G:ENESIS
UNLOCKING VALUE

Integrating Climate Smart Agriculture into E-Voucher Farmer Input Subsidy Programme: Insights from Zambia

Paper commissioned by Vuna | February 2018

Adam Smith International

VUNA

UKaid
from the British people

Please cite this publication as follows:

Genesis Analytics, 2018. *Integration of Climate Smart Agriculture into E-Voucher Farmer Input Subsidy Programme: Insights from Zambia. Vuna Research Report.* Pretoria: Vuna.

Disclaimer

The British Government's Department for International Development (DFID) financed this work as part of the United Kingdom's aid programme. However, the views and recommendations contained in this paper are those of the consultant, and DFID is not responsible for, or bound by the recommendations made.

TABLE OF CONTENTS

List of Tables

List of Figures

List of Boxes

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 Out-grower Schemes: Insights from Musoma Food Company Ltd and G2L Ltd in Tanzania;
- Integrating Climate Smart Agriculture into E-Voucher Farmer Input Subsidy Programme: Insights from Zambia (this paper); 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's 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

AEZ	Agro-ecological zone
CSA	Climate Smart Agriculture
DACOs	District Agricultural Coordinators
DFID	The United Kingdom's Department for International Development
ESA	East and Southern Africa
FISP	Farmer Input Subsidy Programmes
GRZ	Government of the Republic of Zambia
IAPRI	Indaba Agricultural Policy Research Institute
IPCC	Intergovernmental Panel on Climate Change
MoA	Ministry of Agriculture
ND	no date
NGO	Non-governmental organisation
PICS	Purdue Improved Crop Storage
PCO	Programme Coordinating Office
POS	Point-of-Sale
WFP	World Food Programme
WII	Weather Index Insurance
ZNFU	Zambia National Farmers Union

Executive Summary

The Zambian government through the Ministry of Agriculture (MoA) has been implementing the e-voucher programme under its Farmer Input Subsidy Programme (FISP) with the aim of increasing access to and use of modern inputs; raise crop yield and production; improve food security; reduce hunger; raise incomes and reduce poverty. The e-voucher is delivered through pre-paid bank cards where farmers receive a bankcard loaded with the government subsidy contribution of ZMW 1,700. The card is activated for input purchase once the farmer loads their contribution of ZMW 400 bringing the total redeemable amount on the card to ZMW 2,100. The subsidy is redeemable through Point-of-Sale (POS) devices against a wide range of agricultural inputs from a wide range of 'authorised' agro-dealers in the districts. Traditionally, FISP focused on providing farmers with access to fertiliser and seed for maize production offering farmers few opportunities to diversify into production of other crops and invest in CSA practices. Against this background, Musika Development Initiatives (Musika) in partnership with Vuna CSA Programme identified a potential to cost effectively integrate CSA into the e-voucher subsidy scheme. The objective was to build the resilience and adaptive capacity of e-voucher beneficiaries[1] to the impacts of climate change through improved incomes and food and nutrition security. Integration of CSA was done through facilitating access to CSA knowledge, inputs, and practices; weather index insurance (WII) and improved national policy support for CSA initiatives.

This paper provides an assessment of preliminary findings and lessons learned from the Vuna CSA model of integration of CSA into the Zambian e-voucher FISP. The paper assesses the efficacy, potential sustainability and potential scalability of integrating CSA into the e-voucher scheme, adoption levels of the various CSA practices promoted by the model, and the efficacy of the practices in building the resilience of the e-voucher beneficiaries. Primary and secondary information from literature and interviews with the key stakeholders[2] informed the body of this paper.

Preliminary findings from the study indicate that:

- Integration of CSA practices into the e-voucher scheme has been a success as evidenced by the Government of the Republic of Zambia (GRZ)'s policy directive that all e-voucher farmer beneficiaries commit 30% of their subsidy allocation towards legume production and 10% to the purchase of WII policies. This was driven mainly by CSA trainings, awareness campaigns, and policy lobbying at various levels of government by the project.
- Adoption of CSA practices and their efficacy in building beneficiaries' resilience revealed mixed results across different CSA practices. Positive results include increased legumes production, particularly cowpeas and early maturing varieties of cereals. Increased CSA training and awareness campaigns delivered through community radios, public extension systems and agro-dealers were noted to have contributed towards farmer behaviour change which resulted in an increased production of legumes and use of early maturing cereal varieties.
- The availability of e-voucher subsidy funds and the increased supply of CSA inputs by input suppliers contributed towards the increased adoption of CSA practices, in particular, early maturing maize varieties and certified legume seed. Continuous sensitisation on CSA practices, availability of government subsidy funds, and private sector offtake markets for CSA commodities are key factors for the sustainability of the integration and adoption of CSA into the e-voucher model.
- While there is emerging evidence of improved incomes and food and nutrition security due to the CSA e-voucher integration model intervention, the extent to which it has effectively built resilience among beneficiaries is still limited due to the short implementation timeframe of the Vuna project. Farmers reported increased incomes resulting primarily from production of legumes, which fetch higher prices on the market compared to maize. Agro-dealers reported that the growth in legume production and use of certified early maturing cereal seed

1 Smallholder farmers are the primary beneficiaries of e-voucher while agro-dealers are indirect beneficiaries
2 Musika Development Initiatives, Indaba Agricultural Policy Research Institute (IAPRI), the Government of the Republic of Zambia (GRZ), input suppliers, agro-dealers, farmers, financial institutions, insurance companies and donor organisations

contributed significantly towards the growth of their businesses as some reported business turnover increases of more than 100%.

- However, limited product knowledge and understanding of other components of the model such as WII, post-harvest technologies, and output markets resulted in low adoption translating to equally less satisfactory potentially resilience building results. For WII in particular, sustainable adoption is largely reliant on farmer understanding of the product and accrued benefits to the farmer.

In conclusion, while the integration of CSA into the e-voucher scheme was a success and has the potential to build farmers' and market players' climate resilience, the twin challenges of the absence of private sector offtake markets and beneficiaries' limited knowledge of some of the CSA practices puts the sustainability and scalability of the model into question. Recommendations for model improvement include the following:

> Access to improved CSA inputs, practices and technologies is critical for building farmer resilience but not sufficient. Without appropriate market access resilience is not established and, potentially, undermined.

- **Access to improved CSA inputs, practices and technologies is critical for building farmer resilience but not sufficient**. Without appropriate market access resilience is not established and, potentially, undermined. It is therefore important to explore alternative private sector off take markets for CSA commodities to ensure continued production of these commodities by farmers. Options include the feed market for leguminous crops such as cowpea.
- **An exhaustive market systems analysis is required before designing an intervention.** In this case, the design should have factored in private sector off-take markets into which farmers would sell their "CSA output" on the back of purchasing CSA relevant inputs. The choice of these private sector off-take partners usually makes or breaks a market systems intervention
- **Increase in productivity, and not only production, is a greater driver of sustainability at the farm level.** Whilst it is a noble objective to achieve a national tonnage of specific crops, attention must also be paid to the farmers' productivity per hectare as this is a far greater determinant of profitability and sustainability than land are under cultivation alone
- **E-voucher schemes, where they already exist, can be leveraged to increase adoption of CSA initiatives.** However, voucher mechanisms' dependence on government support puts the sustainability of these initiatives at risk and can potentially distort the market. Commercialising voucher schemes by ensuring beneficiaries venture into production of commercial crops that increase farmers' incomes which can be used to purchase CSA inputs can help reduce the dependence on subsidies to support farmer investment in CSA practices.
- **CSA uptake requires supporting information and know-how**. It is important that CSA information and know-how dissemination functions be embedded into and delivered by market players familiar to and trusted by farmers and who interact with farmers on a regular basis. This is key in ensuring sustainability beyond the existence of project support.
- **Information asymmetry between donors/donor programmes and the private sector creates misconceptions of what is and what is not possible**. Donor programmes usually have preset log frame targets and indicators which are not necessarily informed by the realities in the market. The programmes then attempt to align these with the objectives of the private sector which sometime is not possible. The key point here being that programmes must understand the market thoroughly before designing interventions that have the potential of leaving farmers worse off. Conversely, private sector partners must share the developmental ethos of most donor programmes and make a concerted effort to implement these diligently
- **Appropriate product design is equally important in driving insurance product adoption**. Insurance products should be designed in a manner that provides adequate cover against weather related losses. The product should also ensure that pay outs are made to farmers in a timely manner and be aligned to the value of the losses incurred by the farmer to allow farmers to replace lost inputs.

