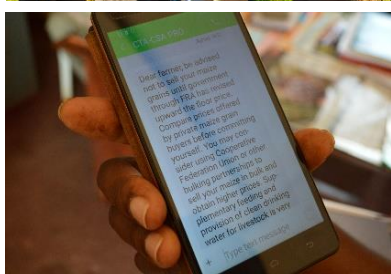


Project Completion Report

Project Title: **Scaling up Climate-smart Agricultural Solutions for Cereal and Livestock Farmers in Southern Africa**

Organisations: **CTA / Zambia Open University (ZAOU); Zimbabwe Farmers Union (ZFU); National Smallholder Farmers Association of Malawi (NASFAM); Southern African Confederation of Agricultural Union (SACAU)**

Project Coordinator: **Oluyede Ajayi**



Date: July 2020

This project completion report (project number D:11130026) was prepared by **Oluyede Ajayi, Mariam Kadzamira and Alicia Bailly**.

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1 Assessment of implementation of project activities

1.1 Description table

Name of Project Coordinator:	Oluyede Ajayi
Major Partner(s)	Technical Centre for Agricultural and Rural Cooperation (CTA) Zambia Open University (ZAOU) Zimbabwe Farmers Union (ZFU) National Smallholder Farmers Association of Malawi (NASFAM) Southern African Confederation of Agricultural Union (SACAU) Several others minor partners e.g. event organisers
Project Coordination Team:	Oluyede Ajayi, Mariam Kadzamira, Alicia Bailly
Title of the Action:	Scaling up Climate-smart Agricultural Solutions in southern Africa (ScalingupSA)
Start date and end date of the Action:	August 2017 – May 2020
Targeted beneficiaries:	Smallholder Cereal and Livestock Farmers in Southern Africa region Policy-makers and shapers and private sector in the region
Final beneficiaries and/or target groups (if different) (including numbers of women and men):	Same as above
Target region(s):	Southern African region
Country(ies) in which the activities take place:	Mainly in Malawi, Zambia, Zimbabwe (policy work was done throughout countries in the region)

1.2 Executive summary of the activities implemented

Weather patterns highly influence agricultural activities in southern Africa, and in turn the food security, nutrition and income of rural households. The high vulnerability of the region to climatic change causes recurrent swings between food scarcity and surplus and, food insecurity for up to six million people. The project sought to contribute to increase the resilience of food security, nutrition and income of smallholder households to climate change by facilitating farmers' access to four mutually-reinforcing climate-smart agricultural solutions. These solutions were identified having taken cognizance of the different but, interconnected challenges that smallholder farmers in southern Africa face:

- less and erratic rainfall, drier weather conditions for farming – hence the promotion of drought-tolerant seeds by the project
- weakened and poor state of the traditional (face-to-face) extension – hence the project focuses on information and communication technology (ICT)-enabled dissemination of information to farmers extension

- limited and vulnerability of farmers' livelihoods options when severe climate occurs – hence the project sought to expand and diversify livelihood options for farmers through integrated crop livestock farming
- absence or fast degrading traditional communal fallback safety nets for smallholder farmers – hence weather insurance

The project also recognised that adoption of climate-smart agricultural (CSA) practices requires a combination of field and policy-level support but the policy context in many countries are not conducive, hence it facilitated policy actions to promote CSA/weather insurance.

Working with a consortium of partners including the private sector (telecommunications, seed companies), government agencies (extension departments, climate change and meteorology departments), producer organisations (Zimbabwe Farmers Union, National Association of SmallScale Farmers NASFAM, Southern African Confederation of Agric Unions SACAU), knowledge centres on climate change (weather data companies, universities), the project's aim was to deliver bundle of CSA solutions to smallholder farmers using ICT-enabled extension mechanism, innovative partnership and facilitated support environment. CTA's activities in response to climate change has focused on helping to build the resilience of farmers to climate change by scaling an integrated bundle of climate solutions to farmers through a consortium of partners and models of partnership models. Project activities are carried out in two main prongs:

Prong A:

Field-based activities to bridge the gap between the potentials of CSA interventions and the actual level of uptake among farmers

The field activities are directed primarily at farmers to promote their access to a bundle of CSA solutions using digital-enabled agricultural extension approaches. The “bundled solutions” approach was adopted to ensure a combination of interventions that provide mutually reinforcing and multiple layers of protection to farmers to strengthen their ability to adapt to climatic variations. The bundled CSA solutions are:

- *Stress-Tolerant Germplasms*: Improve farmers' access to drought-tolerant seeds to reduce risks under a changing climate. These germplasms are genetically improved varieties that can withstand diverse climate stress conditions such as heat or drought. These varieties enable farmers to continue to produce food (crops and livestock) even in climatically stressed situations
- *ICT-Enabled Climate Information Services and Advisory Services*: provide weather information forecast and agricultural advisory services to farmers to help them make informed decision about their farmer operations to ensure improved income and profit
- *Diversified Livelihood Options*: promote diversification of farming options to reduce farmers' reliance on a single commodity, by helping them to spread their livelihood risks to a second commodity which can be another crop or livestock
- *Weather-based Index Insurance*: working with private sector to design farm insurance products to protect farmers against shocks emanating from adverse weather patterns and conditions in a given farming season

Prong B:

Multistakeholder engagement in policy processes to facilitate adoption of CSA at national/regional levels

These are activities focus on the following:

- action plans to facilitate conducive policy environment for the accelerated uptake of CSA solutions
- identifying opportunities from existing policy frameworks for investment that support climate actions in agriculture

The project began in September 2017 and ended in May 2020 with a target to reach 140,000 smallholder beneficiary farmers primarily in three project countries – Malawi, Zambia and Zimbabwe.

1.3 Project background

Southern Africa has a mono-modal rainfall regime (one rainy season per year) and most smallholder farms are tied to this pattern because they are mainly rainfed. As a result, farmer's success is essentially tied to the vagaries of the weather. When farmers cannot rely on the timing of the rainy season, or on other weather patterns they have known for decades, their work becomes more challenging. This challenge is exacerbated by weather extremes and uncertainties due to climate change. This results in crop failure due to below normal rainfall and, livestock deaths due to poor grazing and/or lack of water during droughts. For many years, the response to climate change has focused mainly on “relief efforts” i.e. giving food aid to farmers and rural areas when crops fail. Farmers and stakeholders are increasingly requesting for “production relief” i.e., assistance to help farmers adapt to climate change and assure agricultural production despite climatic uncertainties, an approach that stakeholders in the region acknowledged as a more sustainable solution. Some adaptation solutions that can help farmers adapt to climate change and improve their resilience exist in the region. FAO estimates that the livestock sector can cut down its emissions by 30% with already available technologies and practices while maintaining or improving production. Unfortunately, few farmers know about or have reliable or affordable access to these technologies due to several factors: (i) many developers of the solutions are not equipped and/or do not have the mandate to carry out widespread dissemination, (ii) traditional public face-to-face agricultural extension has collapsed in many countries in the region, (iii) mechanisms for sharing information on existing CRS in a manner that is useful to farmers and policy-makers are absent, (iv) enabling policies to encourage private sector engagement in climate solutions and facilitate farmer access to the solutions are largely not available.

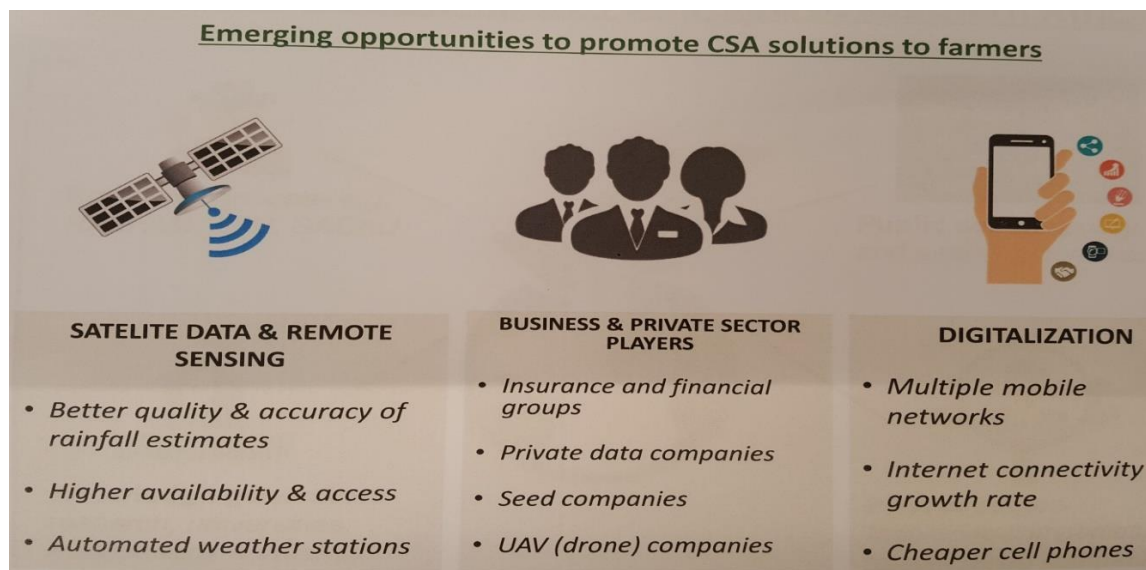
To respond to these challenges, CTA initiated the project to scale up CSA solutions in the Southern Africa Development Community (SADC) region. To ensure a sound implementation of the project, CTA convened a regional forum with participants drawn from farmer organisations, international development cooperation partners, agriculture research centres, universities, private sector and the media. The forum helped to assess the state of knowledge on climate-smart agriculture in the region, identify regional priorities related to climate and agriculture, take an inventory of ongoing initiatives being undertaken by different partners in the region (to avoid duplication of efforts), identify existing gaps and prioritise what CTA should do about those gaps.

