Deliverable

3

Water Research Commission

Project Number: **K5/2719/4**

Project Title: **Collaborative knowledge creation and mediation strategies for the dissemination of Water and Soil Conservation practices and Climate Smart Agriculture in smallholder farming systems**.

Deliverable No.3: Report- Decision support system for CSA in smallholder farming developed

Date: January 2018

Submitted to:
Dr Gerhard Backeberg
Executive Manager: Water Utilisation in Agriculture
Water Research Commission
Pretoria

Prepared By:
Project team led by Mahlathini Development Foundation.

Submitted to:
Executive Manager: Water Utilisation in Agriculture
Water Research Commission
Pretoria

Project team:
Mahlathini Development Centre
Erna Kruger
Sylvester Selala
Mazwi Dlamini
Khethiwe Mthethwa
Temakholo Mathebula
Institute of Natural Resources NPC
Jon McCosh
Rural Integrated Engineering (Pty) Ltd
Christiaan Stymie
Rhodes University Environmental Learning Research Centre
Lawrence Sisitka

CONTENTS

FIGURES

TABLES

Report- Decision support system for CSA in smallholder farming developed

1 OVERVIEW OF PROJECT AND DELIVERABLE

Contract Summary

Project objectives

1. To evaluate and identify best practice options for CSA and Soil and Water Conservation (SWC) in smallholder farming systems, in two bioclimatic regions in South Africa. (Output 1)
2. To amplify collaborative knowledge creation of CSA practices with smallholder farmers in South Africa (Output 2)
3. To test and adapt existing CSA decision support systems (DSS) for the South African smallholder context (Outputs 2,3)
4. To evaluate the impact of CSA interventions identified through the DSS by piloting interventions in smallholder farmer systems, considering water productivity, social acceptability and farm-scale resilience (Outputs 3,4)
5. Visual and proxy indicators appropriate for a Payment for Ecosystems based model are tested at community level for local assessment of progress and tested against field and laboratory analysis of soil physical and chemical properties, and water productivity (Output 5)

Deliverables

No	Deliverable	Description	Target date
FINANCIAL YEAR 2017/2018			
1	Report: Desktop review of CSA and WSC	Desktop review of current science, indigenous and traditional knowledge, and best practice in relation to CSA and WSC in the South African context	1 June 2017
2	Report on stakeholder engagement and case study development and site identification	Identifying and engaging with projects and stakeholders implementing CSA and WSC processes and capturing case studies applicable to prioritized bioclimatic regions Identification of pilot research sites	1 September 2017
3	Decision support system for CSA in smallholder farming developed (Report)	Decision support system for prioritization of best bet CSA options in a particular locality; initial database and models. Review existing models, in conjunction with stakeholder discussions for initial criteria	15 January 2018
FINANCIAL YEAR: 2018/2019			
4	CoPs and demonstration sites established (report)	Establish communities of practice (CoP)s including stakeholders and smallholder farmers in each bioclimatic region.5. With each CoP, identify and select demonstration sites in each bioclimatic region and pilot chosen collaborative strategies for introduction of a range of CSA and WSC strategies in homestead farming systems (gardens and fields)	1 May 2018
5	Interim report: Refined decision support system for CSA in smallholder farming (report)	Refinement of criteria and practices, introduction of new ideas and innovations, updating of decision support system	1 October 2018
6	Interim report: Results of pilots, season 1	Pilot chosen collaborative strategies for introduction of a range of CSA and WSC strategies, working with the CoPs in each site and the decisions support system. Create knowledge mediation productions,	31 January 2019

		manuals, handouts and other resources necessary for learning and implementation.	
FINANCIAL YEAR 2019/2020			
7	Report: Appropriate quantitative measurement procedures for verification of the visual indicators.	Set up farmer and researcher level experimentation	1 May 2019
8	Interim report: Development of indicators, proxies and benchmarks and knowledge mediation processes	Document and record appropriate visual indicators and proxies for community level assessment, work with CoPs to implement and refine indicators. Link proxies and benchmarks to quantitative research to verify and formalise. Explore potential incentive schemes and financing mechanisms. Analysis of contemporary approaches to collaborative knowledge creation within the agricultural sector. Conduct survey of present knowledge mediation processes in community and smallholder settings. Develop appropriate knowledge mediation processes for each CoP. Develop CoP decision support systems	1 August 2019
9	Interim report: results of pilots, season 2	Pilot chosen collaborative strategies for introduction of a range of CSA and WSC strategies, working with the CoPs in each site and the decisions support system. Create knowledge mediation productions, manuals, handouts and other resources necessary for learning and implementation.	31 January 2020
FINANCIAL YEAR 2020/2021			
10	Final report: Results of pilots, season	Pilot chosen collaborative strategies for introduction of a range of CSA and WSC strategies , working with the CoPs in each site and the decisions support system. Create knowledge mediation productions, manuals, handouts and other resources necessary for learning and implementation.	1 May 2020
11	Final Report: Consolidation and finalisation of decision support system	Finalisation of criteria and practices, introduction of new ideas and innovations, updating of decision support system	3 July 2020
12	Final report - Summarise and disseminate recommendations for best practice options.	Summarise and disseminate recommendations for best practice options for knowledge mediation and CSA and SWC techniques for prioritized bioclimatic regions	7 August 2020

Overview of Deliverable 3

The design of the decision support system is seen as an ongoing process divided into three distinct parts:

- **Practices:** Collation, review, testing, and finalisation of those CSA practices to be included. Allows for new ideas and local practices to be included over time. This also includes linkages and reference to external sources of technical information around climate change, soils, water management etc and how this will be done;
- **Process:** Through which climate smart agricultural practices are implemented at smallholder farmer level. This also includes the facilitation component, communities of practice, communication strategies and capacity building and
- **Monitoring and evaluation:** local and visual assessment protocols for assessing implementation and impact of practices as well as processes used. This also includes site selection and quantitative measurements undertaken to support the visual assessment protocols and development of visual and proxy indicators for future use in inactive based support schemes for smallholder farmers

Activities in this four month period have included:

- Team planning meeting (9-11 October 2017)
- Dialogues in climate change adaptation- including assessment of practices – Limpopo (25-27 October 2017)

- Design and implementation of process methodology for introduction of climate smart agriculture and practices at community level; 4 villages across KZN and Limpopo (27Nov-1 Dec and 4-8 Dec 2017)
- Training of trainers process for introduction of process methodology (20 Nov 2017)
- Visual and descriptive outlines of all practices in the database; Attached as a separate document
- Set up of sites for quantitative measurements: KZN – field sites (Ezibomvini, Eqeleni, Mhlwazini); garden site (Ezibomvini), Limpopo – field sites (Sedawa, Mametje, Botshabelo) garden site (Sedawa)
- Capacity building and publications: Research presentations and chapters, newsletter articles (GrainSA), conferences (PLAAS postgraduate conference) and awareness raising events (Swayimane Conservation Agriculture day); Attached as separate Documents.

2 DECISION SUPPORT SYSTEM METHODOLOGY

By Lawrence Sisitka

2.1 Introduction

Section 2.3.3 in Deliverable 2 provided a broad introduction to and analysis of some existing Decision Support Systems (also known as Decision Support Frameworks) in the global agricultural sector. It was made clear that most such DSS have been developed to inform policy making at national or regional levels. The developers of the framework "targetCSA" for example are very specific that: *The spatially-explicit multi-criteria decision support framework "targetCSA" … aims to aid the targeting of climate-smart agriculture (CSA) at the national level* (emphasis added) (Brandt, Kvakić, Butterbach-Bahl, & Rufino, 2017)

Similarly the CCAFS Climate Smart Adaptation Prioritisation (CSAP) toolkit is intended to: … *arm policymakers with the information that they need to choose the best climate-smart interventions in the short, medium and long term under varying climate scenarios* (emphasis added) (Corner-Dolloff, 2015).

Such wide-scale DSS can certainly provide a broad picture of where particular crops and particular CSA practices may be most appropriate, according to bio-geographic and climatic zones, climate-change predictions and other metrics such as soil types and fertility. In this way they can frame the options for farmers in different areas.

In Deliverable 2 it was also made clear that South Africa currently does not have a DSS, or equivalent, for agriculture in relation to climate change, at either national or provincial levels, although it has been proposed that the National Climate Change Response Policy (NCCRP) (DEA, 2011) can, together with the Climate Change Sector Plan for Agriculture Forestry and Fisheries (CCSP) (DAFF, 2013) provide something of a framework for CSA. However it has also been suggested that these are both too broad and too commercial in focus to be of much value to the small-scale and emergent farmers who are the focus of this CSA project. This is not to say that they have no value, and any development of a DSS within this project must certainly correlate with these policies. But without clear national and provincial frameworks within which decisions can be made at a local level, such decision-making will inevitably be based on understandings of local conditions, augmented by knowledge of wider-scale climate predictions. In relation to the latter South Africa is fortunate to have the South African Risk and Vulnerability Atlas (SARVA) portal (www.SARVA.dirisa.org), through which up-to-date information on climate predictions for all parts of the country, and a host of related information, can be accessed. However, in the form presented in the portal, much of this information is perhaps not readily accessible to the majority of farmers, or indeed, many people working with them.

As a DSS at a more local level, the International Centre for Tropical Agriculture (CIAT) has developed a Climate Smart Agriculture Rapid Appraisal (CSA-RA) methodology, described as "A tool for Prioritisation of Climate Smart Agriculture across Landscapes" (Mwongera, et al., 2016) (. This is designed for use at the household-farm, community-landscape, and sub-regional scales, and is based on a participatory approach, with farmers and external specialists, to the identification of site-specific CSA interventions.

Access to information of all kinds is absolutely essential for effective decision-making, and much of the information generated and used in formal DSS, such as those described above, is highly technical and captured in ways inaccessible to most farmers. Many national and regional-scale DSS are internet-based, and involve complex analyses, using sophisticated modelling and computational tools considerably beyond the capacity of all but the specialists who develop such tools to grasp. While such information and analyses can to some degree be mediated through careful facilitation, the ownership of information, and process and indeed the decisions themselves is often left strongly in the hands of the specialists. In developing DSS for farmers, the more information is directly accessible and understood by them, and the more open and comprehensible the analyses, the better, as they will then have stronger ownership of these, and of the decisions taken through them. The CIAT approach, described above, draws strongly on information from the farmers themselves, although also incorporating specialist technical information on climate change predictions and would appear to place the ownership of decision making quite firmly in the farmers' own hands.

2.1.1 Criteria

DSS require the identification of a range of technical and social criteria relevant to the context, which decision-makers need to analyse in order to reach their decisions. The basis of the analysis in Decision Support Systems is often an assessment of vulnerability. TargetCSA, for example uses a range of 'climate change vulnerability indicators' as follows:

Biophysical

- Annual precipitation (as an indicator for water availability and ecosystem productivity)
- Soil organic matter (as an indicator of soil fertility and ecosystem productivity)

Social

- Percentage of households with access to safe water sources (as an indicator of household well-being)
- Literacy rate (as an educational indicator for adaptive capacity, i.e. for making informed decisions)

Economic

- Female participation in economic activities (as an indicator for women's empowerment and gender equity)
- Connectivity through transport infrastructure (as an indicator of farmers' accessibility to markets)

It is worth remembering that targetCSA is a DSS developed for a broad spatial analysis, at either national or regional levels, with the decision makers being mostly policy-makers, albeit with input from some farmers. These fairly broad indicators are essentially proxies for complex biophysical, social and economic realities, and are prone to considerable variation when applied on such a broad scale. Their relevance in some situations may also be questionable, such as with literacy levels as a proxy for adaptive capacity, suggesting that farmers with some formal education are more likely to have this capacity than those without education. There is also the issue that on this scale farmers are seen as a homogenous entity, rather than, as is the reality, a group of individuals with individual circumstances, needs and aspirations.

In targetCSA these vulnerability indicators are linked to a range of generic CSA practices, or practice approaches considered appropriate responses in the light of particular combinations of the indicators. The practices identified, with their suggested links to the indicators are:

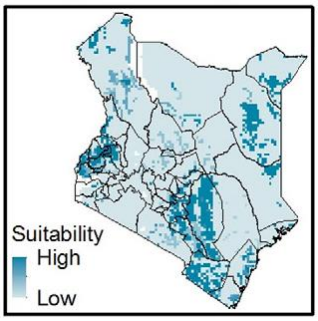
CSA Practices

- *Improvement of soil fertility and soil management* – linked to: soil organic matter and literacy rate
- *Identification and distribution of drought tolerant cereal crops* – linked to: annual precipitation and literacy rate
- *Reduction of greenhouse gas emissions from the livestock sector* – identified as a mitigation measure, linked to all the vulnerability indicators
- *Improvement of water harvesting and water management* – linked to: annual precipitation; percentage of households with access to safe water sources; literacy rate; and connectivity through transport infrastructure
- *Identification and establishment of agroforestry practices* – linked to: soil organic matter and female participation in economic activities
- *Implementation of livestock insurances* – linked to: annual precipitation; percentage of households with access to safe water sources; literacy rate; and connectivity through transport infrastructure

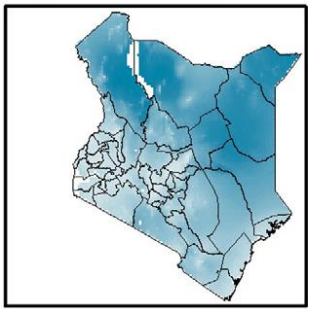
On the scale at which targetCSA is intended to operate as a DSS these generic practices can provide useful guidance for which specific practices might be most appropriate in different areas.

For example, in Kenya, where target CSA was piloted, areas were identified for their suitability for different generic practices:

Improvement of soil fertility and soil management



Improvement of water harvesting and water management



These show clearly that while improved soil management was important across almost the entire country, it was particularly appropriate in some western, many southern central, and some eastern areas. Improved water management is also appropriate across the country, but particularly vital in the northern and eastern parts. When working at a local level, this DSS may help focus attention on those specific interventions and practices most allied to the broad requirements identified by the DSS for any particular area.

The CIAT CSA-RA methodology involves a rather different set of criteria, which are more locally relevant, with the information for most of them coming from the farming communities. The process was therefore more inherently participatory than that of targetCSA which was very expert-driven. The focus is more on the existing situation in terms of farming practices, livelihoods and the challenges faced by the communities. Although the criteria are neither clearly defined, nor conveniently categorised, the main ones are:

- Current farming practices (farm size, inputs, yields crops, livestock)
- Community resources
- Community organisation and organisations
- Income sources, including off-farm income
- Household food security
- Challenges to current and changing practices

Much of this information is derived through the use of a range of Participatory Rural Appraisal (PRA) techniques, such as resource maps, cropping and climate calendars, and institutional mapping.

Some practices identified as CSA practices for prioritisation by farmers are:

- Seed selection
- Timely planting
- Improved varieties
- Broadcasting
- Controlled burning
- Crop rotation
- Intercropping
- Correct spacing
- Wetland conservation
- Agroforestry
- Improved breeds

It can be seen that while some are specific others are more generic, and perhaps some would not necessarily be considered CSA practices, but rather basic farming practices. However it appears that these practices were identified with the farmers in Northern Uganda, one of the sites where the methodology was piloted. This provides a useful lesson in that we cannot, as outsiders, be too prescriptive in terms of what should be considered CSA, and that farmers themselves may interpret other practices as being appropriate.

The prioritisation itself was disaggregated in terms of gender and agro-ecological zone, and showed extraordinary differences in the responses:

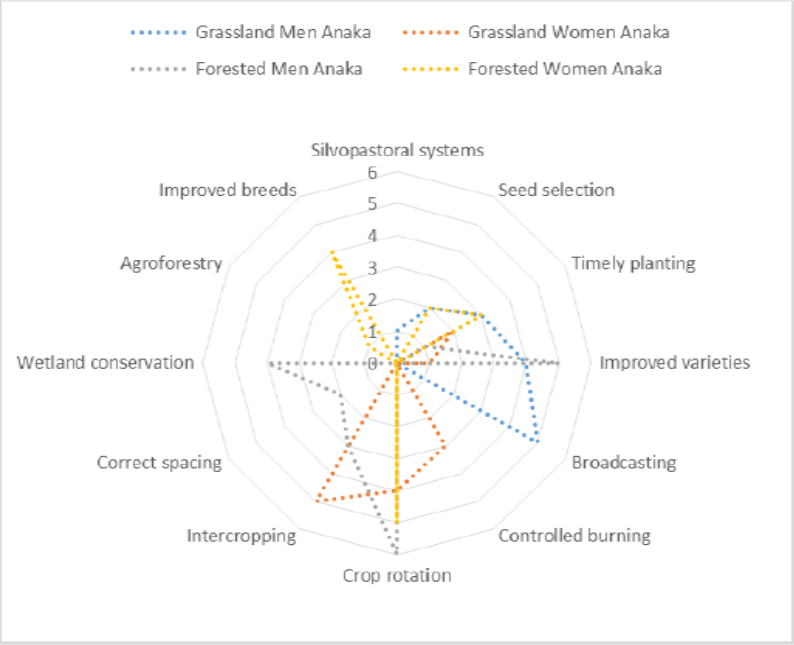


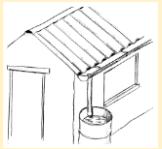
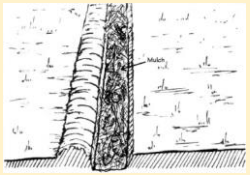
Figure 1:Disaggregated prioritisation of practices (CIAT CSA_RA, 2016)

This suggests that achieving a consensus on prioritisation may be extremely challenging, even impossible, and that an individual approach, where each farmer decides on their own priorities is may be more achievable.

Other DSS or DSS-related models developed in relation to CSA use a range of criteria which while related can differ quite widely from each other. This difference often arises, as in the two examples above, from the different scales at which they are targeted, with the broader scale using more generic criteria or indicators, and the more local scale approaches able to be more specific in focus.

A form of DSS has been developed by the 'Amanzi for Food' project (Amanzi for Food, 2015) to assist farmers in selecting rainwater harvesting and conservation (RWH&C) practices in which they were interested, and wished to learn more about from the WRC materials which the project was intended to make more accessible. This DSS is known as the 'Navigation Tool', as it is intended to aid navigation of the materials to find the specific information which was being sought. However, the basis of the Tool is an initial selection of RWH&C practices, for which some basic information is provided, for example:

Table 1: Excerpt from the Amanzi for Food Navigation Tool, 2015.

