and increase the incentive for increased use of modern inputs and practices, even in the face of rising weather risks. Organizations such as Tulaa (recently evolved out of Esoko) are increasingly active in this area. Given the need for much testing and design work to ensure such platforms not only work technically, but also in practice, any such future initiatives will also initially have to be donor or philanthropically funded.

5 Specific Case Example: Opportunities for Impact for AB InBev

In this section, we will discuss the specific case of Anheuser-Busch InBev (AB InBev) which sources maize via local third parties for its local associate Tanzania Brewery Limited (TBL).

TBL sources a significant proportion of its ingredients locally to meet its volume requirements. Sourcing maize locally via third parties provides a formal market for smallholders and helps improve their livelihoods, while contributing to the company's supply security and reputation. However this may also expose TBL and AB InBev to a greater degree of climate risk, underpinned by increasing uncertainty about the quantity and quality of locally available maize, as production is increasingly affected by increased weather volatility.

By supporting local farmers to adopt climate resilient behaviors, AB InBev and TBL would not only contribute to improving local farmers' livelihoods further but also mitigate the farmers' and the company's own climate risks. One of the most effective ways to do this would be through deeper engagement and partnership between integrated platforms such as WFP Farm to Market Alliance and private sector companies such as AB InBev. For example:

- **Visibility of demand:** By providing information about the expected demand each year and committing to multi-year purchasing for specific volumes, as well as building in expansion plans for the future, AB InBev can contribute to make the platform across the value chain more reliable and predictable. This would enable the platform to reduce future local supply risks to all players including AB InBev.
- **Investment:** Neither FMA nor IGGSAS platforms are adequately funded to address climate risks comprehensively at present. Complementary investment from a private sector player can, whether structured into a development impact bond or not, be used to incentivize other value chain players and partners to support a broader range of activities to reduce climate risks.

- **Reputation:** Visibly improving AB InBev's commitments to the maize sector in Tanzania will enhance the company's reputation in the country, which may be very useful in under-pinning relations with the Government and helping to address future policy uncertainties.

The company will not decide to invest in climate resilience programs as a standalone decision, but as part of a wider set of strategic decisions around how to advance its sourcing, supply security and sustainability agendas. Nonetheless, climate risk and mitigation actions required should be measured and understood as part of the company's sourcing plans. Partnership, especially with integrated multi-stakeholder platforms present the best opportunity to reduce this risk, while increasing supply security and improving smallholder farmer livelihoods.