- **Profitability of actors throughout the market system is critical to the long term sustainability of this model.** Farmers, agro-dealers, private buyers (off-takers) and insurance/financial services providers are all in business to make a profit and must therefore see positive returns on their investment in CSA to prevent disadoption of the practices.

1 Introduction

Climate change is changing rainfall patterns, and inducing more severe and frequent extreme weather events such as droughts and flooding in many parts of East and Southern Africa. 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.

Climate Smart Agriculture (CSA) is the most promising adaptation approach for the agricultural sector that has gained much traction amongst 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) 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 provides an assessment of preliminary findings and lessons learned from the Vuna CSA model of integration of CSA into the Zambian e-voucher Farmer Input Subsidy Programme (FISP). The paper highlights strengths and weaknesses in design and implementation of the model and crafting recommendations for best practice.

1.2 Local livelihood system

The CSA e-voucher integration model targeted more than 400,000 farmers in 28 districts of Central, Southern, Lusaka, Eastern and Western provinces that have historically been more prone to adverse climatic variability. As illustrated in Figure 1, Zambia is divided into four main agro-ecological zones (AEZ) based on soils, climatic factors, rainfall patterns and common agricultural activities. The AEZs for the pilot project area, referred to as regions are described as follows:

- **Region I:** spans across Western, Southern, Lusaka, Central, and Eastern Provinces characterised as a drought prone area with rainfall between 600-800 millimetres and a short growing season (80-120 days).
- **Region IIa**: also spans across all of the five target provinces and is characterised by the most fertile soils with rainfall between 800-1,000 millimetres with the growing season ranging 100-140 days. Consequently, the region hosts most of the country's commercial farms.
- **Region III:** only spans Central, Eastern, and Western Provinces and is characterised by high-rainfall above 1,000 millimetres, with a growing season ranging from 120-180 days. The region's soils are also characterised by extreme acidity and Al toxicity (Chikowo, ND; MTENR, 2007).

The majority of smallholder farmers in these zones depend on agriculture for their livelihoods. Agricultural activities in these provinces are characterised by rain-fed subsistence farming with a few farmers using irrigation schemes to grow

commercial crops. Maize is the major crop grown mainly for food security purposes with some farmers growing other leguminous crops including cowpeas, common beans and groundnuts for home consumption and selling to the market.

1.3 Climate risks and impacts

Due to high dependency on rain-fed agriculture, smallholder farmers in Zambia are highly vulnerable to climate change with drought reported as the main climate risk. Farmers and other stakeholders were asked to report on their observation of the rainfall patterns with results confirming that rainfall patterns have declined over the past years, characterised by shorter rainfall seasons (rains starting late and finishing early) and by high occurrences of dry spells during the season. Historical analysis supported these observations (Figure 2 and Annex1).

According to rainfall trends analysis conducted by the Indaba Agricultural Policy Research Institute (IAPRI),[3] rainfall in Zambia has on average been declining over the past 20 years. A study of the historical rainfall trends from 1970 to 2012 indicates a decrease in rainfall in Region I (which was identified as the most vulnerable region) with a mean annual rainfall of 684 millimetres over the 37 years. The comparison of historical rainfall in all three regions is highlighted in Table 1.

Table 1: Comparison of mean, minimum, and maximum rainfall among the three agro-ecological regions in Zambia over a 30-year period

Precipitation	Agro-ecological region		
	Region I	Region II	Region III
Mean Annual Precipitation (mm)	684	830	1,151
Highest precipitation in 30 years (mm)	1,048	1,205	1,373
Lowest precipitation in 30 years (mm)	428	544	836

The trends noted in Region I as described above are also noted in Region II and III, with increased dryness and more seasons of below average rainfall. The seasons of below average or minimum rainfall coincide with El Niño events while the above average rainfall correlates to La Nina events.

In terms of projected rainfall[4], the mean annual rainfall is less certain, with Intergovernmental Panel on Climate Change (IPCC) projections highlighting a reduction of approximately 10-20% by 2050 as a result of climate change variability. Seasonal variability will result in less rainfall possibly leading to hotter and drier seasons especially between September and October. However, heavy rainfall is expected during the rainy season (December to February) in Region III[5]. In other studies, rainfall projections up to the year 2070 highlight maximum annual rainfall of 560 millimetres in Region I by 2059 and a minimum of 105 millimetres by 2043. While there will be a general decline in rainfall, some years will experience marginal increases in rainfall.

Zambia experiences hot and dry seasons with temperature of between 26 and 38 degrees Celsius; cool dry seasons with temperatures ranging from 13 to 26 degrees Celsius and rainy seasons with temperatures as high 34 degrees Celsius[6]. An assessment of historic temperature changes (1975-2012) indicates increased drying, with Southern province experiencing the highest increase in temperature from 0.79 degrees Celsius (areas in brown) to 1.2 degrees Celsius

3 Climate Trends and Farmers' Perceptions of Climate Change in Zambia: IAPRI (2014)
4 Climate Models HADCM3 GCM - HadCM3 (abbreviation for Hadley Centre Coupled Model, version 3) is a coupled atmosphere-ocean general circulation model (AOGCM) developed at the Hadley Centre in the United Kingdom. It was one of the major models used in the IPCC Third Assessment Report in 2001. Gordon, C.; Cooper, C.; Senior, C.A.; Banks, H.; Gregory, J.M.; Johns, T.C.; Mitchell, J.F.B.; Wood, R.A. (2000). "The simulation of SST, sea ice extents and ocean heat transports in a version of the Hadley Centre coupled model without flux adjustments". Climate Dynamics. 16 (2–3): 147–168
5 UNDP, 2010
6 ibid

(areas in red) as illustrated in Figure 1 The other provinces, such as Western have a wide range of temperature increases extending from 0.33 to 1.1 degrees Celsius; while other provinces, show marginal increases in temperature from 0.33 to 0.69 degrees Celsius for the Eastern province, 0.62 to 0.87 degrees Celsius for Lusaka and 0.49 to 0. 87 degrees Celsius in Central province as illustrated in Figure 1.

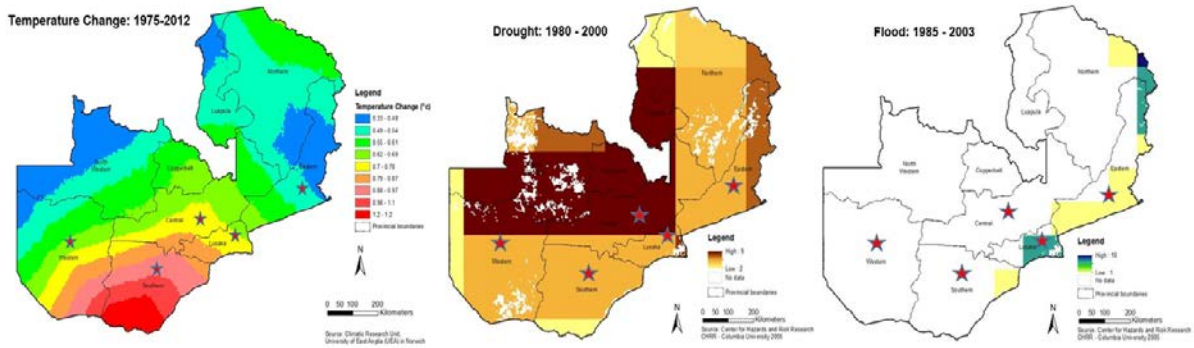


Figure 1: Climate trends in Zimbabwe. Temperature change (left) incidents of drought (middle) and floods (right). The provinces where the Vuna CSA e-voucher integration project are located are highlighted by the red stars.

