ACTIONABLE GUIDELINES FOR THE IMPLEMENTATION OF CLIMATE SMART AGRICULTURE IN SOUTH AFRICA

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EXECUTIVE SUMMARY

Agriculture has been identified as one of the key sectors that will contribute towards the greening of the South African economy (CSIR, 2014). Crop production and rangeland management in particular, have the greatest potential to contribute towards a green economy for South Africa, although, the realization of this potential is threatened by changing climatic conditions caused by the global climate change. Climate Smart Agriculture (CSA) is now widely promoted as the best approach for addressing the effects of climate change because it includes both mitigation and adaptation interventions.

Volume 2 of this Guideline report described actionable guidelines for CSA practices whose implementation will contribute to the roll out of CSA in South Africa and facilitate the country's transition to an all-inclusive green economy. The **CSA practices** described included soil and water management, crop production, urban agriculture, rangeland management, and agro-processing. However, the successful implementation of these practices is dependent on a conducive **enabling environment**. Enabling environments for CSA are the framework conditions that facilitate and support the adoption of climate-smart technologies and practices. The report described herein and summarized below covers aspects of the **CSA enabling environment** considered critically important for the rollout of CSA in South Africa. They include agricultural marketing, climate information services (CIS), weather-indexed insurance (WII), CSA knowledge dissemination, gender and social inclusion and general CSA policies.

Agricultral Marketing

The adoption of CSA practices in the productive sectors of agriculture will result in increased productivity. This will not be a problem in the commercial farming sector which is already well connected to marketing channels. However, this is not the case for the smallholder farming sector where marketing channels are not well developed. The planned introduction of Agri-Parks in District Municipalities that will include a Rural Urban Marketing Centre (RUMC) and a Farmer Production Support Unit (FPSU) will contribute to the alleviation of the marketing problem. These units will act as centres of marketing services from controlling input supply, logistic support, grading and packaging as well as auctions amongst others. Guidelines are described as part of this report on how marketing functions in rural areas can be improved so as to positively contribute towards CSA marketing. These initiatives include group marketing which will improve market access, economies of scale, agribusiness contracts and access to agricultural technologies.

Climate information services

Climate Information Services (CIS) are critical for effective risk management and achievement of CSA objectives. Improvement of farmers' capacity to manage risk can be achieved by providing them with CISs. Although South Africa generates substantial amounts of climatic information and services, it is done with limited interaction between providers and users. The stakeholders involved include scientists, forecasters, intermediaries, farmers, and extension workers. Additionally, dissemination of the information is not yet conducted in a participatory manner. Experiences from various developing countries, however, illustrate successful examples of dissemination of CIS through participatory processes and communication methods. The South African government needs to ensure that CISs are disseminated in multiple languages using numerous communication methods. Generation of these advisories needs to involve farmers, multi-disciplinary scientists and other relevant stakeholders. Farmer-to-farmer extension should be promoted for reaching the highest number of farmers in South Africa. It is also critical to include a feedback mechanism on the quality of the CISs and effectiveness of dissemination methods. This will allow continuous improvement on the delivery of the CISs. Practical guidelines are provided to facilitate use of participatory CIS dissemination and utilisation in South Africa.

Weather index based insurance (WII)

The ability of smallholder farmers to bounce back and make investments after experiencing a weather-related shock will be improved by availability of appropriate agricultural insurance. Insurance products currently available in South Africa are not suitable for smallholder farmers due to high cost. WII provides an affordable insurance option for resource-poor smallholder farmers. Guidelines for developing and implementing WII prod-

ucts are presented. The procedure involves conducting a pre-feasibility assessment to determine if conditions for establishing WII exist in a given country.

If favourable conditions exist, a pilot study is initiated in limited sites to test the viability of selected WII products. This is then followed by scaling-up provision of WII products if they are profitable and in demand in that particular country. Case studies from east Africa showed that WII was launched successfully in several countries in that region, and it is covering millions of crop and livestock farmers. The South African Insurance industry and government are urged to work together and launch WII in the country in order to protect local farmers against the adverse effects of climate change.

CSA knowledge dissemination

CSA/CA in South Africa has been taken up by large-scale commercial farmers at a rapid pace when compared to small-scale farmers, where the uptake has been slow and sometimes halting. Large-scale commercial farmers have shown their ability to adopt and adapt CSA/CA spontaneously, which could be attributed to support received from industry bodies and government. There is, however, little evidence of spontaneous uptake of CSA/CA among small-scale farmers except where there is sustained support, in particular from NGO partners.

One key advantage that large-scale farmers have over small-scale farmers when considering whether or not to take up CSA, is the capacity and inclination to experiment, learn and adapt. There are examples of best practice for both crop-based and livestock-based CSA in South Africa that could serve as models that government could build upon in an attempt to scale-up CSA. These are the CA Farmers' Innovation Programme led by GrainSA and the smallholder–based Holistic Range Management programme operated by the Olive Leaf Foundation.

The guideline offers recommendations on what would be required for the scaling up of CSA to happen focusing in particular on the training aspects, which would involve both government extension officers and tractor service SMMEs.

Gender and social inclusiveness

CSA has much to offer women farmers, although, based on the evidence from other African countries, much depends on the circumstances of particular women farmers, as well as the specific elements of the CSA/CA package that they are trying to adopt. In order to encourage CSA uptake by women the implications of the technology for women's financial and time resources ought to be taken into account.

For the most part the South African context is favourable, in that women farmers generally receive extension support on a par with men farmers, are equally likely to own livestock, and are well represented in the best practice initiatives mentioned earlier. Thus rather than offering suggestions as to how special care must be taken to ensure women benefit from an attempt to scale up CSA, what is being suggested, is the proposal for the ongoing vigilance, for which simple indicators and data collection exercises are identified.

Conclusions

The development of practical guidelines for CSA practices for South Africa presented in Volume 2 of the CSA guideline report has paved the way for the rollout of CSA in the country. However, a successful rollout will be dependent upon a conducive enabling policy environment.

The government needs to finalize its CSA policy that should include, among other things, provision for cross-sectoral coordination of CSA initiatives, an effective CSA promotion and mainstreaming strategy, a coherent CSA mechanization policy, and availability of enabling resources such as: (i) CSA funding sources, (ii) climate information services, (iii) appropriate agricultural insurance, and (iv) agricultural marketing infrastructure. Additionally, the policy should promote the elimination of perverse incentives that hinder CSA implementation. Given the extent and growing importance of urban agriculture in the country, its formal recognition is necessary as well as a policy to guide its support and development in a climate smart way.

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Acronyms

AATF	African Agricultural Technology Foundation
ACDI	African Climate & Development Institute
ACRE	Agriculture and Climate Risk Enterprise
AFIS	Advanced Fires Information System
AFOLU	Agriculture, Forestry and Other Land Use
AGRA	Alliance for a Green Revolution in Africa
ARC	Agricultural Research Council
ARC-GCI	Agricultural Research Council-Grain Crop Institute
ARC-ISCW	Agricultural Research Council-Institute of Soil, Climate & Water
ARC-PPRI	Agricultural Research Council-Plant Protection Research Institute
ARC-SGI	Agricultural Research Council-Small Grains Institute
ARMT	Agricultural Risk Management Team (World Bank)
BMPs	Better management practices
BONSUCRO	Better Sugar Cane Initiative
CA	Conservation Agriculture
CA-FIP	Conservation Agriculture-Farmer Innovation Programme
CARWG	Conservation Agriculture Regional Working Group
CCAFS CGIAR	Research Program on Climate Change, Agriculture and Food Security
CEEPA	Centre for Environmental Economics & Policy in Africa
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
CIMMYT	International Wheat & Maize Improvement Centre
CIS	Climate information services
CPSI	Centre for Public Service Innovation
CS	Climate Smart
CSA	Climate Smart Agriculture
CSAG	Climate Systems Analysis Group
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture Forestry and Fisheries
DEA	Department of Environmental Affairs
DRDLR	Department of Rural Development and Land Reform
EWS	Early Warning System
ERWH	Ex-field rainwater harvesting
FAO	Food and Agriculture Organization

Fertasa	Fertilizer Association of Southern Africa
FIP	Farmer Innovation Platform
FSA	Farm Sustainability Assessment
FPSU	Farmer Production Support Unit
GAP	Good Agricultural Practice
GDP	Gross Domestic Product
GEF	Global Environment Facility
GFCS	Global Framework for Climate Services
GHG	Green House Gas
GrainSA	Grain South Africa
IBRD	International Bank for Reconstruction and Development
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
ICT	Information Communication Technology
IPCC	Intergovernmental Panel for Climate Change
KSA	Key Strategic Area
KZN	KwaZulu-Natal
LDC	Less Developed Countries
LTAS	Long Term Adaptation Scenario
MFP	Mahlatini Development Foundation
NAMC	National Agricultural Marketing Council
NCATF	National Conservation Agriculture Task Force-Malawi
NCCRP	National Climate Change Response Policy
NDP	National Development Plan
NEMA	National Environmental Management Act
NGO	Non-Governmental Organization
PICSA	Participatory Integrated Climate Services for Agriculture
PRA	Participatory Rural Appraisal
RAM	Resource Allocation Map
R&D	Research and Development
SA	South Africa
SADC	Southern Africa Development Community
SADLF	Southern Africa Drought & Low Soil Fertility Project
SAG	SWITCH Africa Green

SAIA	South African Insurance Association
SAQ	Self-Assessment Questionnaire
SAWS	South African Weather Services
SSA	Sub-Saharan Africa
STATS SA	Statistics South Africa
SUSFARMS®	Sustainable Sugarcane Farms Management System
SUSTAINET	Sustainable Agriculture Initiative
UCT	University of Cape Town
UNFCCC	United Nations Framework Convention for Climate Change
US	United States
USA	United States of America
USAID	United States Agency for International Development
VCF	Value Chain Financing
WEMA	Water Efficient Maize
WAMIS	Wide Area Monitoring Information System
WC	Western Cape
WCDoA	Western Cape Department of Agriculture
WC DEA& DP	Western Cape Department of Environmental Affairs & Development Planning
WFP	World Food Programme
WII	Weather Index-Based Insurance
WMO	World Meteorological Organization
WPS	Wind-Powered Systems
WRC	Water Research Commission
WRMF	Weather Risk Management Facility
WWF	World Wide Fund for Nature
WWF SA	World Wide Fund for Nature South Africa

Definitions

Basis insurance risk	Basis risk in index insurance arises when the index measurements do not match an individual insured's actual losses. There are two major sources of basis risk in index insurance. One source of basis risk
Biosecurity	Procedures or measures designed to protect the population against harmful biological or biochemical
Orthophoto	An orthophoto is an aerial photograph that has been geometrically corrected or 'ortho-rectified' such that the scale of the photograph is uniform and utilised in the same manner as a map. An ortho-photograph can be used to measure true distances of features within the photograph.
Subsistence farming	The farmer only grows or produces enough to feed his or her family, often suffer food deficits.
Weather-index insurance:	A class of insurance products that can allow weather-related risk to be insured in developing countries where traditional agricultural insurance may not always be feasible, thereby helping to increase farmers' ability (and willingness) to invest in measures that might increase their productivity.

Introduction

Agriculture is a crucial sector and an important engine of growth for the South African economy because of its backward and forward linkages to other sectors of the economy (DAFF, 2016a). It is for this reason that it has been identified as one of the key sectors that will contribute towards the greening of the South African economy (CSIR, 2014). Crop production and rangeland management in particular, have the greatest potential to contribute towards a green economy for South Africa, although, the realization of this potential is threatened by changing climatic conditions caused by the global climate change. The climate change is believed to be anthropogenically forced through increases in atmospheric greenhouse gas (GHGs) concentrations which are believed to be largely responsible for global warming. Agriculture contributes about 14% to GHG emissions (DEA, 2013) and is thus one of the culprits of climate change.