The key innovations and thrusts of the implementation of the project are anchored on the following:

1.3.1 New opportunities to promote climate-smart solutions to farmers

While there has been a gradual weakening of the traditional face-to-face agricultural extension systems in many countries, there has been an increase in digital opportunities to support e-extension of agricultural technologies to farmers. As presented in Figure 1, these include emerging opportunities in satellite weather data that ensure better quality and accuracy of rainfall estimates, increasing interest of private businesses to engage in climate resilience and, the increasing rate of internet connectivity and cheap phones to access digital information by farmers.

Figure 1: New opportunities to promote digital extension of agricultural information

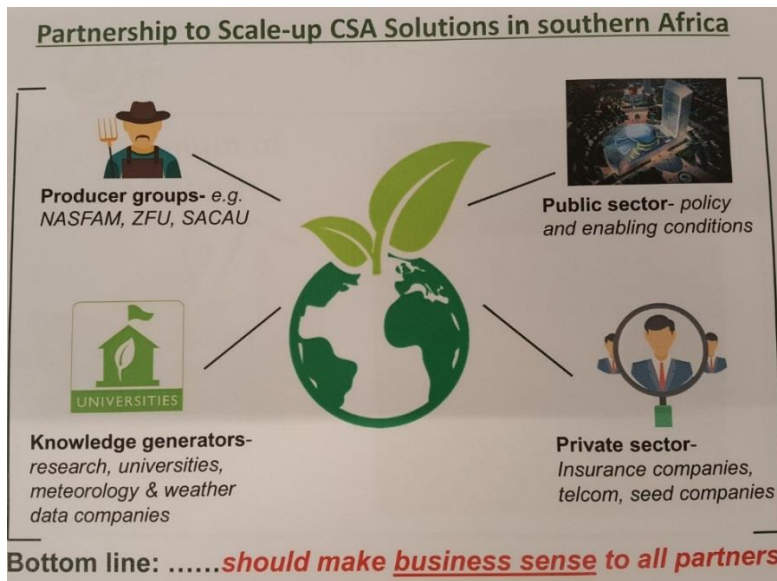


1.3.2 Innovative partnership to scale up the solutions

Recognising that efforts to bring about positive change to climate resilience in southern Africa requires genuine partnership between multiple partners at different levels, CTA has positioned itself as honest information broker and play the role of a catalyst to facilitate bridging of gaps and building of strong and inclusive partnership among various stakeholders. Accordingly, partnership relationships were established with diverse partners to implement the project. The partnership is presented in Figure 2.

- Producer groups – *e.g. Zimbabwe Farmers' Union, NASFAM, SACAU*
- Public sector – *policy and enabling conditions*
- Knowledge generators – *research, universities, meteorology and weather data companies*
- Private sector – *Insurance companies, telecom, seed companies*

Figure 2: Partnerships established to upscale CSA solutions by the project

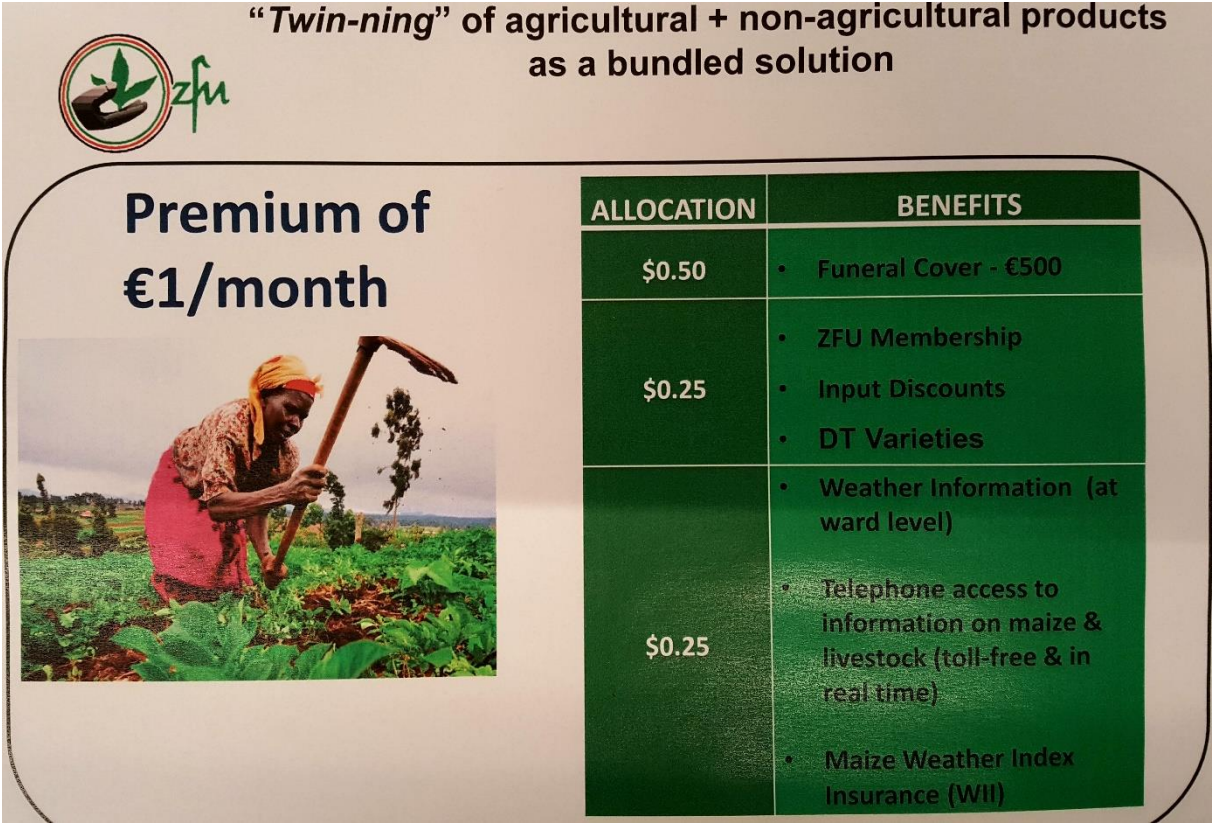


In particular, through this project, we wanted to change the narrative where activities and impact of agricultural development projects fizzle out shortly after external donor funding to the project had ended. At the beginning of the project, CTA and field implementors of the project brokered new partnerships with private sector operators (insurance companies, seed companies, mobile telecommunications, weather service data). These companies contributed own resources to leverage funds from CTA, creating a sound business case of the project and a continuation of the project when CTA external funds ended.

1.3.3 Integrated solution and multi-layer approach

Due to the wide uncertainties with climate change and its impact on agriculture e.g. from too much rain to insufficient rainfall, focusing exclusively on a single solution offers a limited coverage and less effective, the project adopted a multi-layer bundle of solutions that are mutually reinforcing and offer maximum protection of farm household and their livelihood. Part of the integration of solution is the twinning of agricultural products with non-agricultural insurance products. For example, to enhance adoption and acceptance of the crop insurance, project partners combined funeral insurance, crop insurance, weather information services as an integrated services so that farmers who subscribed to the insurance policy and paid premiums would be able to benefit from all the services.

Figure 3: Combining agricultural and non-agricultural products to improve resilience of farmers in Zimbabwe



1.3.4 Multiprong approach – Field work and policy engagement

One of the key findings on previous field efforts to disseminate CSA is that beyond technical fixes, upscaling of CSA should take cognizance of policy and institutional environment. This is because successful upscaling of these innovations does not depend exclusively on their technical characteristics only, but also on the enabling policy environment within which they are disseminated to farmers, i.e. favourable policies, institutional capacities. Previous field studies have shown clearly that policies play an important role to facilitate CSAs, and that CSAs that are aligned with national policy priorities are more likely to be successfully scaled up. The project thus combined field activities with engagement with policy engagement by working with farmers organisations to build their capacity and facilitate their engagement in policy processes.

1.3.5 Baseline report of the project

In Zimbabwe, the average household size was 4.4 members with an average household dependency ratio was 1.9. About a third (30%) of the sampled households owned smart phones, while the remainder (69.5%) had ownership of feature phones, with no difference between intervention and non-intervention cohorts. The average area under maize was 1.36ha in the treatment districts and 0.99 ha in the control districts, which is significant (<0.05). Average maize yields in treatment districts were about 2 t/ha. Gross margins for maize were quite positive ranging from US\$600. Most rural households experienced acute poverty with 30-45% reporting not being food secure throughout the year.

In Malawi, average maize yield is about 2.0 t/ha, with a maize gross margin analysis of about US\$100/ha. This is much lower than that in Zimbabwe. The percentage of farmers who have adopted mobile-enabled weather information was about 20%. Farmers adopted a multiple CSA practices ranging from minimum tillage, mulching and crop mixes and drought-tolerant maize

In Zimbabwe, the maize gross margin is estimated at US\$270. Average yield of maize is 2.4 t/ha. Several CSA practices were used ranging from crop residues, minimum tillage, planting soil fertility trees, use of manure. Adoption of weather-based index insurance is very low, estimated at less than 5%.

Further information about the baseline reports is presented in the Annex of this report.