The projected changes in temperature for the regions in the country indicate increases in temperature from 2010 to 2070, with an average increase of approximately 2 degrees Celsius, from 24.5 to 26, over the 60-year period[7]. Currently, the country has average annual potential evapotranspiration range of 1,394-1,892 millimetres, exceeding rainfall, which is approximately 684 millimetres in the 1970 to 2000 period. As a result, a deficit of up to 1,100 millimetres annually is noted. This negatively affects agricultural production and water availability[5]. The projected increases in temperature will be detrimental to the average annual potential evapotranspiration especially in Regions I and II and this will have an impact on livelihoods that depend on agriculture[7].

1.4 The nature of the problem facing smallholder Zambian farmers

Much of Zambian smallholder agriculture remains low-input, low-output with widespread under-investment and/or under-utilisation in new and improved inputs and technologies. This renders smallholder agriculture in the country relatively uncompetitive both nationally and regionally. While levels of investment in the smallholder sector are on the increase, it is often based on limited understanding of the availability of improved inputs and/or partial understanding of their application. Incentive schemes promoting input use have historically supported food security objectives as opposed to targeting climate smart inputs and practices, and have favoured inputs often less well-suited to prevailing climate risks and conditions.

Farmers and other key stakeholders (agro-dealers, extension service providers and seed companies) were asked to report on the current strategies adopted when dealing with effects and impacts of climate change. The results revealed a wide range of strategies across the different geographies. In Chongwe District of Lusaka Province (AEZ II), farmers cited growing early maturing varieties of maize as the main adaptation strategy. Other adaptation strategies cited include growing legumes (groundnuts, soybeans, and cowpeas), rearing small livestock, crop rotation, mixed planting, staggering planting dates across the season and growing vegetables. The farmers revealed that the decision to diversify into legumes was based on the fact that legumes on average have a shorter growing season compared to cereals, and thus are a better drought mitigation strategy. In Kalomo District of Southern Province (AEZ I) farmers reported growing drought tolerant small grains and growing vegetables and legumes (mostly cowpeas) as key adaptation strategies.

The notable climate change adaptation strategies reported by and observed among seed companies included the development of early maturing varieties of maize and other cereals, and promotion of legumes, which, on average, have

a shorter growing season or period compared to cereals. However, it was observed that while the large seed companies operating in the country have invested significantly in the production of new seed varieties of maize including early maturing and drought tolerant varieties and other cereals as one way to mitigate the effects of climate change, most of them have not devoted sufficient resources into the production of seed for other crops such as legumes. The tendency by farmers to use recycled and uncertified seed for legume production has not incentivised largescale seed companies to invest in the expansion of certified legume seed production. This is consistent with several other studies, which have also found low demand and supply for certified legume seed in Zambia (see for example, Tembo *et al*., 2014; Lubungu *et al.,* 2013; Mofya-Mukuka and Shipekesa, 2013). Consequently, legume seed is developed and distributed mostly by small and emerging seed companies, usually in relatively smaller quantities. The public and private extension service providers interviewed indicated that they had integrated CSA messages in their extension activities to raise awareness among local level input distributors (agro-dealers) and the farmers on the effects of climate change and the adaptation strategies currently available to fight the negative effects of climate change.

While the strategies reported by farmers have some positive impact on addressing the impact of climate change, stakeholder[7] discussions revealed that these current adaptation strategies were not sufficient to address the impacts of climate change at scale. These stakeholders indicated that there is also need for farmers to have access to irrigation facilities to increase their productivity in the event of a drought. Access to offtake markets for their farmers' commodities was also cited as an important adaptation strategy.

The Electronic Voucher System (e-voucher) – Zambia.

The e-voucher programme is an integral part of the Zambian Government FISP. The programme uses a mobile delivery and tracking system to distribute subsidised inputs to farmers through agro-dealers and input suppliers across all 39 districts in Zambia. Targeted farmers receive a Visa bankcard pre-loaded with the government subsidy of ZMW 1,700 that would be activated by the farmer contribution of ZMW 400. Diverse agricultural inputs would be redeemable through POS devices from a wide range of 'authorised' sales points in the districts across the country.

The key partners in the program are the MOA (including the agricultural coordinators at provincial and district levels (Provincial Agricultural Coordinators and District Agricultural Coordinators (DACOs) and camp agricultural committees); ZNFU; Farmer organisations and cooperatives, agro-dealers and input suppliers; MUSIKA; IAPRI; and banks. The FSIP e-voucher system is implemented by MOA through the programme coordinating office (PCO). This office is also responsible for creating awareness of the e-voucher system. The DACOs office, through the agricultural extension officers, was responsible for awareness among farmers. As the lead agency, MOA is responsible for identifying beneficiaries, targeting, budget management and front-line interaction with farmers.

Box 1: Introducing the Zambia e-voucher system

2 Innovation model description

2.1 Innovation model rationale

Prior to the introduction of the e-voucher scheme, the GRZ had been implementing the FISP since the 2002-2003 agricultural season, as part of its efforts to stimulate agricultural production and reduce vulnerability among poor households. Targeting smallholder farmers classified as 'vulnerable but viable' with 50% subsidy of agricultural inputs, the FISP primarily financed access to maize seed and fertilizer. This was meant to stimulate smallholders' productivity in maize and participation in maize markets[8]. Until 2014, the government was responsible for both procurement and distribution

7 Farmer organisations, private sector, development organisations, agro-dealers, and government.
8 Xu *et al*., 2009

of inputs (maize seed and fertiliser) to farmers enrolled under the subsidy programme. This was associated with several implementation and policy challenges. First, by distributing standard input packs, the FISP was not tailored to the maize seed variety as well as crop type requirements for the different agro-ecological zones. This not only constrained farming diversification efforts in the sector but also resulted in inefficiencies in production especially in areas not suitable for maize production. Second, the direct distribution of inputs by the government was characterised by very high logistical and administrative costs and gross inefficiencies that resulted in delivery delays of the inputs and misappropriation of programme resources.

In order to address these challenges and after six years of stalled progress, the MoA initiated the e-voucher system as pilot project delivering the FISP input subsidy through pre-paid bank cards rather than via centrally procured and directly delivered inputs. It targeted an initial 241,000 farmers across 13 districts in Southern, Lusaka, Central, and Copperbelt Provinces, utilising the Visa-enabled 'pre-paid' bank card system successfully pioneered and piloted by the Zambia National Farmers Union (ZNFU) with the support of Musika for the Lima Credit Scheme[9] in 2014. In addition to the need to address inefficiency challenges of the FISP, the migration from to e-voucher was specifically motivated by the need to:

- Encourage more private sector participation in agro-input distribution, thereby reducing the public expenditure on the delivery of private goods such as fertilizer and seed
- Ensure timely delivery and access to inputs by smallholder farmers
- Allow farmers to choose crops of their choice, thereby promoting agricultural diversification
- Reduce leakage (better targeting) and increase the number of beneficiaries

Despite these changes to the GRZ's subsidy delivery programme it was noted that the e-voucher programme and its key actors lacked access to CSA awareness and knowledge, inputs, and practices; access to WII; and that there was limited policy support for CSA initiatives despite most of the e-voucher beneficiaries being constantly affected by climatic shocks and stresses. Against this background, Musika Development Initiatives (Musika) in partnership with Vuna CSA Programme identified a potential to cost effectively integrate CSA into the e-voucher subsidy scheme.