Collecting, Reducing Loss and Holding Rainwater				
Practice (and other names)	**Type and Scale (1,2 or 3)**	**Main Purpose and Description**	**Other Factors**	**WRC Materials: Text (T), Case Studies (CS), Handouts (H)**
Roofwater Harvesting 	Harvest Mainly used for domestic supply. Surplus can be used in home gardens. (1)	Collecting water from roofs for household and garden use is widely practiced across South Africa. Tanks and containers of all types – from brick reservoirs to makeshift drums and buckets – are a common sight in urban and rural areas.	Low to medium technology, low to medium skills and understandings, medium cost, medium maintenance	WH&C (**T**: Pp156-165), AWHGS (**T**: Vol.2, Part2,Pp5-83 to 5-90 and **H**: Vol.2,Part2, Chap.5,H1, Pp9-11),
Swales (Bunds, contour ridges, berm 'n basin, contour ditches) 	Harvest, conserve and use. Often used with diversion furrows and mulching. (1 and 2)	An earth bank constructed along the contour with a furrow on the up-slope side – this is filled with dry leaves, compost and soil. The top of the earth bank is levelled off to allow planting. The swale intercepts runoff, spreads it out and helps it infiltrate deep into the ground. Used in home-gardens and smallholder fields. Widely used within permaculture systems. Good groundwater recharge.	Low to medium technology, medium skills and understandings, low to medium cost (mostly labour), medium maintenance	WH&C (**T**: Pp145-146 &**H**), AWHGS (**CS**: Vol2, Part2,P5-25 and H: Vol.2,Part2, Chap.5,H1, Pp6-7),

The Scales (column 2) are categorised (typologised) as follows:

1. **Umzi** (garden/homestead) – fundamentally subsistence level production. This is the smallest scale band, and includes homestead gardens and shared community gardens, with the focus very much on production for own use, although with potential for sharing, barter, and limited sales. Entirely fresh produce for local consumption. Can include small numbers of small livestock. The production sites are either attached to or relatively close to the farmers' (or gardeners') homes. Unlikely to involve employment of farm workers from outside the family. Low input costs, with little or no gross profit margin in the form of financial income. Areas involved rarely more than 1ha.
2. Small arable (**Field)** – small-scale commercial production. This mid-scale band encompasses larger shared community/co-operative gardens, and dedicated arable plots, with the emphasis on production for income generation, with some for own use, sharing and bartering. Generally producing fresh produce, although with potential for processing and value-adding. Supplying local and nearby, and potentially some national markets. Can include small livestock production. Production areas may be some distance from the farmers' homes. May involve employment of workers from outside the family. Increased input costs with generation of some gross profit. Generally areas of 1 – 2ha
3. Large arable and livestock (**Farm**) – Full commercial arable production, differing levels of (small and large) livestock production. Essentially focussed on production for income generation, with little if any for own consumption. Some fresh produce, but also produce grown for mass processing. This can include production of crops not consumed locally, for national or international markets. Production areas may be some distance from the farmers' homes. Almost invariably involving employment of workers from outside the family. Relatively high input costs, with reasonable gross profit margins. Generally areas of more than 2ha.

And the Other Factors (column 4) are described:

Low:

- Technologies – basic gardening equipment;
- Skills and understandings – as required for basic gardening;
- Cost R0 – R1000;
- Maintenance – none or one or two days a year, simple repairs

Medium:

- Technologies – simple testing or measuring kits, tanks, pipes;
- Skills and understandings – as required for small-scale business;
- Cost R1000 – R10,000;
- Maintenance – regular but infrequent checking/repair, 7 – 10 days/year, technical repairs.

High:

- Technologies – specialised equipment (tractors, mechanical pumps, laboratories etc.);
- Skills and understandings – as required for professional specialists;
- Cost >R10, 000;
- Maintenance – essential regular and frequent checking and repair, up to 50 days/year, complex technical repairs

The Tool is divided into four (4) broad categories of practice:

- General Skills, applicable to and underpinning many of the practices
- Collecting, reducing loss, and holding rainwater (as in example, above)
- Storing rainwater
- Using rainwater (irrigation)

Essentially here the criteria used for decision making are:

- Category of practice
- Type of practice
- Scale of farming operation
- Required technologies
- Required skills and understandings
- Cost
- Maintenance requirements

These do not include any bio-geographic or climate criteria, as most RWH&C practices are considered appropriate in most except the very wettest (maybe not necessary) or very driest (probably not realistic) areas. The aim is for farmers themselves to be able decide on the practices in which they are most interested, according to their own context and needs, without requiring any external support, and then to access more information on these from the materials.

While this last example does not include some criteria which may be crucial for a CSA DSS, and the farming typologies may differ from those adopted by the WRC-CSA project, the fact that this is designed for use by very much the same types of farmers who are the focus of the CSA project suggests that the simplicity and immediate accessibility of this model may provide a valuable guide to a CSA DSS.

2.1.2 Process

DSS in general comprise both technical and social elements, each of which has both qualitative and quantitative dimensions. DSS are essentially processes, involving recognition of the need to make a decision; identification and collection of appropriate information (based on the criteria selected for the particular DSS); analysis of this information; identification of available options; selection of best option and decision-making. A generic decision-making process followed by a DSS, initially presented in Deliverable 2, can take the following shape:

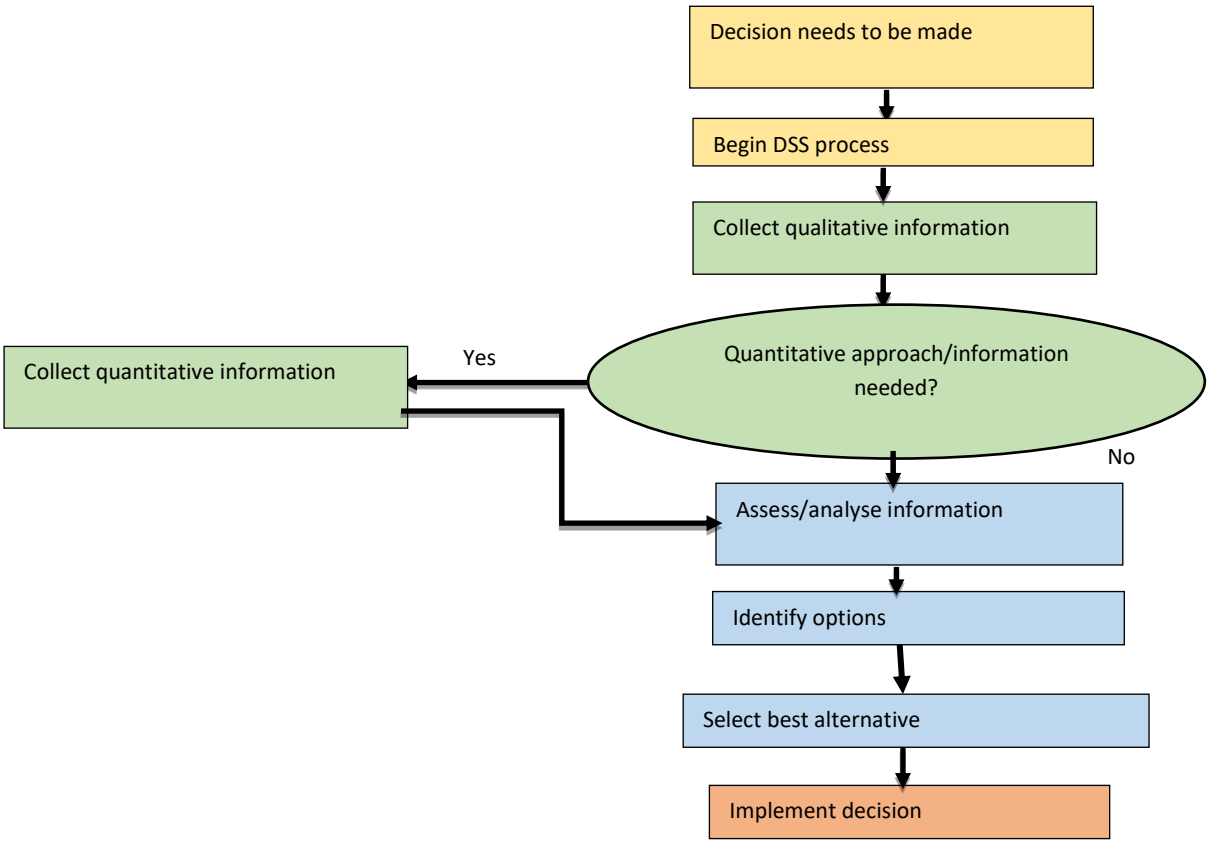


Figure 2: decision making process (Adapted from Heinemann, 1988)

This suggests that while qualitative information, both technical (i.e. soil types, climate) and social (i.e. availability of skills and resources) is essential for the process to be effective, this is not necessarily the case for quantitative information (i.e. precise rainfall predictions, or specific market requirements); indeed the latter may be extremely difficult to access.

One aspect of a decision-making process is the prioritisation of criteria, as those with the highest priority may well provide the starting point for decision-making. For the targetCSA DSS, described above, the clear priorities are climate predictions and soil types, the combination of which, in concert with social criteria such as literacy level, according to the developers of this DSS determine which practices might be most appropriate. The CIAS CSA-RA methodology is less clear about prioritisation, and appears to leave this more to the farmers themselves, which is entirely appropriate at the local level. The Amanzi for Food Navigation Tool, while not being prescriptive in this respect does suggest that the scale of farming is quite a strong priority in terms of criteria, as some practices , such as Saaidamme, are really only appropriate on a larger scale, while others, such as mulching are most appropriate at the smaller scales. However, as with the CSA-RA approach, it is the farmers themselves who mostly identify their own priorities in relation to the criteria.

2.1.3 Facilitation

An important tool in relation to understanding the social context within which farmers are operating is a vulnerability assessment, for which a valuable toolkit is the CGIAR/CCAFS Working Paper 108: *Climate Change & Food Security Vulnerability Assessment Toolkit for assessing community-level*

potential for adaptation to climate change (Ulrichs, Cannon, Newsham, Naess, & Marshall, 2015). This toolkit, as discussed in Deliverable 2 is premised on 5 dimensions of vulnerability (DoV):

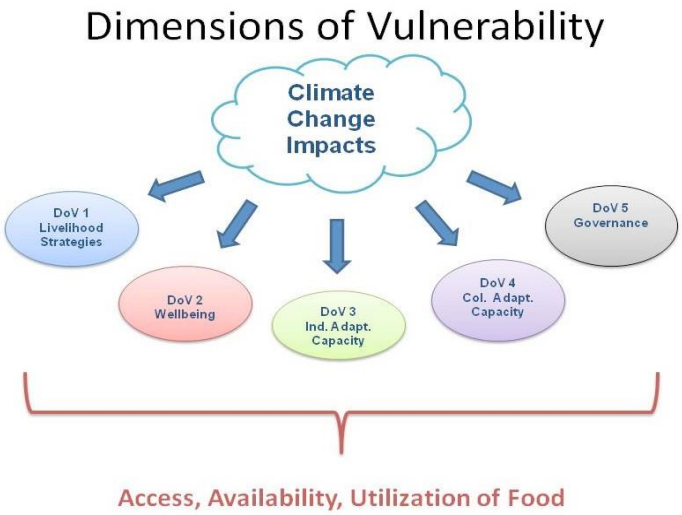


Figure 3: Dimensions of Vulnerability (CGIAR/CCAFS, 2015)

Such an assessment provides a strong foundation for determining the capacity of farmers for adaptation. This approach has been adopted by different programmes globally, and is often combined with a specialist, or external expert-driven process.

However, the broader aim of any facilitation in regard to the use of a DSS is to empower the farmers to be confident in their decision-making with the support of the DSS. Any DSS at the local level must be fully and easily accessible and useable by the farmers themselves with minimal facilitation long after the project has finished. So while a facilitation process may begin with an analysis of vulnerability, it must also, and very importantly, move to a recognition of opportunity and developing farmers' recognition of their own capacities to rise to challenges and grasp opportunities.

The Appreciative Inquiry approach of the Taos Institute, USA and the Voluntary Organisation for Rural Development (VORD) in Bangladesh, takes very much this positive approach and their "…guide on '*Appreciative Inquiry to Promote Local Innovations among Farmers Adapting to Climate Change'* is prepared for the development workers who would like to facilitate a community learning and adaptation process, especially for farmers in agriculture; facing challenges of climate change. This guide is not about agricultural technologies which would help farmers to adapt but it is about facilitating a process of sharing knowledge and technologies farmers are continuously innovating to overcome challenges." (Saya, 2012)

They define Appreciative Inquiry as:
"Ap-pre'ci-ate, v., 1. valuing; the act of recognizing the best in people or the world around us; affirming past and present strengths, successes, and potentials; to perceive those things that give life (health, vitality, excellence) to living systems. **2**. to increase in value, e.g. the economy has appreciated in value. Synonyms: VALUING, PRIZING, ESTEEMING, and HONORING.

In-quire' (kwir), v., 1. the act of exploration and discovery. **2**. To ask questions; to be open to seeing new potentials and possibilities. Synonyms: DISCOVERY, SEARCH, and SYSTEMATIC EXPLORATION, STUDY."

The process is promoted as a positive alternative to the problem-solving approach to development, and is described as a 4D (Discovery, Dream, Design, Destiny) Cycle, centred on an Affirmative Topic.

The Dialogues in Climate Change and Adaptation (DICLAD) process developed by the Association for Water and Rural Development Resilm programme on the Oliphants River (AWARD, 2017), takes a similar approach, which informs the following explorative process concerning climate change and adaptation:

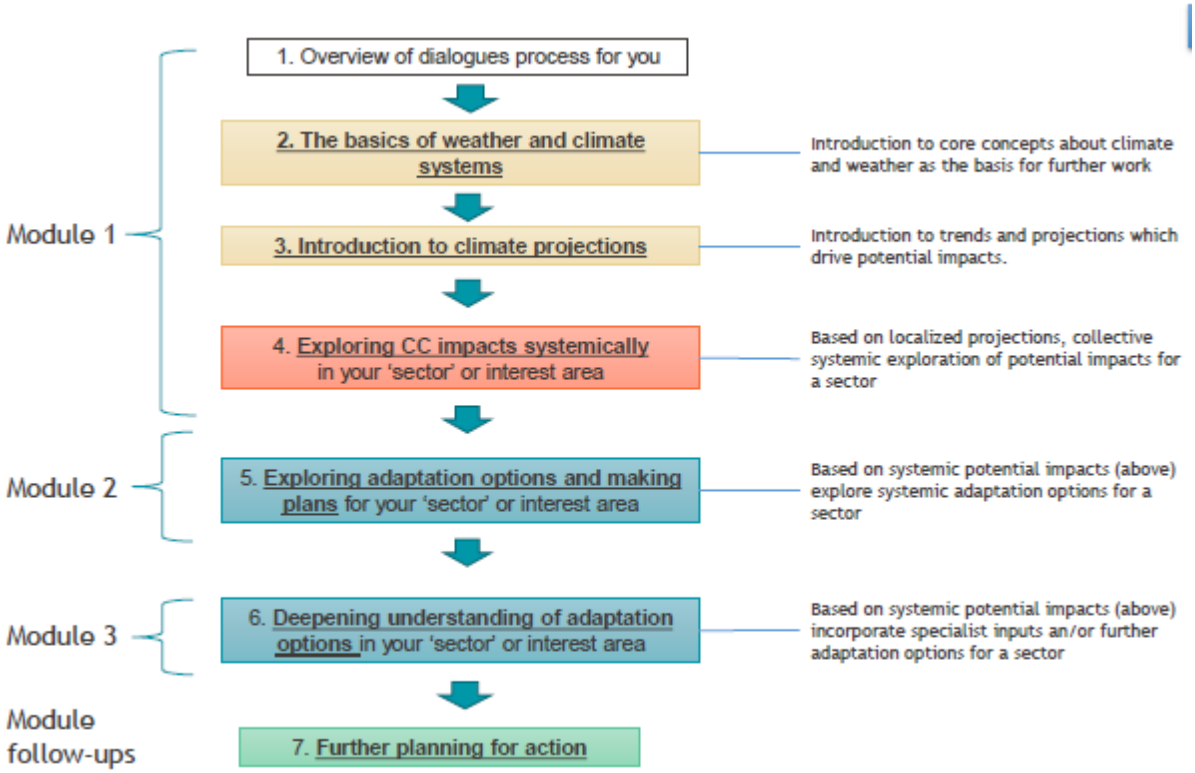


Figure 4: Schematic for DICLAD; Facilitating Understanding of Climate Change and Adaptation (AWARD, 2017)

The facilitation process appropriate for introducing the WRC-CSA DSS is described in Section 2 and 3 , below, and draws on the more participatory and positive approaches exemplified by the Appreciative Inquiry and the DICLAD processes.

2.1.4 DSS for this project

The main aim of the DSS is for individual farmers or farming collectives to be capacitated to strengthen their farming practices in the light of potential climate change impacts. A subsidiary aim is to encourage farmers to support each other in this enterprise, and to encourage others, including agricultural extension officers and personnel from local agricultural training institutions to also support the process. Such support can be provided through the establishment of learning networks as described later in Section 6.

The WRC-CSA project DSS process follows a fundamentally participatory approach with emphasis on farmers' own experiences and understandings of climate change. Through a closely facilitated process they identify trends, which they ascribe to climate change, which have impacted their farming activities in recent years, and are encouraged to extrapolate from these to make predictions about possible future impacts. In this they are supported by climate change and agricultural impact predictions developed by the specialists. Following this there is an exploration of the farming typologies in terms of scales of operation, the crops and livestock produced, and the specific resources, natural and other, to which the farmers have access for their operations. Issues affecting the natural resources are also explored.

These preliminaries lay the ground for discussion of what options are available to farmers to improve their situation, particularly in the light of the predicted climate change impacts, and for the introduction of a wide range of farming practices considered appropriate for increasing resilience in the face of climate change. Based on their own understandings of their contexts, their skills, knowledge and aspirations they can then select from the available practice options those they feel are most appropriate and relevant to their situation. They can then be supported in the implementation of these practices both by the facilitating organisation, initially the WRC-CSA team, and indeed by other farmers and other members of their learning network.

At this stage in the project the idea is that the project team itself facilitates the DSS with the farmers in the different areas, but the aim is, following extensive piloting of the process and the inevitable refining that will follow, for the DSS to be developed as a complete package which can be facilitated anywhere in the country by suitably skilled NGO or agricultural extension service personnel.

2.2 Decision Support System for CSA in smallholder farming systems

By Erna Kruger

The process of implementing the decision support system at farmer level is to follow the six steps outlined below. Within each, there is a further process/ methodology for how this can be achieved.

Basically, the decision process moves from; Farmer typology ➡ Aspirations ➡ Farming systems ➡ Practices ➡ Prioritized practices for experimentation.

This is a cyclical review, planning and action process.