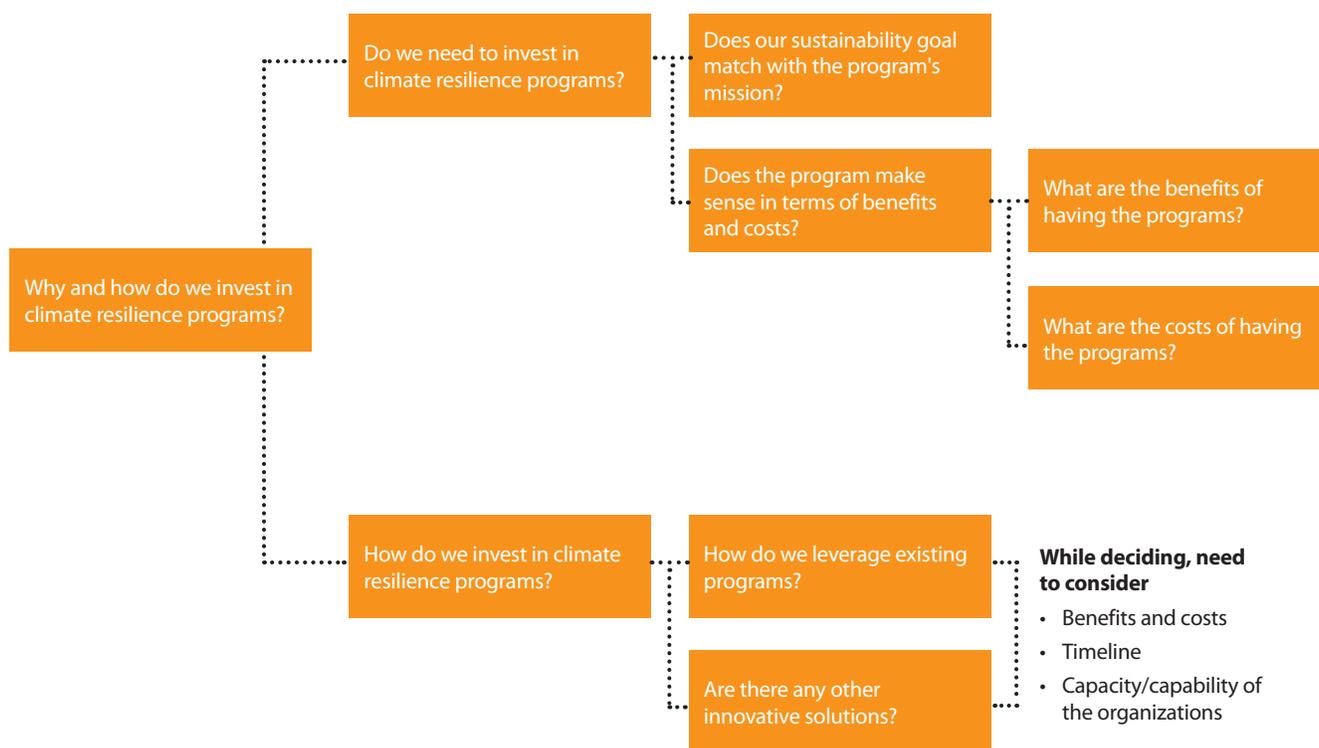
6 Conclusion

This case is primarily aimed at guiding staple crop value chain players as to how to think about addressing climate and weather risks in their activities, with the underlying hypothesis being that increased innovation, investment and collaboration are needed to help improve the ability of value chain players to cope with increasing risk and volatility. We provide here a sample decision tree to guide stakeholders' considerations of these questions in a more standardized manner.

The case shines a particular light on cases where end-buyers are not sourcing from producers directly. It does not provide participating companies with a blueprint of how to build

the financial, economic and social case for an expanded investment in future production improvement and reduced procurement risks in the Tanzania maize supply chain or to unambiguously suggest they should make such investments. This is work that companies need to do by themselves. This case does indicate the breadth of such an assessment, including a range of factors that need to be evaluated, as well as the business and sustainability logic that can be used to explore and justify any such investment. This is an important steer not only in the particular case of maize in Tanzania, but also for companies facing similar multi-layered and risky agricultural supply chains in a much broader range of commodities across the developing world.

Figure 9. **Decision tree to invest in climate resilience program**



Acknowledgements

This paper was based on field work and interviews with people working in the production and processing segments of the maize sector in Tanzania and in particular in the programs and businesses cited in the report. Several of them gave feedback and reviewed the document including representatives from Kibaigwa Flour Supplies, AB InBev, AGRA and the World Food Programme. A portion of this research was supported by Sustainable Food Lab through the USAID Feed the Future program, under the Learning Community for Supply Chain Resilience. In addition, a debt of gratitude is extended to Jane Nelson for her inspiration, guidance, and support with the exercise. While all mentioned had input into the report, the work and all its possible flaws and misinterpretations remain the work of the authors themselves.

Appendix 1

List of interviewees

Ananth Raj, FMA Coordinator,
World Food Program in Tanzania

Sebastian Msola, CEO, Kibaigwa Flour
Supplies (KFS)

Kelvin Msola, CFO, Kibaigwa Flour
Supplies (KFS)

Chawanako Farmers Associations
(8 farmers)

Mcombezi Soko Kuu Saccos (Farmers'
association) (12 farmers)

Fabian Mwakatuma and **Jesca Njau**,
Purchasing Department, Tanzania
Brewery Limited

Victor Manyong, International Institute
of Tropical Agriculture

William Thomson, Imperial College

Mary Mgonja, Country Head, AGRA

Appendix 2

Cost and value analysis

FMA program is designed that farmers sell their crops to private players – contracted millers. Thus, for apple-to-apple comparison, we used average prices sold to private players (not government agency) for both 'Before FMA' and 'Under FMA'. While government's National Food Reserve Agency

(NFRA) procures basic crops to maintain the prices, millers and end-buyers often have difficulties to source maize in time because farmers tend to wait for selling their crops first to NFRA with higher prices, and then to private sellers.

Cost & values before FMA

COST	ITEMS	per acre (TSH)	Share in total cost
	Fertilizer		0%
	Hybrid seed		0%
	Pesticide		0%
	Labor (before harvesting)	135,000	44%
	Labor for applying fertilizer and pesticide		0%
	Labor (harvesting)	30,000	10%
	Post harvest	140,000	46%
	Interests		0%
	TOTAL	305,000	100%

VALUE	ITEMS	per acre (TSH)	
	Average production (kg/acre)	800	
	Minimum production (kg/acre)	200	
	Average price (TSH/kg)	415	
	Average	332,000	
Minimum	83,000		

Cost & values under FMA (with all climate resilient inputs)