Musika Development Initiatives Profile

Musika is a Zambian non-profit company that works to stimulate private sector investment in the smallholder markets. Musika helps businesses to develop mutually beneficial and transparent commercial relationships with smallholders that integrate the provision of information and technology adoption, and provide confidence and long-term incentives for smallholders to invest in their farming business. The company supports innovative market-based solutions to environmental issues and strives to ensure women are key participants in improved agricultural markets. Musika works with all stakeholders in the agricultural market system, with an emphasis on private sector entities that are committed to working with the rural poor as their suppliers, consumers, clients or employees.

Musika's role within the integration of CSA into the FISP e-voucher Scheme was to develop and roll out CSA training and messaging awareness and deliver training of trainers' sessions.

Box 2: Musika profile

2.2 The innovation model

The CSA e-voucher integration model is a CSA initiative implemented by Musika with support from the United Kingdom Department for International Development (DFID) funded Vuna CSA Programme under the Zambian government's FISP. The model sought to integrate CSA practices and WII into e-voucher with the objective of sustainably building farmers and agro-dealers' resilience to climate change through improved incomes and improved food and nutrition security. Specifically, the model sought to integrate CSA into the e-voucher scheme through:

- Developing and implementing a CSA training programme designed to build awareness, knowledge,

9 Lima Credit Scheme is a ZNFU led agricultural inputs and asset loans scheme for unbanked smallscale farmers of Zambia. The credit scheme targets smallscale farmers, who are able to produce for the market (beyond subsistence) and practice farming as a business

and capacity of smallholders, agro-dealers, insurance companies and ministry of agriculture staff participating in the e-voucher initiative;

- Developing a new WII product and market offering, as an add-on for smallholders who receive FISP e-vouchers, and catalysing the formation of markets for such insurance;
- Facilitating access to CSA relevant inputs and technologies (in particular legumes, but also other early maturing seeds, land management technologies etc.) and accompanying product and technical information within the target districts through the agricultural retail industry.

The CSA e-voucher integration model brought about two fundamental changes to the e-voucher programme. First, under the CSA integration model, all e-voucher beneficiaries are required to have a weather-based insurance cover for the inputs procured under the e-voucher. The insurance premiums cost ZMW 100 and are deducted from the government's ZMW 1700 subsidy contribution and are paid directly to the insurance companies by government. Second, government has passed a rule that 30% of the total redeemable amount of ZMW 2,000, the balance after paying insurance premiums, should be devoted to legumes meaning that only 70% of the redeemable amount can be used to purchase inputs for non-leguminous crops. Farmers receive CSA training and awareness from agro-dealers when purchasing inputs where they are guided on which varieties are better suited to their agro-ecological zones.

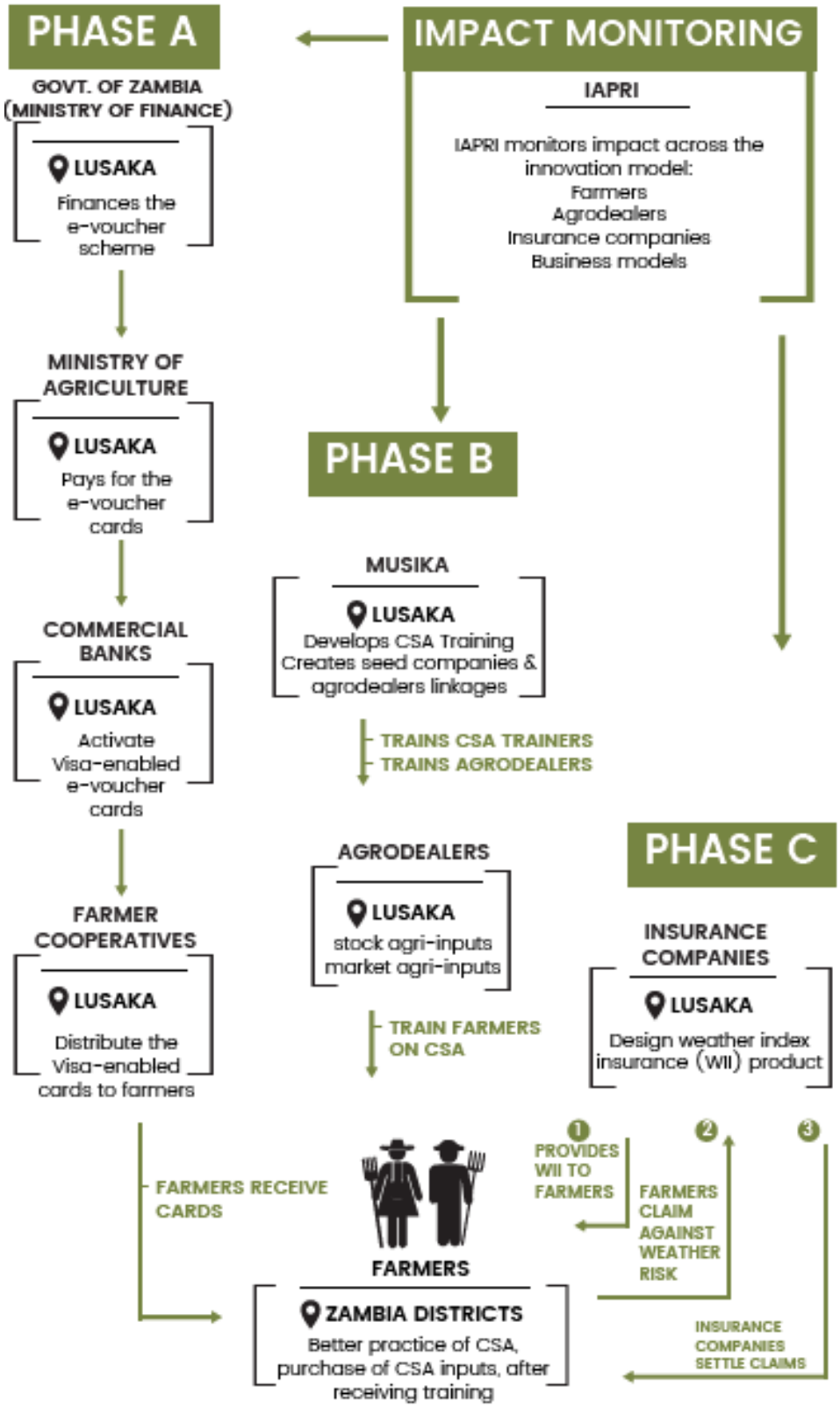


Figure 2: Zambia CSA e-voucher integration model Adapted from Vuna 2016

2.1.1 Key stakeholders and their roles

The CSA e-voucher model is implemented by a number of partners across private, public and NGOs. Table 2 summarises the model's key stakeholders and their roles.