1. ***Climate change:***
    a. Hotter, drier
    b. Rain variability, more intense

    Summarise external information and baseline assessments: agro-ecological zones, climate regimes (predictions, rainfall distribution, temperatures etc), socio-economic data social issues, land use options (farming systems)

2. ***Issues, constraints, risks, vulnerabilities, aspirations/priorities***

Community level climate change adaptation analysis
Farmer typologies (A,B,C)
Aspirations: Gardens, fields, livestock, trees

3. *Potential adaptive measures and criteria for assessment*

5 Categories of farming system (water, soil, crops, livestock, natural resources)

4. Practices

List of practices – filtered for farmer typology, aspiration, farming system

5. *Prioritization of practices for farmer innovation*

Ranking for implementation of farmer experimentation within existing practices using;

- *Farmer criteria*
- *Biophysical and climate criteria(rainfall, temperature, topography, soil)*
-

6. *Monitoring, review, re-planning*

Choice of visual (qualitative) and quantitative indicators for assessment by farmers and researchers
Assessment of adaptation and also impact

The diagram below summarises the above information

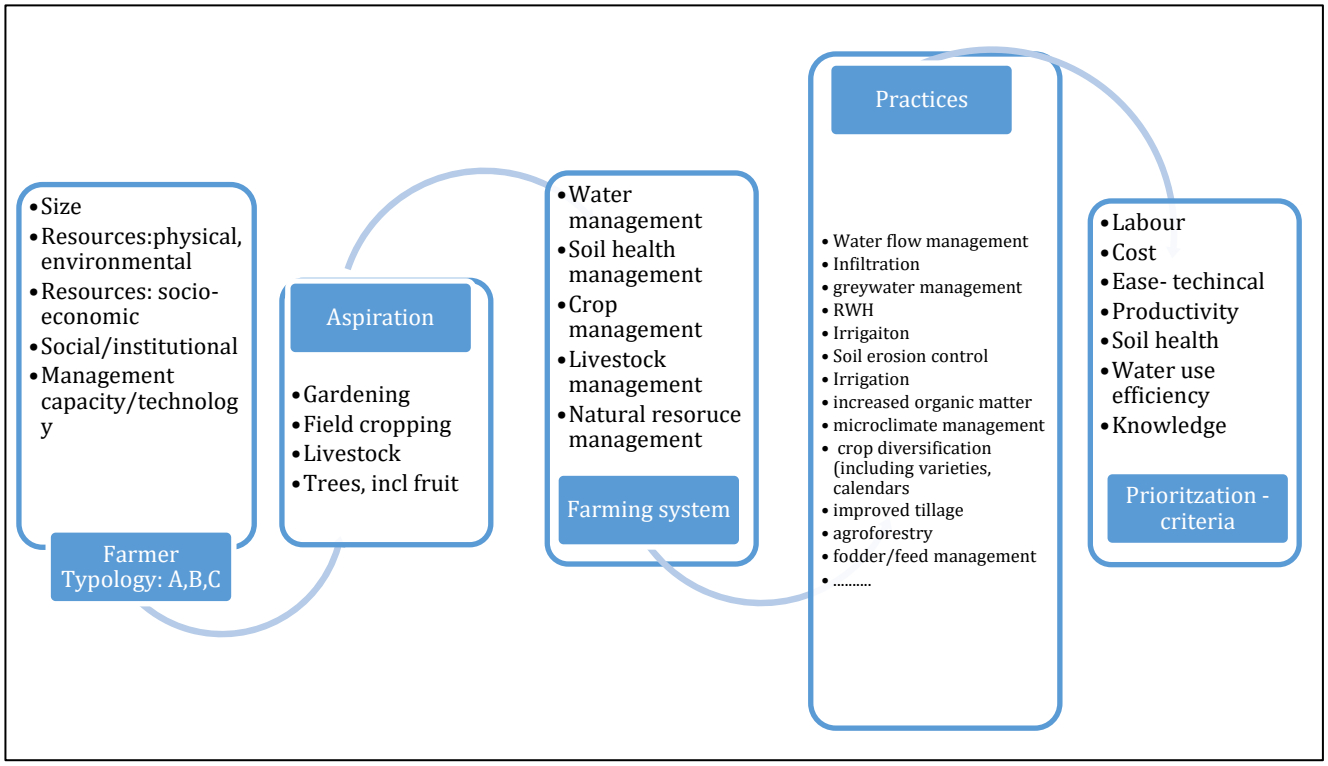


Figure 5: The DSS for smallholder farming systems

2.3 Issues, constraints, risks and vulnerabilities

2.3.1 Community level climate change adaptation analysis

In these community level workshops -dialogues; facilitation tools are to be designed that can assist in the analysis. These are to be carefully chosen to ensure an ability to differentiate between weather and climate change, unpack changes in the environment and livelihoods and those affected by climate change and impacts of these and current practices and adaptations already being implemented to respond to these changes.

Facilitation steps proposed are as follows:

1. Contextualization: Natural resources, need to look at climate change databases for KZN/EC/Limpopo, and discuss with people how these will affect them. Also look at the difference between variability in weather and climate change. NB! There is variability in weather and there is also a major change in that variability in weather, predictions and certainty (*Tools; impact picture, role plays,*
2. Exploration of temperature and rainfall and participants'' understanding of how these are changing *(Tool: Seasonal diagrams on temperature and rainfall – normal and how these are changing)*
3. Timeline in terms of agriculture *(Tool: livelihoods and farming timelines -assessment of past, present and future)*
4. Reality Map: changes (in natural resources), impacts (of changes), practices (past, present, future), challenges/responses (*Tool: Mind mapping of impacts)*
5. Current practices and responses (effectiveness of responses) (*Tool: outlining adaptive measures on mind map)*

Using these facilitation steps a workshop process has been designed (and tested). Below is a summary of the workshop outline:

1. What we are seeing around us, what has been happening (nature, economy, society, village, livelihoods, farming) *(list main issues (biophysical, social, economic) – with ranking of vulnerability*, *organisational mapping, financial flows and services mapping*,
2. Past, present, future of farming activities and livelihoods *(timelines and trends*)
3. Climate vs weather *(role play)*
4. Scientific understanding of climate change (*Power point input)*
5. Seasonality diagrams of temperature and rainfall – generally what it is, what is changing (*seasonality diagrams)*
6. Reality maps (choose temp, or rainfall): draw up mind maps of impacts *(mind mapping)*
7. Turn impacts in to priority goals (positive statements) and think through adaptive measures that we know of or think could work
8. Introduce a range of practices (facilitation team) related to these goals to broaden potential adaptive measures *(A4 picture summaries and power point presentations)*
9. Walkabouts and individual interviews (*transect walks, key informant interviews, mapping of local innovations/adaptations)*
10. Prioritization of practices – matrix using farmer level criteria for assessment *(matrix ranking and scoring)*
11. Planning of farmer experimentation, learning sessions and implementation of practices (*Individual experimentation outlines, lists)*

This process framework is explained in more detail in Section 3 below.

The facilitation process (Steps 1-10), have been piloted in four villages:

- 2 in Limpopo (Tzaneen, Hoedpsruit): **Sekororo** (Lima RDF - Mahlathini), Turkey- Sedawa Ext (AWARD-Mahlathini)
- 2 in KZN midlands (Estcourt, Bergville): **Thabamhlope** (Lima RDF-Mahlathini), Thamela (GrainSA-Mahlathini)

These villages were chosen so that 1 village in each province is already implementing food security and some CSA practices and the other is new to the idea of considering climate change adaptation in their farming.

2.3.2 Farmer typology

Individual interviews (10-20minimum), transect walks, household visits
Summarise and present in focus group discussions for review
Here farmers choose a category (A,B,C) within which they feel the most comfortable based on the following criteria;

- Head of household (male/female)
- No of adults
- No of children
- Dependency ratio
- Income sources
- Level of income
- Scale of operation; 0,1-1ha, 1-2(5) ha, > 2 (5) ha
- Farming activities; Aspirations – gardens, fields, livestock, trees
- Market access
- Other activities
- Resources
- Water access
- Infrastructure
- Knowledge and skills
- Literacy rate/ level of schooling
- Social organisation

This process was initiated and a sample of household interviews conducted in the four villages where the process has been piloted. From here the work will continue in fleshing out farmer typologies that make sense to local participants.

2.4 Potential adaptive measures and criteria for assessment

The matrix ranking exercise was conducted in two of the four pilot villages; the two villages where food security implementation is already under way. The practices chosen by the groups were assessed against the criteria using a simple scale of 1-3 where 1 is little/bad, 2 is medium or OK and 3 is good or a lot.

Below is a small table that compares the different criteria used by the participants in Limpopo and KZN. As can be seen there are a number of criteria used by all three groups and across both

provinces; including increased water availability, increased water access, costs, increased crop quality and labour requirements.

Table 2 :Community level criteria for assessment of CSA practices; Nov-Dec 2017

CRITERIA	Sekororo	Thabamhlophe (2 groups)	
Increased water availability/ water use efficiency			
Increased water access			
Increased soil fertility			
Costs			
Increased crop quality			
Labour			
Time taken for implementing practice			
Tools			
Availability of materials			
Fewer pests			

From these exercises it will be possible to outline a number of criteria which are common across different groups in different areas and work with these to fine tune categories of practices for the DSS. Criteria will also differ slightly depending which sets of practices are being compared.

Practices chosen by participants (as shown in the photos below) included: tower gardens, keyhole gardens, eco-circles, trench beds, mulching, intercropping, No -till (with planters and using hand hoes), underground storage tanks, jo-jo- tanks, diversion furrows, furrows and ridges, tunnels, lizard hotels (promotion of pest predators)

Clockwise from top left: Sekororo matrix of practices assessed against criteria and matrices for 2 groups in Thabamhlophe.

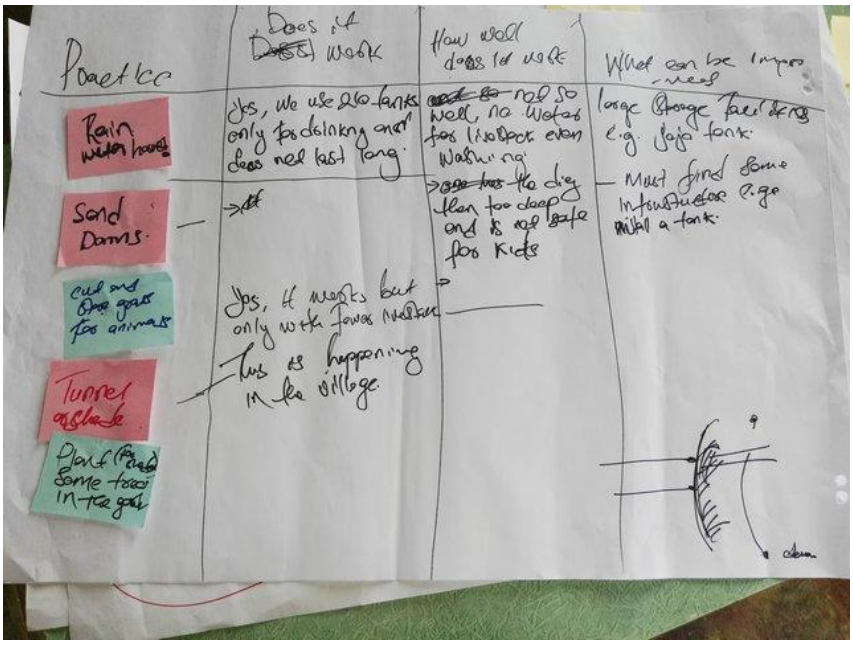
For the two new villages, it did not make sense to compare practices against each other without participants knowing much

about them. Here a slightly different process to elucidate criteria for assessment from participants would need to be designed. We tried out an exercise where participants did an assessment of practices they are already aware of in the village and asked them whether it works and if not why not to begin to tease out some of the criteria participants would use.

In Turkey for example the participants came up with the following analysis:

In this picture participants looked at rainwater harvesting, sand dams, cutting grass and storage for fodder for livestock, tunnels and planting indigenous trees in their gardens for shade.

Criteria they used here to assess how well these practices work in the village were; costs versus benefit, labour and safety.



Right: Picture of an analysis of local climate adaptation measures in Turkey (Hoedspruit, Limpopo, Nov 2017)

This is an ongoing process and will be explored further in the next round of workshops.

2.5 **Practices**

The database of practices that has been developed throughout deliverables 1 and 2 has been slightly expanded and tidied up. The inventory of practices has been updated and practices related to livestock management have been given some attention, as it is clear already from our interaction with communities that this is going to be a more central theme than initially anticipated. See Attachment: DSS Flowchart_20171218

Practices that have been suggested by participants which are not yet in the database (but will be included) are:

- Windbreaks
- Spring protection
- Strip cropping
- Fodder production (dryland and irrigated) and
- Biogas digesters

An A4 summary of each practice with pictures and criteria. These can be presented initially as an overview of options (related to what participants are prioritizing) and later used as the basis for information provision in learning events. A few examples are shown below

Mulching

- Rainfall: >150mm/year
- Temperature: >5°C
- Topography: 0-30%
- Soil: all types, and depths

- Gardens, fields
- <0,1ha
- Low cost, local resources
- Easy to do and maintain; labour intensive

DESCRIPTION

-Soil covered by a variety of crop residues and organic matter

- To save water, reduce soil temperatures, and increase soil health

Diversion ditches

- Rainfall: >150mm/year
- Temperature: >5°C
- Topography: 0-10%
- Soil: 5-35% clay, depth >15cm

- Gardens, fields
- <0,1ha, 0,1-1ha
- Low cost, local resources
- Easy to do and maintain; labour intensive

DESCRIPTION

- Ditches 30cm deep and 30cm wide are dug at a shallow gradient -1,5-3% to channel water to beds in the garden or field
- Planting can be done in the ridge, adding manure and compost
- And mulching of both ridges and ditches is a good idea

The process of working with the facilitation team to choose a small selection 5-8 practices to present to the participants in the workshop situation has worked well. Some form of prioritization is required (this will eventually happen through the DSS), as all practices cannot presented all at once to the group. These practices are based on the discussions on impacts and adaptive measures done on the first day of the workshop.

2.6 Prioritization of practices for farmer innovation

A process will be designed to assist individual farmers to prioritize practices for themselves that they would like to try and implement. This is likely to occur within the five categories (water management, soil management, crop management, livestock management and natural resources). Implementation of some practices of course require join activities, social organisation and agency and will be introduced and discussed in the learning group situation and supported through the CoPs in each site. These aspects will be focussed on in the deliverables following on from here. Aspects that will be considered include:

- Farmer experimentation

- Learning groups

- Individual choices of practices

- Discussion around researcher managed trials

- Local level monitoring

-Learning needs and sessions planning

- Associated issues; stakeholder relations

- Financial issues; VSLA (Village savings and loan associations)

2.7 Monitoring, review and re-planning

We need to clearly outline how the practices relate to the three principles of CSA and then how these three principles are used in monitoring

A. Increase in productivity
B. Increase resilience to climate change and variability
C. Reducing agriculture's contribution to climate change

To monitor indicators, use benchmarking/ validation/ threshold values. Develop ranges and scales for determination of applicability and impact. The initial steps in setting out experiments for both qualitative and quantitative measurements (for gardens and fields) have been put in place. This is discussed in more detail in Section 4 (Site selection) below.

2.8 Indicators

Physical and quantitative indicators (potential- to be linked to researcher managed trials)

Productivity

- Yield
- Soil fertility/ nutrient availability
- Water availability
- Infiltration rates
- Moisture holding capacity
- Soil carbon/ soil organic matter
- Diversification

Resilience

- Trends over time

- Diversity of practices
- Social agency
- Adaptability- awareness and response, system and farmer flexibility
- Robustness- soil health
- Reduced risk- reduced water demands

Carbon

- Soil management practices
- Crop and animal husbandry management
- Reduced carbon emissions-reduce mechanization, Extensive livestock production
- Increase carbon capture- reduction of veld burning, increase in SOM

3 PROCESS FRAMEWORK

By Temakholo Mathebula

3.1 Climate Smart Agriculture: Process Facilitation

3.1.1 Introduction

The introduction of climate smart agriculture (CSA) requires a clear understanding of its suitability, costs and benefits, and environmental implications in a local context. Hence, the approaches that aim to identify and prioritize locally appropriate CSA practices will need to address the context specific and multi-dimensional complexity in agricultural systems. When addressing complex challenges that cannot be solved by formal research alone and for which various stakeholders are required to identify solutions, more participatory and learning orientated approaches need to be applied. Stimulating stakeholder participation (government, NGO's, community members, researchers, extension practitioners) in the different stages of research will result in more relevant and effective solutions to challenges that will be addressed. Participation includes people's involvement in the decision making processes, program implementation, and information sharing as well program evaluation. Participatory tools can be used to incorporate people's ideas into development plans and empower them to acquire skills and knowledge to make more informed decisions. Incorporating participatory approaches will be of importance in the WRC CSA project as it will allow for deeper understanding of the realities in the communities across the three provinces, KwaZulu-Natal (KZN), Limpopo and Eastern Cape (EC) and thus the identification of relevant and context specific practices.

Process Facilitation

The initial phase of implementation of the WRC CSA project will include a study of climate change databases for KZN, EC and Limpopo to gain an understanding of the change in rainfall patterns and temperatures in the three provinces, which will be discussed with participants. Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) tools will be used in the contextualization of the realities and issues relating to climate change, local resources, farming practices and socio-economic status. The PRA/RRA tools to be used include a focus group discussion, community resource map, seasonal calendar, historical timeline, village walk and the ranking matrix. The expected outcome will be a greater understanding of farmer perceptions towards climate change, current practices and responses, prioritization of issues and the identification of the most relevant practices.

The process facilitation will be conducted over a period of two days. The first day will commence with a focus group discussion on climate change, its impacts and farmer responses to changes. The focus group will be followed by a group exercise of community resource mapping with the objective of graphically presenting the access to, control and distribution of resources. The third tool is a seasonal calendar of farming activities, depicting seasonal variations and periods of vulnerability. Lastly, a historical timeline will be used to depict changes in crop production over time and the factors driving these changes.

Day 1

Focus Group Discussion

A focus group discussion consists of people with similar concerns, share a common problem and purpose. It is used to obtain information that would not be expressed in a larger setting and the advantages of this tool are that a lot of information can be collected in a short space of time, the information gathered is grounded in the local setting, different views and perspectives are shared on one platform and sensitization and awareness raising to decision making on specific topics. The focus group discussion will seek to answer the following:

- What are the farmers' current understanding of climate change?
- Do farmers know the difference between climate change and weather variability?
- What does research say about climate change in their local context?
- What practices are they currently using?
- How effective are their current practices in mitigating the effects of climate change?
- What do the farmers foresee happening in the future based on what they are currently doing?
- What are their biggest challenges and who do they think can assist in addressing those challenges?

The focus group discussion will serve to give background information on existing paradigms regarding climate change and will allow for exploration and cross checking of different views.

Community Resource Map

A Community Resource Map is used to depict the occurrence, spatial distribution access to and utilization of resources. The group will draw a map showing rivers, forests, livelihoods, households and infrastructure and will include information they find relevant starting from a main reference point. The facilitator will not intervene once the drawing has begun as the purpose of this exercise will be for participants to depict their current situation as they see and perceive it. The map will be used for further analysis during the transect walk to help gain an understanding of how the participants picture their situation compared to what is actually taking place. The outcome of resource mapping will be to identify local resources and strengths within the community.

Table 3: Community resource map description and uses

Name of Tool	Community Resource Map
Description	Depicts information regarding the occurrence, distribution, access to and distribution of resources from the perspective of the participants
Uses	To identify links between resources, landmarks, households and activities Allows people to picture their resources and show their significance through drawing Identify resources, challenges and opportunities
Information gathered	Graphical presentation of how people view their environment, participants' analysis of their natural environment
Complementary tools	Transect walk, seasonal calendar
Time	1.5 to 2 hours

Seasonal Calendar

A seasonal calendar reflects the participants' concept of time and seasonal categories. The tool is useful in identifying main crops, planting sequences and the associated activities. It also allows for a plenary discussion regarding access to and control of resources between men and women and how gender roles impact uptake of practices. A period of a year is covered using a seasonal calendar,

but ideally a longer period of up to 18 months or more will give the full seasonal variations. Symbols can be used to show the different seasons. The facilitator will ask which phenomena (production, climate, social, economic, resource distribution etc.) fluctuate on a seasonal basis and these will be listed. Priority will be given to aspects which are clearly linked to the main focus of the research.

Table 4: Seasonal calendar description and uses

Name of Tool	Seasonal Calendar
Description	Visual method of showing the distribution of seasonally varying phenomena related to and influencing production
Uses	Gives insights into seasonal differences Highlights cause-and-effect relationships between seasonally varying phenomena Identify periods of the season where social groups are more or less vulnerable Identify coping and mitigation strategies used by participants to minimize risk
Information gathered	Seasonal variations in vulnerability, control of and access to resources, activities
Complementary tool	Ranking Matrix
Time	1.5 to 2 hours

Table 5:Seasonal calendar

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Temperature and Rainfall												
Crops												
Livestock												
Income and expenditure												
Social activities												
Illness and diseases												
Employment												

Historical Timeline

The historical timeline gives insight into specific changes over an extended period of time. The advantage of using this tool is that it links different issues in time, and helps participants identify significant changes in agricultural production over time. The timeline should return to the most distant point in time or as far as participants can remember as a starting point. Events are placed

in a vertical line that represent the timeline with the oldest event placed at the top. When the timeline is concluded, trends and important events will be discussed, i.e. changes in crop varieties, weather conditions, significant changes in yields and other important factors.