COST	ITEMS	per acre (TSH)	Share in total cost
	Fertilizer	143,000	22%
	Hybrid seed	45,000	7%
	Pesticide	77,000	12%
	Labor (before harvesting)	135,000	21%
	Labor for applying pesticide	20,000	3%
	Labor (harvesting)	30,000	5%
	Post harvest	148,500	23%
	Interests	44,080	7%
	TOTAL	642,580	100%

VALUE	ITEMS	per acre (TSH)	
	Average production (kg/acre)	3,254	
	Average price (TSH/kg)	465	
	Minimum price (TSH/kg)	330	
Average	1,513,110		
Minimum	1,073,820		

Cost & values under FMA (without pesticides)

COST	ITEMS	per acre (TSH)	Share in total cost
	Fertilizer	143,000	25%
	Hybrid seed	45,000	8%
	Pesticide	-	0%
	Labor (before harvesting)	205,000	36%
	Labor for applying pesticide		0%
	Labor (harvesting)	30,000	5%
	Post harvest	123,500	21%
	Interests	28,576	5%
TOTAL	305,000	100%	

VALUE	ITEMS	per acre (TSH)	
	Average production (kg/acre)	1,600	
	Average price (TSH/kg)	465	
	Minimum price (TSH/kg)	330	
	Average	744,000	
Minimum	528,000		

Appendix 3

Additional revenue for each player

Assumptions used for calculation

Additional revenue for 3,125 farmers					
	Base	Productivity growth			Crop loss management
	Base	Input firms	Banks	Farmers	Farmers
Value creation (TSH)	1,037,500,000	828,125,000	137,500,000	3,650,000,000	620,500,000
Assumptions	332,000 (average value creation per farmer) x 3,125 (# of farmers)	265,000 (cost spent on improved input per farmer) x 3,125 (# of farmers)	44,000 (interest paid to banks) x 3,125 (# of farmers)	1,168,000 (additional revenue per farmers) x 3,125 (# of farmers)	17% improvement from the additional revenue

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- Tanzania WFP Food Security 2012
- <http://www.wfp.org/climate-change/initiatives/r4-rural-resilience-initiative>