Table 2: Zambia CSA e-voucher stakeholders

Stakeholder	Type of organisation	Roles
Musika Development Initiatives	Not-for profit company	• Develop and roll out CSA training and messaging awareness • Delivering training of trainers' sessions
IAPRI	Agricultural Policy Research Institute (Evaluator)	• Project monitoring and evaluation
Ministry of Agriculture	Public sector	• To endorse the intervention as a key value addition component to its existing input subsidy programme • Imparting CSA knowledge and information to farmers through extension department.
Mayfair Insurance	Insurance company	• To underwrite, re-insure, market and manage the weather index insurance products • To verify any loss calculations and pay out to eligible farmers
RiskShield	WII product developers and consultants	• To develop a weather insurance product relevant to the e-voucher initiative across the target districts • To support the insurance companies to market, distribute and monitor the products
Farmers	Farmers (ultimate beneficiaries)	• To invest in CSA relevant inputs and technologies where appropriate to their farming businesses, utilising the e-voucher subsidy
Primary input suppliers (Future Seed, AfriSeed etc.)	Private seed companies	• To facilitate access by agro-dealers and farmers to a range of CSA relevant agricultural inputs and technologies • To support the agro-dealers to which they supply, with relevant product knowledge that can then be cascaded to farmers • To support (and cost share where appropriate) a series of promotional activities to encourage adoption of CSA relevant inputs and technologies
Agro-dealers	Local level input distributors	• To facilitate access by farmers to a range of CSA relevant agricultural inputs and technologies and the relevant technical knowledge to accompany these • To display and distribute a range of CSA messaging

Stakeholder	Type of organisation	Roles
		materials relevant to farmers
ZNFU	National farmer organisation	• To impart knowledge on CSA to farmers with whom the staff engage, and to guide farmers on the use of the e-voucher to drive CSA strategies at farm level. • To facilitate access to the e-voucher bank cards for third-party payments to enable any insurance pay outs to be made into the bank cards.
Commercial banks	Financial institutions	• Issue e-cards to farmers and POS devices to agro-dealers.
Commodity Traders	Providers of off-take markets	• To offer output marketing opportunities for a range of crops (particularly legumes) that form part of the CSA relevant cropping portfolio
Media companies	Local and community radio stations	• Disseminating CSA information

Source: Musika Development Initiatives

2.1.2 Model theory of change

How the model is designed to build resilience

The model's approach is to build resilience through improved incomes and food & nutrition security by integrating CSA practices into the e-voucher scheme and the beneficiaries it targets including farmers, input supplies, and agro-dealers. The model is designed to integrate CSA at the policy level and drive adoption of practices at the farmer level by disseminating CSA information in the market system to strengthen the level of CSA related training and awareness linked to e-voucher. The idea is to trigger systemic change where there will be a sustained private sector led delivery of CSA practices and technologies with input suppliers and agro-dealers supplying climate smart inputs and information services to farmers. Agro-dealers and public extension officers are trained to enable them to sell CSA relevant inputs and disseminate CSA information to smallholder farmers. The model is designed to also leverage community radios as other CSA information dissemination platforms, including public extension officers, to increase outreach to the entire market system. The hypothesis is that creating awareness and training around CSA practices combined with availability and access to CSA practices and technologies will trigger behaviour change among market players leading to greater adoption of CSA inputs, technologies and practices within the broader agricultural market system, which will ultimately build the resilience of the market system in general, and smallholder farmers in particular.

The rationale for integrating WII was to build farmers' resilience in the event of losses related to unfavourable weather patterns. The argument is that when affected by bad weather events farmers receive insurance pay outs to enable them to replace inputs for affected crops. Further, insurance is expected to lower the risk profile of smallholder farmers and unlock access to finance opportunities, which will improve farmers' investment options, and ultimately, their incomes.

In addition, the model seeks to build the resilience of farmers through facilitating linkages to output markets. Access to output markets has the potential to build the economic resilience of smallholder farmers, aggregators and off-takers through improved incomes and creation of new supply markets, respectively. Other CSA technologies promoted by the model include hermetically sealed grain storage technologies, which are expected to build economic resilience through reducing income losses related to post-harvest losses.

How the model is designed for sustainability and scalability

The CSA e-voucher integration model is designed to achieve sustainability and scalability through improved private sector participation, and increasing adoption by inducing demand for new CSA practices among smallholder farmers CSA awareness. The sustainability approach leverages existing mechanisms designed to stimulate more active private sector led input delivery, information, and promotion. Profitability both at the farmer and private sector level and increased private sector participation are essential to the model's sustainability and scalability.

The model seeks to induce increased and sustained demand for and thus uptake of CSA technology adoption through two approaches namely smart subsidies and creating awareness of new technologies. The model uses smart subsidies in the form of promotions and discounts to farmers that encourage investment and test customer demand and technology adoption without distorting commercial pricing. Training of trainers including, public extension workers and agro-dealers, and using community radios are some of the approaches the model uses to create awareness of and stimulate demand for new technologies and practices.

3. Assessing the success of the innovation model adoption

3.1 Model success in integrating CSA into e-voucher

Overall, integration of CSA practices into e-voucher has been generally successful as evidenced by the GRZ's policy directive that all e-voucher beneficiaries commit 30% of their subsidy allocation towards production of legumes and 10% to purchase weather index insurance policies. While this was a widely welcomed development among stakeholders, there was no clear plan on how the government will enforce this requirement to monitor compliance among the farmers.

> CSA awareness through community radios, public extension workers, and agro-dealers was cited as having contributed significantly towards farmers' behaviour change particularly when purchasing inputs

The CSA e-voucher model sought to integrate CSA inputs and technologies. These include early maturing varieties of maize and other drought tolerant cereals (sorghum and millet), legume seed such as groundnut, cowpea, pigeon pea; post-harvest technologies such as hermetically sealed grain bags, and land preparation and smallscale irrigation equipment. Assessment of the successful adoption of these practices revealed mixed results across different practices and technologies. Beneficiaries mainly adopted the production of early maturing varieties of maize and legumes, particularly cowpeas. CSA awareness through community radios, public extension workers, and agro-dealers was cited as having contributed significantly towards farmers' behaviour change particularly when purchasing inputs. Agro-dealers reported that due to continued training and awareness on CSA there is a growing trend of farmers purchasing early maturing maize varieties and certified seed of legumes as opposed to growing recycled seed.

Figure 3: Input stocks and a poster of the government e-voucher cards at one of the agro-dealer shops visited during fieldwork.

Farmers also confirmed receiving CSA training through agro-dealers, a move which they attributed to assisting them in procuring CSA relevant inputs.

Other innovation model components, such as, WII were not significantly adopted during the pilot, prior to the government directive that all e-voucher beneficiaries should have WII. Stakeholders reported that the unsatisfactory success of the WII product, in particular, was due to the limited knowledge and understanding of the product and what it covers. A key recommendation from stakeholders was that service providers had to ensure that farmers have adequate product knowledge and that the product is appropriately designed to ensure farmers realise valuable benefits from the pay outs in the event of weather related losses. Further, embedding sensitisation of WII into local community structures including agro-dealers and lead farmers to allow for continued access to product awareness and knowledge among farmers was also encouraged. However, the recent announcement by the GRZ that all e-voucher beneficiaries have a WII cover is going to lead to an involuntary increase in the adoption of the product among farmers.

3.2 Signs of model impact on sensitivity and adaptive capacity of farmers and other players

Integration of CSA into the e-voucher scheme was done with the objective of reducing the sensitivity of smallholder farmer market systems to the impacts of climate change and building the adaptive capacity of smallholder farmer systems through improved incomes and food & nutrition security. Results from the analysis of the model's impact on farmer systems' sensitivity and adaptive capacity mirror those of the practices' adoption rates. CSA practices that recorded higher adoption rates were found to be contributing positively towards building adaptive capacity of farmers whereas those with low adoption levels contributed less.

Farmers reported that growing cowpeas had contributed significantly towards their livelihoods through improved incomes and dietary diversity. Further, growing legumes had mapped a pathway towards resilience building through diversifying on-farm enterprises thus spreading farmers' risk across different enterprises. Agro-dealers reported that growth in legume production had contributed significantly towards the growth of their business with some agro-dealers reporting a 100% increase in business turnover. This has seen some agro-dealers expanding their retail network to other districts and creating employment opportunities.