Day 2

Village Walk

The village walk is a walkabout with the aim to raise participants' awareness on the spatial distribution of agricultural resources and their management. A transect diagram depicting soil, topography, water access and natural resources is drawn up with their different uses and variations, associated challenges and opportunities. The walkabout is conducted along the largest diversity of areas and land uses. Questions to be answered during this activity are:

- Which resources are present (land uses, vegetation, crops)?
- Why are these resources present?
- How is labour distributed and who benefits from these resources?
- What changes have the participants observed in the past?

3.1.2 Design of the CCA community level workshop outline

By Erna Kruger

A number of smaller preparation session were undertaken prior to the joint process planning workshop – designed to set out the community level methodology and process for introducing the Climate Change concepts and the decision support process.

At the workshop a joint methodology was agreed upon and a process outline was developed.
The table below indicates the outline for 2 workshops to be conducted in KZN and thus names the team involved there. As a generic outline the team members will change, but the rest is meant to remain similar throughout.

Community level climate change adaptation exploration workshop outline					
DAY 1					
Time	**Activity**	**Process**	**Notes**	**Materials**	**Who**
9:00am	**INTRODUCTION**				
9:00-9:45am	Community and team introductions	In pairs, take 5 minutes to talk to each other. Then introduce each other to the group. Choose a person you don't know well (both team and community). [include Name and surname, farming activities (garden, field, livestock natural	Depending on the size of the group, this can take a long time. If time is short, then just do a quick round of intro's.	**Attendance register** - with columns for farming enterprises (so that each participant can tick what they do) - in English and Zulu/Pedi. **Name tags;** stickers, kokis	**Nozipho Facilitation:** Lindelwa **Recording:** Nozipho, Nonka

		resources), income from farming]			
	Purpose of the day	Introduction of the organisation/s and purpose of this workshop- link to already ongoing activities if possible and introduce visitors and other stakeholders involved	Talk to CC necessitating adaptation from us - we may need to change how we do things and what we do to - This w/s is to help us explore options for such changes	Flipstand, newsprint, kokis, data projector, screen, extension chords, plugs - double adaptors. Black refuse bags and masking tape (for blacking out windows), camera- and one person to undertake to take **photos** throughout the day. Extra batteries for camera and sim card	**Materials: Nozipho, Nonka** **Facilitation:** Lindelwa **Recording:** Nozipho, Nonka
9:50am	**PRESENT SITUATION**				
9:50-10:30am	Present livelihoods and farming situation - discuss impacts related to CC	Use a series of impact pictures- from the local situation . Include the 5 categories (and describe them to the group) - water management (increased efficiency and access), soil management (erosion control ,fertility, health), crops, livestock and natural resources	Impact pictures- either ppt or printed on A4 to facilitate dialogue (or both) Record community comments)	**Power point presentation pictures**	**Mazwi - ppt** **Facilitation**: Mazwi Nozipho, Nonka
10:30am	**PAST, PRESENT, FUTURE**				
10:30-11:30am	Discuss farming activities as they have changed , what they are now and what may happen in the future if the present trends continue	SMALL GROUPS (5-10people): facilitated discussion on farming activities (include the 5 categories) - prompt for all five and keep conversation focussed OR Facilitate a shorter plenary discussion on how things are changing (if time is pressing)	Important to note and record any discussions around changes and adaptations- so things people are already doing to accommodate for changes - also where they are not sure what to do	Small groups; each needs a facilitator and recorder (Mazwi, Phumzile, Lindelwa, Madondo) (Nonka, Nozipho, Tema),	**Facilitation**: Lindelwa **Recording**: Nozipho, Nonka
11:30am-12:00pm	**TEA**	Fruit (apples, oranges, biscuits, juice and water, paper cups (lots) and plates… Generous helpings - and lots of juice if it is hot. Find someone to be in charge of food and refreshments, while the rest of the workshop continues			Nozipo, Nonka, **Tema**
12:00am	**CLIMATE CHANGE PREDICTIONS**				

12:00 - 12:50pm	Summary of predictions for the locality (from scientific basis)[15min]	Present to group - using flipchart or power point - Keep it simple with brief bold statements that can be remembered. Include concepts of certainty - and CC scenarios - unmitigated, neutral and mitigated			**Facilitation:** Mazwi/Tema **Recording:** Nozipho, Nonka
	Weather vs Climate [10min]	Role play; phone conversation - weekend visit for weather, relocating to an area for seasonality/climate.	check in with participants how they understand the difference from the role play		**Facilitation:** Mazwi, Nonka
	Seasonality diagrams [25min]	SMALL GROUPS (5-10people): facilitated discussion on temperatures for each month of the year- in a normal year and then discuss how this is chaning and going to change. Start with the hottest month and then the coldest month as reference points	Do temperature frist or if the group is small and works quickly inlcude rainfall then on the same chart.	Easy to use kebab sticks bought from supermarket for this. Small groups; each needs a facilitator and recorder (Mazwi, Phumzile, Lindelwa, Madondo) (Nonka, Nozipho, Tema),	**Facilitation**: Lindelwa **Recording**: Nozipho, Nonka
1:00pm	**REALITY/IMPACT MAPS**				
1:00-2:00pm	Impact of CC mind map	SMALL GROUPS (5-10people): facilitated discussion - MIND MAP of livelihood and farming impacts (using the 5 categories) using Hotter (drier) as the starting point - LINKAGES between cards on the mind map - make arrows (and include more cards if need be and discuss (e.g. hotter soils, lead to poor germination lead to poor yields lead to hunger)	Prompt for social, economic, environmental impacts as well if these don't come up in the group…	Small groups; each needs a **facilitator and recorder** (Mazwi, Phumzile, Lindelwa, Madondo) (Nonka, Nozipho, Tema) **CARDS**- Coloured paper of differnet colours cut into squares	**Nozipho - prepare cards** **Facilitation**: Lindelwa **Recording**: Nozipho, Nonka
2:00-2:30pm	Possible adaptive measures	POSSIBLE SOLUTIONS: things that people know, have changed, have tried and or are trying to deal with the changes. Use different coloured cards to attach these solutions to the mind map. If participants are struggling then rephrase	Also make a separate list on newsprint of names of people trying things plus the innovation they are trying (this is to facilitate h/h visits on day 2)	The cards need to be written in local language with smaller translations in English written in on the cards as well (to avoid the need for alter translations)	**Facilitation**: Lindelwa **Recording**: Nozipho, Nonka

		the -ve impact statements into a +ve outcome and ask what actions are possible.			
2:30-2:45pm	**CLOSURE**	REPORT BACKS - of possible solutions PLANNING FOR DAY 2 - choose 3-4 participants for household visits and ask for a small group of other interested individuals to join. Decide on venue and time (12 noon) for continuing with practices	Households to be within walking distance hopefully. Otherwise drive these 3-4 participants around and meet for focus group thereafter	Rapporteurs need to be chosen from the group to summarise the solutions in the report backs [5min/group]	**Facilitation**: Lindelwa **Recording**: Nozipho, Nonka
	LUNCH Local catering groups to provide meals - ~R45 per head (Rice and stew with one veg… or something similar-)				**Tema**, Nonka, Nozipho
DAY 2					
9:00am	**HOUSEHOLD VISITS**				
9:00 am-12:00pm		To look at local adaptations and innovations To assess the household situations To start to elucidate criteria people use to make choices and decisions	Use questionnaire and fill in through semi structured interview and observations	Questionnaires to contain the following info: • Head of household (male/female) • No of adults • No of children (dependency ratio) • Income sources • Level of income • Scale of operation; 0,1-1ha, 1-2(5)ha, > 2 (5)ha • Farming activities; Aspirations – gardens, fields, livestock ,trees • Market access • Other activities • Resources • Water access • Infrastructure • Knowledge and skills • Literacy rate • Social organisation	**Nozipho finalise and print out questionnaires** **Facilitation**: Mazwi, Lindelwa, Phumzile **Recording**: Tema, Nozipho, Nonka
		Team meets in evening (BEFORE DAY 2) to discuss mind maps and lists of solutions and choose a range of practices from the database to present. (5-10) Also, summarise criteria that came from the household visit discussions			

	TEA	Packed tea for on the go to share with household members			
12:00	**PRACTICES**				
12:00-1:00pm	New ideas/ practices/ innovations	Recap and summary of day 1 Introduce a selection of new practices _power point and A4s (chosen the night before by facilitation team to match the general sense of what participants need ideas for or what they are trying (to improve upon those). Provide descriptions and get questions and comments	Select the 5-10 practices beforehand and make sure there are 3-4 copies of the A4s for the small groups and or a power point presentation - **record comments from participants**	Sets of practices (A 4s), attendance registers	**Materials: Nozipho** **Facilitation**: Lindelwa **Recording**: Nozipho, Nonka
1:00-1:20pm	Criteria for selection of practices	In plenary present criteria, discuss with group and add more (prompt for criteria to relate to five categories (e.g., saving and using water well, increasing access to water, improving organic matter, increasing soil health, increasing natural resources.... etc) along with criteria like cost, labour, time....	Choose 5-7/8 criteria max. Some criteria can be made from two into one…	Flipchart, newsprint, kokis	**Facilitation**: Mazwi/ Lindelwa **Recording**: Nozipho, Nonka
1:20 - 2:00pm	Prioritization of practices	SMALL GROUPS: Choose a selection of practices from their own suggestions and new ideas presented (5-10) and assess them using the criteria chosen in a matrix.	Let the group decided for each square using a scale of 0-2 where 0 = bad or little, 1=ok to medium and 2 = a lot to good.	Newsprint, kokis. Small group facilitator and recorder (Mazwi, Phumzile, Lindelwa, Madondo) (Nonka, Nozipho, Tema)	**Facilitation**: Mazwi/ Tema **Recording**: Nozipho, Nonka
2:00pm	**WAY FORWARD**				
2:00-2:30pm		Each individual choses their practices Set up sessions in January to refine choices and start on demonstrations and training in implementation of practices and farmer experimentation Choose 'volunteers' for the 4 proposed tunnels for joint /group	Learning sessions 16-24 January, tunnels training sometime in February (Order by December)	Put together a list for each small group for each individual to record their name, surname, tel /cell phone and practices	**Tunnels: Sylvester - order collect** **Practices list: Nozipho** **Facilitation:** Mazwi/ Tema

		experimentation per site			
	LUNCH Local catering groups to provide meals - ~R45 per head (Rice and stew with one veg… or something similar-)				**Tema**, Nonka, Nozipho
	CLIMATE CHANGE PREDICTIONS:				
	Hotter	1-4 degrees Celcius	For every month of the year	HIGH probability/ Certainty	
	Less rain	Similar amount of rain but over a shorter period of time (fewer rainy days per season)	This will lead to an overall drying effect in the environment	MEDIUM certainty	
		Ggreater intensity of rainfall			
		More rain in spring and or more rain in summer	Storms	LOW certainty	
	Longer term	Greater frequency of droughts under scenarios 1 and 2		Scenario 1 - Business as usual; Scenario 2 - Stabilise emissions; Scenario- 3-Reduce emissions	
		Greater frequency of extreme rainfall events under scenarios 1 and 2			

This was followed by a Facilitation Learning event (training of trainers), to train facilitators from all three NGOs presently involved in use of the methodology and process
This included specific practical learning of the participatory techniques such a seasonality diagrams, mind mapping, ranking and matrices.

One session was held with facilitators in KZN (13 November 2017)- (Lindelwa Ndaba (Lima), and the Mahlathini team (Mazwi Dlamini, Phumzile Ngcobo, Temakholo Mathebula, Nozipho Zwane, Khethiwe Mthethwa and Nonkanyiso Zondi) and one in Limpopo (27 November 2017)-(Karabo Makgoba (Lima) and the Mahlathini team for Limpopo (Sylvester Selala, Nozipho Zwane and Temakholo Mathebula).

3.2 Testing the process

As mentioned this was done in four villages; 2 in Limpopo and KZN respectively, where 1 village in each area has been implementing CCA or food security projects and one is 'new"

See Appendix 3 (Section 9) for an example of a workshop run in Limpopo (Sekororo).

In summary the process has helped to elucidate and analyse a wealth of information from smallholder farmers and it has worked well as the beginnings of a decision support process around practices;

especially in areas where participants have some familiarity with at least some of the practices. Next steps are to strengthen the process and continue with the informed decision making and farmer experimentation process.

In KZN, in one of the "new" villages we worked in Thamela in Bergville – participants had no concept of climate change to work from. Their conception of weather variability is locked into local belief systems of weather magic. In this case it was not possible to employ the process designed to it's best benefit and alternate processes need to be put in place for such situations in future.

4 SITE SELECTION

4.1 Introduction

Site selection for the first iteration (2018) or cycle of testing the DSS has been done.

Province	Site 1	Site 2
KZN	Bergville: Eibomvini, Thamela (Mahlathini, GrainSA)	Estcourt: Thabamhlophe (Lima, Mahlathini)
Limpopo	Hoedspruit: Sedawa, Turkey (Mahlathini, AWARD)	Tzaneen: Sekororo (Lima, Mahlathini)
EC	Fort Cox: Imvutho Buboni Learning Network (Amanzi for Food, Mahlathini)	

Quantitative measurements for garden and field cropping are to be conducted in KZN and Bergville in this coming season

4.2 Work Plan for measurements for KZN and Limpopo for 2017/2018 season

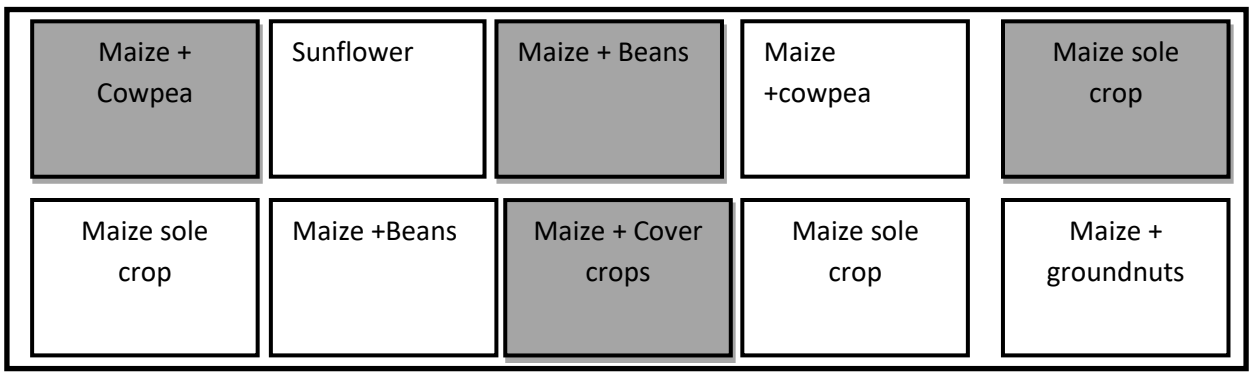
By Sylvester Selala

Three mother sites for both dry land farming and vegetable gardening will be selected in each province (KZN, Limpopo and EC). A mother site is described as semi controlled experimental site where experimental units are selected following specified methods (e.g. randomized block design) which are also supported by the farmer. Several indicator sites will be selected in each of the villages where there is a mother site. Indicator sites are those sites where farmers are experimenting with similar concepts but under uncontrolled environments. Indicator sites will allow us to develop proxies or indicators which can be used to measure some of the parameters locally.

4.2.1 Plot layout

The mother sites for dry land farming will be selected in three different villages and the plot layout shown below is an example of the experimental design, designed following a randomized block design.

This example is based on the design for CA plots in the mother site in Sedawa village and plots highlighted in grey indicate where runoff plots will be installed. One of the runoff plots will be installed in the control plot (conventional tillage plot). At a minimum, most of the soil water measurements (e.g. gravimetric water content) are going to be taken in the highlighted plots. Measurements for soil properties (e.g. bulk density, texture, structure, fertility and health) will be taken for all ten plots.



5 Lab-Lab beans	4 Maize sole crop	3 Maize sole crop	2. Maize +Beans	1 Maize sole crop w WCC
6 Maize +Cowpeas	7 Maize +Cowpeas	8 Beans sole crop	9 SCC – summer cover crops	10 Maize sole crop

4.2.2 Participants for dryland cropping and gardening in KZN and Limpopo

The table below outlines the sites selected for both dry land farming and vegetable gardening in KZN and Limpopo. Conservation Agriculture (CA) plots in KZN were planted in the last week of November while the ones in Limpopo were planted in early to mid- December 2017.

Table 6: Participants in quantitative measurements for trials; KZN and Limpopo

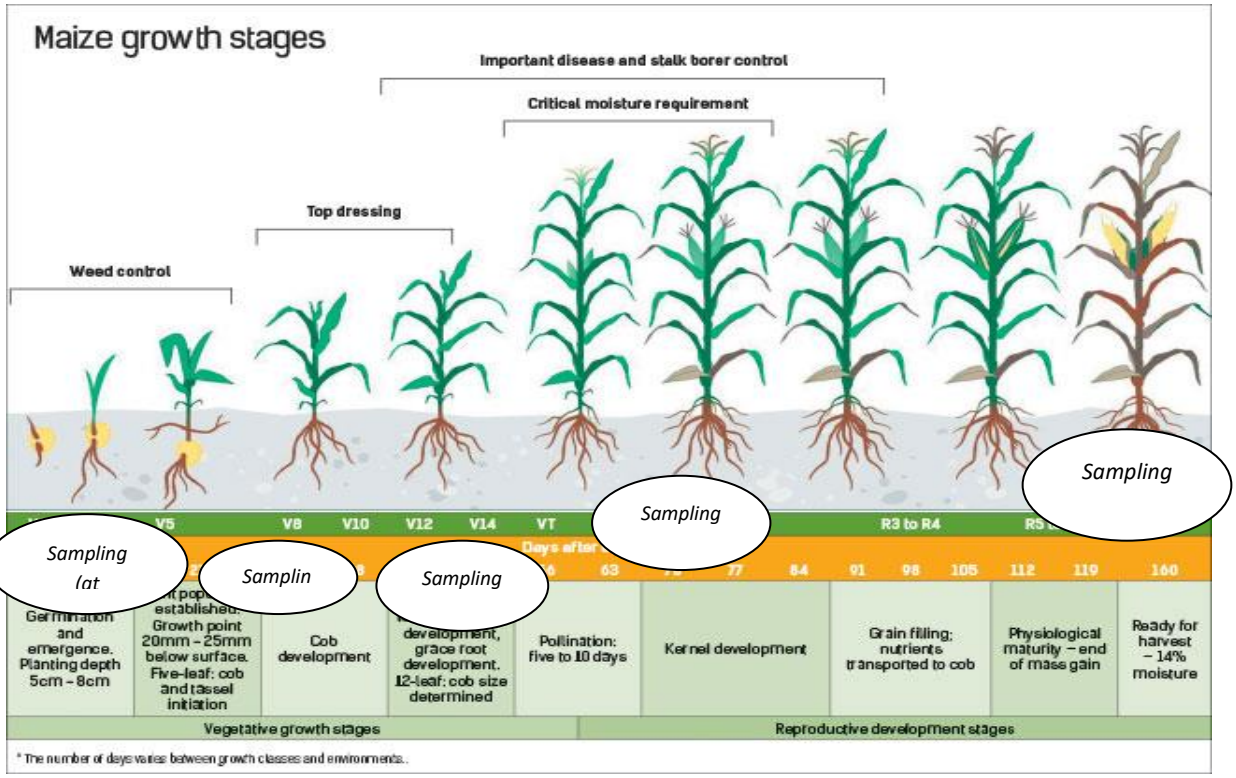
Province	Category	Name of participants	Name of village	Date of planting
Limpopo	Field cropping	Koko Maphori	Sedawa	05/12/2017
		Moruti Sekgobela	Mametja	06/12/2017
		Mariam Malepe	Botshabelo	07/12/2017
	Gardening	Christinah Tobetjane	Sedawa	11 – 15 Dec 2017
		Norah Malepe	Mametja	11 – 15 Dec 2017
		Mariam Malepe	Botshabelo	11 – 15 Dec 2017
KwaZulu-Natal	Field cropping	Ntombake Zikode	Eqeleni	20-24 Nov 2017
		Phumelele Hlongwane	Ezimbomzini	20-24 Nov 2017
		Phumzile Zimba	Mhlwazini	20-24 Nov 2017
	Gardening	Smephi Hlatswayo	Eqeleni	27-30 Nov 2017
		Phumelele Hlongwane	Ezibomvini	27-30 Nov 2017
			Thamela	27-30 Nov 2017

Table 7: Measurements to be taken for the gardening trials

Parameter	Instruments	Dates
Soil moisture	Chameleon water sensors	On going
Amount of water applied	Measuring cylinder	On going
Rainfall	Rain gauge	On going
Weighing of the harvest	Weighing scale	On going
Rand value of the harvest	Local market price	At harvest

4.2.3 Soil and Water Measurements

The diagram bellow shows different stages of crop development at which gravimetric water content will be taken. The table following the diagram shows the dates when measurements are going to be taken.