1.4 Impacts and outcomes

The key impacts and outcomes of the project are categorised and highlighted below:

1.4.1 Increase in farm income

- 40% – the increase in orders and sales of improved and drought-tolerant seeds in project areas in Zimbabwe
- 25% – increase in farm income using information on SMS advisory services on crop marketing in Zambia
- Farm income from maize has increased by ranging from **41%** in Malawi to **90%** in Zimbabwe
- In terms of diversified livelihood options, estimates from partners show that sales and income from livestock production quadrupled relative to the baseline in 2017

1.4.2 Increase in adoption of CSA solutions

- In Zimbabwe, **84%** of farmers (76% female and 94% males) who were **sensitised** by the project about CSA eventually **adopted** at least one of the CSA practices.
- Up to 10% – Negotiated price discounts on seed and stock feeds for project farmers negotiated with seed houses and stock feed suppliers in Zimbabwe.
- Farmers in the project areas are diversifying away from maize crop to cash crops. This is expected to further improve farm income, the diversification will help farmers to minimise exposure of their livelihood to climate as they spread the risks over several crops and improve resilience to climatic shock on a single crop.
- In Zimbabwe specifically, the number of farmers who eventually **adopted**, i.e. actually paid subscription for weather information and crop insurance is **19,202** comprising of **9,395** females and **9,807** males.
- **35%** of farmers who are aware of Weather-Based Index insurance have subscribed to it and paying the premiums



- **46%** of farmers in project areas are adopting CSA in 2019 in Zimbabwe

1.4.3 National and regional policy

- Project’s training manual adopted by the Zambian govt to train extension officers on Weather insurance in the country.



- Policy proposal by the project partners for regional pooling of weather risks through a (southern Africa) regional weather-based insurance scheme has been adopted in August 2019 by the stakeholders as a model to implement risk sharing in the region. The proposal had four high level goals and associated objectives and identified 11 key priority areas for attention that would constitute a regional framework. Task Force on the implementation of the proposal and to champion the dialogue with the Regional Economic Communities has been set up.

Task Force on the implementation of the proposal and to champion the dialogue with the Regional Economic Communities has been set up.

- Project partners in Zambia have influenced the remodelling of the Government of Zambia’s national roll out of weather insurance towards a yield-based insurance scheme effective from 2019/2020 season across the country using field results and information from the project.

- Results from the project were used in communications and engagement with regional regulatory authorities to address cross-border issues on agricultural insurance, particularly the creation of an enabling environment to encourage cross-border pooling of risk by the private sector and subsequently facilitate farmers’ access to such solutions.



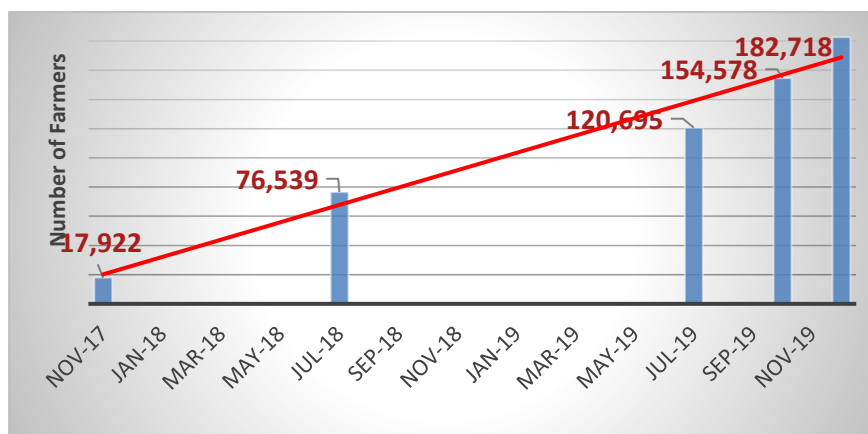
- The project has also catalysed the establishment of a community of practice on this important subject in the region.

1.5 Outputs and key activities

1.5.1 Digital registration of farmers

One of the key thrusts of the project is to harness the power of digitalisation to promote electronic approach to agricultural information. To enable farmers to receive appropriate information and advisories, digital registration was initiated and then linking them to digital platforms that disseminate appropriate information to them. At the end of field work in December 2019 in the three countries, total **182,718** farmers were registered on the three platforms hosted by the project in the three countries.

Figure 4: Cumulative number of farmers digitally registered in the Southern Africa region



As presented in Figure 1 below, from only 17,922 in November 2017, the number increased rapidly to 182,718 farmers i.e. by ten folds or 1,000%, after two years (end of 2019) of the project implementation. This figure is much higher than the initial project target of 140,000. The increase is attributed to the ability of project partners to quickly overcome initial challenges in the setting up of the digital platforms, purchase of mobile phones and to aid farmer registration, training and active engagement of government agricultural extension officers in the registration and a better understanding and appreciation of the potential benefits of the project by farmers.

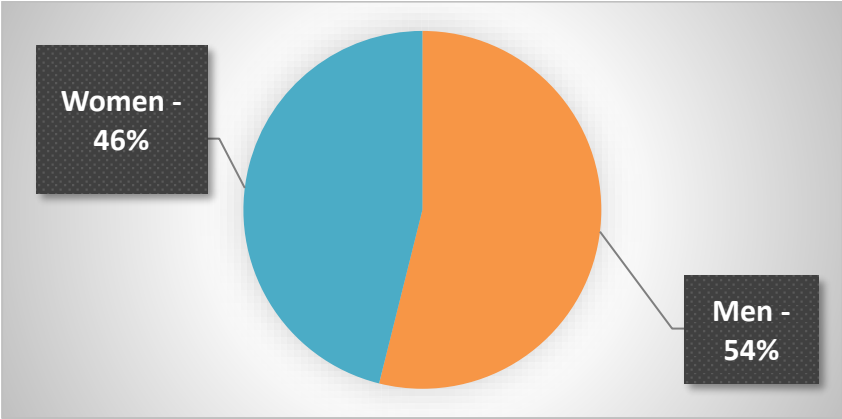
Figure 5: Training of extension officers on digital registration of farmers for the project



The number varied in each project country from 80,997 in Zambia to 65,220 in Malawi and much lower figure of 36,501 in Zimbabwe. The difference is due to the initial target set by the project and the implementation modalities adopted in each country e.g. Zimbabwe focused much more on registering farmers who have subscribed to insurance bundle.

The project deliberately ensured that women benefited from the registration to avoid the usual challenges that women faced with traditional face-to-face extension where men have preferential access to extension officers and agricultural information. As a result, 46% of all the registered farmers were women

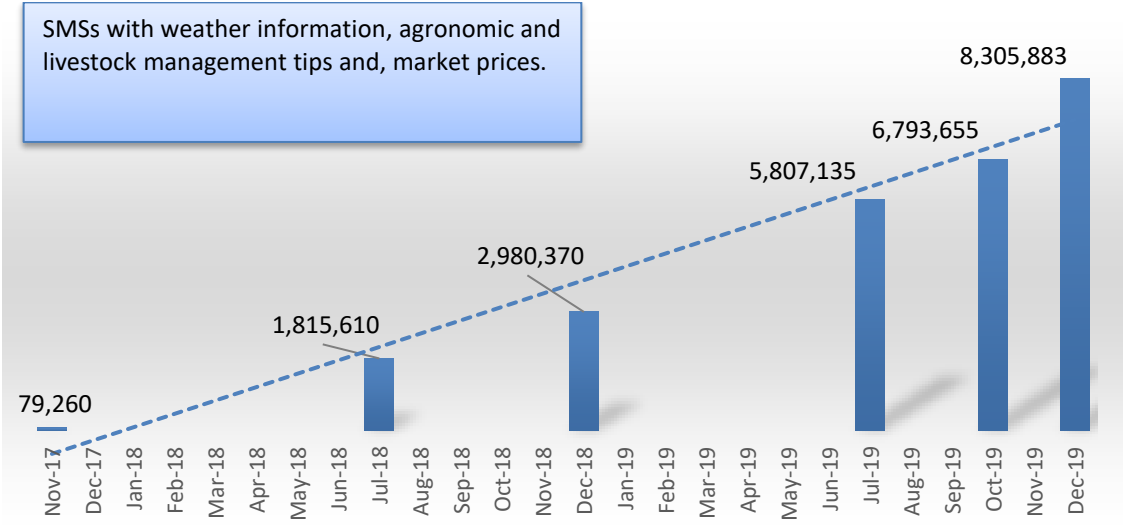
Figure 6: Distribution of digitally-registered farmers by gender



1.5.2 Dissemination of SMS on weather information and advisory to farmers

The project partners sent SMS messages on information to farmers on regular intervals focusing on weather information and agronomic tips during the cropping season. After harvesting and during the dry season, tips focus more on market information and advisory on livestock. The rationale for market information is to ensure that that farmers are able to improve their livelihood from the good prices for their products and, avoid the common phenomenon in the project countries where improved yield do not translate to farmers’ welfare as the prices that farmers received are much lower than the market prices.