Early maturing varieties of maize were reported to be contributing towards building adaptive capacity of farmers to climate change through improved productivity in the event of low rainfall. While there were reports of some farmers

starting to purchase post-harvest technologies such as Purdue Improved Crop Storage (PICS) [10] bags, there were no reports of observed reduced post-harvest losses as a result of the technologies as at the time of the study.

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

The general consensus among key stakeholders is that the integration of CSA into e-voucher has achieved moderate success and that the future success of the model is dependent on the availability of off take markets for legumes and timely availability of subsidy funds to purchase CSA inputs. Most stakeholders are of the view that the success of the model hinges to a large extent, on the existence and success of the government e-voucher subsidy programme under which it is integrated.

Farmers' view is that the success of the model and their continued adoption of CSA practices relies on the availability of off-take markets, for legumes in particular. They also reported that the late activation of e-cards had affected their ability to access inputs in time to grow commodities in line with the season. For WII, most farmers and key stakeholders were unclear on how the product works and were not keen on adopting the product following previous experiences with the pay outs and lack thereof in certain areas. There were reports of farmers who received pay outs as little as ZMW 20 which farmers indicated were too little to cover for the losses incurred from the weather. Farmers' understanding of the WII cover and pay out was that in the event of a weather related loss, farmers will receive pay outs that would enable them to replace their inputs or purchase grain for household consumption. This reflected the need for WII product sensitisation and awareness among the farmers.

Agro-dealers expressed concerns on the late activation of the e-cards indicating that it had affected their ability to pay input suppliers for inputs they receive on consignment. This resulted in some input suppliers moving towards a cash based arrangement where agro-dealers are required to purchase inputs on a cash basis despite having no access to financial services to support this. In this regard, agro-dealers reported that availability of affordable financial services to purchase inputs from input suppliers in time to allow timely availability of the inputs to farmers has become important to the success of the model. Access to affordable trade finance services was also noted as key by agro-dealers who provide aggregation services for large off-takers, citing the need for financial services to allow them to purchase commodities from farmers.

Insurance companies indicated that the success of the model is subject to the outreach and spread of their insurance product. Due to the low margins associated with working with smallholder farmers, insurance companies indicated that increasing the numbers of farmers served with insurance services will allow them to cover the high transaction costs. Further, spreading risk across different geographies was also reported as key to the sustainability of their model as concentrating their exposure in one locality will put their insurance portfolio at risk.

10 PICS bags are a simple and cost effective way of storing grain and seed without using chemicals to control insect pests. A PICS bag has three layers -- two liners fitted inside a woven sack. PICS enables farmers to store a variety of legume and cereal crops for more than one year after harvest. With this feature, the PICS technology is helping to improve food security and increase income of millions of smallholder farmers in Africa and beyond.

4 Assessing model adaptation and potential for sustainability

4.1 Extent of model adaptation

This section looks at the extent to which e-voucher stakeholders have begun investing in or mapped a pathway to investment in CSA practices without the support from Musika and Vuna. Observations suggest marginal adaptation among key stakeholders. Analysis at the agro-dealer level indicates that some agro-dealers had begun expanding their retail businesses to other districts not covered by the Musika CSA intervention, selling CSA inputs and offering CSA knowledge to farmers independent of support from Vuna and Musika's intervention. These adaptation efforts were mainly driven by the profitability resulting from farmers buying more improved seed.

Model adaptation analysis at the farmer level did not reveal any evidence of e-voucher beneficiaries investing in CSA practices without the support from government. Farmers were not investing any additional funds outside the subsidy to expand production of legumes and early maturing varieties of maize. Input suppliers and agro-dealers did, however, express keen interest to continue supplying CSA inputs beyond Vuna and Musika's intervention but indicated that this is dependent on farmers' continued production of legumes using certified seed, which in turn is dependent on availability of off-take markets and subsidy funds from government. It is apparent, therefore, that these adoption efforts have been sustained by the availability of subsidy funds from the e-voucher programme. Farmers indicated that in the absence of subsidy funds and off take markets they are likely to revert to growing legumes using recycled seed as they cannot afford to buy certified seed using their own money. Currently, farmers growing legumes (cowpeas) depend on one off-taker, The World Food Programme (WFP), which buys cowpeas to supply into its school feeding programme. The fact that output markets for legumes are dominated by a donor organisation raises concerns around the sustainability of the model beyond the donor's intervention, suggesting a need to explore private sector off take opportunities.

While the successful integration of CSA into the e-voucher schemes creates optimism that the CSA model will deliver on its intended objectives, there was a general concern around the Vuna funding coming to an end in 2018 given how some of the model's interventions such as CSA training were sustained by the model. Model stakeholders, albeit market facilitator, such as Musika pointed out that the reduction in the project period is likely to limit the impact of the model on the set outcome and impact indicators. This emanated from the realisation that the Vuna project was coming to an end before all farmers, following the e-voucher scale up to all the districts in the country, had received CSA trainings and awareness.

Discussions with farmers indicated that the limited availability of sustainable output markets for legumes puts the model and legume market system at risk as farmers will likely discontinue legume production if they fail to sell. Thus, while some agro-dealers increased business turnover by up to 100% and are considering expanding business interests to other districts, this trend remains fragile and dependant on continued demand from producers, linked to markets for products. Without such demand, agro-dealers will most likely reduce or stop stocking certified legume seed and input suppliers may reduce or stop the supply of legume seed.

4.2 Model's commercial viability

In addition to assessing the model's potential sustainability on the basis of its ability to effect systemic change, the assessment also considered the commercial viability of the model as an indicator of sustainability and scalability. This assessment looked at the extent to which the integration of CSA has increased the profitability of key private sector actors namely farmers, agro-dealers, input suppliers and insurance companies. The growth in legume production was

reported to have contributed to improved incomes particularly for agro-dealers who reported increased business turnovers. For smallholder farmers, improved incomes from legume production were reported for seasons when they had access to off-take markets. However, at the time of conducting this research, some farmers had not sold their legumes as there were no available off-take markets. As a result, there were no reports of improved incomes among interviewed farmers resulting from legume sales for the 2016-17 season. Therefore, additional efforts to promote development of alternative markets for the produce from CSA inputs through processing, for example, are especially required to assure the commercial viability of the model supported by the Vuna project with Musika. Agro-dealers reported growth in business turnover in some cases by over 100% due to the growing demand for CSA inputs.

“ the potential commercial viability of new inputs and practices will also need to be assessed against the subsidised nature of their cost to farmers. Viability should be assessed against the full market value of inputs rather than the cost under subsidised conditions which cannot be expected to prevail indefinitely

It is noteworthy, however, that the potential commercial viability of new inputs and practices will also need to be assessed against the subsidised nature of their cost to farmers. Viability should be assessed against the full market value of inputs rather than the cost under subsidised conditions which cannot be expected to prevail indefinitely. Viability also remains subject to the availability of a viable end market – a factor that currently remains in question for some legumes being promoted.

4.3 Expansion and wider adoption and benefits

Model expansion looked at the extent to which the CSA model has triggered wider adoption of the model (or elements thereof) by market system actors that were not part of the Vuna supported project. Whilst the project implementation period was too short to enable assessment of systemic change, the research assessed to what extent the foundations of systemic change had been laid by this project's activities. The CSA e-voucher model has triggered a number of changes in the FISP market system. The most notable change being the emerging private sector led CSA delivery model anchored on agro-dealers. Agro-dealers have become central to the success of the CSA e-voucher integration model acting as distribution points for CSA inputs, information, financial services, and in some cases aggregation points for off-take markets.

Figure 4: Cowpea farmer grading produce at an agro-dealer

Other expansion changes identified include agro-dealers and farmers who were not part of the intervention moving towards the supply of CSA inputs and growing of legumes respectively. Interviews with non-FISP beneficiaries revealed

that the scheme's interventions are having ripple effects as some farmers are beginning to invest in growing of legumes despite not having received subsidy support.