Endnotes

- 1 See for example: Morton, JF. The impact of climate change on smallholder and subsistence agriculture. *Proc Natl Acad Sci USA*. 2007; 104: 19680–19685
- 2 See R. Trevor Wilson, J. Lewis, 2015, *The Maize Value Chain in Tanzania: A report from the Southern Highlands Food Systems Programme*, FAO
- 3 List of interviewees can be found in the Appendix 1
- 4 Bill & Melinda Gates Foundation, Multi Crop Value Chain Phase II- Maize Tanzania, September 2014
- 5 R. Trevor Wilson and J. Lewis, *The Maize Value Chain in Tanzania: A report from the Southern Highlands Food Systems Programme*, Food and Agriculture Organization of the United Nations, 2015.
- 6 Bill & Melinda Gates Foundation, Multi Crop Value Chain Phase II- Maize Tanzania, September 2014.
- 7 FAOSTAT
- 8 FAOSTAT
- 9 The AGRA report gathered data from 380 smallholder maize producing households in Kilimanjaro, Arusha, Iringa, Ruvuma, Manyara, Dodoma
- 10 Hillocks, R.J, 2015, Addressing the yield gap in Sub-Saharan Africa, *Outlook on Agriculture* Vol 43, No 2, 2014, pp 85-90 doi: 10.5367/oa.2014.0163
- 11 Tanzania WFP Food Security 2012
- 12 R. Trevor Wilson and J. Lewis, *The Maize Value Chain in Tanzania: A report from the Southern Highlands Food Systems Programme*, Food and Agriculture Organization of the United Nations, 2015
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- 14 Tanzania WFP Food Security 2012
- 15 Bill & Melinda Gates Foundation, Multi Crop Value Chain Phase II- Maize Tanzania, September 2014.
- 16 CCAFS is a cross-system initiative of the Consultative Group on International Agricultural Research (CGIAR), funded by a variety of donors and with a large number of partner research organizations both within the CGIAR and outside.
- 17 Julian Ramirez-Villegas (CIAT) and Philip K Thornton (CCAFS), *Climate change impacts on maize in Tanzania: key findings from CCAFS research*, 2016
- 18 R. Trevor Wilson and J. Lewis, *The Maize Value Chain in Tanzania: A report from the Southern Highlands Food Systems Programme*, Food and Agriculture Organization of the United Nations, 2015.
- 19 Formerly known as Patient Procurement Platform. For more details about the platform, refer to WFP website and Dalberg, *The Patient Procurement Platform: Diagnosing Risk in Tanzania*, 2015
- 20 On average, each farmer in the program produces 3 tonnes of maize in the long season harvest. By design, participating farmers commit 1 tonnes of their maize to the program so that they can retain 2 tonnes for home consumption and “side-selling”.
- 21 Dalberg, *The Patient Procurement Platform: Diagnosing Risk in Tanzania*, 2015
- 22 Feedback provided by Ananth Raj, World Food Program, June 2016
- 23 The best price was 800 Tsh per kg during the past 5 years.
- 24 Known as the WINnERS programme – see <http://www.winners-project.org/work-programmes/contract-design/>
- 25 The sample are 271 farmers from three farmer groups, which are suppliers to KFS – Chawanako, Mkombozi Soko Kuu, and Muhangu. While Chawanako did not use pesticides and produced 1,000kg per acre on average, farmers from other two groups used pesticides and produced between 2,500 – 3,750 kg per care.
- 26 Information received during miller interview, March 2016
- 27 For detailed assumptions, refer to Appendix 2
- 28 Julian Ramirez-Villegas (CIAT) and Philip K Thornton (CCAFS), *Climate change impacts on maize in Tanzania: key findings from CCAFS research*, 2016
- 29 See for example this announcement of additional investment in May 2017: [https://africabusinesscommunities.com/news/tanzania-yara-announces-\\$36-million-investment-in-dar-port-to-improve-supply-of-fertilizer/](https://africabusinesscommunities.com/news/tanzania-yara-announces-$36-million-investment-in-dar-port-to-improve-supply-of-fertilizer/)
- 30 See AGRA, 2016, “AGRA IGGAS Inception Phase – Final Progress Report (July 2015-September 2016)”
- 31 Currently, Kibaigwa Food Supplies (KFS) sources some 5000mt per year. Under PPP, farmer groups in Kibaigwa within MFA produce 1,600kg per acre and are willing to sell 1,600kg while keeping the remaining products for the family consumption. Sourcing 1,600kg per household means that it needs 3,125 household to meet 5,000mt per year.
- 32 The figure did not consider additional costs of input companies
- 33 Warehouse receipt programmes in Sub-Saharan Africa have a troubled history, but that does not mean the concept should not continue to be explored and improved based on prior lessons – see for example: J Coulter Consulting Ltd. and Sullivan & Worcester UK LLP, 2014, “Study on appropriate warehousing and collateral management systems in Sub-Saharan Africa: Volume i – key findings”
- 34 See <https://acreafrica.com/> for details
- 35 This paper is not suggesting a priori that smallholder weather index insurance can be provided commercially without the need for any sort of subsidy.
- 36 See <http://www.wfp.org/climate-change/initiatives/r4-rural-resilience-initiative>

About the authors

Simon Winter worked on this report as a Senior Fellow at the Mossavar-Rahmani Center for Business and Government at Harvard's Kennedy School, where he researched climate risks and sub-Saharan African food and agricultural systems, and co-published prior papers with the Corporate Responsibility Initiative. Since September 2017, he has been the Executive Director of the Syngenta Foundation for Sustainable Agriculture. Prior to that he was TechnoServe's Senior Vice President of Development. He has worked with McKinsey and Company, co-leading the firm's international development practice, as an economic planner for the Botswana government, a development consultant in Southern Africa, and at Barclays Bank plc. Simon serves on several boards and advisory councils focused on agriculture and global development, and holds a PhD in economics from the School of Oriental and African Studies, University of London.

Kyunghwa Rebecca Jang graduated from Harvard Kennedy School's MPA in International Development (MPA/ID) Program in 2017, where she worked on this report. She is now working with McKinsey & Company, focusing on strategy development and organizational transformation. Previously, she worked with the government of Sri Lanka on trade and foreign investment promotion, with an NGO in Tanzania on healthcare human resources management, and collaboratively with the Jordanian government, USAID, and a US-based nonprofit on their public-private partnership for economic development. She also holds a MA in Economics and a BA in Political Science & International Relations from Korea University.

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About Sustainable Food Lab

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<https://sustainablefoodlab.org>

About TechnoServe

TechnoServe works with enterprising men and women in the developing world to build competitive farms, businesses and industries. A nonprofit organization operating in 29 countries, TechnoServe is a leader in harnessing the power of the private sector to help people lift themselves out of poverty. By linking people to information, capital and markets, it has helped millions to create lasting prosperity for their families and communities. With nearly 50 years of proven results, TechnoServe believes in the power of private enterprise to transform lives.

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Corporate Responsibility Initiative

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Harvard Kennedy School
79 John F. Kennedy Street
Cambridge, MA 02138 USA

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