Figure 7: Tend of the cumulative number of SMS messages sent to farmers



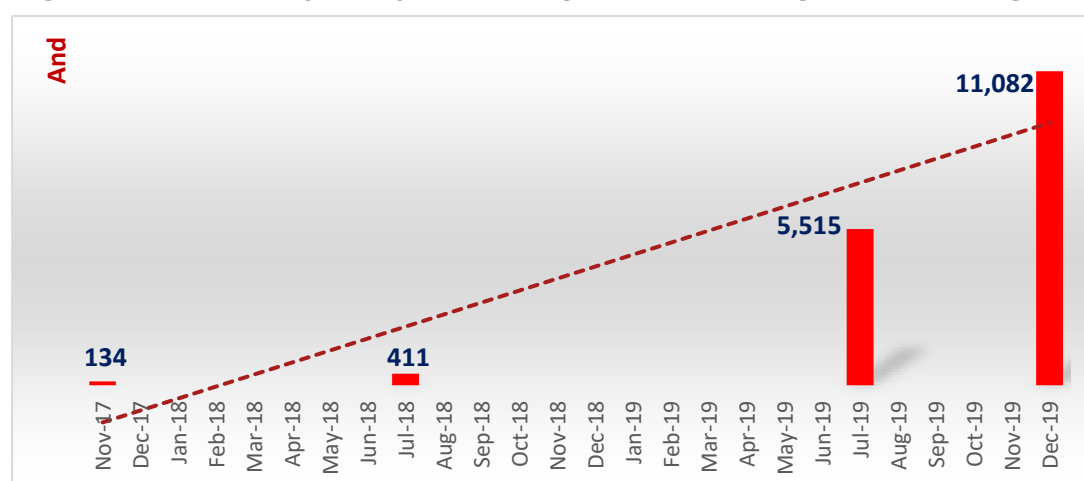
1.5.3 Training of Lead farmers, agro-dealers and government agents

A critical mass of key intermediaries along the value chain is essential to continue to champion the ideals of the project, even after CTA funding ends. The group of individuals identified are those that play influential roles in shaping access and adoption decision of farmers. Lead farmers are influencers and well-respected opinion shapers in rural communities. Agro-dealers are based in rural communities and provide a one-stop shop for agricultural inputs and often facilitate informal exchange of information on agricultural matters with farmers. Government agricultural agents have official mandate for agricultural extension in their respective districts.

The number of the intermediaries increased from 134 in November 2017 to 11,082 two years later. The rapid increase in the training of the intermediaries especially at the middle and later period of the project is due to the increasing awareness of their role to sustain the project after CTA support. Women feature prominently in the trainings organised for the intermediaries, as they constitute almost half (48%) of the beneficiaries.



Figure 8: Number of lead farmers, agro-dealer and government agents trained



1.5.4 Seed and CSA information fairs

One of the goals of the project is to contribute to improved smallholder farmer's resilience through increased access and use of stress-tolerant seeds. The project conducted several seed fairs in project sites with the following objectives: (i) Enable different seed companies to showcase their seed "best bet" seed varieties and facilitate information exchange to help farmers make informed decision and sometimes help farmers to negotiate good bargain on seeds with seed companies. (ii) sensitise farmers on the benefits of the different types of climate-smart agriculture practices and the synergies between them (iii) Educate smallholder farmers on the benefits of crop and livestock integration.

Overall, **13,604** farmers benefited from the seed fairs comprising of 7,600 males (**56%**) and 6,004 females (**44%**)

In Zambia for example, the seed fairs were usually opened by the District Commissioners who served as guests of honour and political leverage of the importance of the seed fairs. The District Agriculture Coordinating Officers, Senior Agricultural Officers (SAOs) played significant roles to support the project partners in organising, coordinating and in some cases facilitating the seed fairs. In Zambia, project partnered with seed companies, Agro-dealers and some local radio stations in ensuring the successful hosting of the seed fairs. Some of the companies that participated include ZAM-SEED, SEED-CO, MRI, DEKALB, PANNER, SYNGETA, PIONEER, K2, and Good Nature Seed). Other exhibitors that were not seed

producers were: STANBIC Bank, VITALITE (Solar Energy Company), ATS AGRICHEM, ETG, Zambia Meteorological Department, AIRTEL, BYTA FM, CHIKUNI RADIO, agro-dealers and smallholder farmers seed grower associations.

“After attending the seed fair, I now know that it is possible to produce different varieties of maize next to each other without the fear of contamination” – Denford Dzenze, farmer in Mutoko District of Zimbabwe

1.5.5 Policy and dialogue events to support uptake of CSA

The project carried out multistakeholder policy dialogue and engagement sessions with policy-makers and shapers to facilitate the adoption of CSA. Total of 694 individuals, comprising 343 males (49%) and 351 females (51%) participated in policy dialogues organised by the project. Key aspects of the policy component of the project include facilitating the development of a regional (southern Africa) policy/regulatory framework for supporting the development of climate resilient solutions. This was to address the problem of the limited uptake of weather-based index insurance (WBI) on a large scale by farmers, which is mainly due to its limited availability and high premiums. The high premiums have largely been attributed to the high costs of re-insurance, which in turn is a result of the concentration of risk over a relatively small geographic area. Thus, pooling of risk across different countries in the region is expected to lead to the reduction of the cost of the product, and a policy/regulatory framework was considered necessary to facilitate this. In addition, a regional approach implied a larger market which would in turn attract investment in this area thereby increasing the availability of the product and further reducing the cost of the product to farmers.



1.6 Financial overview

Information about budget allocation to the project at the initial phase when the project was being planned and actual expenditure by project country and partners is presented in Table 1 below.

Table 1: Budget distribution CSA Southern Africa

Managed by CTA/Partner	Country	Budget allocation at project design stage (euro)	Actual expenditure	Actual vs budgeted (%)
ZAOU, PICZ and Musika	Zambia	390,807	380,612	97%
NASFAM	Malawi	365,158	347,126	95%
ZFU and ECONET	Zimbabwe	246,301	241,612	98%
SACAU	Regional	162,370	134,821	83%
CTA	Regional	278,000	236,818	86%

1.7 Key success factors, scalability and sustainability of the project

Factors that led to successes in the impacts, outcomes and outputs achieved by the project and which are expected to contribute to continued success and, sustainability of beyond CTA support are outlined below:

- The project identification of project activities and components were effectively done jointly with partners during the regional forum. This helped to reflect priorities of stakeholders and co-ownership of the project by project partners.
- A sound business model has been elaborated for the project in all the three participating countries. There was a strong co-investment from the private sector and their active engagement in the implementation of the project.
- Deliberate efforts to ensure that women benefit from CSA projects assisted to boost the high proportion of gender beneficiaries recorded by the project. The programme design is informed by a meeting held on “Gender and Climate Smart Agriculture in Southern and Eastern Africa” in 2016 in which CTA’s project leader participated. This meeting has helped to highlight how smallholder farmers in general and, women in particular in Africa are vulnerable to the negative effects of climate change and, has assisted the CTA project leader to be inspired to specifically address this in the project.
- A strong consortium of partners drawn from the public sector (agricultural extension departments, national research), producer organisations, private sector players (mobile telecommunications, seed companies), NGOS and knowledge institutions (universities) have been built in each project country to continue the project.
- There was strong involvement of the ultimate beneficiaries (farmers) in the project, who implemented the projects in the countries.
- The project addresses a critical topic which is well acknowledged by stakeholders in the region.
- Partners capacity has been strengthened and able to continue the project with own and other support.
- The project was implemented with active engagement of government’s agricultural extension and climate change departments, who are in the process of mainstreaming the project in their normal activities.
- The adoption of the insurance model being promoted by the project by the government of Zambia under the nation-wide Farmers Input Support Programme is an indication that the project has attracted the interest of the government and should strengthen the sustainability of the project.
- The project component has become an integral part of the partners strategic intervention areas in the future e.g. RECs and AU-NEPAD co-funded and co-organised climate finance events in their respective regions and are keen to continue on this topic. In SACAU’s five-year (2019-2023) strategy, the management of climate risk is a major investment area, and insurance solutions are considered a key component in this regard. Policy advocacy for CSA is one of SACAU’s focus areas.

- Some of the project partners have established a firm strategic partnerships and collaborative arrangements with several organisations e.g. IFPRI/CCAFS to continue objectives of the project.

1.8 Changes and highlights of lessons learned from the project

To ensure that the project is effectively implemented on the ground in accordance with the realities on the ground and in line with CTA as a knowledge management and information broker institution, we carried out a cross lesson learning and project review after each cropping season. The reviews led to some adjustments to the implementation modalities of the project. Some of the key lessons that the project team learned in the process of implementing the CSA project are presented in the form of an “outgoing valedictorian” passing messages on to “incoming students” who may want to implement similar CSA project in the project countries:

Table 2: Key lessons learned with implementation the CSA project

Topic	Lessons
Engagement with appropriate government officials	Engagement of government extension workers is still essential even if extension services is digitalised. This will help to work with them as allies this ensure the project is mainstreamed into government activities after external funding ends. It also allayed their fears of a parallel extension system that may render them technically redundant
Project budget and number of target beneficiaries	While the total number of target beneficiaries should be retained, the expectation of the contributions from each project country should not be static but amended after each project review taking cognizance of the performance and context of the project country. For example, the number of target beneficiaries for Zimbabwe was reduced while that of Zambia was increased during the project period. The cost to reach a farmer beneficiary varied widely between the countries. Accordingly, project budget was re-allocated during implementation to in line with this and, also taking cognizance of the revised target beneficiaries
Crop insurance	Crop insurance should never be disseminated to farmers as a single solution. It is better to “twin” with other products and offered to farmers as an inclusive bundle or package. When there are recurring seasons of good rainfall, farmers’ adoption of crop insurance could wane and some even withdrew/dropped out of the scheme because they perceived that they see no benefit/ returns on their investments. For example, the number of farmers who have adopted crop insurance in Zimbabwe fell from over 21,000 to under 20,000 because of this reason.
Pooling of climate risk across the region	Cross-border sharing of WBI and risk pooling requires better understanding prior to developing proposal/framework. Advocacy for a completely new regional framework would take many years. A better strategy is to advocate for the incorporation of the key proposals into existing regional policies/protocols e.g. SADC’s Draft Regional Resilience Strategic Framework 2020-2030.
Government economic and monetary policies	Government economic and monetary policies greatly influence the implementation of development project in rural areas, e.g. in Zimbabwe, the policy on exchange controls between US dollar and RTGS dollar had an effect on project implementation
Power supply	In Zambia, some of the venues used for training sessions for farmer leaders, agro-dealers and extension officers had no electricity supply. Project team decided to hire generators for the period of the training.