The CSA e-voucher model has also led to changes at the policy level with the GRZ drafting policies making it mandatory for all e-voucher beneficiaries to commit at least 30% and 10% of their input subsidy to legume production and weather insurance premiums, respectively. This has, in turn, increased the effective demand for purchased CSA inputs such as certified seed and other services (e.g. insurance and extension) piloted by the innovation model. The seed companies that collaborated with the project indicated that they would respond to this increased demand for CSA seed by increasing the range of seeds they make available to the agro-dealers for onward marketing to the farmers. In addition, agro-dealers were reporting that the largescale seed companies who are not part of the intervention are also readjusting their operations to increase production and distribution of CSA seed.

5 Findings and lessons for model improvement

The successful integration of CSA into the e-voucher scheme has the potential to build the resilience of farmers and market players to climate change. However, the evident absence of private sector offtake markets for key CSA commodities such as legumes and limited knowledge of CSA technologies puts the sustainability and scalability of the model into question. Recommendations for model improvement include the following:

- **Access to off-take markets:** Without appropriate market access resilience is not established and, potentially, undermined. It is therefore important to explore alternative private sector off take markets for CSA commodities to ensure continued production of these commodities by farmers. Options include the feed market for leguminous crops such as cowpea.
  Lesson: Access to improved CSA inputs, practices and technologies is critical for building farmer resilience but not sufficient.
- **Market systems analysis:** In this case, the design should have factored in private sector off-take markets into which farmers would sell their "CSA output" on the back of purchasing CSA relevant inputs. The choice of these private sector off-take partners usually makes or breaks a market systems intervention.
  Lesson: An exhaustive market systems analysis is required before designing an intervention.
- **Farm level sustainability:** Whilst it is a noble objective to achieve a national tonnage of specific crops, attention must also be paid to the farmers' productivity per hectare as this is a far greater determinant of profitability and sustainability than land are under cultivation alone.
  Lesson: Increase in productivity, and not only production, is a greater driver of sustainability at the farm level.
- **E-voucher schemes and CSA:** However, voucher mechanisms' dependence on government support puts the sustainability of these initiatives at risk and can potentially distort the market. Commercialising voucher schemes by ensuring beneficiaries venture into production of commercial crops that increase farmers' incomes which can be used to purchase CSA inputs can help reduce the dependence on subsidies to support farmer investment in CSA practices.
  Lesson: E-voucher schemes, where they already exist, can be leveraged to increase adoption of CSA initiatives.
- **CSA adoption:** It is important that CSA information and know-how dissemination functions be embedded into and delivered by market players familiar to and trusted by farmers and who interact with farmers on a regular basis. This is key to ensuring sustainability beyond the existence of project support.
  Lesson: CSA uptake requires supporting information and know-how.

"Commercialising voucher schemes by ensuring beneficiaries venture into production of commercial crops that increase farmers' incomes which can be used to purchase CSA inputs can help reduce the dependence on subsidies to support farmer investment in CSA practices.

- **Information asymmetry:** Donor programmes usually have preset log frame targets and indicators which are not necessarily informed by the realities in the market. The programmes then attempt to align these with the objectives of the private sector which sometime is not possible. The key point here being that programmes must understand the market thoroughly before designing interventions that have the potential of leaving farmers worse off. Conversely, private sector partners must share the developmental ethos of most donor programmes and make a concerted effort to implement these diligently.

  Lesson: Information asymmetry between donors/donor programmes and the private sector creates misconceptions of what is and what is not possible.
- **Product design**: Insurance products should be designed in a manner that provides adequate cover against weather related losses. The product should also ensure that pay outs are made to farmers in a timely manner and be aligned to the value of the losses incurred by the farmer to allow farmers to replace lost inputs.

  Lesson: Appropriate product design is equally important in driving insurance product adoption.
- **Market system sustainability:** Farmers, agro-dealers, private buyers (off-takers) and insurance/financial services providers are all in business to make a profit and must therefore see positive returns on their investment in CSA to prevent disadoption of the practices.

  Lesson: Profitability of actors throughout the market system is critical to the long term sustainability of this model.


MUSIKA
VUNA
Practice Climate Smart Agriculture
PICS Bags: Chemical-free Crop Storage
PICS
Purdue Improved Crop Storage

ANNEX 1:

Climate trends and risks for agriculture in Zambia

Extreme weather events

Extreme weather events such floods and droughts are on the increase in southern Africa, including in Zambia. Historic temperature changes indicate increased drying, as well as the highest variation from 0.79 ºC (areas in brown) to 1.2ºC (areas in red) within the Southern province (Figure A1 left). Moderate drought incidents of between 2-5 were recorded between 1980-2000, in parts of Lusaka, with Western and Central provinces getting as high as ten drought incidents over this period (Figure A1, centre). The Eastern province recorded approximately seven events. In the past 16 years at least 6 droughts have been recorded with the 2004/5 agricultural year resulting in massive maize crop failures, the largest in the country's history[11].

There was no data available to map flood incidents for the country with the exception of limited events in the Eastern, Southern and Lusaka provinces, which recorded moderately high incidents of approximately eight while the rest of the areas had around one event (Figure A1, right). Despite this lack of data, we acknowledge that flooding events are on the increase in the country[12]. Since 2000, two major flooding incidents have been recorded in 2002/2 and then again in 2006/7[13], with the later floods affecting 41 of the 72 districts including areas that were not prone to flooding. While the Western province regularly experiences flooding events; the last floods were earlier and more intense than ever experienced[14]. The probable increase in the frequency and intensity of droughts and floods is expected in the country. In addition, the geographical areas susceptible to these events will also change[2].

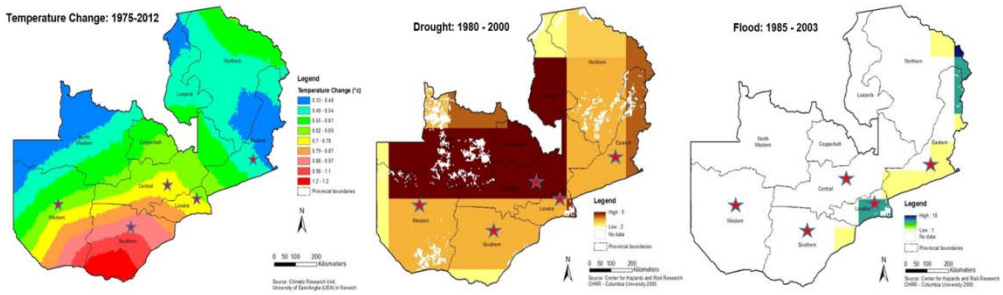


Figure A1: Climate trends in Zimbabwe. Temperature change (left) incidents of drought (middle) and flood (right). The provinces where the projects are located are highlighted by the red stars.

11 UNDP, 2010
12 Davies *et al*., 2017
13 AIACC, 2004
14 UNDP, 2010; MTENR, 2007

Impacts of rainfall on agriculture

A reduction in rainfall will result in reduced crop yields especially for staple crops such as maize and will be detrimental to livelihoods that depend on agriculture and other economic sectors that depend on water [15].

Impacts of temperature on agriculture

Increases in temperature will result in increased dryness which will affect crop yields and increased incidents of pests and diseases affecting livestock.

Impacts of extreme weather events on agriculture

Similarly, to rainfall and temperature, drought and floods will affect livelihoods as well agriculture and livestock. Droughts will reduce the amount of rainfall for agriculture, while floods will result in massive crop failures.

Programmes that drive the principles and practice of CSA such as the e–voucher programme will go a long way to assistant poor communal farmers adapt to climate change by reducing their vulnerability. The e-voucher programme will also allow access to essential resources for CSA input technologies and practices needed for sustainable agricultural livelihoods.