Climate change projections for South Africa indicate increased temperatures across the country, an increase in precipitation in some parts of the country and a decline in precipitation in other parts; as well as increases in the magnitude and frequency of extreme events such as floods and droughts (Lumsden *et al*., 2009, Kohler, 2016, Bell *et al*. 2018). The projected temperature and rainfall changes are expected to adversely affect a wide range of agricultural activities over the next few decades. Major impacts will include reduction in the amount of land suitable for both arable and pastoral agriculture, the reduction in the length of the growing season and a decrease in yields.

Since agriculture is both a culprit and victim of climate change, interventions aimed at greening the economy must address both aspects. Climate Smart Agriculture (CSA) is now widely promoted as the best approach for addressing both the causes and effects of climate change. While there is a considerable body of knowledge on CSA in South Africa (Mnkeni and Mutengwa, 2014), there is a lack of practical guidelines for its implementation. The SWITCH Africa Green (SAG) programme in its efforts to support South Africa's efforts to move towards an inclusive green economy supported the development of detailed guidelines that will contribute to the implementation of CSA in South Africa. A detailed background to the guidelines in the form of a literature review is given in Volume 1 of this report (Mnkeni *et al.* 2019a).

Volume 2 of this Guideline report (Mnkeni *et al.* 2019b) described actionable guidelines for CSA practices whose implementation would contribute to the rolling out of CSA in South Africa. The CSA practices included soil and water management, crop production (cereal production, sugar production, fruit and viticulture production), urban agriculture, rangeland management, and agro-processing. However, the successful implementation of these practices is dependent on a conducive enabling environment. Enabling environments for CSA are the framework conditions that facilitate and support the adoption of climate-smart technologies and practices. They are inclusive of agriculture marketing, climate information services, indexed-based insurance, CSA knowledge dissemination, gender and social inclusion. The actionable guidelines for these enabling environments described in this report are specifically targeting policy makers responsible for formulating policies that will create a conducive and supportive environment for the speedy implementation of CSA in South Africa. A policy brief, highlighting specific action areas for policy makers has also been compiled (Mnkeni, 2019).

2. Actionable Guidelines to Climate Smart Agriculture (CSA) marketing

2.1 Introduction

A possible avenue to alleviate the CSA marketing constraints is the planned introduction of Agri-Parks which comprises of a Rural Urban Marketing Centre (RUMC) and a Farmer Production Support Unit (FPSU) in District Municipalities. These units will act as centres of marketing services from controlling input supply, logistic support, grading and packaging as well as auctions amongst others.

The RUMC and FPSUs can act as CSA information conduits since they are (i) established in each district within the country thus making access to farmers and markets easier, and (ii) are involved in marketing functions, and thus can positively contribute towards CSA marketing.

However, the initiative still lacks a clear framework as to how CSA initiatives can be incorporated in the whole marketing system relative to the productive sub-system. These initiatives include the possibility for group marketing which will improve market access, economies of scale, agri-business contracts and access to agricultural technologies, and thus adoption of CSA.

The framework for the RUMCs and FPSU will provide a basis upon which actionable guidelines for CSA will be interrogated for dualistic objectives of smooth functioning of the support units as well as incorporation of CSA marketing.

The actionable guidelines that are going to be described pertain to capacitating marketing extension, financing as well as research and development; marketing infrastructure and institutional support. In terms of integrating CSA marketing with the Agri-Parks model, the overall guidelines in Table 2.1, may be incorporated.

2.2 Practical Implementation of climate smart agriculture (CSA) marketing

Successful CSA implementation requires changes in behaviour and strategies, as well as changes in the usual timing of agricultural practices. Some of the guidelines in improving climate smart agricultural marketing include:

2.2.1 Extension, finance as well as research and development

A) Extension

Some of the extension activities that can be undertaken in incorporating Climate Smart (CS) marketing with references to Agri-parks are those shown in Figure 2.1 (Mwongera *et al.*, 2017).

Table 2.1: Guiding principles for Climate Smart (CS) marketing

Agri-park sub unit	Activities	CSA marketing extension guidelines	Climate Smart Agriculture Finance	Climate Smart Agriculture Marketing Research and Development	Infrastructure and Institutional Support
Farmer Production Support Unit	Input supply control (quality, quantity and timeous deployment)	Promote use of CS inputs at each level in the marketing chain.	Provide credit options for CS inputs (e.g. materials credit instead of monetary) at each stage in the marketing chain Promote Public-Private-Partnerships to obtain cheap financing.	Promote research into use of CS inputs.	Promote group marketing in CS input access
	Logistics	Provide information and promote CS logistics (environmentally friendly).	Provide rebates for use of CS logistics.	Promote use of CS transport e.g. energy efficient, electric and solar cars.	Promote feeder road infrastructure development and construction in accessing remote farmers. Promote group marketing for efficient produce collection.
	Primary produce collection, sorting, packaging and processing	Provide information on CS collection, sorting, packaging and processing of agricultural produce.	Provide financial incentives on CS labelled products.	Promote new methods and techniques in collection, sorting, packaging and processing which are CS.	Promote group marketing in collection, sorting, packaging and processing.
	Market Information on commodity prices	Promote use of ICT in marketing information dissemination. Identify localised market information needs for CS produce through PRA.	Promote financing of CSA marketing information systems.	Develop ICT targeting CSA produce markets. Identify localised market information needs for CSA produce through PRA.	Promote group marketing for effective CSA markets. Identify homogenous commodity groups producing CSA produce. Identify CSA information needs for each homogenous farmer group.
Agri-hubs	Storage/warehousing facilities; cold storage, dehydrators, silos	Promote the use of clean energy in maintaining warehouse and cold storage facilities. Promote use of CS storage methods that reduce wastage and spoilage (e.g. drying, salting).	Provide financial incentives for use of CS initiatives such as clean energy and water recycling in storage warehouses and cold storages. Provide rebates in use of CS storage methods that reduce wastage and spoilage (e.g. drying, salting).	Promote use of clean energy in storage/warehouse facilities; cold storage. Develop new CS storage methods to reduce wastage and spoilage (e.g. drying, salting).	Construct climate-smart facilities utilising clean energy. Promote group storage.
	Packaging facilities for national and international markets	Provide information on niche markets (national and international) requiring organic and CSA products.	Provide incentive for use of CS initiatives in packaging of CSA produce.	Promote use of clean energy packaging for CSA produce. Promote use of bio-degradable packaging materials for CS produce.	Promote group marketing and labelling of CSA produce.
	Logistic hubs for collection of goods	Provide information and promote CS logistics (environmentally friendly).	Provide rebates for use of CS logistics.	Promote use of CS transport e.g. energy efficient, electric and solar cars.	Promote feeder road infrastructure development and construction in accessing remote farmers. Promote group marketing for efficient produce collection.
	ICT facilities for business, marketing and banking facilities	Provide CSA ICT based information.	Use ICT to communicate CSA finance options available to the marketing chain.	Develop mobile ICT that can be used by marketing chain players that are linked to business, marketing and business facilities.	Provide mobile ICT infrastructure for wider coverage of chain players that are linked to business, marketing and business facilities.
Rural Urban Marketing Center	Market intelligence	Provide CSA marketing information (e.g. prices, qualities, quantities, rebates).	Promote financing of CS market intelligence (i.e. CSA market research arbitrage, speciality markets).	Develop ICT providing updated CSA information on prices, promotions, qualities, quantities, consumer preferences, seasonality.	Utilise farmer groups to provide CSA produce marketing information concerning prices, qualities, quantities, promotions.
	Farmer and processor assistance in managing contracts	Provide information on CS based contracts.	Provide climate-based financing and contracts instead of output based.	Identify and develop new contracting methods that are CS conscious and adaptable at the farmer and processor level.	Provide infrastructure for location of contract providers close to farmers and processors for visibility and constant feedback.
	Warehousing and cold storage facilities	Promote the use of clean energy in maintaining warehouse and cold storage facilities. Promote use of CS storage methods that reduce wastage and spoilage (e.g. drying, salting).	Provide financial incentives for use of CS initiatives such as clean energy and water recycling in storage warehouses and cold storages. Provide rebates in use of CS storage methods that reduce wastage and spoilage (e.g. drying, salting).	Promote use of clean energy in storage/warehouse facilities; cold storage. Develop new CS storage methods to reduce wastage and spoilage (e.g. drying, salting).	Construct climate-smart facilities utilising clean energy. Promote group storage.
	Logistic in collecting produce	Provide information and promote CS logistics (environmentally friendly).	Provide rebates for use of CS logistics.	Promote use of CS transport e.g. energy efficient, electric and solar cars.	Promote feeder road infrastructure development and construction in accessing remote farmers. Promote group marketing for efficient produce collection.
	Sharing of Agri-Parks	Initiate CSA information triangulation from different Agri-Parks (prevent autarky).	Diversify CSA financing to include other aspects relating to marketing (not only concentrate on production).	Identify and promote CS central markets that are cost effective for each CSA product.	Promote feeder road infrastructure development and construction in linking Agri-Parks and rural urban marketing centers.

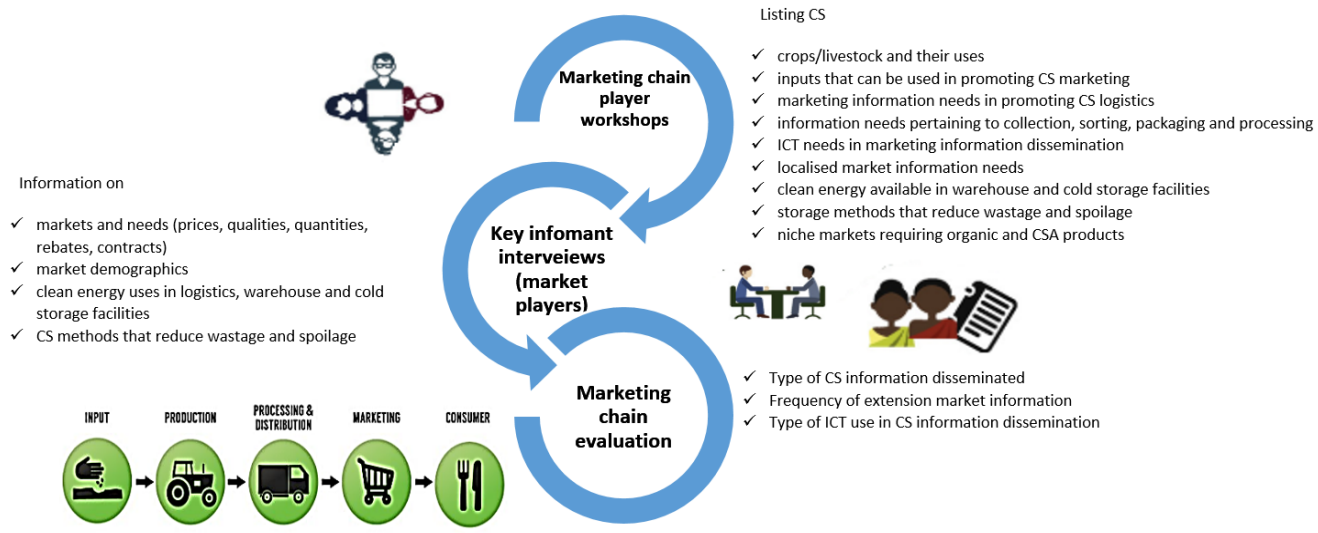

Figure 2.1: Extension activities that can be undertaken in incorporating CS marketing in Agri-Parks

B) Climate smart agriculture marketing finance

Financing activities that can be undertaken in incorporating CS financing with references to Agri-parks are those shown in Figure 2.2 (Mwongera *et al*., 2017).