1.9 Constraints and problems encountered

During the project, CTA and partners encountered some constraints, but took actions to remedy these constraints. Some of these are listed below:

Table 3: Constraints experience and remedial actions taken

Constraint	Remedial action
Poor internet connectivity during registration of farmers	Enumerators were provided with an open software kit that helped to capture farmers data offline. These were then uploaded to the digital platform later in the evening when they have access to internet connectivity.
Government monetary exchange policy	In Zimbabwe, sudden changes in government policy on exchange between United States Dollar and the Real Time Gross Settlement (electronic money transfer across banks) affected the real value of money on which the insurance policy was based. The premium paid for bundle of CSA solution was reviewed in line with the prevailing inflation in the country ensure realistic figures that will be appreciated by farmers where pay-out occurs. The rationale and changes were discussed with farmers accordingly.
Accuracy of weather information	Weather information initially being disseminated to farmers was done at a larger scale and less accurate. CTA and project partners engaged with the weather service providers to ensure a more targeted and accurate weather information. In Zimbabwe, the services of a satellite weather company (aWhere) were procured. In Zambia, project partners, Ministry of Agriculture and the Zambian Open University (ZAOU) project team had to re-construct messages in local language so that farmers received specific and actionable advisory information that are more appropriate to farmers needs in the 12 study districts.
Low financial education of farmers on weather insurance	Farmers' low level of financial literacy impaired their understanding of weather insurance. The project initiated the design of a prototype weather insurance that it used in awareness campaign tool, thus enabling farmers to understand the structure of weather-index insurance and its functionality. Weather insurance was integrated with other products to form a more attractive package to farmers. The combo had a positive impact as there was high uptake by the farmers.
Low accuracy of forecast from weather stations	Introduction of satellite-based weather information improved the system to trigger payments to farmers in the event of a drought or excessive rain. This facilitated the insurance pay-outs to farmers by Econet in some project locations (e.g. Zvimba district) thus re-invigorating their interest again.
Change in country project team leadership	Project team in Zambia changed for reasons not linked to the project. CTA project staff initiated efforts to minimise the impacts by engaging the new project team in intensive and frequent "touching base" and "catch-up calls" to ensure the new partner teams got on board quickly and to continue project activities.

2 Annexes

2.1 Project logical framework

Table 4: Corporate logframe indicators: Impact, outcomes and outputs

Project code	Project specific indicator code	Indicator statement	Target value	Actual value	% achieved
Impact					
H2	H2_OO1.1.2	% increase in farm productivity	40	165	413
H2	H2_OO1.2.2	% increase in farm income	40	131	328
Outcome					
H2	H2_SO1.1	Number of farmers adopting CSA practices (disaggregated by gender) that developed climate resilient CSA practices	70,000	52,424	75
H2	H2_SO1.2	% of smallholder farmers (disaggregated by gender) that have adopted climate resilient CSA practices	50	70	140
H2	H2_SO2.1	Number of new policies/strategies or regulations supporting the upscaling of climate-smart agriculture	1	1	100
H2	H2_SO2.2	Number of countries where policy recommendations coming from the project are adopted	3	2	67
Output					
H2	H2_R1.1	Number of farmers trained on CSA	1,500	3,323	222
H2	H2_R1.2	Number of farmers aware of weather index insurance schemes	50,000	61,062	122
H2	H2_R1.2.1	Number of radio programmes aired	10	11	110
H2	H2_R1.3	Number of farmers with access to ICT-enabled weather information	50,000	141,821	284
H2	H2_R1.3.1	Number of farmers visiting ICT platform for weather information	10,000	20,000	200
H2	H2_R1.4	Number of farmers receiving information from agro-dealers	50,000	34,000	68
H2	H2_R1.5	Number of farmers participating in seed fairs	15,000	13,604	91
H2	H2_R1.7	Number of individuals receiving these SMS (on weather and agricultural advisory)	50,000	166,527	333
H2	H2_R2.1	Number of policy dialogues/ events	2	10	500

Project code	Project specific indicator code	Indicator statement	Target value	Actual value	% achieved
H2	H2_R2.2	Number of participants in policy dialogues	100	694	694
H2	H2_R2.3	Multistakeholder platforms established	4	1	25
H2	H2_R3.1	Number of comprehensive databases	3	3	100
H2	H2_R3.2	Number of service providers trained (agro-dealers, private field extension staff, govt extension staff, youth eco-farmer agents)	2,000	2,411	121
H2	H2_R3.3	Number of farmers digitally profiled	100,000	182,718	183
H2	H2_R3.4	Number of partnerships established	3	12	400
H2	H2_R3.5	Number of knowledge products (policy briefs, features, articles, blogs, brochures, proceedings)	10	26	260

2.2 Partners and key individuals of the project

Table 5: List of key project partners

Country/region	Name of partner	Key Contact Person
Malawi	National Smallholder Farmers Association of Malawi (NASFAM)	<ul style="list-style-type: none"> • Dr Richard Petautchere • Emmanuel Nasasara • Wycliffe Kumwenda
	Department of Climate Change and Meteorological Services (Malawi MET)	<ul style="list-style-type: none"> • Jolamu Nkhokwe
Zambia	Zambia Open University (ZAOU)	<ul style="list-style-type: none"> • Prof. Lovejoy Malambo
	Musika Development Initiatives	<ul style="list-style-type: none"> • Mrs Chisanga Mwamba
	Professional Insurance Company of Zambia (PICZ)	<ul style="list-style-type: none"> • Webster Twaambo
	Ministry of Agriculture and Livestock (MAL)	<ul style="list-style-type: none"> • Morton Mwanza
Zimbabwe	Zimbabwe Farmers Union (ZFU)	<ul style="list-style-type: none"> • Paul Zakaraya • Prince Kuipa • Shadreck Hungwe
	Econet Wireless	<ul style="list-style-type: none"> • Ms Caroline Mozheni
Regional Level	Southern African Confederation of Agricultural Unions (SACAU)	<ul style="list-style-type: none"> • Ishmael Sunga • Dr Majola Mabuza

2.3 List of knowledge products

The following knowledge products were generated under the auspices of the project

Peer-reviewed Journal articles

1. Heather Tallis, Katharine Kreis, Lydia Olander, Claudia Ringler,.. **Ajayi OC** ...et al **2019** Aligning Evidence Generation and Use Across Health, Development and Environment *Current Opinion in Environmental Sustainability* 39:81-93 (available for free download <https://doi.org/10.1016/j.cosust.2019.09.004>)
2. **Ajayi OC**, Akinnifesi FK, Ajayi AO **2016** How by-laws and collective action influence farmers' adoption of agroforestry and natural resource management technologies: lessons from Zambia *Forests, Trees and Livelihood* 25(2): 102-113

Technical features, Blogs, Opinion Pieces

3. **Oluyede Ajayi 2019** How To Make The Business Case for Climate Action in African Agriculture <http://bit.ly/2PzQl2Q>

4. UnaMay Gordon, TO Were, Oluyede **Ajayi 2019** Putting the private sector at the centre of climate-smart agriculture, CTA TECHNICAL BRIEF 26, Wageningen, The Netherlands <http://bit.ly/2Xpd0lb>
5. Ajayi, OC and Kadzamira, MAJT **2019**. *Innovative partnerships based on shared value accelerate the upscaling of CSA solutions* <https://bit.ly/2HlhzbV>
6. Deborah Rubin and **Oluyede C. Ajayi 2019** “*Making climate-smart agriculture work for women farmers and entrepreneurs*” <https://bit.ly/2Mp0Yns>
7. Catherine Mungai, Clément Ouedraogo, **Oluyede Ajayi 2019** Multistakeholder platforms and alliances advance climate-smart agriculture in Africa <http://bit.ly/2Xakg3U>
8. **Ajayi, OC 2018** *Building farmers’ resilience to climate in Southern Africa*. <https://bit.ly/2D4QYOf>
9. **Ajayi OC 2018** Op Ed on CNBC News: These digital innovations will be the key to unlocking the investment that African agriculture needs. <https://bit.ly/2Rp2doe>
10. Kadzamira MATJ and **Ajayi OC 2019** *Adopting climate-smart agricultural innovations in Southern Africa: Knowledge alone is not enough* <https://bit.ly/2T78wld>
11. Deborah Rubin and **Oluyede C. Ajayi 2019** *Engager les femmes dans l’agriculture intelligente face au climat*, CTA, Netherlands, <https://bit.ly/2VZVanV>
12. Ajayi, OC and Kadzamira, MAJT. 2018. *ZFU-Econet Wireless bilateral partnership in Zimbabwe*. <https://bit.ly/2F1ZDQ6>
13. Ajayi, OC and Kadzamira, MAJT. 2018. *Multilateral partnerships for climate-smart cereal solutions in Zambia*. <https://bit.ly/2HmW0Ym>
14. UnaMay Gordon, TO Were, Oluyede **Ajayi 2019** Mettre le secteur privé au coeur de l’agriculture intelligente face au climat. CTA Technical Brief 26. Wageningen, The Netherlands: CTA, <https://hdl.handle.net/10568/103634>
15. Odubote, K, Mulila-Mitti, J, **Ajayi, OC** and Kadzamira, MATJ. **2019**. Seed fairs: an innovative climate-smart practice to share and obtain stress-tolerant seeds. <http://bit.ly/2JIC019>
16. Catherine Mungai, Clément Ouedraogo and **Oluyede Ajayi 2019** *Les plateformes et les alliances multi-acteurs font progresser l’agriculture intelligente face au climat en Afrique* <http://bit.ly/2JDuu9d>