Quick facts:
Climate Change Projections in Zambia

Rainfall

- Projections in Agro-ecological Regions I, II and III show seasons of below average rainfall which coincide with El Niño events and above average rainfall which coincide with La Nina events
- Projected rainfall is expected to reduce by approximately 10-20% by 2050
- The driest years are expected to be 2044 and 2065 in Region I
- The wettest year is expected to be 2040 with 1200mm in Region II.
- Region III exhibits increase in rainfall in 2055 with 900 mm[15].

Temperature

- An average increase of approximately 2°C, from 24.5-26°C, over the sixty-year period is expected from 2010-2070
- Mean temperatures are expected for 2040-2060 in Region I, with Region II having the lowest mean temperatures in 2041 and 2061.
- Low temperatures, especially after 2050, are anticipated for Region III[12].

Extreme Weather Events

- Floods are expected increase as a result of increases in cyclones which will affect southern Africa including Zambia.
- Cyclones are expected to increase in frequency and intensity.
- Droughts are also expected in increase in the region including in Zambia[13]

Box A1: Quick facts on climate change projections in Zambia

Bibliography

Chikowo, R., 2010. GYGA, Zambia. http://www.yieldgap.org/gygamaps/pdf/4th%20GYGA%20Workshop%2010%20-%20Results%20Zambia.pdf

Davis, C., Vincent, K and Mambo, J. 2017. Chapter 3: Socio-Economic Impacts of Extreme Weather Events in Southern Africa in Davis (eds) *Climate Change Risk and Vulnerability: A Hand Book for Southern Africa* Second Edition. https://www.csir.co.za/documents/sadc-handbooksecond-editionfull-reportpdf

Mary Lubungu, William J. Burke, and Nicholas J. Sitko (2013). Analysis of the Soy Bean Value Chain in Zambia's Eastern Province. Indaba Agricultural Policy Research Institute (IAPRI), Working Paper No. 74, Lusaka, Zambia.

Mofya-Mukuka and Shipekesa, A. M. (2013). Value Chain Analysis of the Groundnuts Sector in the Eastern Province of Zambia. Working Paper No. 78, Indaba Agricultural Policy Research Institute (IAPRI), Lusaka, Zambia.

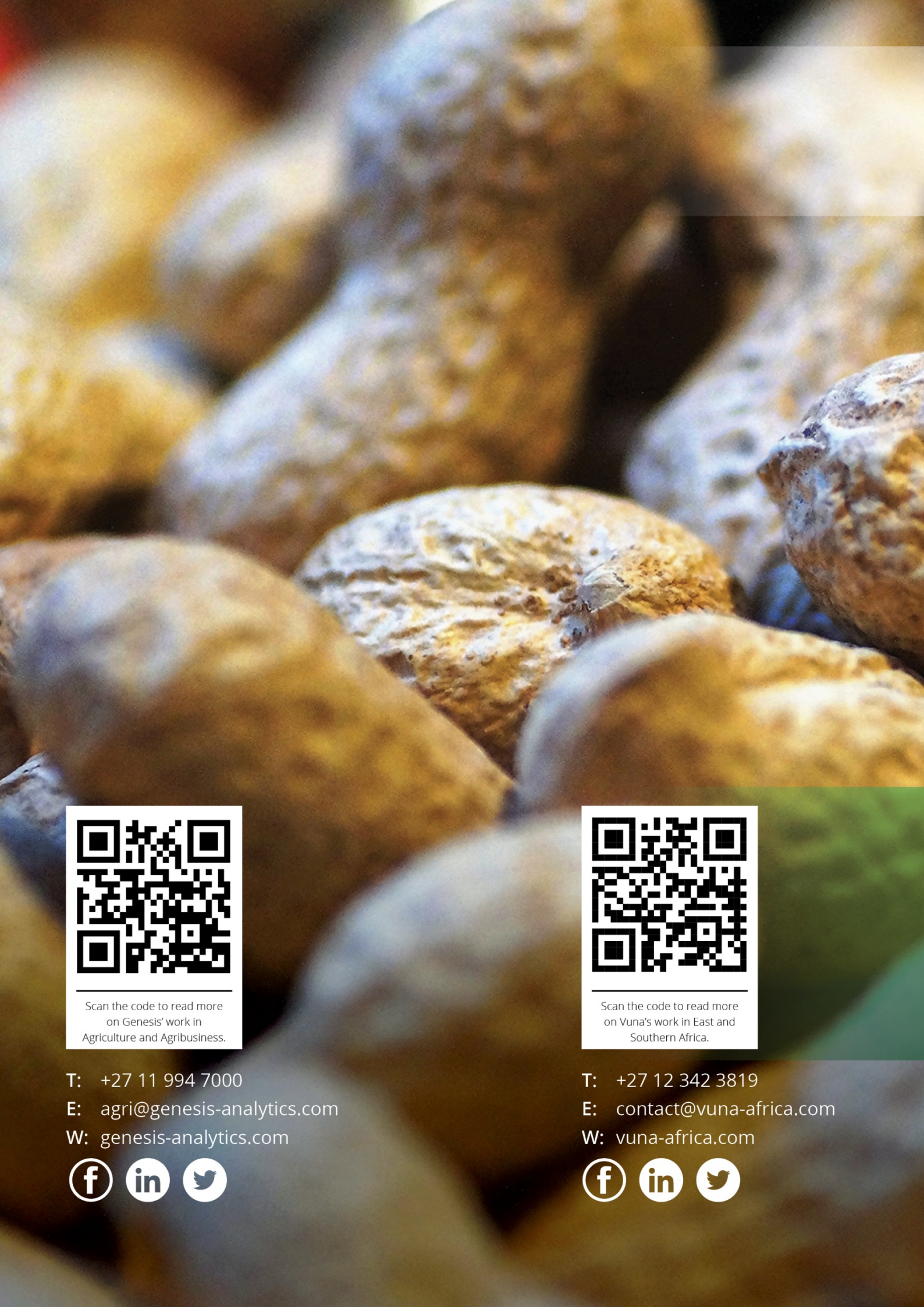
MTENR, 2007. Formulation of The National Adaptation Programme of Action on Climate Change. (Final Report). Ministry of Tourism, Environment and Natural Resources, Republic of Zambia. http://unfccc.int/resource/docs/napa/zmb01.pdf

Mulenga, P and Wineman, A. (2014). Climate Trends and Farmers' Perceptions of Climate Change in Zambia. Indaba Agricultural Policy Research Institute.

UNDP, 2010. Adaptation to the effects of drought and climate change in Agro-ecological Regions I and II in Zambia Government of the Republic of Zambia United Nations Development Programme. http://www.undp.org/content/dam/undp/documents/projects/ZMB/00058205_Adaptation%20ProDoc_FINAL_.pdf

Tembo Gelson, Chibamba Mwansakilwa, Timothy Sichilima and Tembo Nathan (2014). Maize-Legume Value Chains in The Eastern Province of Zambia. Sustainable Intensification of Maize-Legume Systems for the Eastern Province of Zambia (SIMLEZA), International Institute of Tropical Agriculture (IITA) and International Maize and Wheat Improvement Centre (CIMMYT)

Xu, Z., W.J. Burke, T.S. Jayne, and J. Govereh. 2009. Do Input Subsidy Programs "Crowd In" Or "Crowd Out" Commercial Market Development? Modelling Fertilizer Demand in a Two-Channel Marketing System. Agricultural Economics 40.1: 79–94



Scan the code to read more on Genesis' work in Agriculture and Agribusiness.

T: +27 11 994 7000
E: agri@genesis-analytics.com
W: genesis-analytics.com

Scan the code to read more on Vuna's work in East and Southern Africa.

T: +27 12 342 3819
E: contact@vuna-africa.com
W: vuna-africa.com