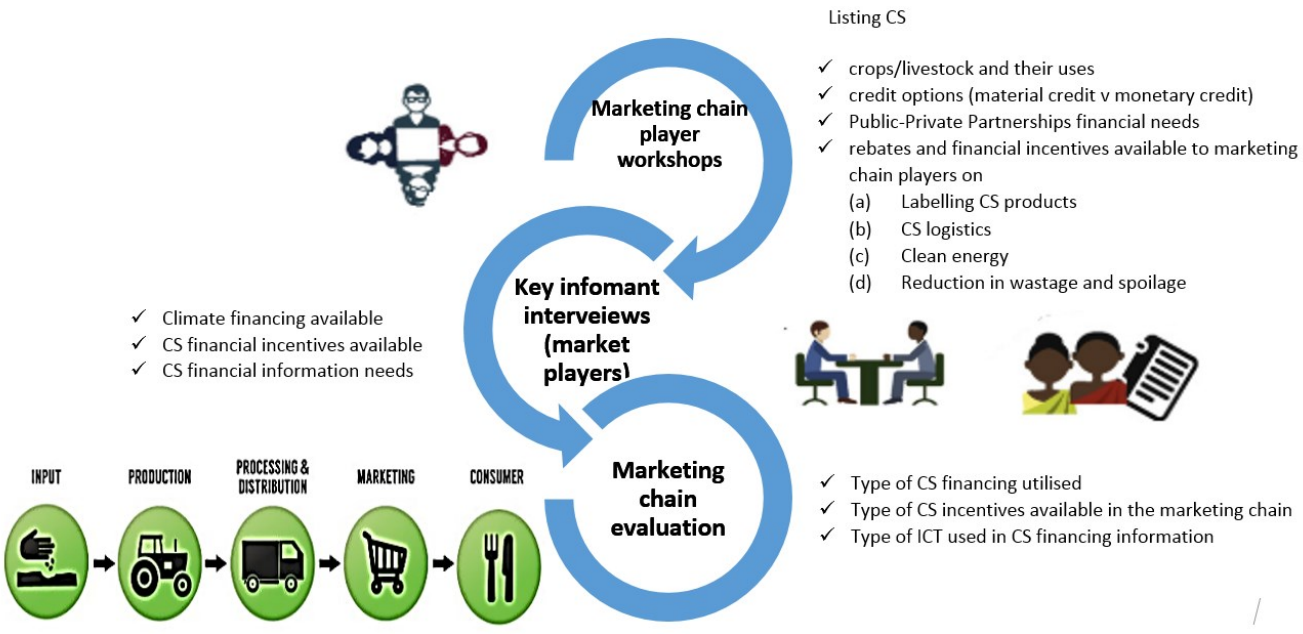

Figure 2.2: Financing activities that can be undertaken in incorporating CS marketing in Agri-Parks initiative in South Africa

2.2.2 Infrastructure and Institutional support

Infrastructural and institutional activities that can be undertaken in incorporating CS infrastructure and institutional support with references to Agri-parks are those shown in Figure 2.2 (Mwongera *et al.,* 2017).

A) Climate smart agriculture marketing research and development (R&D)

Marketing R&D activities that can be undertaken in incorporating CS marketing R&D with references to Agri-Parks are those shown in Figure 2.4 (Mwongera *et al.,* 2017)

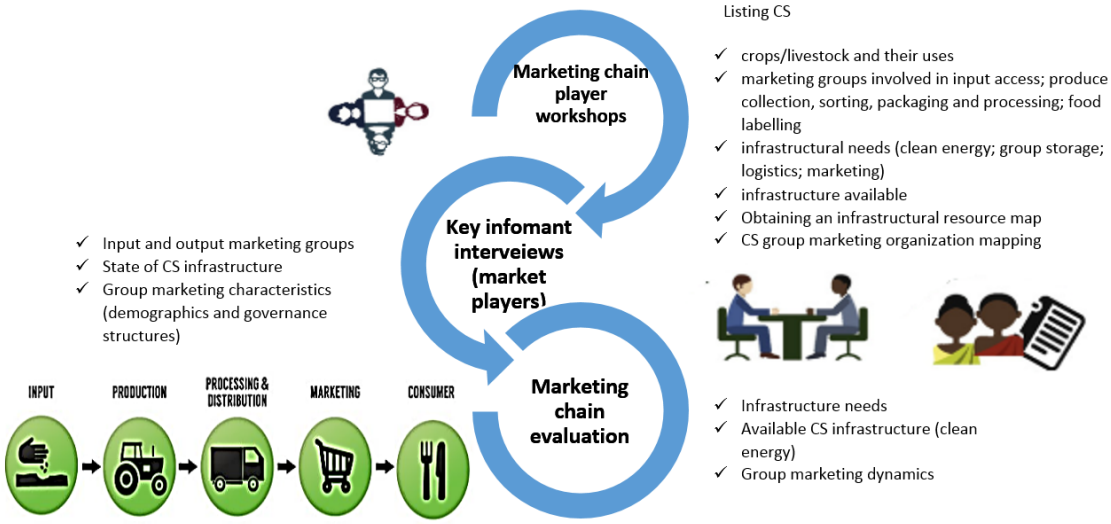

Figure 2.3: Infrastructure and institutional support that can be undertaken in incorporating CS marketing in Agri-Parks

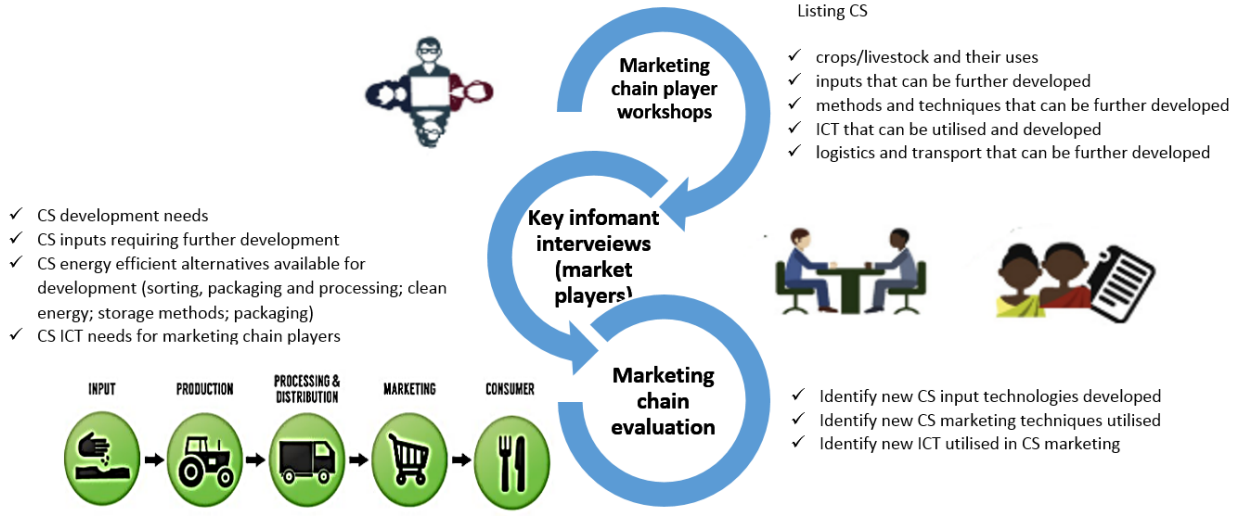

Figure 2.4: Marketing research and development activities that can be undertaken in incorporating CS marketing in Agri-parks

2.3 Key steps in Climate Smart Agriculture marketing

2.3.1 Selection of products for value chain development

This involves selecting promising targets by identifying areas of opportunity that exists for large number of poor people to effectively compete in growing the marketing chain as indicated in Table 2.2.

Table 2.2: Steps in incorporating marketing in climate smart agriculture

Stage	Step	Action	How
Selection of CSA marketing chain	Step 1	Generate a long list of marketing chains for CSA consideration using participatory appraisal (prepare a menu of products and services that South African communities can offer to the market).	Understand the options on which livelihoods of South African communities depend. Prepare a resource map (what are the major sources of livelihoods?). List the relative advantages of CSA products and services (preference ranking) List their unique characteristics. Evaluate the scope to satisfy customers (what volume of CSA products, quality, and specifications are required by the buyers?).
	Step 2	Identify, with justification, the most promising CSA marketing chains. From the list, select the marketing chains for which there is most demand and that have potential to enhance income and build resilience.	Understand the CSA comparative and competitive advantages; market requirements; extent to which each CSA marketing chain offers scope for building resilience, improving livelihoods, and reducing risks; and whether the marketing chain is climate resilient.
Analysis of CSA marketing chain	Step 3	Map the big picture: actors involved in the CSA marketing chain, the links between them, demand and supply data, and other pertinent context information.	Develop a CSA marketing chain map depicting functions, actors, and flow of products. Map CSA support service providers as well as other supporting agencies and development partners, and their roles.
	Step 4	Carry out a detailed diagnosis of specific dimensions of the CSA marketing chain.	Understand CSA value addition at each point in the chain, how income is distributed (how expenditure flows through the chain and income can be increased at points in the chain closer to production), the relationship among actors, governance structure, and so on.
	Step 5	Identify where in the CSA marketing chain to seek change based on strengths, weaknesses, opportunities, and threats.	Identify potential leverage points, drawing on the results of steps 1 to 4, as a basis for steps 6 to 8, focus on priority areas.
Identifying leverage points for intervention in CSA marketing	Step 6	Generate a long list of interventions to address the causes of constraints and to harness opportunities.	Think laterally and rationally in generating the range of possible intervention.
	Step 7	Prioritize interventions on the basis of their impact and feasibility.	Generate an intervention shortlist (identify solutions to address critical bottlenecks hindering growth, actors to implement interventions, and anticipate changes in the CSA chain to achieve impact).
Drawing up strategy and plans and facilitating implementation of interventions	Step 8	Draw up a strategy and plans.	Set operational and upgrading objectives, and package of selected interventions for implementation.
	Step 9	Facilitate the effective implementation of CSA marketing chain upgrading strategy (clarifying roles, design a process, and set entry and exit points).	Facilitates the application of a climate adaptive process from production to packaging. Strengthen vertical and horizontal linkages. Foster public-private partnerships. Improve access to information, finance and other support services. Assessing needs and the responsiveness of public service providers. Build capacity of CSA marketing chain actors/supporters and enablers. Facilitate development of CSA standards and quality assurance. Foster a coherent CSA marketing chain promotion policy.
Monitoring and evaluation and scaling up	Step 10	Formulate the impact hypothesis (theory of change), manage results, and develop a scaling up strategy.	Ensure that the project is moving in the right direction, and results (good practices) are replicated and/or continued by local stakeholders on their own.

2.4 Conclusion

Climate change tends to have differing effects along the marketing chain. Some of the constraints to CS marketing chains in South Africa pertain to limited, fragmented and inaccessible CSA financing; incapacitated institutions (extension and group marketing); as well as inadequate/dilapidated marketing infrastructure. The Agri-Park initiative has been identified as an avenue through which CSA can be incorporated in marketing chains in South Africa. This initiative provided a basis upon which CSA actionable guidelines were formulated.