Books and book chapters

17. Bidogeza JC, Lukwago F, **Ajayi OC**, Jama B. **2020** De-risking smallholder agricultural value chains: promising scalable risk management solutions pp 69-83. In: Islamic Development Bank Group (2020) *Inclusive Growth: Making value chains work for Smallholder Farmers*, Jeddah, Kingdom of Saudi Arabia 126 pp
18. Mafongoya PL and **Ajayi OC (editors) 2017** *Indigenous Knowledge Systems and Climate Change Management in Africa*, CTA, Wageningen, The Netherlands (Download on: <http://bit.ly/2WLnJGA>)

Book chapters

19. Weldesemayat GS, Akinnifesi FK, Mafongoya PL, Kuntashula E, **Ajayi OC. 2020** Potential of Gliricidia-based agroforestry systems for resource limited agro-ecosystems. In: *Gupta SR, Dagar JC and D. Teketay (eds) Handbook of Agroforestry Volume 2: Agroforestry for Degraded Habitats*, Springer Publishers, USA

20. Odubote IK and **Ajayi OC 2019** Scaling Up Climate-Smart Agricultural Solutions for Smallholder Cereals and Livestock Farmers in Zambia. In: *Walter Leal Filho (ed) Handbook of Climate Change Resilience*. Publisher Springer International Publishing AG, Cham, Switzerland. p 1-23. Springer, Cham, Switzerland DOI: 10.1007/978-3-319-71025-9_109-1
21. Kadzamira MATJ and **Ajayi OC 2019** Innovative Partnerships to Scale Up Climate-Smart Agriculture for Smallholder Farmers in Southern Africa. In: Rosenstock TS, Nowak A; Girvetz E **2019** *The Climate-Smart Agriculture Papers: Investigating the Business of a Productive, Resilient and Low Emission Future* pp 289–299. <https://bit.ly/2HBh9h8>
22. Mutamba M and **OC Ajayi 2018** A Business Case for Engaging the Private Sector in Climate-smart Solutions for Smallholder Farmers, Discussion Paper Series, CTA Wageningen, Netherlands, Download at <https://bit.ly/2IaMTb3> 40 pp ISBN: 978-92-9081-631-7
23. Mafongoya PL and **Ajayi OC 2017** Indigenous knowledge and climate change: Overview and basic propositions In: Mafongoya PL and **Ajayi OC (eds) Indigenous Knowledge Systems and Climate Change Management in Africa**, CTA, Wageningen, The Netherlands p17-
24. Mafongoya PL and **Ajayi OC 2017** Indigenous knowledge systems: Their history, development over time and role in sustainable development and climate change management In: Mafongoya PL and **Ajayi OC (eds) Indigenous Knowledge Systems and Climate Change Management in Africa**, CTA, Wageningen, The Netherlands p29-42
25. Okonya JS, **Ajayi OC** and Mafongoya PL **2017** The role of indigenous knowledge in seasonal weather forecasting and planning of farm activities by rural crop farmers in Uganda. In: Mafongoya PL and **Ajayi OC (eds) Indigenous Knowledge Systems and Climate Change Management in Africa**, CTA, Wageningen, The Netherlands p239-254
26. Mafongoya PL and **Ajayi OC 2017** The future of indigenous knowledge systems and climate sciences. In: Mafongoya PL and **Ajayi OC (eds) Indigenous Knowledge Systems and Climate Change Management in Africa**, CTA, Wageningen, The Netherlands p309-314

Conference presentations

27. **Ajayi OC**, Kadzamira MATJ, Odubote KI, Kuipa P, Petautchere R, Mashau F **2018** Building Farmers' Resilience to Climate in Africa through Upscaling Climate-Smart Agricultural Innovations: Lessons from Southern Africa region. Paper presented at the Conference "NVAS Afrikadag 2018: 'Responding to Climate Change in Africa'", Zeist, Netherlands

Partners publications

28. A regional approach to Weather Based Index Insurance – http://www.sacau.org/wp-content/uploads/SACAU_Newsletter_January_February_2018...pdf; SACAU newsletter article
29. Risk pooling: wider access to weather based index insurance – http://www.sacau.org/wp-content/uploads/SACAU_Newsletter_March2018.pdf; SACAU newsletter article
30. 1-2 March 2018 Workshop report – Stakeholders consultation workshop: proposed policy/regulatory framework for weather based index insurance in southern Africa (Report provided as a separate file)

31. Policy Brief: Increasing the uptake of weather based index insurance in southern Africa, SACAU - http://www.sacau.org/wp-content/uploads/2019/08/WBII_Policy-Brief.pdf
32. Information Leaflet: Enhancing availability and access to weather based index insurance in southern Africa - http://www.sacau.org/wp-content/uploads/2019/08/WBII_Leaflet.pdf
33. 5-6 August 2019 Workshop report – Stakeholder engagement: Promoting risk pooling at regional level (Report provided as a separate file)
34. Promoting risk pooling at regional level: Stakeholder engagement workshop on affordable climate insurance strategies for farmers - http://www.sacau.org/wp-content/uploads/2019/08/WBII-SACAU-for-website_upcoming-events.pdf; Press release
35. Thumbs up for weather-based index insurance for southern Africa’s smallholder farmers - <http://www.sacau.org/thumbs-weather-based-index-insurance-southern-africas-smallholder-farmers/>; Press release
36. Thumbs up for weather-based index insurance for southern Africa’s smallholder farmers - <http://www.sacau.org/wp-content/uploads/2019/11/Nov-Newsletter-2019.pdf>; SACAU newsletter article
37. WBII workshop: KEY MESSAGES - <http://www.sacau.org/wp-content/uploads/2019/11/Nov-Newsletter-2019.pdf>; SACAU newsletter article.
38. Farmers, insurers and international bodies commit to smallholder climate insurance - <http://www.sacau.org/wp-content/uploads/2019/11/Nov-Newsletter-2019.pdf>; SACAU newsletter article

2.4 Testimonials and impact stories from the project

Testimonial # 1: Mrs. Mary Mtonga from Mzimba district of Malawi



Ms Mtonga has been growing the local maize varieties of maize harvesting about 10 units of 50kg-sized bags or 500 kg per acre, equivalent to 1.25 t/ha, for a long time. The yield is low because she practised shift cultivation due to soil depletion in the area, they were farming using traditional methods. As a result, she used to struggle with food security and livelihoods issues as the harvest was not sufficient. She had no other income from her farming and so struggled to pay school fees for her children. She became a member of NASFAM and participates in the CTA project. After learning about climate-smart agriculture techniques, she adopted use of manure and mulching, conservation agriculture and cultivation of hybrid drought-tolerant varieties. She benefits from information

received through the phone on weather forecast and it allows her to plan for the season and make properly farm decisions during the harvesting period. She now harvests between 35 to 40 units of 50kg-sized bags per acre, equivalent to 4.3 to 4.9 t per hectare or three to four times the quantity of harvest obtained on the same size of land. With her new yield she is able to live a better life and has food for her family.

Testimonial # 2: Mrs Ella Mazani from Shurungwi District, Midlands Province, Zimbabwe



She receives weather and advisory information specific to her local area (“ward”) on demand by simply dialling *144# on her mobile phone. Through her membership of the CTA–ECONET–ZFU project, she subscribes to an eco-combo, that provided her access to multiple benefits (bundled solutions) that address farm and livelihood issues: weather information allowing her to plan her farm operations properly, agronomic advice, drought-tolerant seeds, crop insurance and funeral insurance in one package. She added that while it is

unfortunate that two members of her Kushinga group died last year, the pay-outs to their respective families by the funeral insurance demonstrated the extended beyond-the-farm benefits of the project to her and her community. Otherwise, the funeral expenses would have drained the purse of the affected families and farm investment in the following year.

2.5 Key findings of the project baseline survey reports

2.5.1 Malawi baseline

Socio-economic and demographic characteristics of farmers

The demographic characteristics examined here include age, sex, education, household size, dependency ratio and arable land holding. The baseline found that 78% of all farmers in the project sites were male-headed households while 22% were from female-headed households. In the comparison sites, 82% of sampled farmers were male headed compared to 18% who were female headed. Compared with figures nationally, the Integrated Household Survey of 2018, shows that across rural areas, 73% of the households were headed by males and 27% were headed by females (NSO, 2016). The mean age of household head was 44 years for male heads and 47 years for females in the project sites, with an overall mean age of 45 years old. Both male and females’ mean age was 44 in the comparison group. The mean household size was five and did not differ between cohorts and gender. The proportion of the population aged 15 years and above that is literate was at 83% for males in the project sites and 77% in the comparison group. The literacy levels were lower among the female population, 66% in comparison group and 73% in the project sites. Overall, the comparison sites reported 72% and the project sites reported 77% heads of household been literate. The National Integrated Household Survey conducted by The National Statistics Office (NSO-2017) reported national literacy rates 73% which is within the same range established by the present baseline. The dependency ratio for project sites was 0.47 for female-headed households and 0.44 for male-headed households, but the difference was not significant. In the comparison sites, the gender difference was not significant, with 0.51 for female-headed households and 0.46 for male-headed households. Overall, the ratio was 0.45 for project sites and 0.48 in comparison group. This implies that the dependants were about half of the economically active members in a given household on average.