The workplan with specific dates for gravimetric soil samples is shown below

	Dates	Planting	End of establishment (20-30days)	Vegetative growth phase(40-50 days)	Tasseling (60-70 days)	Physiological maturity (120-150 days)
Limpopo	4 – 8 Dec 2017					
	8 Jan 2018					
	20 – 22 Jan 2018					
	8 – 9 Feb 2018					
	9 – 13 April 2018					
KwaZulu-Natal	20 – 27 Nov 201					
	4 – 8 Jan 2018					
	20 – 22 Jan 2018					
	8 – 9 Feb 2018					
	9 – 13 April 2018					

Soil property measurements to be taken are shown in the small table below

Property	Lab/ Field measurements	Frequency	Instruments / equipment
Soil structure	Lab	Once off	Mean weigh diameter
Soil texture	lab	Once off	Hydrometer
Bulk density	lab	At the beginning and at harvest	Cylindrical cores
Soil fertility	Lab	At the beginning and at harvest	Cedara
Soil health	lab	At the beginning and at harvest	WARD labs
Infiltration	field	Once off	Double ring infiltrometer
Saturated hydraulic conductivity		Once off	Guelph permeameter
Retentivity curve	Lab	Once off	
Biomass	lab	At harvest	Weighing and drying

Progress to date

- Gardening experiments for KZN have not be designed yet (this would be design after a workshop on tunnel and drip kit design)
- Installation of runoff plots automatic weather station and runoff plots in KZN sites is yet to happen
- Installation of weather station in KZN site, to confirm with Jon
- Installation of rain gauges in KZN is completed, farmers are taking rainfall measurements
- Measurements for soil properties and soil moisture content (gravimetric water content) in KZN is delayed (this will only take place in the week of the 4th to 8th December 2017.
- Planting of trial and Installation rain gauges and runoff plots, as well as collection of gravimetric water content samples in the Limpopo sites to take place in the week of 4th to 8th December 2017.
- Installation of automatic weather station in the Limpopo site (week of 11th to 15th December 2017)
- Installation of water sensors in tunnels in the Limpopo site (week of 11th to 15th December 2017)

4.2.4 Budget for quantitative measurements

This budget has been adjusted to suite the overall budget available better. Instrumentation has been bought and installed in the Limpopo site and will be finalised in KZN by end -January 2018

WRC Quantitative measurements budget			**November 2017**
	Equipment		
Item	**unit price**	**Quantity**	**Total**
Hydrometer	R0,00	1	R0,00
Cylindrical cores	R0,00	1	R0,00
Double ring infiltrometer	R620,00	2	R1 240,00

Geulph permeameter	R0,00	1	R0,00
Watermark	R855,00	0	R0,00
Temperature Sensors	R996,00	0	R0,00
Loggers	R135,00	0	R0,00
Hobo Pro Software and USB cable	R2 200,00	0	R0,00
Davis Weather Station	R20 557,50	2	R41 115,00
Repair anemometer on Davis Weather station	R580,00	1	R580,00
Rain gauges	R125,50	15	R1 882,50
Runoff plots	R1 062,50	45	R47 812,50
Soil fertility test	R90,00	100	R9 000,00
Auger	R1 200,00	2	R2 400,00
Soil health indicators (GrainSA)	R1 000,00	0	R0,00
			R104 030,00

5 COMMUNICATION STRATEGY

By Lawrence Sisitka, Temakholo Mathebula and Khethiwe Mthethwa

5.1 Introduction and Background

One way to describe communication is that it is a process of acquiring, interpreting, and disseminating information to all relevant stakeholders. Communication is the lifeblood of any project as it allows the project team to collaborate, share, integrate and organise information in order to realise project objectives (Ylitovia, 2015). In the WRC-CSA project, which involves many different stakeholders, i.e. government departments, NGO's, community participants, extension practitioners and researchers, effective communication is of vital importance as collaboration will be pivotal in the successful implementation of the project. At the most basic level, communication consists of three different components, namely the transmitter, communication medium and the receiver. The effectiveness of communication is determined by how well the transmitter/sender communicates a message and on how well the receiver decodes/interprets that message. Communication includes message transmission as well as feedback on the message that was transmitted. Feedback is important in communication as it lets the sender know that the message was transmitted successfully. If feedback is delayed, or not transmitted, communication interventions will be required to enhance communication in order to prevent ineffective communication (Zulch, 2014).

In order to come up with effective communication processes for the WRC-CSA project, there first needs to be an understanding of what the project requires from its communication system and which channels or communication methods will be most effective in meeting these requirements. A communication plan can be used as a systematic and practical way of keeping all stakeholders informed and making the project visible throughout its duration (Kerzna and Belack, 2010). There are five primary questions asked in the communication plan to give clarity about the flow of information.

1. Who is the transmitter/sender/primary source of information?
2. What information needs to be communicated?
3. When does this information need to shared/disseminated?
4. What feedback has been received on the information that was transmitted? This step is important as it provides insight as to whether the information was communicated successfully and presents an opportunity to enhance/improve communication
5. What are the mediums of communication?

5.1.1 Levels of Communication

Internal Communication

According to Zulch, 2015, internal and external communication are the two primary levels of communication. Internal project communication is made of the project team which is responsible for carrying out the goals and objectives of the project. The project team requires more regular communication at every phase of the project and is usually made up of a diverse group of stakeholders that can be geographically dispersed, have different educational backgrounds, speak different languages and have different working methods and habits. A diverse project team means that there may be more challenges in implementing the project successfully, especially if some

project team members have not met each other. Project communication becomes more challenging with bigger and geographically dispersed project teams (Karzner & Belack, 2010). The WRC-CSA project is being implemented in three different provinces, namely KZN, Eastern Cape and Limpopo and has diverse team of engineers, researchers, field workers and community participants from different organisations. The challenge for the project will be integrating the project goals with existing programs and schedules of each organisation. Effective communication methods will thus be pivotal in the successful implementation of the project. Effective internal communication requires that every member of the project team is aware of the project goals, their specific roles and responsibilities as well as the relevant internal communication channels. Being aware of and adhering to time frames is important in internal communication. Internal communication involves various communication tools such as oral, written, electronic and visual communication (Ramsig, 2009).

External Communication

Communication does not function in isolation but is a process. External communication which is the second level of communication refers to how the organisation responsible for project implementation interacts with the outside world which includes external stakeholders, media and the general public (Ylitovia, 2015). External stakeholders are individuals/organisations outside the organisation that affect or are affected by the project. Disappointments in many development projects occur as a result of poor stakeholder collaboration during project implementation. Working with external stakeholders is never an easy process as it comes with added challenges of different goals and interests, different timelines, budget allocations and even political affiliations. This adds to the complexity of effective project implementation (Zulch, 2014). Effective communication with external stakeholders can be achieved by clearly outlining the interests of the different stakeholders at the beginning of the project as well as the roles and responsibilities of each stakeholder. External stakeholders for the WRC-CSA project include extension workers, NGO's, local councillors, local authorities (chiefs) as well as local/district municipalities. Communication through media and the general public is the component of external communication that conveys the image of an organisation to the outside world which is also known as corporate communication. Corporate communication is crucial in disseminating important information with outside audiences. Often this type of communication requires institutional communication, good networking skills and exceptional writing skills.

Communication for Community Development

FAO, 2014 defines communication for social development (ComDev) as a communication approach that involves the systematic use of participatory rural appraisal tools and methods, combined with community media and ICT's with the aim to maximize impact, cost effectiveness and the social sustainability of community development programs. ComDev is important in multi-stakeholder projects involving rural communities as the success of these projects is highly dependent on the local's people's perceptions and willingness to change. ComDev communication ensures that the local people's cultures, knowledge and capabilities are taken into consideration when formulating project plans. If the project aims to empower rural stakeholders at the field level, then ComDev is an appropriate approach to communication. The skills of rural practitioners with solid experience in addressing rural issues are essential in the ComDev strategy (FAO, 2014)

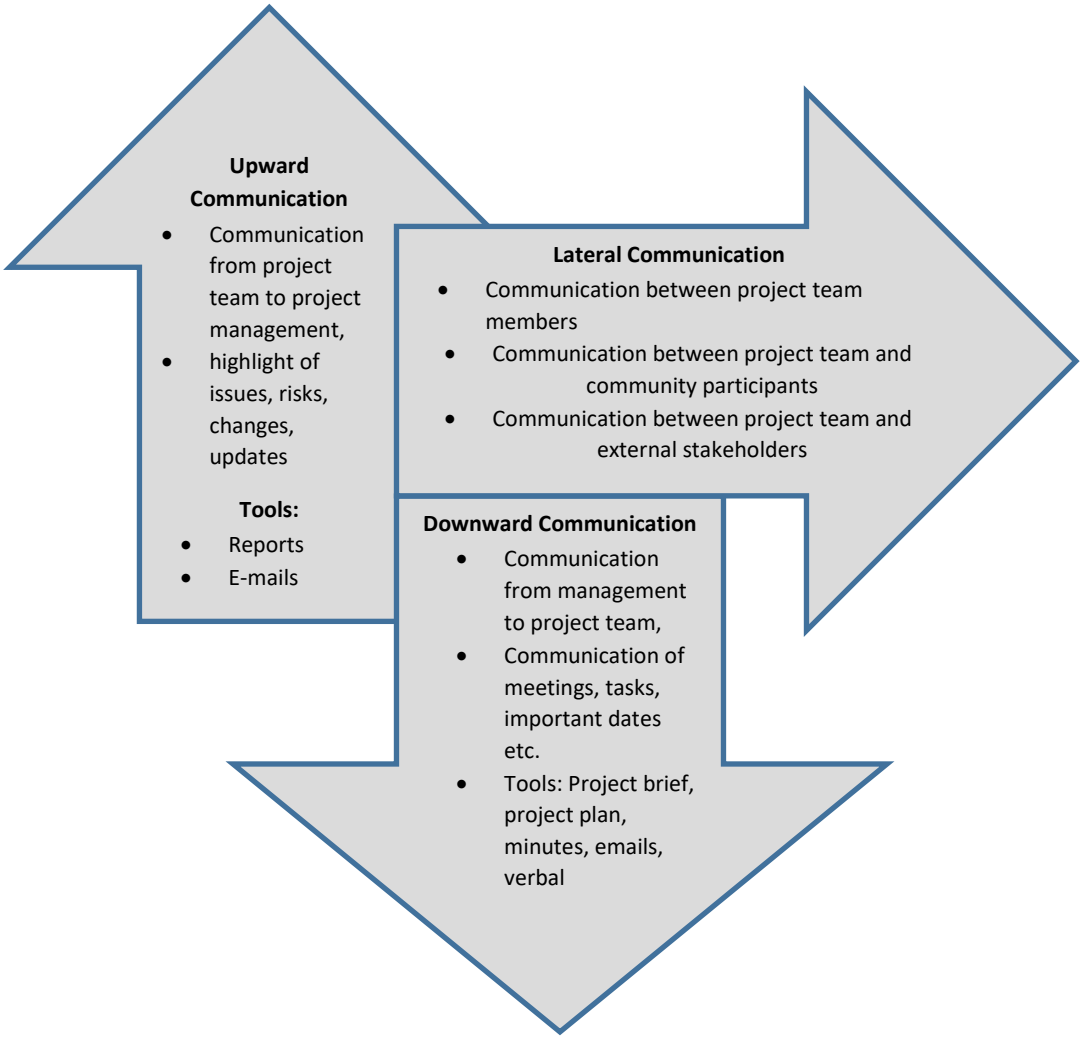
In order to successfully address the present challenges in agriculture solutions must be shared based collective decision making. Historically, top down approaches to development have been ineffective in bringing about meaningful change. There is a need for deliberate and systematic involvement of various stakeholders, especially rural participants in every phase of project implementation (Zulch, 2014). In terms of climate change, coping with shocks and stresses from unfavourable weather conditions requires a significant amount of information and relevant knowledge as well as collective efforts to make rural farming systems more resilient to the negative effects of climate change. Access to technology is not an end to itself but aims to bring out the beliefs and perceptions of rural people which inform their current practices and livelihood strategies (FAO, 2014). Community Development can be integrated into the whole project cycle and if applied effectively it will be instrumental in project accountability and effectiveness. It will serve as a means for rural participants to make their voices heard and thus contribute to bringing about meaningful change. Moreover, Community Development is flexible enough to be incorporated into a project at a later stage or even at the end but is most effective when integrated into the project from the initiation phase.

Table 1: Different types of Communication in Project Implementation

Type of Communication	Purpose	Functions	Limitations/challenges	Core Competencies
Internal Communication	Facilitate communication within a project. The flow of information between project team members	Punctual and effective sharing of information Enhance synergy Avoid duplication	Integrating project plans into existing projects/programs Different educational backgrounds, interests, work methods and habits amongst team members More difficult to manage for diverse project team in different geographical areas	Institutional communication, good writing skills, internet and web skills
External Communication	Facilitate the flow of information between project team and external stakeholders that affect or affected by the project	Improve stakeholder relations Establish new relationships Mutual program support Avoid duplication	Different stakeholders have different goals, interests, timeframes and budget allocations Becoming territorial Competition Political affiliations	Excellent written and verbal communication Diplomacy Patience
Corporate communication	Communication of project mission to external audiences	Use the media To promote project mission, share relevant information with external stakeholders	Media platform used may not reach all the intended participants.	Institutional communication, media contacts, good verbal and writing skills
Communication for Development	Aims to bring about meaning change through empowerment of key stakeholders	Allows Equitable access to information Encourages participation Multi stakeholder dialogue Collective action	Not as effective when introduced later in project cycle	Communication research Participatory approaches Community media, communication and facilitation skills

Channels of Communication

There are three main channels of communication which are important in understanding the flow of information in a project, mainly upward, downward and lateral communication. At the initiation phase of every project it is important to identify how information will flow and how it will be managed as well as which type of communication medium will be used in disseminating information (Zulch, 2014). According to Ylitovia 2015, downward communication flows from top to bottom is the most important in terms of internal communication as it involves communication with all project team members involved in the project. Downward communication involves a lot of direct communication through face-to-face discussion and project meetings between the project manager and the project team. Upward communication flows from the bottom to the top and its primary function is to keep the decision making parties informed. Lateral communication refers to communication between the project leaders and the external stakeholders involved (Ramsing, 2009).



5.2 The Need for a Communication Strategy

The full title of this WRC-CSA project is: Collaborative knowledge creation and mediation strategies for the dissemination of Water and soil conservation practices and Climate Smart Agriculture in smallholder farming systems. This indicates clearly that collaboration and mediation are key components of the project as is the dissemination of the outcomes of these processes. The implication is clearly that the project will interact with and need to communicate with a range of different groups.

One of the critical factors determining the effectiveness of any participatory research activity, such as the WRC–CSA project, is the strength of communication both internally, between project partners, and externally in terms of sharing the lessons from the project. Without effective communication much of the value of any research programme can be lost, and in particular, where the programme includes a practical implementation component, the effectiveness of this is very likely to be compromised. The very notion of 'participation' itself implies the need for good communication, as real effective collaboration is impossible unless communication between the partners is clear and consistent.

The means of communication between different parties in different contexts can also vary considerably, and while there are ever-increasing opportunities for communication, especially through various ICT media, these are not always either accessible or favoured by all groups or individuals. It is therefore important to understand which communication media are most used and most trusted by different parties. For example, at a local level, between farmers, a face-to-face discussion is generally the preferred means of communicating; indeed this is perhaps true for most people. However this is rarely possible, and more distant communication media need to be employed as appropriate in the many different contexts in which the project is functioning.

While much discussion of communication here will focus on the technical means through which communication can be maintained, the critical factor is not the technology, although that is important, but rather the willingness and openness to communicate. Communication cannot simply be left to chance and needs to be approached proactively, based on a good understanding, as discussed above, of the different preferences of the various partners and stakeholders. Communication should be viewed as a vital element in any collaborative venture and approached with the rigour applied to all other aspects. This will also require identification and allocation of specific responsibilities among the project team in relation to establishing and maintaining effective communication with different interest groups. For the WRC–CSA project, therefore, it is necessary to establish clear guidelines for communicating with the various partners and stakeholders. Hence the need for a Communication Strategy.

While such a strategy will focus primarily on communication between the project and partners and stakeholders, an important additional element will be the opportunity to establish communication between the partners themselves and between them and other stakeholders. It is through such a communication matrix that a dynamic Learning Network can be developed.

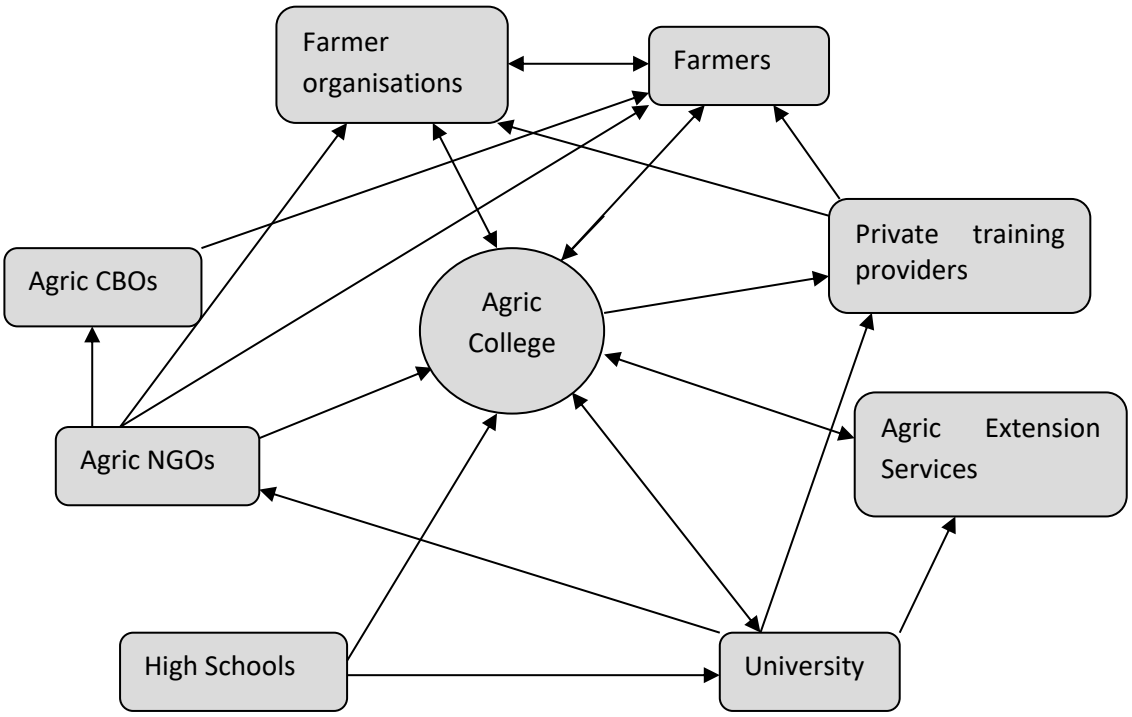


Figure 6: Simplified model of the Imvotho Bubomi Learning Network, Middledrift Area, Eastern Cape

At this stage in the project the finer details of the communication strategy cannot be completed, until all partners and their preferred methods of communicating have been identified, but the foundation can be laid with a discussion of the key options, including direct contact, various cell phone/smart phone options, computer and internet-based options, and local/community radio/television and print media.