The actionable guidelines should focus on identifying CS information needs for the marketing chain as well as its dissemination. Furthermore, the actionable guidelines should also concentrate on climate finance by looking at type of financing that is utilised, the CS incentives that are available in the marketing chain, as well as use of ICT in CS financing information dissemination. Guidelines should also embark on identifying the CS infrastructural needs of the marketing chain, as well as group marketing. In terms of marketing research and development, guidelines should identify new CS input and ICT technologies that have been developed and new marketing techniques utilised.

Some of the more specific guidelines in CS marketing pertain to generating a list of marketing chains for CSA consideration; identifying and justifying the most promising CSA marketing chain; mapping the actors involved in the CSA marketing chain; carrying out specific diagnosis of specific dimensions of the CSA marketing chain; identifying through a SWOT where in the marketing chain CSA change might be effected; generate a list of interventions; prioritize interventions; and finally drawing up strategies and plans.

3. Climate Information Services

3.1 Introduction

It is important improve farmers' capacity to manage risk by providing them with climate information services (CISs). It is important for us to first define weather/climate "information", "advisories", and "services". Information in meteorology/climatology is passive in the sense that there is no indication coming with that information on how to use it. "Raw" weather forecasts and climate predictions are good examples (Stigter *et al.*, 2013).

Information with recommendations on how to use it, or information otherwise made more client-friendly for solving specific problems, may be called advisories (Stigter *et al*., 2013). Climate services refers to the provision of relevant weather and climate information, and a range of advisory services to enable decision-makers to understand and act on the information – within a suitable enabling institutional environment (Tall *et al*., 2014). It includes the whole process of obtaining climate data, storing it, and processing it into specific products that are required by different users in climate-sensitive sectors such as agriculture, disaster-risk reduction and health, among others (Mwenye, 2017). A climate service therefore needs to be responsive to end-user needs.

South Africa generates substantial amounts of climatic information (Ziervogel *et al.* 2010; Zuma-Netshiukhwi *et al*., 2013 and Stigter *et al*., 2013). However, the information is most useful when CISs are an outcome of the interaction between providers and users of the information. These stakeholders include scientists, forecasters, intermediaries, farmers, extension workers, and other affected stakeholders. Similarly, dissemination of the information will be more effective if done in a participatory manner. Experiences from various developing countries illustrate successful examples of dissemination of CISs through participatory processes and communication methods (Sumani, *et al.,* 2016). Provision of CIS in South Africa can be improved by utilisation of such participatory approaches. This chapter describes practical guidelines that could be adopted to improve participatory CIS dissemination and utilisation.

The University of Reading in the United Kingdom (UK) developed the Participatory Integrated Climate Services for Agriculture (PICSA). The Consultative Group on International Agricultural Research (CGIAR) Research Programme on Climate Change, Agriculture and Food Security (CCAFS) supported this university to develop PICSA (Clarkson *et al*., 2017). The PICSA approach uses historical climate records, participatory decision-making tools and seasonal climate forecasts to help farmers identify and better plan livelihood options suited to their own circumstances and climate conditions (Dayamba *et al*., 2018).

The PICSA method can be used by facilitators, such as NGO and extension field staff who have received training in the use of the tool. Guidelines for working though the PICSA approach with farmer groups will be described in this section. PICSA has three key components, namely:

⇒ Providing and considering climate and weather information with farmers, including historical records and forecasts;

⇒ The joint analysis of information on crop, livelihood and livestock options and their risks, by field staff and farmers;

⇒ A set of participatory tools to enable farmers to use this information in planning and decision making for their circumstances.

The PICSA approach is becoming very popular in many countries. It was recently delivered to thousands of farmers in Rwanda, Malawi and Tanzania (Steinmuller and Cramer, 2017). In Senegal and Mali, respectively, 97% and 76% of farmers who used this approach found it to be very useful. The approach enabled farmers to make strategic plans long before the season, based on their improved knowledge of local climate features.

Evidence demonstrated the PICSA approach caused farmers to implement a range of innovations that included: (i) changes in timing of activities such as sowing dates, (ii) implementing soil and water management practices, (iii) selection of crop varieties, (iv) fertiliser management and (v) adaptation of plans for the season based on the actual resources available to them (Dayamba *et al*., 2018). The PICSA approach was also found to facilitate farmer-to-farmer extension (Clarkson *et al.,* 2017; Dayamba *et al*., 2018), which is important in scaling up CIS in the context of limited availability of extension services in South Africa.

3.2 Implementation of the PICSA method

The PICSA approach is divided into twelve steps to be carried out with groups of farmers, as detailed in the Field Manual by Dorward *et al*., (2015). Each step builds on what was covered in previous steps. The initial steps focus on how climate and weather influence activities that farmers are currently doing. The following steps then enable the facilitator to help farmers to use a range of sources of climate, weather, crop, livestock and livelihood information for their planning and decision making.

The 12 steps of the process are as follows:

⇒ **Step A:** Understanding main activities of the farmer
⇒ **Step B:** Historical climate records and farmers' perceptions on climate change
⇒ **Step C:** Using graphs to calculate probabilities to determine the opportunities and risks
⇒ **Step D:** Considering options available to the farmer
⇒ **Step E:** Options by context.
⇒ **Step F:** Comparison of different options and planning.
⇒ **Step G:** The farmer decides.
⇒ **Step H:** Seasonal forecast.
⇒ **Step I:** Identification and selection of possible responses to the forecast.
⇒ **Step J:** Short-term forecasts and warnings.
⇒ **Step K:** Identification of potential responses to short-term forecasts and warnings.
⇒ **Step L:** Learning from experience and improvement of the process.

Each step has a set of activities that the facilitator has to implement with a group of farmers through a series of meetings. A timetable for the meetings has to be planned, taking into consideration the time of year each step needs to take place. Ideally, steps A to G need to happen at least 8 to 12 weeks before the rainy season starts. Steps H and I need to be implemented when the seasonal forecast is available. Steps J and K should take place just before and during the growing season, and Step L at the end of the season. More than one step can also be done during some of the meetings. The following section will provide details of specific activities that have to be accomplished at each step. As one completes these activities, they will have to refer to illustrations and activity sheets provided by Dorward et al., (2015).

3.2.1 Step A – Understanding main activities of the farmer

The idea is to clearly understand the main activities that the farmers currently undertake, their timing and how climate and weather affects those activities. This will be the starting point from which the farmers can use climate and other information to make decisions.

The aims at this step are :

⇒ To better understand what livelihood activities a household undertakes, what resources it has, how they use them and what they produce.
⇒ To understand what main activities a farmer has for different crops and/or livestock, the timing of these activities, and how they are affected by weather and climate.
⇒ To create a starting point from which to explore ways of using climate and other information, and
⇒ To enable the facilitator to better understand the differences between farmers in the group regarding their activities and access to resources.

During this step, farmers should do the following:

⇒ Construct a Resource Allocation Map (RAM).
⇒ Construct a Seasonal Calendar.

3.2.2 Step B – Historical climate records and farmers' perceptions on climate change

Farmers should have an understanding of how the climate is changing and how it varies from year to year. This will be achieved by completing activities B1 and B2 of the Field Manual (Dorward *et al.,* 2015).

The aims of this step are to:

⇒ provide farmers with historical climate information so that

they can have an appreciation of what has been happening to climate over the years.

⇒ analyse the historical climate information and compare it with the farmers' perceptions of change.

⇒ if there are differences between the historical climate graphs and farmers' perceptions - to:

a) explore with farmers the possible reasons for these differences, and

b) discuss whether this means that there are useful changes that can be made to crop, livestock or lively hood activities to address other drivers of change e.g. reduced soil fertility.

⇒ decide with the farmers which characteristics of the climate they should focus on when planning their crops, livestock and livelihood activities.

During this step, the facilitator should assist farmers to:

⇒ understand where historical climate information comes from.

⇒ understand and interpret climate graphs showing annual rainfall totals, start and end of season, season length, dry spells and temperature; and what the implications are for crop, livestock and livelihood activities.

⇒ understand how climate graphs can be useful for planning for the season ahead.

3.2.3 Step C –Using graphs to calculate probabilities to determine the opportunities and risks

The aim of this step is to enable farmers to use graphs with the help of extension officers to work out simple probabilities that are of interest to them and will help them to plan for the coming and future seasons.

The facilitator should therefore assist farmers to:

⇒ Calculate the probabilities of: i) receiving a given amount of rainfall; ii) different start dates for the season; and iii) a season being of a specified length

This will be achieved by completing activity sheet C1 of the Field Manual.

3.2.4 Step D - Considering options available to the farmer

Farmers must be aware of the crop, livestock and livelihood options that are open to them. What individual farmers think is best for their household may vary widely. Individual attitudes to risk and the resources of each household are both likely to influence farmers' choices. It is therefore useful to consider a wide range of options to ensure that all of the farmers, whether they are wealthy, poor, male, female etc., are able to identify options that may be suitable for their circumstances. This will be achieved by completing activity sheets D1 to D3 of the Field Manual (Dorward *et al.,* 2015).

3.2.5 Step E – Options by context

The aim of this step is to acknowledge and/or discuss the concept of 'options by context' with farmers. During this step, the facilitator should complete activity E1 of the Field Manual thereby assisting farmers to:

⇒ understand their options, based upon their individual circumstances.

⇒ choose which options to consider in more detail.

3.2.6 Step F – Comparison of different options and planning

By the end of this step, farmers should be ready to decide on the options that they intend to use in the forthcoming season. This requires a more detailed look at each of the options to help farmers explore which are best suited to their individual context. Participatory budgets will be used to compare the different options when making this decision, though the budgets are not necessarily suited to all options. This step will be accomplished by completing activity sheet F1 of the Field Manual.

3.2.7 Step G – The farmer decides

The aims of this step is to enable each individual farmer to identify the crop, livestock and/or livelihood options that they would like to implement in the coming season/near future. The facilitator should therefore assist farmers to:

⇒ use the products from steps A, D and F to make informed decisions about what they intend to do in the coming season/near future (see activity sheet G1).

⇒ re-visit their individual Resource Allocation Maps and Seasonal Calendars and update them with their plans. It may be easier to create new ones, which is fine too.

This step will be achieved by completing activity sheets G1 and G2 of the Field Manual.

3.2.8 Step H – The seasonal forecast

By the end of this step, farmers should understand the seasonal forecast for their locality for the next season and the implications of this for the plans that they have made. The aims of this step are to:

i) disseminate the seasonal forecast in a way that farmers understand.
ii) help farmers understand what the seasonal forecast means for their location and for them as individuals.

These aims will be accomplished by completing activity sheet H1of the Field Manual. Where it is feasible, Crop models such. Eco-Crop 2, DSSAT, APSIM and AquaCrop can also be integrated with the seasonal forecasts to generate and analyse various scenarios for crop production management practices. This can result in comprehensive advisories that can be considered by farmers.

3.2.9 Step I – Identification and selection of possible responses to the forecast

The aim of this step is to enable farmers to reconsider the plans that they have made within the context of the seasonal forecast and make suitable adjustments. The facilitator should therefore assist farmers to discuss and consider the implications of the Seasonal Forecast and adjust any of their plans for the season if they wish to. Activity sheet I1 of the Field Manual will be used to complete this step.

3.2.10 Step J – Short-term forecasts and warnings

In this step, farmers should understand what short-term forecasts and warnings are, how they can be received, and how they can be useful. Farmers should therefore be assisted to consider different types of short-term forecasts and warnings that they may receive and how they can be used. The facilitator must complete activity sheet J1 with farmers.