Agricultural productivity

Under the agricultural productivity theme, the findings generally show that most farmers grow crops on their own land, maize is the most dominant crop grown, while soy and groundnuts are also widely grown as cash crops. About half of the farmers grow drought-tolerant (DT) maize on about half of their agricultural land.

The key crop grown by farmers which is maize, registered a mean production of around 2 t/ha in both cohorts. The productivity of maize is 1.9 t/ha for intervention sites compared to 2.0 t/ha for comparison sites. Groundnut farmers reported production of 1.2 t/ha and 1.9 t/ha for project areas and comparison farmers, respectively. The yield potential for groundnut

ranges from 1.5–2.5 t/ha depending on the variety. The baseline yield is closer to potential yields because the sample districts are suited to groundnut production, the reference period had good rains and the crop is less intensive in input use. Soybean farmers realised about 1 t/ha among project farmers and about 0.7 t/ha from comparison farmers. This was less than half of the potential yield for soybean (3.5 t/ha).

Tobacco farmers reported 1.2 t/ha (1.5 t/ha) for intervention (comparison). Cassava had the highest production per hectare. It is a special crop because it is able to withstand droughts compared to other crops. Across all crops, there was no systematic difference in production per hectare across gender categories within each cohort.

Farmer gross margins

Gross margins were calculated at two levels: Farm gross margins were calculated by finding sum of farm sales/income less farm variable costs. Second, focus crop (DT maize) gross margin were calculated by finding focus crop sales less focus crop variable costs. The revenue included both the actual revenue from sales and the value of unsold harvest. Costs comprised of the actual costs incurred and imputed costs of labour were not included. The maize gross margin analysis shows that project sites had gross margins of \$99/ha while the comparison sites had \$113/ha for maize enterprises. A further analysis to compare maize gross margins across gender groups showed that there were no systematic differences within cohorts.

Current use of climate-smart agricultural practices.

The percentage of farmers who adopted ICT-/mobile-enabled weather information was 20.8% in project sites compared to 15.6% in comparison sites. DT maize seed was the most adopted of the project package with 45% of farmers in both project and comparison farmers adopting the technology. For indicator on “diversified crop/livestock farming”, the baseline used proxy which measured the percentage of farmers who adopted¹ at least three of the CSA technologies presented in the report. Based on this definition, the baseline found that 64% and 75% of farmers in the project sites and comparison sites, respectively had adopted at least three climate-smart technologies. In addition to the project package, there are other important technologies that are relevant to implementing partners. The percentage of farmers who adopted more than three CSA technologies was 64% in project sites compared to 75% in comparison sites. Those who adopted conservation agriculture, defined as those who adopted minimum tillage, mulching and crop mixes (either intercropping or agroforestry) was reported to be 9% in project sites compared to 7% in comparison sites. The percentage of farmers who practised irrigation in the reference period was 13% for comparison sites and 7% for project sites.

2.5.2 Zambia baseline

Socio-economic characteristics of sampled households

The measured socio-economic characteristics differed between intervention and treatment households in varying degrees. Intervention households generally had superior average values of all the variables except for age of the head and proportion of heads that are disabled. This is, however, of no concern to the end of project impact assessment as these variables will be controlled for in the analysis. The main source of income for both categories of households was crop followed by business and income generation activities, livestock sales, and then formal permanent employment regardless of gender of the household head and together accounting for 88 to 92% of the households.

Baseline levels of key project indicators

Farm Gross Margins: We use the maize gross margin, which is the gross value of production (income) less variable costs per hectare, as the first key project indicator. The overall value was estimated at ZMW 2,691 with no significant difference between intervention and control households as well as male and female-headed households. However, parameters used in the computation of this indicator, especially maize cultivated area, seed and planting costs significantly varied between household types.

Crop Productivity: Using average yields of maize and groundnuts which are the most commonly grown crops in both intervention and control districts accounting for 64% of the frequency of crops grown shows that overall average yields for these respective crops was 2.4 and 0.7 t/ha, respectively, and did not show any significant differences between treatment and control households as well as gender of household head.

Use of CSA practices: we estimate the adoption of DT maize seeds, use of conservation tillage, use of manure, keeping crop residues in the field after crop harvests, planting soil fertility trees in the fields, using weather information, adoption of WII and level of agricultural diversification as measured with SID.

The frequency of planting DT maize was significantly higher among treatment (13%) than control, households (8%). There were, however, no gender differences in rates of adoption of DT maize within the treatment and control households.

The use of other CSA practices ranged from 16% to 61% with the most common being keeping crop residues followed by using minimum tillage, planting soil fertility trees and using animal and/or plant manure, and there were no significant differences in use of these practices between treatment and control households.

Overall, 29% of all the households reported using weather information with the rate significantly higher among treatment households at 35% compared to 23% among their control counterparts, though there were no significant gender differences within the treatment and control households.

WII adoption levels were low at less than 5% across-the-board in the 2016/17 season with no significant differences between treatment and control households.

The average agricultural SID was 0.28 (significantly higher among treatment households at 0.35 compared to 0.21 among their control counterparts), though this did not significantly differ between male and female-headed households.

Baseline levels of other project indicators

Access to climate-smart agriculture training: Over three quarters (82%) of the sampled households have had one form of CSA training, though this was significantly more pronounced among treatment (90%) than control households (75%).

Access to Input Supplier Related Services: Agro-dealers should be not only critical in the distribution of agricultural, fisheries and livestock inputs to small, medium and large-scale farmers but can also play an important role in the dissemination of information that can influence their consumer base. Related to this aspect, findings show that average distances to the nearest agro-dealer (about 23 Km) are not significantly different while there is a significantly higher proportion of treatment households (37% compared to 26%) reporting receiving information from agro-dealers and participating in input dealers' fairs. However, the average number of input fairs reportedly participated in (about 2) among those who participated was not significantly different between intervention and control households.

Access to Weather Information: Access to weather information was relatively low among the respondents. Only 29% (35% treatment and 23% control, which was significantly different) reported receiving weather information from any source. Only 26% (30% treatment and 23%

control, which was significantly different) reported receiving weather information through smart phones.

Uptake of Weather Index Insurance: Only 29% of all the respondents (significantly higher among intervention households at 43% compared with 14%) reported having ever heard about weather-based crop insurance to cover them against crop losses due to drought or disasters. However, uptake was reported low at about 3% (not significantly different between intervention and control households).

Household Gender Decision Making: On key household decision making by gender, findings show that female household heads regardless of intervention status (in female-headed households) are largely responsible for making all these decisions accounting for 82% to 95% of the households; this proportion reduces up to 52% when it comes to making decisions with uptake of WII, DT seeds and use of weather information largely because a larger proportion of households reported having not made any decision (10% to 40%).

In male-headed households, regardless of intervention status:

- Decisions on large household purchases are made by the head for about half of the time, 40% by head and spouse jointly
- Decisions on daily purchases are made by the head, spouse and head/spouse jointly for about a third of the time each
- Income use is decided by the head/spouse jointly half of the time and the head alone 40% of the time
- Uptake of WII, DT seeds and CSA, and using weather information are decided equally 30% to 42% of the time by head and head/spouse jointly while another 12% to 27% represents decisions not yet made.

Household Financial Inclusion: The baseline levels of rural financial inclusion indicators of membership to community savings and loans groups and ownership of a formal bank or mobile money account were found to be quite low at 13% to 19% of the sampled households (with no significant difference by intervention status).

Food Availability and Consumption: We use proportion of households having adequate food provisions all year round, Months of Adequate Household Food Provisions (MAHFP), Household Dietary Diversity Score (HDDS) and Household Food Consumption Score (HFCS) as indicators of food availability and consumption. About half (50-54%) of the sampled households reported having adequate food in the whole year prior to the survey and there was no significant difference between treatment and control households. Likewise, no significant difference was found for the HDDS with the overall average falling at 6.25. Treatment households reported significantly higher MAHFP (10.76 compared to 10.36) and HFCS (8.47 compared to 7.85).

Exposure to Shocks and Key Coping Strategies: main shocks experienced were significantly higher than normal crop or livestock pests/diseases, unusually high prices for food, unusual dry spell during the agricultural season, exceptionally heavy wind/storms/floods, and unusually high costs/unavailability of agricultural inputs. The relative frequency of most of these shocks was not significantly different between the treatment and control households except for the usually higher costs/unavailability of agricultural inputs which was higher among control households as they tended to be in districts further away from the urbanised line of rail, and unusual dry spells which was higher among treatment households as they were located in relatively drier districts. The greatest impact of the shocks was on food production, significantly more among control than treatment households, followed by income (no significant difference between the different types of households), food stocks, purchases and assets all of which were more significant among control households. Despite these shocks 42% to 47% of the sampled households that experienced shocks did not employ any coping

measures to cushion effects of the shocks they experienced. Of those that did, the main coping measures reliance on savings, selling livestock, increasing income generating activities and unconditional help from friends and relatives all which accounted for 47%, with 13 other strategies sharing the remaining while the remaining 9%. The importance of some of these strategies differed significantly between treatment and control household though reasons for such differences cannot be established at this point in time. On a scale of 0 (none) to 1.5 (significant recovery) the average recovery score from these shocks 0.79 (0.78 for treatment and 0.80 for control households though these were not significantly different).