5.2.1 Partners and Stakeholders

The WRC-CSA project will interact with a wide range of people, both as collaborative partners, and, more widely, as interested parties and stakeholders in the agricultural and academic sectors. While it is not possible at this stage in the project to identify each of these groups specifically, it should be possible to highlight the key groups likely to fall within the project's ambit.

Collaborative Partners

It is intended during the implementation of the project to work directly with a number of different groups:

*Smallholder Farmer*s – these are the primary partners in the project, and it will be crucial to maintain continuous and consistent communication with them. As they will be based in 3 distinct and separate areas a number of different communication media will need to be utilised.

Farmer Associations and other Community Based Organisations (CBOs) – Many of the smallholder farmers will be members of farmer associations or other groups such as women's groups, youth groups, church groups etc. While not all members of such groups will be collaborating directly with

the project, they can be considered secondary partners, and it will be necessary to develop means of communicating with them, as part of the dissemination component of the project

Agricultural Extension (or Advice[1]) Services – these have the mandate to support smallholder farmers, and their direct involvement is crucial for the long-term sustainability of the activities and practices developed through the project. They may have a key role to play in monitoring progress with the practices. They have internet access which provides more options for communication.

Non-governmental organisations (NGOs) – Many of the smallholder farmers are likely to be supported by other projects facilitated by agricultural and rural development focussed NGOs. Their involvement, too, is vital for the effectiveness of the project activities, as they are likely to be key partners in developing relationships with the smallholder farmers and facilitating the processes leading to the implementation of the practices. They may also have a role to play in monitoring activities. NGOs may be connected through quite sophisticated communication media.

Agricultural Training Institutes (ATIs[2]), University Agricultural Faculties, Agricultural High Schools – In some areas it may be that the smallholder farmers are interacting with and being supported by different agricultural training institutions, and where this is the case it is essential that these are also brought into partnership with the project. Where this takes place, there will need to be good communication with the institutions, which should have effective internet connections to facilitate such communication.

The Water Research Commission (WRC) – The WRC is clearly a key partner, and the formal channels of communication are enshrined in the contractual relationship between the commission and the project. However there may be other opportunities for less formal but valuable communications between the two.

Interested Parties and Stakeholders

The dissemination of the experiences and understandings gained through the project's activities is a central component of the project's work. This will involve making these available to a wide audience of parties with interests in and responsibilities for agricultural development, particularly in South Africa, but also possibly within the SADC region and beyond.

Academic and Research Institutions, including the Agricultural Research Council (ARC) – such institutions with a particular focus on agricultural development and/or food security should benefit greatly from access to the experiences and outcomes of the project. These need to be communicated appropriately in both formal and informal ways.

Government Departments – Agriculture is a provincial and national mandate, although local municipalities will also have officials with an agricultural brief. The national departments of Water and Sanitation (DWS) and Environmental Affairs and Tourism, and their provincial counterparts should also have interests in the outcomes of the project. Departments concerned with social development and local economic development at all government levels would also benefit from the project's experiences. It is important that as many relevant officials in these and other departments have access to information generated by the project.

[1] There is a current trend for Agricultural Extension Officers to be known as Agricultural Advisors

[2] Formerly Agricultural Colleges. Some are also called Agricultural and Rural Development Institutes (ARDIs)

The NGO community – while the project is likely to interact directly with some local and even national NGOs active in the areas where the project is working, other NGOs, including international NGOs, operating in related fields would benefit from the lessons learned by the project. The communication strategy should ensure that they, too, have access to the key findings.

International research and development organisations – the project is responding to a growing interest in CSA being explored and promoted by a range of international players, from the Food and Agriculture Organisation (FAO) of the United Nations, to the Climate Change, Agriculture and Food Security (CCAFS) research programme under CIAT (International Centre for Tropical Agriculture) and other global research programmes. Links to these and other such organisations need be included within a comprehensive communication strategy.

5.3 Promotion and Sharing of the Decision Support System

One of the key outputs of the WRC-CSA project is a Decision Support System (DSS). This is the main focus of this Deliverable and the key elements of the DSS are described in detail in different sections of this report. The aim of the project is to develop the DSS, pilot it with the farmers' groups with which it is working and then make it available to others who wish to use it. As described elsewhere in this document, the DSS comprises essentially two distinct components: a technical component providing technical guidance on the selection of appropriate CSA options for farmers; and a facilitation component guiding the process for facilitating farmers' use of the DSS. While ideally farmers should be able to access and use the DSS independently, the reality is that many, if not most of them, will require some facilitated support in order to do this effectively. It therefore becomes necessary to identify means of promoting and sharing both components of the DSS as widely as possible.

5.3.1 Potential Users of the DSS

The ultimate end-users of the DSS are the smallholder farmers themselves, and they will need to access it in forms which are appropriate to their various contexts and situations. They may do this as individuals or as collectives such as farmers' associations, or in concert with local community-based organisations (CBOs). Other key users are likely to be the facilitating agencies which may support the farmers in their use of the DSS. These will include primarily agriculture and rural development focussed non-governmental organisations (NGOs) and government agricultural extension and advisory services. It is hoped that Agricultural Training Institutes (ATIs), agricultural high schools, and university agricultural faculties will also see value in the use of the DSS in their teaching programmes. Further afield, given the growing interest in CSA globally, it can be expected that the DSS will be of interest to regional and international NGOs, various government agricultural agencies and perhaps even the relevant United Nations agencies, such as the Food and Agriculture Organisation (FAO).

Means of communicating with these varied and wide-ranging audiences have been discussed in detail in sub-section 5.1 and it will just be necessary here to identify the key ways in which the DSS itself can be shared. Although it will be possible to share information about the DSS, and promote its use through almost every medium available and discussed above, the sharing of the actual product will inevitably be more constrained.

5.3.2 Sharing with Smallholder Farmers

The piloting of the DSS with smallholder farmers will rely very much on direct interaction with them, with the project team facilitating and supporting the use of the DSS. In this situation the DSS will be presented in the form of hard-copy materials, translated into the appropriate languages. The facilitation by team members will be guided by a facilitation manual again in hard copy, but also stored on the facilitators' computers, as, of course, will be the technical component of the DSS.

Making the DSS accessible directly for smallholder farmers and their associations and CBOs following the project may prove something of a challenge, as the only realistic means will be to ensure that the two components are downloadable, probably in pdf format, from at least one website, preferably from a number of websites, including perhaps the WRC website. It may also be possible to persuade the WRC to print large numbers of hard-copies, which can be sent out on request. If access is through a website the farmers will almost certainly need support from either their local NGOs or agricultural extension and advisory services to access, download and print the materials.

5.3.3 Sharing with NGOs, Agricultural Extension and Advisory Services and other Training Institutions/Organisations

It can reasonably be expected that all NGOs and agricultural training institutions/organisations now have access to the internet, the use of computers, and access to printing facilities. This would suggest that having the DSS as widely available on the internet in a downloadable format would make it accessible to all such organisations. The development of a WRC-CSA project website would be the first step, and all materials and information can be made available there. This can be linked to any social media site such as a Facebook page, to draw in more people. The project website can then be linked to other sites used by the extension services, NGOs and others. The challenge here will be to identify which websites are most appropriate, either to upload the DSS components directly, or to link to sites on which they have been uploaded.

Three obvious sites would be the WRC website (http://www.wrc.org.za), the Manstrat Extensionsuite online website (http://www.manstratais.co.za/Extensionsuite.aspx used by the agricultural extension and advisory services), and the Manstrat Agrisuite online website (http://www.manstratais.co.za/AgriSuite.aspx directly accessible to everyone). In order to be able to use any of these sites, of course, a partnership contract will need to be developed with the siteholders; the WRC for their site, or Manstrat Agricultural Information Systems for the latter two. However, many NGOs are linked to different sites and some research will be needed to identify websites most commonly accessed by agriculture and rural development NGOs.

5.3.4 Sharing Internationally

The idea of sharing the DSS internationally is perhaps further down the road, and will probably only be appropriate when the DSS itself has been tested and evaluated thoroughly and shown to be truly

effective. However, it is worthwhile identifying some of the key regional and global linkages, via the internet.

Much of the information drawn on in the development of the DSS has come from the Climate Smart Agriculture page of the United Nation's Food and Agriculture Organisation (FAO) website (http://www.fao.org/climate-smart-agriculture/en/) and there may be potential for establishing links with this. More specifically the FAO run a massive database of resources called AGRIS (International System for Agricultural Science and Technology) accessible through http://agris.fao.org/agris-search/index.do on which the DSS could be placed. Very recently, in November 2017, the FAP launched a new website which they describe as a Climate Smart Agriculture web platform. Essentially it is an updated on-line version of their CSA Sourcebook (http://www.fao.org/climate-smart-agriculture-sourcebook/en/) and CSA Strategy http://www.fao.org/climate-change/en/ from which many other resources can be accessed. It may be possible to agree links to the DSS through the Publications related to CSA.

The CIAT/CGIAR Climate Change Agriculture and Food Security (CCAFS) programme has also been a valuable source of information and inspiration, and there may be the possibility to negotiate the sharing of the DSS through their website: https://ccafs.cgiar.org/ .

5.4 Communication with and between the facilitators and farmers

5.4.1 Introduction

Effective communication is an absolute prerequisite for any participatory process, and particularly where these involve a range of stakeholders, and especially where stakeholders are spread across a number of provinces. In the WRC-CSA project the central relationship is between the project team and the farmers, and those working closely with the farmers. The approaches to communicating and sharing ideas described in this section, while focussing very much on the facilitator/farmer links are entirely appropriate for the wider range of partners operating together in the field.

Inevitably the strongest form of communication, and indeed most people's preferred means is face-to-face, but clearly this is not always possible. Sharing ideas across wide geographical areas requires the adoption of a creative approach employing a range of media appropriate to the various individuals and groups involved.

5.4.2 Participatory videos

Participatory videos are examined in the context of documentary filmmaking, visual studies and community development (Yang, 2016). This is an easy and fun way of making videos within the community (Benset, 2010). It is a participatory culture that has developed since the age of interactive digital media and technology began (Yang, 2016). The approach helps in getting people to unite and plan together to make a change in the community. At the beginning, the community learns to use the video through playing games or exercises. Anyone can gain the skills to make the videos, and they teach each other how to do the filming. The community has a full control of the

process and the video. It is the community who decides what to keep on the video and who they will share it with (Benset, 2010).

The following are the steps showing how participatory video take place:

- Firstly, set up a circle - farmers are orientated about basics on camera switch it off, on and pause.
- The microphone is introduced – people are shown how to hold it and how far it needs to be from the person speaking. Allow the community-learning to flow.
- Introduce the tripod – show how this helps stabilise the camera and reduce 'shake'
- Help them decide what and how to film - use existing videos as examples of how to choose informative visuals.
- Encourage the farmers to work in pairs – one in charge of the camera, and the other asking questions and taking notes, as a journalist. Let them practice and make the film.
- Participatory Editing – this is one of the most difficult parts of the process, where the film and the sound have to be edited down to produce the most effective video. Considerable support is usually needed for this and often a specialist is asked to do the editing with guidance from th3e facilitators and farmers.

After their film is the ready help them organize a community screening – use this to evaluate the process from the filmmakers' and the audiences' perspectives. Ask for permission, especially from the people featured in the video, to show the video to others (Benset, 2010).

Participatory videos are valuable for recording communities' discussions of their issues and solutions. The videos can then be shared with the whole community. The videos are not only shared within the local community but can also be shared with neighbouring communities or other communities around the world. The videos can be easily shared at international conferences. They can also be published on the internet in order to reach the influential audiences like donors and enablers or policy makers (Benset, 2010). It is sometimes difficult to speak to powerful people face to face therefore using the videos is the best way in which community members can share their opinions and ideas (Benset, 2010). This method recognizes that we all have a valuable knowledge and we are all agents (Benset, 2010). The process potentially reduces the power imbalance between the researcher and the participants. It also contributes to empowering participants (Yang, 2016).

5.4.3 WhatsApp

WhatsApp is an instant messaging system for smartphones, it uses the internet to send a text message, documents, images, videos, location and audio messages to other users. To install, one needs an android phone and a mobile number, it can be installed using an app store or a link shared by another user. WhatsApp has a user-friendly chat wall which displays both received and sent messages. In the same wall, audio clips, photos, and videos are displayed and are downloadable. It also has an advantage that it shows a notification that message has been received and seen. Voice recording is done by tapping on a red button on a chat wall, recordings can be sent instantly and are stored in phone storage. WhatsApp is particularly useful for sharing information among groups of people, and is primarily used for this purpose. The Imvotho Bubomi Learning Network (IBLN) in

the Eastern Cape, part of the WRC 'Amanzi for Food' project, uses its WhatsApp group almost constantly to exchange ideas and photographs of the work they are doing, and to ask advice from each other.

In a study which was conducted in Nkhotakota district in Malawi of a group of women who was involved in Agriculture, WhatsApp messengers were installed on their mobile phones and group chats were created. Firstly, the training of women was facilitated, involving training the farmers on the basic technical issues and management of Android phones to provide technical backstopping. An orientation of women's roles in moderating group chats to achieve their objectives was provided and also it was ensured that farmers were conducting the right interviews. A schedule was developed indicating dates, topics, and groups which would contribute their voices each week- The schedule was developed to make sure that all communities participated and contributed their voices. In each group, two women were identified by fellow members to be the representative of their group on android smartphone, recording audios, capturing photos and videos as well as conducting interviews (Banda, 2016)

WhatsApp was chosen because it was seen that it has lower internet costs than other networks such as interactive voice response. It was also chosen because one of the studies found that by February 2016 WhatsApp had a users' base of one billion, showing that the app is one of the most popular means of communication. There are many WhatsApp users and even people in rural areas use WhatsApp these days, therefore, it was going to be easy for women in this project to seek help on technical issues from other individuals in their areas who use the application without having to depend on broadcasters or extension agents (Banda, 2016).

The study showed that most women were interested in gaining new skills on using mobile phones and internet platforms. It was realized that there were unexpected innovations that evolved on the WhatsApp group. In Nkhotakota the WhatsApp group has evolved into a "virtual learning community". External agents were also added to the group. More farmers with mobile phones wanted to be included in the group chats, therefore there were more discussions topics that were being conducted, farmers were seeking agricultural advice from their fellow farmers and experts in the group chat. Agricultural experts indicated that social media is a good way of providing agricultural advice services since farmers are able to take and share pictures and ask questions. Extension workers were able to know what was happening in other extension planning areas, and the chat group also helps expects to know each other and know the activities they are doing within their locations. Extension workers were able to orientate how farmers communicate agricultural messages with their fellow farmers. Pictures that were being shared in group chats were able to be used on fields days and farmer's days to display what has been happening. Mr. Chizimbi who is a local extension worker highlighted that farmers were able to post pictures on WhatsApp of their Conservation Agricultural fields which allowed other farmers to see and emulate how to implement conservation agriculture practices (Banda, 2016).

A study conducted in India further explains other WhatsApp advantages as:

Increases the scope and coverage of Agricultural Extension - In most communities, where few people receive agricultural extension services, the use of mass media such as WhatsApp helps in increasing the number of households receiving information and advice. Extension workers are able to disseminate information to a large number of people without having limitations of time and

geographic boundaries and at the same time, they are able to receive a feedback through using this tool (Devesh, 2017).

It is an easy and convenient way of communicating with the farmers - WhatsApp is easy because it does not require high level ICT skills or expensive equipment. It can be operated through the mobile internet rather than computer-based like other web-based portals. Communication is flexible in a way that it can take place at any time and in any place with reasonable internet connection (Devesh, 2017).

It usually requires less internet data - Compared to other applications, WhatsApp requires fewer internet data bundles. This serves as an advantage since farmers may have limited internet data available (Devesh, 2017).

It is an information enriched medium of information delivery - In other methods of communication such as television and radio, information can be initially be well understood, but later on, it can be forgotten, with WhatsApp information can be stored. In addition, with WhatsApp information can be delivered in multiple ways which include audios, texts, photos and audio-visuals, therefore this way of communication provides many possibilities for sharing information since it is delivered in many ways (Devesh, 2017).

It is more participative and encouraging peer learning - As farmers are able to give feedback through using WhatsApp, it encourages two-way communication between the facilitator and the farmer. Even shy farmers are able to participate in WhatsApp. This tool promotes farmers' networks and interactions. Farmers are able to communicate among themselves and also with the facilitator. Farmers are often the ones who end up answering queries from other farmers. In that case, farmers are able to build networks and trust one another (Devesh, 2017).

WhatsApp Limitations

WhatsApp usage requires careful management, and the goals of and objectives of using WhatsApp in chat-groups should be clarified so that people do not lose enthusiasm, or abuse the system. Most of the time in developing countries there is limited data pack available for usage, and it should not be wasted on unnecessary messages. For example, there should be a strict rule that when a person repeatedly sends jokes or any other form of unnecessary information, they will be removed from the group (Devesh, 2017).

5.4.4 Radios

In many rural areas, radio programmes are used successfully to create a platform for social learning among and between local and neighbouring communities. Farmers who are involved in a certain intervention can talk on radios, where they can be interviewed about their experiences of a new technology. The World Bank in 2011 emphasizes that it is more convincing to other farmers to learn about new innovations from another farmer than from an 'outsider', even if they are an expert.

The study which was conducted by Sailas Nyareza and Archie L. Dick revealed that community radio services were most preferred as a medium of communication for rural farmers since there are not enough facilitators to reach all farmers. Facilitators also do not always have adequate communication skills to effectively interact with farmers, therefore, farmers ended up lacking the motivation to carry on with their work. Community radios covering rural areas, often broadcast

farming programmes in the local language which are relevant to farmers' own agricultural activities. (Dick, 2011).

Radio programmes should be designed to be community centred, and farmers should feel involved and responsible if (Khanal, 2011).

The advantages of using a radio as a communication tool are that radio does not require literacy because radio requires farmers in listening rather than in reading (Dick, 2011). Rural populations are generally familiar with radios because they are affordable and rural people can own them. According to Zijp in his 2003 study, he found that in one of the projects in Malawi radio-training of farmers in new agricultural techniques cost 3000 times less per hour than face to face extension services (Dick, 2011). Radios are relatively cheap, portable and the listener can get the message while engaged in other activities (Kumar, 2000). When used in conjunction with cell phones radio programmes can be highly interactive, enabling farmers to ask questions and share ideas.