3.2.11 Step K –Identification of potential responses to short-term forecasts and warnings

This step will assist farmers to identify how they might usefully employ short-term forecasts and warnings at the start of and during the season. By considering different example forecasts in this exercise, farmers will be better prepared to deal with real forecasts and warnings when they receive them. This will be achieved by completing activity sheet K1 of the Field Manual.

3.2.12 Step L – Learning from experience and improvement of the process

At the end of the season, the facilitator must review the PICSA process with farmers so as to identify lessons for the future. This can be in a group meeting where the following questions must be discussed with farmers:

⇒ In what ways (if any) did farmers find the training and use of PICSA useful?

⇒ Which parts of the process were the most helpful and why?

⇒ In what ways could the PICSA approach be improved?

As noted in the introduction, numerous farmers have used the PICSA approach and they have largely had very positive experiences in using it.

3.3 Other details important for successful implementation

The steps described in this section were derived from the Field Manual by Dorward *et al.*, (2015). It will be very important to use the activity sheets for each step, to simplify the process.

3.4 Monitoring performance of the intervention in terms of the CSA pillars

Examples of general farm and administrative level indicators that could be used are shown in Table 3.1.

Table 3.1: CSA farm level technical indicators

Theme/Pillar	Sub-theme	Farm level Indicators
Productivity	Crop system	Increase in crop yields (ton/ha), resulting from using advisories
	Water use	• Optimum rain water use by choosing appropriate varieties, e.g. long season or short season variety when a very wet or dry season is forecasted, respectively; • Use or no use of supplementary irrigation based on forecasts.
Resilience	Robustness	• By using CIS, increases in stability of production, promotes income • Diversification incorporate site-specific knowledge; • Improved economic resilience through improved profitability of farming enterprise.
	Cropping system	• Increases resilience to drought, such as through using drought tolerant varieties, etc.
	Livestock system	• Increases resilience to drought such as through supplementary feeding when a drought forecasted.
Mitigation	Emissions intensity	• Reduces GHG emissions from for example, avoiding over-application of fertilisers when a dry season is forecasted.

Source: Adapted from The World Bank Group (2016)

3.5 Case studies

Two cases studies are presented below to illustrate initiatives that have been taken to generate CISs in South Africa (Box 3.1) and India (Box 3.2). It is notable that such initiatives started quite early on in India (1976) and that the government eventually intervened resulting in the offering of a very comprehensive service to farmers. On the contrary, there has not been widespread location specific provision of CISs in South Africa. There are therefore numerous lessons that can be learnt from the Indian case study.

Box 3. 1: Case study 3. 1: South Africa, South-Western Free State (derived from Zuma-Netshiukhwi et al., 2013 and Stigter et al., 2013)

Since 2008, research was done on the use of operational weather and climate information in farmer decision making by subsistence as well as commercial farmers in Modder/Riet catchment or the south-western part of the Free State province, South Africa (Zuma-Netshiukhwi *et al*., 2013). Most subsistence farmers were originally not familiar with agrometeorological products and relied on experience and traditional knowledge for decision-making. Farmers' indicators and traditional knowledge ranged from the arrangement of stars, animal behaviour, cloud cover and type, blossoming of certain indigenous trees, appearance and disappearance of reptiles, to migration of bird species amongst others.

On the contrary, commercial farmers performed better compared to the resource poor farmers in terms of livelihoods outcomes because most of them used agrometeorological advisories. Agrometeorological extension efforts were then focused on resource poor farmers who needed extension the most (Stigter *et al*., 2013). Study groups were therefore established in six towns in the smallholder farming area to facilitate use of CIS.

Extension intermediaries participated in disseminating advisories. Analysed long-term rainfall data assisted the farmers to select suitable crops for the area for diversification and sequential planting and determining the suitable planting dates and planting densities. Crop models were used to generate and evaluate a series of management practice scenarios.

These outputs from the analysed climate data and crop models were used to develop advisories that were tailor-made for the farmers. The study, for example, identified potential production areas for vegetables, herbs/spices, food grains, oil seeds, fruits, and other products such as cotton and other fibers. Application of crop models such as Ehler's model and Eco-Crop 2 revealed the thermal and water requirements of these crops which were either fully or partially met in various parts of the catchment.

Participation of farmers in a series of monthly innovative workshops created a conducive environment for knowledge exchange and training. The manner in which this study was structured enhanced a bottom-up approach since it allowed participative approaches in close contact with the study groups, improving farming development by closing the gaps existing between developers, suppliers and users of agrometeorological knowledge and understanding.

The best outcome of this study was that farmers learnt new things and shared their information and experience. It was further suggested that some short-term traditional forecasts/predictions may be successfully merged with science-based climate predictions.

Box 3. 2: Case study 3.2: India's Integrated Agrometeorological Advisory Service (derived from Tall *et al.,* 2014)

Agrometeorological advisories were first initiated in 1976 to provide state level forecast-based advisories to farmers based on short-range weather forecasts issued by the India Meteorological Department (IMD). Since these advisories were made available to farmers one day in advance they were inadequate for planning weather-based agricultural practices and/or undertaking precautionary measures, which required a much longer lead-time. The National Centre for Medium Range Weather Forecasting (NCMRWF) was subsequently established in 1988 by the Government of India as a scientific intervention to develop operational Numerical Weather Prediction (NWP) models for forecasting weather in the medium range. To disseminate these forecasts and build forecast-based agricultural advisories, Agro Meteorological Field Units (AMFUs) were created across the country, in all 127 agro-climatic zones.

By 2006, 86 fully functioning AMFUs, primarily located in state agricultural universities (SAUs) and agricultural research stations, were receiving weather forecasts from the NCMRWF twice a week; each forecast was valid for four to five days. Based on these forecasts, and in consultation with a team of agricultural scientists, the AMFUs prepared agricultural advisory bulletins in both English and a local language, and they were disseminated through a variety of communication channels, including radio, television, newspapers, telephone, internet, posters and sometimes meetings.

In 2007, the Agrometeorological advisory service was combined with the IMD under the Ministry of Earth Sciences, and as a result the District-level Agrometeorological Advisory Service (DAAS) was launched in June 2008. DAAS aims to generate district-level agrometeorological advisories based on weather forecasts. By 2014, the IMD was issuing quantitative district level 5-day weather forecasts twice a week using a Multi-Model Ensemble technique based on forecast products from models available in India and other countries.

The AMFUs are assisted by an advisory board consisting of agricultural scientists representing a wide spectrum of agricultural disciplines in preparation of district-wide agro-advisories. These advisories contain location and crop-specific farm-level advisories as well as descriptions of prevailing weather, soil and crop conditions, and suggestions for taking appropriate measures to minimize losses and optimize inputs in the form of irrigation, fertilizer or pesticides.

A feedback mechanism was also developed to receive inputs from farmers on quality of forecasts, relevance of advisories, and effectiveness of dissemination channels. This allows continuous improvement on the delivery of CISs.

3.6 Conclusions

The need to provide location specific CISs cannot be over-emphasised. The twelve-step PICSA approach has been used successfully in countries such as Rwanda, Malawi and Tanzania. Facilitators are critical to enable farmers to successfully implement all the 12 steps of the PICSA method.

In India, the case study that was presented showed that the Indian government ensured that agrometeorological advisories could be generated at district level, with participation of multi-disciplinary agricultural scientists. In South Africa, different types of forecasts are generated by a multitude of institutions.

While there has been isolated attempts to generate location specific agrometeorological advisories, such efforts need to be intensified so as to reach the majority of smallholder farmers. The South African government must ensure that CISs are disseminated in multiple languages using numerous communication methods. Generation of these advisories needs involve farmers, multi-disciplinary scientists and other relevant stakeholders.

Farmer-to-farmer extension should be promoted for reaching the highest number of farmers in South Africa. It is also critical to include a feedback mechanism on the quality of the CISs and effectiveness of dissemination methods. This will allow continuous improvement on the delivery of the CISs.

4. Weather index-based insurance (WII)

4.1 Introduction

The ability of smallholder farmers to bounce back and make investments after experiencing a weather related shock will be improved by availability of appropriate agricultural insurance. Weather index-based insurance (WII) was reported to be an attractive approach for managing weather risk, especially for smallholder farmers (IFAD, 2011). Programmes conducted in several developing countries have verified the feasibility and affordability of WII products (SAIA, 2016).

Insurance products based on this approach link payment to regional agricultural outcomes rather than direct measurements of production losses on participants (Lybbert and Sumner, 2012). Because it is based on an indirect indicator or an alternative for loss, index-based insurance can offer promising solutions for smallholder agriculture. Agricultural index insurance can reduce poverty, enhance livelihoods of smallholder farmers and address climate change effects (Rispoli, 2017). WII also supports all the three pillars of CSA (Solana and Prashad, 2017), namely adaptation, mitigation and achievement of national development goals.

Insurance products currently available in South Africa are not suitable for smallholder farmers, due to high cost. WII is not yet available in South Africa. However, the South African Insurance Association (SAIA) has previously proposed models for launching WII, and they are currently doing further research on it. This section presents some guidelines for developing WII products.

It is hoped that the government and private insurance providers in South Africa will take advantage of public sector insurance initiatives to launch and finance WII. Such initiatives include:

The G7 Initiative on Climate Risk Insurance ("InsuResilience"); African Risk Capacity (ARC); Climate Risk and Early Warning Systems (CREW); and, the Global Index Insurance Facility (GIIF). These insurance initiatives were elaborated on in the Situation analysis report.

4.2 Practical guidelines for developing weather index-based insurance (WII)

Development and implementation of WII products in any country has three main phases. The first phase consists of conducting a pre-feasibility assessment, which seeks to establish whether conditions in the country are suitable enough for launching WII. Once the basic conditions are seen to be appropriate, a pilot study is initiated in the second phase.

The pilot study involves designing and testing WII products in selected but limited sites in order to determine their feasibility. In cases where the WII products are profitable and there is evidence of substantial demand, the third and final phase consists of scaling-up the WII products so that as many farmers as possible can benefit from this type of insurance. The following sections will provide detailed information on each of these phases. The information was largely derived from a technical guide by the International Fund for Agricultural Development (IFAD, 2011).

4.2.1 Performing the pre-feasibility assessment

Some basic prerequisites for successful implementation of WII have to exist in the country. The objective of performing a pre-feasibility assessment is to determine whether developing a WII pilot is appropriate. The key players who have to conduct this assessment consist of WII consultants and local stakeholders (relevant ministries, national weather service, insurance industry, etc.).

4.2.1.1 Stage 1: Preliminary assessment

The preliminary assessment analyses the general conditions of a country in relation to the potential feasibility of WII. Some basic questions will need to be answered comprehensively before moving on to stage 2 of the assessment.

There are six key areas of research to consider before moving on to the next stage:

⇒ **Country context.** Key questions that require convincing answers with respect to the country context include the following: What is the rural development context? What are the policy, governance, political and economic issues? One should perform financial-sector and agriculture-sector analyses to obtain some of these answers.

⇒ **Weather.** Review the existing natural hazard vulnerability profile. The most basic prerequisite for WII is the existence of a weather risk that affects crop yields in a targeted area.

⇒ **Insurance.** What types of insurance exist in the country? Micro-insurance? Crop insurance? Index insurance? Are there any other initiatives in index insurance or WII? If so, what are the key features of the programme and who are the key players? Are there any current issues that should be considered, such as the government regulatory framework?

⇒ **Intermediaries.** Who are the intermediaries? Consider existing delivery channels, microfinance institutions, input suppliers, etc.

⇒ **Potential clients** and **users**. Who would use the product?