Conclusions and recommendations

Agricultural productivity remains a challenge for smallholder farmers in Zambia more so because they lack the adaptive capacity and an enabling policy environment required to make it possible for them to increase their productivity. In addition to creating an enabling environment, there is need for the fortification of smallholder farmers' resilience to climate change through CSA practices. CSA practices such as use of weather information, use of irrigation and overall agricultural diversification would have a significant positive impact on the income smallholder. Even though weather index insurance adoption was also very low both in the project and comparison sites at less than 5%, there was willingness to pay for weather-related crop insurance at an even higher rate than that of the government of ZMW 100 (ZMW 139, not significantly different between intervention and control households). This means that what has to be improved is both the knowledge on and access to insurance services.

2.5.3 Zimbabwe baseline

Socio-economic diagnosis

The average household size was 4.4 members, with a standard deviation of 1.7 (where $n = 1,405$). The bulk (59.6%) of the sampled households was male headed, while the rest were female-headed households (40.4%). The average household dependency ratio was 1.9. A proportion of 88.8–97.5% of the sampled households in the treatment districts were members of the ZFU, while comparative statistics were 9.6–11.5% in control districts, which is significant (<0.01). Registration for the Scaling Up CSA project has accentuated ZFU membership in treatment districts. On the other hand, there were no differences in ownership of smart and feature phones across treatment and control districts. Only about a third (30.5%) of the sampled households owned smart phones, while the remainder (69.5%) had ownership of feature phones, with no difference between intervention and non-intervention cohorts. There is more equitable distribution of power in both treatment and control districts in making decisions for signing up for WBI, decision on how to use weather insurance and the adoption of CSA techniques, where 30.9–32.6% of the decisions are made by male counterparts, 25.6–26.0% are made by the female counterparts and 37.3–38.8% are joint decisions.

Agricultural production and productivity

The average area under maize was 1.36ha in the treatment districts and 0.99 ha in the control districts, which is significant (<0.05). Average maize yields in treatment districts were 2.05 t/ha in Mashonaland West Province and 1.92 t/ha in the Midlands Province. On the other hand, maize yields in control districts were shown as 8.47 t/ha in Mashonaland West Province (regarded as the country's bread basket due to its greater potential in staple food production) and 1.89 t/ha in the more marginal Midlands Province. Gross margins for maize were quite positive, with overall gross margins of US\$654 in treatment districts and US\$533 in control districts. Cotton had a high allocation of land to it with at least 0.75ha allocated in each district for the households producing the crop. For cereal crops, sorghum was being grown on at least 0.4ha across the study districts. Overall statistics showed the average sorghum yield as being 1.74 t/ha in treatment districts and 1.45 t/ha in control districts. The respective average yields of other crops were 3.47 t/ha and 1.68 t/ha for millet, 3.65 t/ha and 5.23 t/ha for groundnuts,

4.58 t/ha and 1.73 t/ha for soyabean, and 4.93 t/ha and 7.28 t/ha for cowpeas. The gross margin analysis for the rest of the crops produced mixed results. Average cattle ownership is 10 head and below across all districts and across both intervention and non-intervention districts. Goat stock size ownership is equally low across all districts with the districts averaging 10 goats and below per household. Mortality is high across all livestock categories and classes. Overall, there was an increase in herd size for cattle, goats, sheep, pigs and indigenous chickens across all the districts for the period 2016 to 2017. The overall livestock gross margins are positive for Chegutu, Shurugwi and Zvimba districts, while the livestock enterprises in other districts are failing to breakeven.

Household income and asset ownership

The majority of households own cattle, ox drawn ploughs, scotch carts and wheelbarrows, Knapsack sprays, bicycles and water wells. The overall average asset value for intervention households is \$3,410 while that for non-intervention households is \$2,731. The average arable land size was 2.02ha (n = 1,403) per household. The baseline study established that the number of fields and gardens ranged from one to five per household. There is a statistically significant difference in sizes of land owned by male-headed and female-headed households (p=0.021), as well as between intervention and non-intervention households (p=0.000). Crop production remains the major source of income for the households. A total of 548 of the 735 sampled households (75.8%) in treatment districts rely on crop production and sales as the major means of survival. In comparison, a total of 452 of the 697 sampled households (71.2%) in control districts considered crop production and sales as the major source of income. The mean annual household income was US\$114.59 in treatment districts and US\$91.06 in control districts. The level of contribution through crop production sales to sources of income per household is very high. Crop production sales contribute 74.9% in Mashonaland West and 77% in the Midlands Province for the intervention areas. With respect to the non-intervention areas crop production sales contribute 65.1% for Mashonaland West and 67.3% for the Midlands Province.

Climate-change shocks and mitigation strategies

Climate shocks have included exceptionally heavy wind/storms/floods (experienced by 42.1–49.0% of the sampled households), unusually high prices for food (35.9–43.5%), higher incidences of crop/livestock diseases, and the high costs of food. According to the interviewed households, climate change has also had a significant negative impact on food production (as perceived by 36.7–48.6% of the sampled households), with this having had knock on effects on available food stocks (37.0–49.1%) and on the households' capacity to purchase supplementary food on the market (26.0–35.6%). Mono-cropping, a practice adopted by 59.3% of the sampled households in treatment districts and 51.7% in control districts, remains the major cropping system established by the baseline survey. The majority of the farming households cut and remove crop residue from the field to feed to their animals for both intervention (41.4%) and non-intervention (41%) districts. The most common tillage practice across both intervention and non-intervention districts is ploughing. This is followed by the use of hand hoes and zero tillage, respectively. The proportion of households with fields in wetlands ranges from 13.1% to 17.6% across both intervention and non-intervention districts.

Agro-dealers play an important role in providing advice and information on CSA inputs for the treatment districts in the Midlands Province (61.8%) and a relatively lower role in Mashonaland province (42.5%). On average, proportionally more households in treatment districts received CSA information than in control districts. A proportion of 60.0% of the sampled households in treatment districts received WBI information, 66.9% received weather-related information, and 75.4% received information on the use of drought-tolerant crops. The respective statistics for control districts were 14.8%, 27.5% and 57.4%. As expected, the access to WBI is very low both in the Midlands and Mashonaland West provinces in respect of Ecosure (7.8%), micro finance (0.3%) and large firms (0.1%). The proportion of households insuring different crops is also low with maize (13%) followed groundnuts (1.4%) overall. The amounts

paid for insurance average \$45.67 overall with the treatment districts paying an average \$46.71 and control districts paying \$5.67 for the 2016/17 farming season. Farmers are willing to pay \$23.43 overall for WBI.

The number of respondents who had heard about WBI at the time of enumeration was 57.4% for treatment districts and 12.9% for control districts. The ZFU was ranked highly as the topmost CSA information provider followed by Econet/ Eco-farmer and the Government of Zimbabwe extension staff. The number of households who indicated that they had heard of smart phone weather information was highest in the Midlands (72.8%). Messages received on the phone were mainly daily weather forecasts (19%), seasonal weather forecasts 18.9% and floods warning (14.4%). Overall, Econet/Eco-farmer SMS platform (25%) had the highest proportion of recipients of weather information followed by the meteorological department (24.1%) and ZFU 16.3%. Other channels used to access weather information in 2016/2017 were SMS (31.8%), radio (27.9%), ZFU (12.1%) and public and private extension (8%) overall. Overall, the farmers used the information received to change crops to grow (16.6%), changed planting date (28.5%), bought inputs earlier (12.6%), met other farmers to analyse and plan (28.4%), while 12.4% did not use the information.

Both females and males have mobile money accounts equitably, except for Kadoma (62.9%) with a relatively low female prevalence of bank account holders compared to male counterparts at 80.3%. Access to input and output markets as proxies by distance in km of households to nearest agro-dealers who sell agricultural inputs shows averages ranging from 22.4 km for Zvimba intervention district to 44.4 km for Kadoma non-intervention district.

Food and nutrition security

The past two agricultural seasons that is 2015/16 to 2016/17 seasons have been characterised by late rainfall and heavy flooding in some areas. A number of households have not completely recovered from the adverse weather effects in the 2015/16 production year caused by the El Nino drought followed by the Tropical Depression Dineo in 2016/17 agricultural season which resulted in flooding that destroyed crops, livestock and infrastructure. As a result, most rural households are now living in severe to acute poverty with 30-45% of the interviewed households reporting not being food secure throughout the year. Total food insecure households for the intervention districts is 35.5% while that for control districts was 37.4% with Zvimba and Gokwe having the highest number of households at 44% while Shurugwi had the least with 23.6%. Analysis also showed that from the food insecure households, 55.6% from the intervention experience at least 3 months of food insecurity while the proportion is higher for the non-intervention group with 59.2% households.

The HDDS was used as a proxy indicator for the estimation of the quality of a household's diet as well as determining the household's food access by measuring the number of different food groups consumed over the last 24 hours. Out of a total of 12 given food groups, the average HDDS for the treatment districts was 7.86 (7.76 for female-headed households and 7.93 for male-headed households), while that for control districts was 7.32 (7.19 for female-headed households and 7.40 for male-headed households). Overall, the results show a significant difference ($p=0.000$.) between the treatment and control districts.