However, radios also come with their limitations, which can include:

- Not everyone in the community owns a radio (Dick, 2011),
- Radios use batteries and batteries are expensive for rural farmers (Dick, 2011)
- Other people can misuse radios since it is accessible and available for the free expression of ideas which if abused can lead up to building communities of hate (Hartley, 2000)
- There are few repair facilities for radios in rural areas (Oakley, 1997)
- If a farmer does not switch on the radio during the time in which the programme is transmitted, there will be no further opportunity for the farmer to listen to the programme (Oakley, 1997).
- The farmer cannot rewind the programme if he or she did not understand something properly (Oakley, 1997). However this can be overcome to some extent through interactive programmes, where farmers can call in with their questions either during or after the programme.

5.4.5 Audio cassettes

Facilitators involved in many projects with farmers found audio cassettes very useful for the storing and sharing of information, especially where information is very specific to one area for it to be broadcast by radio. Alternatively, CDs can also be used for farmers who have CD playing equipment; cassettes and CDs serve the same function.

Figure 7: Audio cassettes

Advantages of audio cassettes

Audio cassettes (and CDs) are more flexible than radio. The tape can be stopped and replayed, it can be listened to at any time of the day, and the same tape can be used over and over again (new information recorded and unwanted information being removed). For many copies, information can be recorded in the studio, or a blank cassette can be used to record information in the field. Cassettes can also be used for updating the facilitator's technical information, sharing experiences between farmer's groups and between communities-interviews of individual farmers can be recorded in one village and can be shared with other villages and also provide a commentary voice that can be used in videos (filmstrips and slides set) to create a clear picture of what is being said (Oakley, 1997).

Disadvantages of audio cassettes

Cassette recorders are less common in rural areas than radios, Rural people are less familiar with cassettes recorders as a source of information, the cassette has to be distributed physically, cassettes and cassette players need to be maintained, and should be kept free from dust as much as possible (not always easy in rural areas). Recording heads should be kept clean by the use of fluids such as white spirits, which are not always available in rural areas (Oakley, 1997).

5.4.6 Community Group meetings

This is a common extension method where a group of farmers in the local community and a facilitator come together to exchange information and ideas. There are different purposes for which community meetings can be conducted. They can be for the purpose of information sharing where a facilitator communicates a specific new kind of information to farmers. It can be for the purpose of planning where farmers review a particular problem and suggest potential solutions to solve it. Meetings can also take place for discussing a specific topic of interest, e.g horticulture, or beekeeping and these topics can be discussed in detail at a level of relevance to those participating. Sometimes meetings can take place to discuss topics of general interest to the community.

The disadvantage of community meetings is that sometimes farmers may feel that their time has been wasted in coming to meetings in a way that they end up not attending meetings. It is therefore vital that all meetings have a clear purpose which is likely to be of real benefit to the farmers

It is also very important that the facilitator makes thorough preparations and arrangements for the meetings.

5.4.7 Demonstrations

To 'demonstrate' means to show. There is a clear difference between demonstration and experimentation, although it is possible to combine the two. A demonstration is showing a proven

technique; how it is implemented and its value. An experiment is trying out a new idea, sometimes under artificial conditions, although experiments can also be conducted in real field conditions. Demonstrations are often used to show different methods of doing things, or different practices, and the results of these (Kumar, 2000).

The main goal of extension services is to demonstrate useful and practical information. On-farm demonstrations are regarded as one of the most effective extension education tools. Demonstrations often require a lot of time and effort, but their fruit comes when the farmer is ready to adopt the practice, when they consider it to be appropriate in their real environment, this is known as "seeing is believing" and also farmer who observes demonstrations and then applies them to their own particular situation is regarded as a present and future extension leader (Hancock, 1997).

> "What a man hears, he may doubt;
> What he sees, he may also doubt; but
> What he does, he cannot doubt."
> Seaman A. Knapp
> Agriculture Extension Pioneer

For farmers who cannot read, demonstrations are the most appropriate method that can be used to communicate. Farmers like to see how a new idea works through demonstrations (Oakley, 1997). Demonstration makes every step to be easy to understand, It makes use of visual aid like charts, posters, farmers become convinced and are encouraged to try a new practice (Kumar, 2000).

In the WRC Amanzi for Food project 'Productive Demonstration Sites' play a central role in sharing knowledge of different practices. The name is derived from the need for the demonstration sites to be productive to show the effectiveness of the practice. This also requires the sites to be well-maintained to ensure continued productivity.

As mentioned above, there are times when demonstrations are linked to experiments. In such cases there can be five steps in which the demonstrations are conducted:

- Diagnosis of the conditions, practices, and problems of farmers. Once the problem is identified, there should be:
- Participatory design of a research demonstration program which will have the purpose of solving the problem.
- The experimental demonstration is then conducted on farmer's fields
- The experiments are evaluated using the farmers' criteria
- Recommendations are made based on the results of the evaluation (Hancock, 1997).

5.4.8 Farm visits/ homestead visit

This is a very common way of communication, and farm or homestead visits should always have a clear purpose and should be planned carefully. Farm visits can make a facilitator be familiar with

the farmer and his family (Hancock, 1997). The method helps in building trust between the facilitator, organization, and farmers (Kumar, 2000). The facilitator gives information and advice which is specific and relevant to farmer's problem, the facilitator is familiar with the area of the farmer and the problems she or he is facing. This method makes monitoring of the farmers' practices easier and allows new recommendations to be made. This method promotes a good partnership between the facilitator and the farmer, and stimulates farmers' involvement in extension activities (Hancock, 1997). However, farm visits also have some limitations:

- They take a lot of time, much of it spent travelling, and choosing a time which is most convenient to farmers is difficult.
- It is always possible that a date and time agreed with farmers is not honoured, as other activities intervene, leading to considerable loss of time and costs
- They can be very costly, with much of the visit concentrated on a few, more responsive farmers (Kumar, 2000)
- They require considerable organisation in terms of logistics, materials, catering etc.

5.4.9 Farmer-to-farmer Extension model

This is a model where farmers are fully involved in the in the generation and dissemination of information and technology. The model allows farmers to be able to take full ownership of the intervention. Farmers are involved in all the relevant processes of development and assimilation of new technology rather than technology simply being transferred to them (Semakula, 2011). The farmer to farmer extension approach is described as a process which gives respect to farmers' traditional knowledge, it also emphasizes farmers' experimentation, sharing of knowledge and innovation (Kruger, 1995). The level of adoption of technology introduced by farmers themselves tends to be higher than if the technology is introduced by outsiders or external organizations. Farmers become very concerned about the results if they participate fully in the innovation of technologies (Duveskog, 2002).

5.4.10 Office Calls

This is a method whereby Extension office is placed in a convenient location (Kumar, 2000). This method is not common in South Africa. Office calls is a method whereby the farmer visits the facilitator in the office (Oakley, 1997). This can mostly be done when the framers have gained more confidence with the facilitator. For the facilitator, office visits are less time-consuming. Office visits need to be prepared (Oakley, 1997). There should be proper arrangements that should be made, which includes noticeboard communication where there is a clear display accessibility of the facilitator, useful and up-to-date information (Oakley, 1997). Regular office hours should be announced and maintained (Kumar, 2000). The office should be neat, orderly and attractive (Kumar, 2000), there should be visitors' chairs waiting for appointments (Oakley, 1997). The disadvantages of this communication method are that the facilitator will not be always willing to be overwhelmed by farmers visit, instead can also rather prefer going for a field visit and not every farmer will be able to visit the facilitator. In case a farmer is not able to pay a visit to the facilitator, letters can be used.

5.4.11 Telephone calls

The facilitator deals with farmers through the telephone, either landline or cell or smartphone. Telephones are generally used to pass a specific advice or information, with the interaction being quite short as the phone-call costs are very high. It is very important that the facilitator speak clearly and she makes sure that main points that are being discussed are fully understood and are noted down and kept in the farmer's records (Oakley, 1997).

5.4.12 Informal contacts

This kind of communication can occur when facilitators stay in a particular area for a period of time. It becomes more effective as the relationships develop between the facilitators and the farmers. Otherwise informal interactions can take place at public events, such as a farmers' market, holiday celebration or a religious events where the facilitators will be able to make contact with the farmers who is involved in the project and talk about their problems. Information and ideas are passed informally (Oakley, 1997).

5.4.13 Internet-based platforms

While internet-based platforms such as websites, Facebook and other social media have previously been considered out of the reach of many smallholder farmers, and are still, perhaps more appropriate for better-resourced stakeholders, such as academics, researchers and government officials, this is changing. With the advent of the smartphone and its increasing take-up by farmers and others in rural areas, these platforms are coming within reach of many more people. This enables them to engage with social media, and blogs linked to websites. Such media are still not necessarily the preferred means of communication and information sharing for most farmers, but they can certainly add to the mix.

5.4.14 'Hard Copy' Materials

Traditionally one of the main ways of sharing information, especially within a training context, is through the use of what are known as 'hard-copy' or paper documents. While these can have quite serious limitations, as described below, they are often favoured by both trainers, and trainees, as they provide a permanent record of the information being shared, and can be used by trainees in their work contexts, well beyond the lifespan of the course itself. For the trainers, these materials can and should help guide them in their training processes. Perhaps the greatest value of such materials, however, is simply that people like to have real paper documents to work with, and to take with them from their training into their home and work contexts; they also help trainees to share the information with friends and colleagues who did not attend the training.

The liking for paper documents is such that although the information in them can be made readily accessible in various formats on different internet-based platforms, there is a very strong tendency for people to want to download and print them rather than working with them in a virtual space. Information to be shared should therefore be in formats which make this easily possible.

Despite the popularity of printed documents, we should not overlook their limitations, the main one perhaps being that the information in them is fixed in a particular time, and is not easy to adapt or change according to changing situations or circumstances. Printed documents require considerable sophistication in their use, with users needing to have the capacity to take the raw information and adapt it into their own context, which in itself is a high level skill.

The WRC – CSA project will be developing two distinct training components for the promotion and sharing of the DSS; the DSS itself, and a facilitation process for building farmers' and others' capacities for accessing, understanding and using the DSS. Both of these components will be produced initially in printed form to support the piloting of the DSS with partners, with the longer term intention being for others; NGOs, extension services and agricultural training organisations and institutions to be able to facilitate the use of the DSS with their constituencies. The two components will need to be developed in such a way that they foster and support the building of adaptive competences not only in relation to the farming practices themselves, but also in the use of the DSS.

Training manuals

A manual is a book of information or instructions (Tonge, 2010). When designing a training manual it is very important to use a good content and a good design that makes the manual to be appealing, credible and easy to read and understand information. Most manuals usually include background and description of information, directions on how to use the manual, course planning forms and checklists, guidance on tailoring each particular workshop so that it can match the needs and wants of the participants. Specific, measurable and realistic learning objectives, clear and complete programme content, integrated evaluation plan and tools (Hamza, 2012). One of the limitations with manuals is that they are sometimes difficult to read, or to understand, and can require quite high levels of literacy and content understanding. Manual are often more theoretical in approach and fail to provide a practical approach (Tonge, 2010), although this need not be the case. The level of information provided can be above the reader's requirement, with writers adding information they think is needed (Tonge, 2010).

The DSS and accompanying facilitation manual need to be developed in cognisance of the shortcomings of many conventional training manuals, and

Handouts

Handouts are basically sheets of paper sumarising information based on the topic of interest within a group of people. It is used to convey key points and ideas from lectures or larger units such as modules or chapter goals to participants (Bligh, 1998). Handouts come in many different forms, depending on the people who create them. Handouts can incorporate images, photos and pictures to help in emphasizing the information being explained. The purpose of handouts is to help people to catch up and understand information that was not clear during workshops or presentations (Mayank, 2013). The advantage of using a handouts is that they can create audience participation, in that the information contained in them can be discussed, and it is easy to update and maintain

handouts. Participants do not easily forget the information that has been shared and also presented on handouts because handouts are being used as a reference (Guffey, 2011). Creating handouts is cost effective and it can cover lot of information (Ahead, 2005). A disadvantage of using a handout is that participants can lose attention to the speaker or else handouts may cause distraction rather than help in giving a reference (Ahead, 2005). However if the handouts are distributed immediately following discussion of the topic at hand, in order for trainees to have a good summary to share with others in their home and work contexts, they can be very valuable.

5.4.15 Considerations in determining appropriate educational and communication methods

There are many factors that should be considered when choosing communication methods to use in a given programme. These factors will be based on the preferences or special needs of selected participants. Different people have different learning styles and different ways in which they prefer to share information. These factors can include**:**

- Literacy and reading level - the level of farmers' education will influence the choice of learning tools that the facilitator chooses to use in a learning process. For instance, farmers cannot be given a case study to read if their level of reading is low (Richardson, 1999)
- Socio-economic - some of these methods require the learner to have access to equipment that they may not be able to afford. For instant, receiving emails requires a farmer to have a computer or smartphone and access to adequate data. Many smallholder farmers do not have such access which can be very expensive (Richardson, 1999).
- Lifestyles - it is very important to choose a method that allows flexibility such as home study kits, for people with very busy lifestyles, who need to be able to work at their own pace and in their own time (Richardson, 1999).
- Cultural relevance - it is important to learn which are most appropriate education or communication approaches in different cultural contexts (Richardson, 1999).
- Financing - it is very important to conduct a proper budgeting exercise before choosing a communication method because some methods are very expensive to deliver (Richardson, 1999)
- Time - it is important to conduct thorough planning since some methods may require more time to plan and implement. The timeline of a project should be specific (Richardson, 1999).
- Human Resources - some methods can require additional staff or volunteers to assist in carrying out the learning experience, and they may require specific skills (Richardson, 1999)
- Facilities or Equipment - some methods require a special facility or equipment e.g. making a participatory video requires computer access for the editing process, therefore a computer should be made available so that the implementation of the programme becomes a success (Richardson, 1999).

In most participatory processes a range of communication methods are used at different times, with different groups, and in different contexts. The idea is to select, with input from all partners and stakeholders a mix of methods which are practical and appropriate for different groups.

6 CAPACITY BUILDING

6.1 Team Capacity building

A capacity building process is in place for the implementation team: Field staff for Mahlathini Development Foundation, the Institute of Natural Resources, The Association for Water and Rural Development and Lima RDF.

- Field staff, interns (and students) for these organisations are being involved in the design, planning and implementation of the decision support framework and system through a number of process:
- Staff members and interns participate in writing and review teams for deliverable reports including summarising independent research briefs (e. g. desk top review, specific CSA practices, methodologies, quantitative measurement techniques etc)
- The whole team participates in joint planning sessions
- In these session information provision through small presentations is included for increasing knowledge around climate change, analysis of case studies and the like
- Small groups undertake specific tasks and
- Write-ups and reports are undertaken by team members
- Sub-teams undertake specific actions such as the design of a community based process, running workshops at community level and analysis of monitoring data.
- Senior team members provide a mentoring and review role
- Comments from staff members regarding this process have included that it has helped them a lot to learn to write more formal reports, that they initially were a bit lost and found it hard to apply the information they found to this particular application, but now are starting to appreciate the scope of the project and what it entails.

6.2 Postgraduate students

6.2.1 Sanelisiwe Tafa-Fort Hare University (EC).

He has completed his Masters in Agricultural Economics, using information provided by the GrainSA Smallholder Farmer Innovation Programme supporting Conservation Agriculture implementation for smallholder farmers. His work on cost-benefit analysis will be useful as a model for the present work

He has written a paper entitled: **Farm Level Cost-Benefit Analysis: The evaluation of economics of conservation agriculture in Bergville Town in Kwa-Zulu Natal Province of South Africa**

His abstract for this paper reads as follows "*On-farm economic benefits between conservation and conventional agriculture are not thought to be that pronounced. General inferences can be made, however; a comprehensive assessment of the net private benefits from greater use of conservation tillage is necessary. With the use of Gross Margin as well as appraisal indicators such as Net*

Present Value, Benefit Cost Ratio and Internal Rate of Returns, the study revealed that there are more incentives for adoption of conservation agriculture (productivity changes and reversal of soil degradation) over conventional agriculture. The study therefore recommends that the promotion of conservation agriculture should be encouraged and this is promising more incentives in the long-run.

6.2.2 Khethiwe Mthethwa (University of KwaZulu Natal)

Khethiwe has submitted her Honours thesis in Rural Resource Management within the Faculty of Agriculture. She has also worked within the Conservation Agriculture ambit during this year, but has also been a team member for this research process. Her Honours paper is entitled: **Investigating the sustainability of adoption of conservation agriculture by small-scale farmers in Bergville.**

In summary her study argues that "*Farmers have gained necessary skills and knowledge to be able to sustain the adoption of the CA (Conservation Agriculture), suggesting that farmers can stand on their own and continue to practice the CA even in the absence of the CA promoters. It was also found that farmers who adopted the CA are willing to share their experiences and knowledge with other farmers in the area. This increases the likelihood to expand the adoption of CA. More research needs to be done to find out communication strategies that can be used to communicate new innovations, which is technology and knowledge-intensive like CA. It is recommended that more research be undertaken to find out whether farmers are willing to extend mixed cropping in their plots. Further research also needs to be conducted to find out more about factors which have influenced small-scale farmers to abandon CA practices.*

She has provided information in her study that suggests that the learning and implementation process of the CA SFIP supported through GrainSA, namely farmer innovation development and working with farmer innovation platforms, provides for sustainable adoption of CA among smallholders.

6.2.3 Mazwi Dlamini (UWC-PLAAS)

Mazwi has now completed 1 year of a 3 year part-time Masters programme through the Programme for Land and Agrarian Studies at UWC. He has submitted his desktop review and research methodology sections. Mazwi's study is to involve a detailed analysis ofr adoption of CA under the GrainSA SFIP. His study is entitled: **Factors influencing the adoption and non-adoption of Conservation Agriculture in smallholder farming systems, and the implications of these for livelihoods and food security in Bergville, Kwazulu-Natal.**

He intends to work within an Action research framework using focus group discussions (including tools such as well being ranking, social mapping, transect walks, seasonal diagrams, participatory mapping and spider diagrams for analysis of relationships). Other tools that will be used include questionnaires (household and individual) and life histories. Household questionnaires will be administered for the purposes of establishing a baseline of livelihoods and general food security status in the area, and this will be undertaken both pre- and post- season in order to assess changes as a result of adoption of CA. Individual questionnaires are to focus on the intricacies of their CA production processes. Data to be collected will include information of how the households are composed, sources of income, and how much these contribute to household livelihood and food insecurity. Information on productive assets within the households will also be explored, along with their control and use. Rural livelihoods are diverse and change all the time in attempts to manage risk and improve security in the household and life histories across a certain timeline may help

capture changes that might have taken place. Data to be collected will look at assets and their use over time.

6.2.4 Palesa Motaung (University of Pretoria)

Palesa is registered for Masters in the Department of Plant Production and Soil Science and will also

Focus on Conservation Agriculture, albeit a different aspect. Her study is entitled: **Quantifying the restorative effect of Conservation Agriculture on the degraded soils of the upper Drakensberg area of Bergville, Kwazulu-Natal using qualitative versus quantitative soil quality indicators.**

Her study aims to evaluate the various methods that can be used to assess soil quality while investigating the changes (if any) in soil quality of degraded soil under CA management. She will also attempt to identify appropriate indicators that can be used to monitor changes in soil quality.

She will be conducting soil heath tests and analysis for a number of farmers in three villages in the Bergville area, who have been involved in CA for 3-4 years. She will look at a number of different trials including conventional tillage controls, mono-cropped and inter-cropped plots and plots where cover crops have also been used in rotation to ascertain the differences in quantitative soil health indicators. She is intending also to use the VSA (Visual Soil Assessment methodology) to come up with a soil quality index that can be benchmarked against the quantitative assessments.