4.2.1.2 Stage 2: In-field pre-feasibility assessment

The objective of the in-field pre-feasibility assessment is to understand whether WII would be appropriate in the country. An in-field pre-feasibility assessment involves discovering, verifying and understanding many different data points.

4.2.2 Existence of weather risk and potential demand for WII

The most basic prerequisite for WII is the existence of a weather risk that affects crop yields in a targeted area. The justification for launching WII must include a clear, verifiable need, as well as strong potential demand from the micro and/or meso level. A risk assessment of an enterprise, or a farming system, is conducted to quantify risks faced by farmers, as well as other actors in the value chain such as buyers, processors, packers, service providers, and marketers.

Preliminary existence of weather risk can be assessed through a combination of the following:

⇒ Analysis of yield data;

⇒ Damage statistics for a pre-identified crop or variety of crops;

⇒ Weather data;

⇒ Farmer interviews; and

⇒ Expert opinion, especially of local extension officers.

WII can best be applied where there is a strong correlation between crop losses and adverse weather events.

4.2.3 Availability of weather data and infrastructure

WII relies on historical and current weather data. Historical data are used as the basis for data analysis in product design and pricing. Current data available at local weather stations provide information needed in the operational phase. Daily data is needed for index design, and experience has shown that such data will not be available in some areas thereby reducing the suitability of establishing WII.

The recommended requirement for setting-up WII insurance is that there be at least 20 years of historical daily data and that missing data should not exceed 3% of the total daily dataset. Methodologies for generating artificial datasets are available and they are sometimes used in situations where there is no historical data. Manual measurement of weather variables is not regarded as sufficiently reliable and secure. It is ideal to install additional of automatic weather stations that report daily to headquarters via telecommunications networks.

4.2.4 Availability of agricultural data and information

Agricultural data are necessary for a pre-feasibility assessment, including:

⇒ Rapid assessment of crop area;

⇒ Production techniques and yield data;

⇒ Official loss or damage data (if available);

⇒ Information on mechanization and intensity;

⇒ Cropping patterns and varieties;

⇒ Soil types; and

⇒ Basic water-balance parameters (e.g. from the Climate Information Tool of the Food and Agriculture Organization of the United Nations [FAO]).

National or regional agricultural research institutes and International linkages can be sought in order to bring additional key expertise for collection and assessment of agricultural data. Key expertise is required in applied knowledge of crop production, crop modelling, agro- meteorology and crop losses.

4.2.5 Regulatory environment

Policy has to create an enabling legal and regulatory environment to ensure that the sale and management of products are fair to both buyers and sellers of agricultural insurance.

Most nations have approved index insurance due to its importance to the agricultural sector, especially in the smallholder farming sector. Where regulators have not yet approved, the initiative can be started as a pilot, which can be granted preliminary approval on a trial basis.

4.2.6 Government policies and interest

The Current government policies with respect to agriculture and insurance need to be understood during the pre-feasibility study. It is important to understand how index insurance might blend in with existing risk management policies and how these policies impact incentives for index insurance. Some countries, e.g. India and China, provide heavily subsidized crop insurance alternatives to index insurance.

Such insurance schemes are designed to outcompete privately provided index insurance (IFAD, 2011). Governments that have interest in and will be committed to supporting WII can be seen by taking supportive roles, such as investing in collection and provision of weather data and agricultural statistics.

4.2.7 Availability of partners, stakeholders, interested parties and champions

One of the critical success factors in establishing a WII programme is the existence and commitment of key stakeholders. It is important to identify key 'local champions' who will be keen to enter into partnerships. Assessing capacity, interest and commitment is key to overcoming initial set-up challenges, and champions can act as a common thread for all stakeholders involved (IFAD, 2011). The following key stakeholders will be needed for successful launch of a WII programme:

4.2.7.1 Insurers

Insurers play a key role in designing and underwriting the product. A trustworthy local insurer must be willing to issue the policy, accept some risk and play an administrative role. In an early pilot stage, sometimes insurers will join as a pool, and an association of insurers, can play a facilitating role. In some instances, the insurer has been the key champion driving the pilot study. In South Africa, the South African Insurance Association (SAIA) is already playing a facilitator's role by engaging with the government on behalf of its members.

4.2.7.2 Intermediaries and delivery channels

Since insurers do not normally have offices in rural areas, distribution is best organized through a stakeholder who interacts with farmers or farmer groups on a regular basis, and has earned their trust. Such stakeholders include banks, processors, cooperatives, agro-dealer shops, commodity associations, etc. Embedding WII into a development programme, or into a package linked with credit, inputs or contract farming, can strongly add value to the proposition for farmers and other stakeholders. Such an arrangement will make it easier to sustain and eventually scale up WII.

4.2.7.3 Financial service providers

Existing rural financial institutions are interested in protecting both their clients and themselves against weather risks. They

are, therefore, a natural partner for WII distribution.

4.2.7.4 Cooperatives and farmer organizations.

Cooperatives and farmer organizations are composed of the basic clients for any new WII products. They also serve as important delivery channels for products destined for farmers.

4.2.7.5 Input suppliers and processors

They are both wary of and vulnerable to covariate risks facing producers, which in turn trap smallholders in a cycle of small-scale production. These entities can thus have a stake in acting as an intermediary for WII. For example, inputs such as good-quality seed or fertilizer could be sold on credit if the risk were to be transferred through index insurance (IFAD, 2011).

4.2.8 Piloting weather index-based insurance

Once basic conditions in the country are suitable for establishing WII products, the next phase will consist of establishing a pilot study. Thus, WII will be tested appropriately before marketing it on a large scale. Setting up an appropriate pilot is recommended because assessing the real potential of WII can take time. With a relatively small budget, pilots can provide useful indications about acceptance of the product, willingness to pay and product design alternatives. The project team should develop a work plan for setting up the WII pilot. The plan should include the following stages:

⇒ Development of product distribution channels.
⇒ Interacting with the regulator for product approval.
⇒ Selection of pilot areas.
⇒ Collection of weather data and defining data transmission procedure.
⇒ Collecting agricultural data.
⇒ Designing and validating WII contracts.
⇒ Developing programme implementation materials and training retailers.
⇒ Designing marketing and education materials for clients and end-users.
⇒ Carrying out and analyzing the baseline survey as well as monitoring and evaluating pilot.

4.2.8.1 Development of product distribution channels

In planning implementation of a WII pilot, the first step is to set up the market arrangement of the risk transfer and distribution proposition. Key insurers and distribution channels may have already been identified during the pre-feasibility assessment.

In general terms, there are two types of distribution arrangements that can be classified as follows: (a) insurance policies retailed through an intermediary, such as a credit institution (bank, credit cooperative, etc.) or an agribusiness firm; or (b) contracts directly distributed by the underwriting insurance company, often through the company's agents.

Experience has shown that selling the WII may be easier when it is linked to a loan or input product. In this case the intermediary will provide access to existing retail networks for the loan or input thereby reaching out to a much larger number of clients. The partnership may therefore provide distinct benefits for the intermediary. For example, credit institutions may be interested in linking WII to their lending operations in order to reduce default rates generated by adverse weather events. On the other hand, agribusiness firms may see offering WII as a competitive advantage for their products (IFAD, 2011).

When setting up the risk transfer proposition, it is critical that the insurers have access to appropriate re-insurance coverage. WII transactions are highly exposed to covariate risk, and in the case of a triggering event, payouts tend to be significant. Regardless of the retailing model adopted, the insurance company must have access to the re-insurance industry, usually at the international level (IFAD, 2011).

4.2.8.2 Interacting with regulator for product approval

The pilot programme must receive approval from the regulatory authority responsible for the area in which the pilot is to be implemented. This stage ensures that the pilot complies with local regulations. Because the approval process may take considerable time, the project team should engage regulators as soon as

feasible. Additionally, the regulator's requirements may affect the actual design of the WII products.

4.2.8.3 Selection of pilot areas

The success of the WII pilot depends heavily on the area in which it is implemented. The following criteria should be considered when selecting a pilot area, which should be:

⇒ Exposed to relevant (but not excessive) weather risk for crop production.
⇒ Covered by a suitable weather station with an acceptable history of weather data collection.
⇒ Relevant to the partnering insurers and delivery channels in terms of business development.

4.2.8.4 Collection of weather data and defining data transmission procedures

The data used to construct the underlying weather indices should adhere to quality requirements, including:

⇒ Reliable and trustworthy on-going daily collection and reporting procedures.
⇒ Periodic checks and quality control.
⇒ An independent source of data for verification, such as from surrounding weather stations.

Another pilot zone should be considered if an area has no access to weather data satisfying the above criteria.

The general criteria for weather data requirements for WII applications is as follows:

⇒ At least 20 years of historical weather data;
⇒ Limited missing values and out-of-range values (preferably less than 3 per cent missing data from the entire historical dataset);
⇒ Availability of a nearby station for fall-back verification purposes;
⇒ Consistency of observation techniques – manual versus automated;
⇒ Limited changes in instrumentation/orientation/configuration;
⇒ Integrity of weather-data recording procedure.

The WII contracts are written for specific areas tied to a specific weather station. A general rule of thumb is to consider a specific WII contract marketable within a 20km radius of the weather station; but in many cases the applicable area is smaller. The more the terrain varies, the more the acceptable distance from a station decreases.

4.2.8.5 Collection of agricultural data

The most relevant information to be collected is data on productivity, as determined by the yield. A clear description of the agricultural production practices carried out in the areas of interest is also necessary. Unfortunately, the availability of quality yield-data for a substantially long period is not common. In such cases, alternative approaches to estimating yield variability should be used. One possibility is to simulate synthetic yield-data series through plant-growth models. Examples of crop growth models that can be used in South Africa include APSIM (Agricultural Production Systems Simulator), DSSAT (Decision Support System for Agrotechnology Transfer) and AquaCrop.

Specific information must also be collected from potential WII end-users on local cultivation practices and procedures. Such information is essential in designing a meaningful WII contract and it includes crop varieties used, planting periods, management practices, related costs, risk profiles, historical recollection of the impact of the hazard, and the most sensitive phases in growth cycle of the crop.

4.2.8.6 Designing and validating weather index-based insurance contracts

When designing a contract, it is important to define a structure that effectively captures the relationship between the weather variable and the potential crop loss and to select the index that is most effective in providing payouts when losses are experienced. Basis risk must be eliminated as far as possible. The set of possible index combinations is unlimited, and numerous structures have been developed, thus far (IFAD, 2011).

One of the most commonly adopted structures is that of a pay-out that is triggered by a cumulative measure of the weather variable (e.g. rainfall) for each of the different crop growth stages. Thus, farmers will be paid by the Insurer if rainfall will be below a certain critical minimum amount for a given crop growth stage. Contract design is probably the most challenging part of developing a pilot programme. Expertise will be needed to carry out the necessary research and development activities. Such specialists can come from the previously identified national and international partnerships. Building the technical capacities of local insurers will be critical for future contract adjustment and design.

4.2.8.7 Developing the programme implementation materials and train retailers

Programme implementation materials are needed to carry out the insurance transactions. The underwriter must develop a product manual that describes the different elements of the transaction, such as treatment of weather data, customer eligibility, contract features, underwriting processes, product pricing, and contract monitoring and settlement processes.

The underwriter must also develop the client information sheet, which explains the WII product to the client. Dedicated training sessions for WII retailers must be organised to ensure that the information on the type of coverage provided by WII is delivered correctly and that the intermediaries understand the product (IFAD, 2011).

4.2.8.8. Designing marketing and education for clients and end-users

Marketing and education sessions must be organised for prospective clients, end-users and intermediaries. This is particularly important because African rural communities are not familiar with agricultural insurance policies, as well as the basic concepts of insurance transactions. Such clients will have to be exposed to specific features of WII in order to understand aspects such as events that will trigger insurance payouts and the subsequent claims process. During these sessions, it will also be important to make sure that the clients are aware of the exact location in which the weather variable will be measured, and confirm whether their operations are carried out in locations with similar weather patterns (IFAD, 2011).

4.2.8.9 Carrying out and analysing baseline survey as well as monitoring and evaluating the pilot

A baseline survey enables collection of the initial information to be used for assessment of any changes in policyholders' behaviour once the pilot study has been completed. After A monitoring and evaluation exercise is conducted after the pilot study, so as to compare results against baseline indicators. It will also be important to monitor performance in order to identify any additional constraints and opportunities, so that any necessary adjustments from previous steps can be made (IFAD, 2011).

4.2.8.10 Scaling-up and sustaining weather index-based insurance

If the pilot(s) indicate(s) that there is viable demand and supply for WII in the local market, the project can be scaled up. In the interests of sustainability, stakeholders should continue applying the expertise they developed in the pilot. If index insurance is to be scaled up, governments and donors will need to intervene more actively by playing enabling and facilitating roles.

Key areas in which donors and governments could assist in ensuring scaling-up and sustainability of WII initiatives include: building weather station infrastructure and data systems; providing technical assistance, training and product development; funding innovation that may open new directions in the market; facilitating development of an enabling legal and regulatory environment; educating farmers on the role of insurance; facilitating initial access to re-insurance; supporting regular monitoring; and, conducting evaluation and impact studies (IFAD, 2011).

4.3 Monitoring performance of the intervention in terms of the CSA pillars

Table 4.1: CSA farm level technical indicators

Theme/Pillar	Sub-theme	Farm level Indicators
Productivity	Crop system	Increase in crop yields (ton/ha), by taking informed risks; Accessibility of financial services, e.g. credit, and inputs from bundled insurance products.
Resilience	Robustness	Increases in stability of production, promotes income diversification, incorporate site-specific knowledge.
	Cropping system	Increases resilience to drought, such as by compensation for lost produce.
	Livestock system	Increases resilience to drought such as through supplementary feeding accessed as part of bundled insurance products.

Source: Adapted from The World Bank Group (2016)

4.4 Case studies

As noted earlier, WII is not yet available to South African farmers. Two case studies were therefore taken from east Africa, one covering both crops and livestock (Box 4.1), while the other one only covered livestock (Box 4.2). The case studies clearly show that WII is being effectively used to cover millions of resource-poor smallholder farmers against climate related risks.

Box 4. 1: Case study 4.1: Agriculture and Climate Risk Enterprise (ACRE) Africa (derived from Ribeiro, 2017)

The Agriculture and Climate Risk Enterprise (ACRE) Africa is a registered company in East Africa. At the end of 2016, products designed by ACRE insured cumulatively more than a million farmers in East Africa. Farmers can insure their dairy cows or their crops, including maize, sorghum, coffee, sunflower, tea, cashew nut or potato. These products are underwritten by UAP Insurance Kenya, CIC Insurance Group Limited, APA Insurance, UAP Insurance Tanzania and SORAS Insurance Rwanda.

One of ACRE's Africa most attractive innovations has been the bundling of farm inputs and insurance. In order to reach a large number of farmers, ACRE products are distributed mostly through aggregators, such as lending institutions, cooperatives and outgrowers, or directly to medium-scale farmers. ACRE's most popular product is packaged with maize seeds. The replanting guarantee is an insurance directly included in the price of a bag of seeds. When opening the bag, farmers will find a card with a code to send by the short message system (SMS) to activate a 21-day cover. The insurance is free for the client, as the input company pays the premium. When the client sends the SMS, ACRE receives the farmer's location and monitors the weather in the area, thanks to satellite imagery and automated weather stations. If there is insufficient rainfall following the 21 days after planting, germination fails. Insured farmers will be automatically reimbursed the value of the seeds on their mobile wallets, without filing any claim. This whole system is based on partnerships with a farm input company and a mobile operator.

Box 4.2: Case study 4.2: Index-Based Livestock Insurance (IBLI) in Kenya and Ethiopia (derived from Ceballos *et al.,* 2016)

The index-based livestock insurance (IBLI) program in Ethiopia and Kenya was launched in 2010 with the objective of improving the resilience of pastoralist households against droughts and facilitating investments in livestock and access to credit. The International Livestock Research Institute (ILRI) teamed up with the University of California, Davis, to design an index-based livestock insurance relying on the normalized difference vegetation index (NVDI).

The NVDI is calculated from remotely sensed satellite measurements and used to estimate the availability of forage for livestock. The project derived a statistical relationship between the NVDI and livestock mortality data to serve as a basis for insurance payouts. In February 2017, the government of Kenya, in partnership with Kenyan insurers, announced payments to more than 12 000 pastoral households under IBLI. The program provided substantial benefits to households, who were less likely to sell their livestock and in some cases increased their number of livestock and improved their overall food security.

In 2015, the government of Kenya, supported by the World Bank, launched the Kenya Livestock Insurance Program (KLIP) using a design based on the NVDI. In October 2015, KLIP covered the livestock of 5 000 pastoralists in two counties. Further expansions are planned.

4.5 Conclusions

Agricultural insurance is needed for farmers to be able to bounce back from the adverse effects of weather. WII provides an affordable insurance option for resource-poor smallholder farmers. Guidelines for developing and implementing WII products were presented. The procedure involves conducting a pre-feasibility assessment to determine if conditions for establishing WII exist in a given country.

If favourable conditions exist, a pilot study is initiated in limited sites to test the viability of selected WII products. This is then followed by scaling-up provision of WII products if they are profitable and in demand in that particular country. Case studies from east Africa showed that WII was launched successfully in several countries in that region, and it is covering millions of crop and livestock farmers. The South African Insurance industry and government are urged to work together and launch WII in order to protect local farmers against the adverse effects of climate change.

5. Actionable Guidelines for promoting knowledge dissemination regarding Climate Smart Agriculture

5.1 Introduction

The international experience indicates that taking up the practice of Climate Smart Agriculture requires not only adoption but adaptation, and that this in turn requires time, resources, and an investment in learning. Whereas large-scale commercial farmers can to a large degree absorb the costs associated with taking up CSA, small-scale farmers cannot. Therefore, consideration should be given to the appropriate mix of support and other measures to be provided from a policy perspective, in order to encourage uptake of CSA. There is scope for re-orienting the use of resources which are already dedicated to the support of small-scale farmers.

South Africa is fortunate to have an instance of best practice in promoting CSA among smallholders, namely the CA Farmer Innovation Programme for Smallholders implemented by the Mahlathini Development Foundation (based in Pietermaritzburg, KwaZulu-Natal) in collaboration with Grain SA (based in Pretoria, Gauteng). This assessment is based not only by considering its track record within South Africa, but by looking at the evidence regarding efforts to promote CSA in other African countries.

What is excellent about the CA Farmer Innovation Programme for Smallholders is that it is designed explicitly in such a way as to assist small-scale farmers to experiment, learn and adapt, and it does so by building on the well-established pedagogical approach developed in the 1980s by the FAO known as Farmer Field Schools. The question considered in this section is whether South African extension officers can be genuinely equipped to do something similar, i.e. if the basic approach of the CA Farmer Innovation Programme for Smallholders could be adopted and scaled up by the public sector. If so, then the logical approach would be to use the CA Farmer Innovation Programme for Smallholders as a model on the basis of which a core group of government extension officers could be empowered to promote CSA/CA in the same fashion, perhaps starting with pilots in a number of provinces.

This section also considers one other aspect of the 'appropriate mix of support and other measures' to promote CSA, albeit briefly, namely how to promote CSA-appropriate tractor services.

5.2 Promoting better knowledge of CSA among extension officers

Although DAFF's recent National Extension and Advisory Services Policy (DAFF, 2014a) calls for a pluralistic approach to extension in which government, private sector, and the non-governmental sector all play a role with the benefit of careful coordination, the reality is that government has a much greater number of extension officers on the ground than the private sector or NGOs, and scaling up of CSA among small-scale farmers will necessarily depend on government extension officers playing the major role.

The key point is that scaling up CSA among small-scale farmers will depend not only on improving extension officers' knowledge, but at least as much on improving their skills, their work method, and their accessibility. This must be part of what Kassam et al. refer to as a "knowledge and learning system for CA", which must "be built up in the farming, extension and research community and should always be put out and demonstrated to stakeholders as evidence of relevance and feasibility, and used for hands-on training students, researchers, extension agents and farmers as well as sensitizing institution leaders and decision-makers" (Kassam, Friedrich, Shaxson, Bartz, Mello, Kienzle and Pretty, 2014: 8-9).

Based on the international experience with promoting CSA/CA, Kassam et al. propose a system comprising five main elements, namely 'staff training', 'demonstration areas', 'field days and study-visits', 'participatory and interdisciplinary learning process', and 'operational research'. They describe the staff training component as follows:

> *Key to success of participatory approaches is that the advisers and lead farmers should be fully conversant with the ethos, changed mind-set, agro-ecologic and socioeconomic principles, and modes of application of CA. Dedicated train-*

ing courses for this purpose are needed, to generate a *commonality of understanding among the trainees. On this they can base understanding of what they encounter among farmers and in the field, and provide consistent information. The training institution should maintain close links with the fieldwork and experiences to gain feedback and make appropriate adjustments to the programme for the refining of future courses which cover both theory and practice. (Kassam et al., 2014: 9)*

This suggests something more intensive and advanced than the National Qualifications Framework (NQF) level 4 'short course' on conservation agriculture offered by some service providers. If the short course forms part of a national drive to promote CSA, then it probably implies that national government will need to assume a strong leadership and coordinating role to ensure that a proper training programme is put into place specifically for extension officers, and that significant numbers of government extension officers from around the country take the course on an annual basis. The draft policy on conservation agriculture states that, "Government should invest substantially in appropriate public and private sector training initiatives that relate to CA farmer-centred innovation and implementation" (DAFF, 2017: 11). While this is a good start, it probably understates the leadership role that national government must play, first to ensure that the right kind of courses are established, and secondly that sufficient numbers of extension officers take them.

The curriculum for such a training programme should be not only be in the technical aspects of climate-smart agriculture, but in the principles and practice of participatory research. In short, the training should be such that provincial agriculture departments are able to implement the related activities that are presently undertaken by the CA Farmer Innovation Programme for Smallholders, and this in turn might be taken to mean that, in the short run, some of the sites that are presently the focus of that Programme, can also serve as 'demonstration areas' which can be used as part of the new CSA curriculum, i.e. where extension officers in training can be exposed to 'participatory and interdisciplinary learning processes'. (For training extension officers in the practice of smallholder-based holistic rangeland management, a comparable site could perhaps be found operated by either the Olive Leaf Foundation or Conservation South Africa).

A logical next step would be that each provincial agriculture department would establish its own 'demonstration areas', which would contribute further to sensitising more extension officers to both the principles of CSA and those of participatory research. This is critical not just for scaling up purposes, but also for 'de-centralising' the approach, which in any case needs to take local context into account. In respect of the promotion of participatory research, Kassam et al. have indicated as follows:

For the development of CA in the field, active feedback loops for intercommunication between farmers, researchers and advisers are helpful. In this way information can be shared within and between the farming, advisory and scientist communities. A participatory process should be the basis for the analysis of socio-economic and agro-ecological factors which determine problems at farming system level and the methodology to identify practical solutions, which can be managed by farmers. This has certain implications for policy -makers. On the one hand, an assumption that CA will spread on its own in some desirable fashion is not appropriate. On the other hand, a uniform policy prescription to fit many locations is not realistic either, whether it consists of direct interventions or more indirect incentives stemming from research and/or development (Kassam et al., 2014: 9).

Presently, there are approximately 2600 government extension officers in South Africa, belonging to 283 local offices. It is unknown how many have been trained in CSA, but in any case most of this training will have involved minimal practical experience and little or nothing by way of training in participatory research. Supposing a minimum goal of training two officers per local office within a period of four years, that would imply training about 140 officers per year.

5.3 Complementary skills development to promote CSA uptake – providers of tractor services

In order to significantly promote crop-oriented CSA within South Africa's smallholder sector, there needs to be more careful attention to government's mechanisation policy than what is provided for in the draft policy on conservation agriculture (DAFF, 2017), or for that matter in DAFF's mechanisation support framework (DAFF, 2014b). In particular, there is a lack of appre-

ciation in that most tractor services accessed by small-scale farmers at present, are provided by local tractor owners who provide such services as informal SMMEs without benefit of government support. While it is beyond the scope of this report to indicate what a fully functional CSA-friendly mechanisation support policy would look like, the idea is that for smallholders to practice CSA beyond small gardens, they need access to appropriately skilled and equipped tractor services, and that government should take decisive measures to assist tractor owners and their drivers to develop practical knowledge of CSA so that they can provide such services:

> *A more immediate solution is to equip and train CA service provision entrepreneurs. With the right equipment, selected for the needs of their local clientele, and the right technical and business management training, such entrepreneurs can make a livelihood by supplying high quality CA and other mechanization services on a fully costed basis (Sims and Kienzle, 2015: 139)*

This means in turn the development of a course specifically aimed at small-scale tractor owners / drivers with a large practical component, must be developed and implemented.

The course would have to include general principles of CSA, but focus specifically on the implementation of CSA using different types of equipment, and covering aspects such as planting, weed control, cover crops, and residue management. Complementary measures will also be required in some form so that such small-scale entrepreneurs are able to access appropriate equipment.

5.4 Monitoring and performance evaluation

With regard to monitoring and performance evaluation in respect of promoting knowledge dissemination for CSA, it follows from the above that the key focus should be on government extension officers and SMME tractor services. The obvious indicators would be 'action indicators' relating first as to whether or not appropriate courses and programmes have been established, and secondly as to how many people have completed them. The other main indicator would be the number of demonstration areas being successfully established.

5.5 Conclusion

The Mahlathini Development Foundation in collaboration with Grain SA, in recognition of the fact that this programme is an excellent local example of what Kassam et al. refer to generically as a "knowledge and learning system for CA" calls for government intervention and scale up. However, the caveat is that it is not necessarily easy to maintain the integrity of an approach while scaling it up; the accomplishments of the CA Farmer Innovation Programme owes to the hard, patient work of a highly experienced and competent team, and will not be quickly and easily absorbed by others.

In principle, however, it can be done, and the argument of this section is that it can and must be further strengthened by government, as government already has the extension staff in place, as well as other resources. The scaling up process must include a careful but ambitious training programme so that a minimum core of extension officers not only learn the technical aspects of CSA, but just as importantly, practice and then master the process and pedagogical aspects associated with participatory learning and research.

An important complementary initiative is to develop a training programme that will serve to give existing tractor service SMMEs the knowledge and skills to practice CA in their day-to-day work.

6. Actionable guidelines for facilitating uptake of CSA by women and members of other vulnerable groups

6.1 Introduction

CSA has much to offer women farmers. However, based on the evidence from other African countries, much depends on the specifics and details, not least the cultural milieu, the agricultural environment, and the CSA technology options on offer. A major consideration is whether the adoption of CSA practices reduces women's labour burden or aggravates it. Other considerations include whether or not women have the resources with which to take up CSA and therefore benefit from it, and whether policies and programmes are really developed and designed with the interests of women, and of other vulnerable groups, in mind.

Generally speaking, the environment for promoting CSA among women farmers is reasonably conducive in South Africa. The widely accessed social grants would appear to go some distance in providing a safety-net, in the absence of which fewer women would probably be willing to venture into CSA. Another reality that works in favour of women farmers in South Africa is that women farmers (or at least women farmers who are household heads) are about as likely to receive extension and other support from government as their male counterparts, as evidenced for example by data from Stats SA's General Household Survey (Stats SA, 2018)[1], which may be due to the fact that approximately 45% of South Africa's extension officers are women (personal communication, T. Lukhalo, 2018). This is in contrast to many other countries, where women are relatively neglected by extension services (e.g. Mbo'o-Tchouawou and Colverson, 2014), and where most extension officers are men. Further, female-headed households are as likely to own livestock as male-headed households, though on average, they own approximately 20% fewer head of cattle, sheep and goats (based on calculations from Stats SA's Community Survey 2016), in comparison to their male counterparts.

However, from the perspective of promoting CSA, one shortcoming of the South African environment is the absence of a conducive mechanisation policy, which unless corrected will probably mean that many low-income women farmers will only be able to consider relatively labour-intensive forms of CSA/CA, which will likely limit their willingness to take it on, or the benefits of doing so.

The previous section also argued that the CA Farmer Innovation Programme for Smallholders implemented by the Mahlathini Development Foundation and Grain SA represents local best practice regarding crop-oriented CSA, whereas the holistic rangeland management pilots of the Olive Leaf Foundation and Conservation South Africa, appear to represent local best practice regarding livestock-oriented CSA. Whether by design or by chance, most of the participants in the CA Farmer Innovation Programme are women (Kruger and Smith, 2017a), probably simply reflecting the majority of the crop farmers in the area are also women. For the holistic rangeland management initiative in Hewu, Eastern Cape, there are slightly more active male participants than female (personal communication, A. Mrwebi, 2018).

As conceptualised here, scaling up CSA among South African smallholders, therefore, largely means designing and implementing a training programme that would give government extension officers the competence to do what is presently happening at these non-governmental initiatives, while also ensuring complementary actions and forms of support, such as appropriate demonstration sites and subsidising the acquisition of CSA-appropriate tractor equipment. The question is whether the apparent gender equity of the existing best practice models could be kept intact?

1. It is important to put these assertions in perspective. While perhaps it is heartening that women farmers do not appear to be neglected relative to men farmers, the bigger picture is that both women and men farmers are badly neglected by extension services in South Africa, and this represents a large threat to any well intentioned effort to scale up CSA. On the positive side there is reason to suppose that the extension methodology proposed as the vehicle for farmer support – namely some kind of variation on farmer field schools – has genuine potential to improve access to extension services because in various respects it is a more efficient work method for extension officers, at least in rural areas where small-scale farmers are relatively 'dense'.

6.2 Guidelines to ensure women and other vulnerable individuals benefit from efforts to scale up CSA?

In light of the preceding discussion, it is unclear whether any specific interventions or guidelines should be introduced to ensure that women, and other vulnerable / socially excluded individuals, benefit equitably from efforts to scale up CSA.

The main issue is to be vigilant in the course of any scaling up effort, such that if asymmetries based on gender or other characteristics do arise, they are quickly spotted and analysed. Presumably, the guiding principle is that women farmers should benefit at least as much as men farmers, i.e. in proportion to their relative numbers in different areas.

However, given the complexity of agricultural systems and how they affect and are affected by gender, it is not sufficient to simply count numbers of farmers involved by gender (which in itself is possibly more challenging than it sounds), but to conduct mixed methods research so as to understand as soon as possible the material and non-material experiences of women and men farmers.

6.3 Monitoring and performance evaluation

Regarding the monitoring and performance evaluation of gender and related aspects in the context of scaling up CSA, there are two levels of concern. The first we can call 'incidence' – to what extent are efforts to scale up CSA in an area reaching women as well as men? The second level of concerns is on establishing an in-depth understanding of who does and does take advantage of opportunities to adopt CSA (which in a sense is trying to understand patterns of incidence that might emerge), and then to understand their actual experience after having done so.

Even establishing incidence may not be so simple, as it might appear. Government generally lacks credible administrative data as to numbers and types of farmers supported through extension, and it is not clear whether efforts to improve this – e.g. through the introduction in some provinces of the 'smart pen' technology – have succeeded.

However, much depends on the mode of interaction. If the scaling up process is based on the model of the CA Farmer Innovation Programme for Smallholders or the Olive Leaf Foundation, where there are identifiable 'participants', then it will not be difficult, although one might miss out local farmers who are adopting CSA, as a result of traditional diffusion, i.e. they observe what others are doing and attempt to do it themselves, even in the absence of direct support.

The latter would be all the more likely if progress were made in promoting CSA-friendly SMME-based tractor services, which could well spread the practice of CSA (or some aspects of it) beyond the study groups or farmer field schools established by government.

Beyond these important exercises in tracking numbers of women and male farmers making use of CSA techniques at some level, there is the question raised earlier regarding impact.

This is a good area for in-depth research, but for purposes of these guidelines and in deference to practicality, perhaps the most pragmatic approach is to commission separate focus group discussions with women and men farmers, including both those who have and have not attempted to practise CSA, and, to do this in areas where CSA is being actively and directly promoted.

While these would not allow measurement of income effects, etc., they would likely provide a rich understanding of the gendered dynamics of uptake of CSA, and help identify emerging concerns and opportunities.

Also, such an open-ended approach would allow one to probe what other types of vulnerable or socially excluded individuals are afforded an opportunity to benefit from taking up CSA.

6.4 Conclusion

Table 6.1 proposes a relatively simple way of monitoring the implications of scaling up of CSA for women relative to men, while also keeping the door open to observe whether and how other vulnerable groups may be affected.

Table 6. 1: Performance 'indicators' related to gender and other vulnerable / social excluded individuals

	Direct participants	Indirect participants
Participation	⇒ Numbers of women versus men participants ⇒ Area operated by women versus men participants ⇒ Livestock owned by women versus men participants Source of information: administrative data	⇒ Numbers of women versus men participants Sources of information: key informant interviews, interviews with SMME-based tractor service operators
Benefits derived	⇒ Perceptions regarding the advantages and disadvantages of CSA and its specific elements Sources of information: focus group discussions	⇒ Perceptions regarding the advantages and disadvantages of CSA and its specific elements Sources of information: focus group discussions

Although simple conceptually, the monitoring cannot be reduced to only countable indicators. Thus, provision is made for a form of qualitative research – focus group discussions – that is well suited to exploring what is happening with and near new initiatives to promote CSA, including but not limited to the gendered dynamics of CSA adoption

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7. General Conclusions

The practical guidelines for CSA practices for South Africa presented in Volume 2 of the CSA guideline report (Mnkeni *et al*. 2019) and the guidelines for enabling environments described in this report have paved the way for the rollout of CSA in the country. The implementation of these guidelines, where applicable, should help South Africa's transition to an all-inclusive green economy. As underscored in this report, a successful CSA rollout will be dependent upon a conducive enabling policy environment. The government needs to finalize its CSA policy that should include, among other things, provision for cross-sectoral coordination of CSA initiatives, an effective CSA promotion and mainstreaming strategy, a coherent CSA mechanization policy, and availability of enabling resources such as: (i) CSA funding sources, (ii) climate information services, (iii) appropriate agricultural insurance, and (iv) agricultural marketing infrastructure. Additionally, the policy should promote the elimination of perverse incentives that hinder CSA implementation while ensuring the re-allocation of resources to programmes that provide incentives for the adoption of CSA.

Given the extent and growing importance of urban agriculture in the country, its formal recognition is necessary as well as a policy to guide its support and development in a climate smart way.

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