6.2.5 Sylvester Selala (UKZN)

Sylvester is intending to register for a PhD that will extend across the disciplines of Crops Science and Hydrology. He has not written his proposal as yet, but has already started focussing on some of the quantitative aspects of his proposed research through this programme. He is intending to use quantitative and qualitative assessment techniques related to water productivity of various CSA practises as one of the central themes in his research.

7 APPENDIX 1: WRC PLANNING MEETING: 09-11 OCTOBER 2017

PRESENT: Erna Kruger, Chris Stimie, Lawrence Sisitka, Jon McCosh, Temakholo Mathebula, Mazwi Dlamini, Sylvester Selala, Phumzile Ngcobo, and interns Khethiwe Mthethwa and Nozipho Zwane

7.1 DAY 1: AGENDA

Trajectory for the year 2018 and milestones that need to be reached

1. Objective of Meeting

Overview of what we going to do in 2018, purpose of meeting is to plan activities and allocate time for each area, make decisions about overall methodology, criteria we want to use for the decision support system, look at indicators and explore quantitative deliverables.

2. Output for today

Table of contents for deliverable three, includes practical activities. Deliverable 3 needs to be submitted by the 15th of January.

Final decision on sites for the WRC project

3. Budget

Deliverable 1 and 2 paid for, WRC was satisfied with submissions. There is also some money from the First Rand Foundation that will help offset the pressure on the WRC budget.

ACTION: Chris: *Chameleons: possibility of obtaining chameleons for free, at least 2 or 3 chameleons in each site*.

7.2 Decision Support System

7.3 (Part 1)

1. Practices (broad basket>likely)
2. Criteria

We need to have a suite of practices that are suitable in each context, we need to come up with criteria to use when selecting the practices (e.g. costs, skills incl. Amanz for food). The criteria will be the basis for the decision support system. The methodology selected can be applied everywhere but criteria will be specific to research area, i.e. they will be a set of generic and selective criteria (technical, weather, facilitation, farmer)

The present list of practices needs to be reviewed, tidied up and finalised in a way that it can support the overall DSS.

7.4 Decision Support System (Part 2)

Methodology: How will the decision support system be implemented/facilitated in a community setting e.g. PID, people choose something that they compare with what they doing already and select the best practice based on outcome.

Media Access….how will the information be distributed? Come up with an overall communication strategy

7.5 Decision Support System (Part 3)

Lawrence: Implementation Monitoring (indicators): monitoring review process must be integral to the whole process, i.e. it must be part of implementation and not left until the end. We need indicators on the process side and on the practical side.

7.6 Deliverable 3 Outcomes

1. Practices

CSA: Climate Smart Agriculture-we need to clearly outline what practices we refer to when talking about CSA practices. Principles of CSA:

A. Increase in productivity
B. Increase resilience to climate change and variability
C. Reducing agriculture's contribution to climate change

These are made explicit within the choice of practices for the database- the whole basket and then again in the monitoring – as they are unlikely to be explicit criteria chosen by farmers

In terms of monitoring- especially related to mitigation one gets into the debate of carbon – credits, offsets, tax etc and the very real difficulty of measuring carbon sequestration

Difficulty in measuring Organic Matter in soil: difficult to measure as there are many factors to consider, e.g. temperatures, moisture levels in the soil, where soil OM tests are conducted. (Indices, proxies, weighing of criteria)

John: How many CSA practices are we looking at: if we come up with 20 practices, and farmers select all of them, it will be very difficult to measure the results. Chances of people selecting many practices are slim.

It also means we need to have a process for farmers to prioritize, according to their criteria which practices to start with and which are the most important

Erna: From AWARD case studies, people who selected a wide range of practices saw a more coherent outcome and got better results than people that selected one practice. So, it will be important to somehow group the practices that are synergistic.

2 Categories

a. Vegetable production, Field crop production, Livestock management, Water and soil management, Indigenous practices (the five fingers according to the AWARD model of implementation)

   Selection of practices, will be based on information dissemination, people will choose based on familiarity and ease of implementation.

   What information base will we use for the decision support system (information sources, databases, training material, Amanzi for food, WRC SAPWAT, extension suite online, local technical information?)

b. Technical/specialist

   Weather: ecotones/ecozones/agro ecological zones: information scaled down to local level.

c. **Facilitation:** what specialist information is required and what underpinning knowledge do we require to make informed decisions.
   John: ISCW (Inst Soil Climate and Water), a soil scientist is required as part of the team, Piet Nel is a soil scientist working under ARC that can assist and does not charge a lot, if hired on an individual basis. Sue Walker: works for the ARC and can be good contact to work with on climate databases.
d. **Scale**: Farmer segmentation: important to understand context in which practice is applied, e.g. mulching may not be practical for big fields. Also, practices introduced at garden level may not be applicable at field level.
e. **Budget**: R10 000- R20 000 for each learning group for inputs, to take away the risk from the farmesr.

Project to be implemented in three provinces: EC, KZN, LIMPOPO

3 Decision support system: implementation method

What would you do if you approach a new learning group to introduce CSA?
Look at present activities, agriculture, recent history, discussion of practices i.e. climate smart agriculture:

- Livelihoods contexts
- Past-present-future
- Start with agric the discussions, resources, issues, present practices, issues, potential alternatives,

Erna: different factors affect approach in introducing CSA. In Limpopo it was easy to introduce CSA because the changes were more apparent, whereas in Bergville, the change is variability, i.e. irregular weather outline. So the introduction of CC concepts needs to be more carefully handled to ensure that people can differentiate impacts caused by CC as opposed to those caused by past and present human and farming activities, and those that are 'just' weather related.
There are three related processes that can support this process: GrainSA -CA, AWARD -ResilimO and Wesbank – Innovation Fund

7.6.1 AWARD CASE STUDY – An example of CC dialogue facilitation at community level

OVERVIEW OF DIALOGUES PROCESS: Have you ever heard about climate change and what is your understanding of it?
THE BASICS OF WEATHER AND CLIMATE SYSTEMS (introduction to core contexts)
Module 1: EXPLORING CC IMPACTS SYSTEMATICALLY (talk about what scientists have found regarding CC and relate it to local, tools: mind map/seasonal diagrams)-look at different climate change scenarios to base practices on. And explore impacts of CC on livelihoods and farming. One day workshop
Module 2: EXPLORING ADAPTATION OPTIONS AND MAKING PLANS, based on systemic potential impacts explore systemic adaptation options for a sector

7.6.2 GrainSA Conservation Agriculture

PARTICIPANTS (existing, positive, aspiring), mainly work WRC project into CA. there are well settled existing learning groups and sites where measurements are already taking place. These can link to and support the WRC process.
The thought here is to introduce the DSS both in existing learning groups under CA- so an expansion of what they are now focusing on, with the likelihood of doing the quantitative measurements and trials with individual members from these groups and in new groups- just starting out. It is likely that the facilitation process- or at least emphasis of different steps in the process will differ between new groups and existing ones.
Potential new sites (CA): SKZN: Plainhill and St Elois. It is mportant to stay coherent with the sites.
Existing sites in Bergville: Ezibomvini, Eqeleni, Stulwane **New Groups**: Thamela, Thunzini

7.6.3 First Rand Foundation /WESBANK/FS Funding

Funding is mainly for Innovation (R 250 000, November to March 2018, joint funding for MDF and Lima)
AREAS:

- KZN :Lima- NtabaMhlophe, MDF-Bergville
- Limpopo: Lima- Sekororo, MDF- Lower Olifants_Memetje

METHODOLOGY:
The intention is to work within the ambit of Food security implementation and work with existing learning groups for Lima and MDF to introduce Climate Change Adaptation concepts, then elucidate adaptive measures and practices with the farmers and come up with practices to experiment with. So it is one round of the same process of setting up a DSS within the WRC project. It can assist with field level facilitation support (money to run workshops0 and also limited funding for the experimentation (in this instance primarily tunnels and drip kits) along with intensive gardening techniques and S&WC
The idea is to use this process to design and run the first round of facilitator level training to start to solidify the DSS aspects on that level, develop some training material and start on farmer level learning materials;
The methodology for this at community level is as follows:

- Context
- CC dialogue
- Practices/principles
- DSS - Matrix: practices vs. criteria
- Farmer Experimentation

It is Important for farmers to be an integral part of monitoring process. Existing groups can help guide how to adjust the DSS for it to be more effective.

7.7 DAY 2 Agenda

Presentations of case studies – from Deliverable 2

Criteria linked to categories (two groups)
Practices (doable 1 group)
Process (1 group)
After Lunch
CoP: Stakeholders
Quantitative measurements
Capacity building (post grad and social learning)

1. Presentations

Short presentations of what was written up in Deliverable 2 to remind the whole team of what these are and how they will be incorporated into this work.

7.7.1 Infrastructure/ engineering Practices: Chris

Technology developed in recent years, accessible, doable and replicable. Challenges with accessing materials from local hardware stores. Two technologies, drip kits and tunnels

Drip kits

This is an old idea that has not worked well in the past, has also been tried in Limpopo, but recently working better – as kits are being developed that farmers can set up for themselves. This removes the restrictive nature of pre-designed kits and allows capacity building in the community.

Kits consist of a 20l bucket – with sand and stone filter for greywater and 2x5m long dripper lines- made up of string drippers that farmers themselves make.

The idea is that a 15mm PVC pipe is used, it is expensive but accessible, plus 1.8 mm/15 gauge surgical needle (not vet needles), cheaper to purchase in bulk. Needle is put straight through the pipe, through both sides, and a fish line is threaded through the holes and a piece of bailing twine is hooked and a knot is made on each side. Bailing twine must be tight, if it's loose it drips too much. Spacing is 300mm, and it is then put in a 25 lit bucket, which is placed at 1.5 m height. To make the filter; Mutton cloth is placed at the bottom of the bucket to ensure sand or particles to not get into the dripper lines, gravel is placed inside bucket and sand is placed on top (wrapped in mutton cloth with a knot at the bottom and at the top). When grey water is poured on it, it is filtered. Sand has to be replaced after a period of time as it becomes saturated with soap. Three different buckets are needed for three trench beds (1mx5m). Irrigation is done every day and this provides 10 ml a week/ 10 ml in two weeks is not enough.

John: How bad is soap? Soap is too alkaline, so when it reaches high concentrations it kills plants. Farmers need to put clean water at least once a week to wash out the soap. Ash can also be used to neutralize soap as it binds phosphates and nitrates found in soap. Grey water works best with mulch, as mulch helps reduce build up.

Drip kits cost ~R300 each

Tunnels- shade cloth structures

Again, these are kits that are provided that farmers themselves construct. The kits are designed to use mostly locally available materials and to be highly resistant to wind damage and breakage

The tunnel is 4.2. metres by 5.9 metres, with four arches. We started with steel that was bent commercially, then went to PVC plastic 50ml (not easily accessible). What is used now is galvanized (does not need to be painted) conduits which are bent on site (2 halves for each arch). These are then

joined with conduit links. The arches are pressed directly into the ground in pre-made narrow cylindrical holes. A hollow steel pipe is used to make holes. Net used is 40% grey/agricultural net. Maintenance is very important and it is very important to have a very robust system from the get go; it can last for + 20 years.

Tunnel kit coast ~ R 3000

The above is a commercial price but if you do it yourself you can get away with half of this amount. Individual smallholders have got to a point where one tunnel generates at least R10 000/annum which enables them to be able to buy these materials for themselves. There is also a business opportunity in this because people can supply the kits and assist with construction. This came as a result of the Mining CSI programme. These kits are available to specification and only thing required is for you to set it up. The suppliers (Sociotechnical INterfacing) deliver if 10- 15 orders come in and also provide the training.

7.7.2 AMANZI FOR FOOD: Lawrence

WRC realised that over the years they have done a lot of research on water conservation and rain water harvesting but the results of the research was not reaching the people the research was aimed for. WRC commissioned the Environmental Research Centres (ELRC) at Rhodes UNiversity to assist in making information accessible for small scale farmers and the public in general.

The concept is based on social learning: communities of practice (CoPs) around rain water harvesting are set up including stakeholders such as extension officers, government and researchers, awa farmers. What was developed was the training of trainer's course, for all stakeholders involved. These CoPs are learning networks where participants share information and implement practices together. Media is a critical componenet: local radio, whatsapp, local newspapers, word of mouth, internet (for those that have access) as communication is vital in communities. Important to have someone focused on maintaining communication/updates on media platform chosen.

Training material was WRC research.

Categories looked at:

1. Scale (scale bands): bigger scale = higher risk, mainly crop
- Scale 1 (umzi)-homestead garden, school garden, attached or close to homestead less than 1 ha
- Scale 2 (small arable field), more than 1-2 ha, also involves higher levels of technology
- Scale 3 (large arable, livestock): higher level of technology, has employed people

Aspiration: people want to grow in terms of production, but it is not always the case. Up scaling takes a lot more resources.

2. Criteria
- Subsistence, semi-commercial, commercial
- Labour
- Input requirements
- Technology requirements risk
- Aspiration
3. Indices
- Low-med-high

NB!! Remove barriers to learning
Different practices are suitable to different levels of production. E.g. saaidamme are a great way of harvesting and saving water but small scale farmers may not implement it as it is done on a large scale. Navigation tool very useful in obtaining useful information for rainwater harvesting and soil water conservation.

7.7.3 Agroforestry: John

WRC research project, implemented in Nokweja and Bergville with Mr Madondo. Field trials have been going on for two years. Researcher managed trials are focused on two types of systems. Improved fallow (two legume species, pigeon pea) and legumes intercropped with agroforestry species. Plant material is worked back into the soil. Measurements of water use, nitrogen fixation (relationship between nitrogen fixation by legumes and requirements by plants) and a number of other indicators. The project in Nokweja (intercropping, relay cropping etc), uses Sesbania Sesban and pigeon peas and bulgardia albia (used in East Africa, grows leaves in winter and in summer, leaves drop). The Bergville site was abandoned due to people letting cattle into the fields. Objective of project: measure water use efficiency of fodder crops and develop a guideline for extension officers. Uses of crops: fodder, firewood, nitrogen fixation. Idea is for farmers to see the net benefit of increased yield over time, even though they may sacrifice some of their maize crop yields when planting agroforestry species.

7.7.4 Conservation Agriculture: Sylvester

Three principles, focus is on minimum disturbance, planters don't disturb soil so impact was not measured. Soil cover was measured, developed a square which was thrown randomly and the percentage was measure based. Infiltrometers and spades were used to measure water infiltration in the soil. Results are highly variable, more measurements need to be conducted. Other measurements, soil colour, texture, effective rooting depth, tillage pan and rainfall data. Five rain gauges were placed in community and farmers were asked to record rainfall which worked quite well. Runoff plots were also done in two households in Bergville, also had mixed results. Percentage germination was also measured, linked to yields.

Measurements:

- Soil cover
- Infiltration rates
- Visual soil assessment
- Rain gauges
- Runoff plots
- % germination
- Soil fertility and soil health tests.

7.8 Coming up with a Decision Support System

We started by working on potential categories to be used in specific situations/localities to decide on an appropriate basket of options of practices

7.8.1 Categories

Scale (1 ha, 1-2 ha, >2ha)

- Inputs (costs/supply)
- Skills/ understanding/knowledge/technical support
- Sources of water
- Cost/benefit

Productivity

- Efficiency/ use of resources
- Cost/benefit
- Increased yield
- Diversification including continuity

Resilience

- Trends over time
- Diversity of practices
- Social agency
- Adaptability- awareness and response, system and farmer flexibility
- Robustness- soil health
- Reduced risk- reduced water demands

Carbon

- Soil management practices
- Crop and animal husbandry management
- Reduced carbon emissions-reduce mechanization, Extensive livestock production
- Increase carbon capture- reduction of veld burning, increase in SOM

Climate

- Heat
- Variability
- Extreme (drought/floods)

Things to be think about

- Preferences
- Farming system
- Dry land vs. irrigated
- Diversity
- Locality

DSS

Use benchmarking/validation/threshold values

Monitoring indicators (feedback info to make more informed decisions)

Climate variables

Processes

Set up what processes are required:

- Introduction to climate change, what it means and how to do it.
- Community involvement
- Management of information

We divided our team into two sub-groups; one to focus on the technical aspects of the practices and one to work on the process of introduction at community level.

7.8.2 Group work: Technical aspects: Report back

1. **Practices (report back)**

Categories

- Soil management-soil fertility, soil health, soil erosion control
- Water management-manage available water, increase available water
- Crop management- types, productivity, manage pests and weeds
- Natural resources: landscape management, land use planning,
- Livestock-rotational grazing systems, relay cropping and cover crops under CA systems… It might be more viable to look at integration systems, look at livestock within the CSA context, information on livestock is available but the facilitation component is missing, might be complicated to look into livestock as there is no one on the team who has expertise on livestock management.

We reviewed the existing database on practices we put together for Deliverable 1 and made some comments regarding practices to include/exclude, scope, description etc in order to finalise the database. Issues to be considered:

- Modifications to table e.g. improve soil fertility, recommendations were chemical based solutions, natural based solutions, and then have sub categories specifying practices.
- Introduce a few more ideas e.g Push-pull: pest control planting Desmodium in field and Napier grass on the sides.
- Criteria: Cost, technical difficulty, labour, maintenance scale.
- Practices: System, appropriate scale, do-ability (can the farmer implement it in their system? short term vs. long term benefits)
- Ranking according to scale (plot, field, farm)
    - Low cost and easy to do= 1
    - Low cost difficult to do= 2
    - High cost and easy to do =2
    - High cost and difficult= 3
- Suggestion to put criteria into different columns. Most practices were a 2 except for minimum tillage and then add a column with the scale.

Way forward: reformat table on practices and circulate edited version – Chris, Sylvester, Jon

2. **Processes (report back)**

Below is a chronology of steps or processes to be undertaken at community level, assuming there is already some level of relationship and interest**.** These steps work towards building a CoP /learning group:

- Understanding climate change and impact (our understanding, community understanding)

- Climate change and agriculture (farmer roles and responsibilities, current practices/challenges)
- Changes, reasons and responses; Responses (what are we doing already, what do we think can do that will help, willingness to change [* Comfort Zone game- comfort zone- stretch – panic- growth], discussions around change, most important problems, what do we foresee in the future based on what we are doing, effectiveness of responses)
- Who do we want to work with- outside organisation, local institutions, learning groups new relationships, new ways of working together
- Is anyone doing new and interesting things – local innovations to consider – what has been tried and how well has it worked.
- Introduction of practices
    a. Reality map; present agricultural practices and impact
    b. Walk about in village
    c. Desktop review
    d. Focus group discussions
    e. Prioritising- defining criteria
    f. Practices that mostly match criteria (short visual introductions for likely doable practices in the area, introduce about 5 practices – facilitator's judgement call) Link to local practices
    g. Ranking exercise linking criteria to practices
    h. Learning group members choose practices they would like to implement or experiment with. This could mean
        i. subgroups dealing with different topics (e.g. gardens, fields livestock)
        ii. whole learning group doing practices in succession (e,g start with gardens first)
        iii. Defining a chronology of activities e.g. start with trench beds and mulching, then implement diversion ditches and stone bunds etc
        iv. Individuals choose an initial set of 5 practices for example and then upon review decide how to build on that in a following season…
    i. Implementation, training and mentoring, demos, cross visits, specialists (sources of expertise), lead farmers
    j. Monitoring and review.

3. Quantitative measurements

(Look at deliverable 2 report, last chapter)

Soil Physical properties

1. Water retentivity/ bulk density: Monitoring **bulk density** requires info on soil organic carbon, bulk density is very important, take steel ring, put it in soil, take it out, weigh it wet and weigh it dry, mainly weighs density when soil is dry, useful in showing soil health in fields, gardens, forestry, also important in reviewing porosity over time). Bulk density used to check relevant changes and track changes over time. Soil bulk density decreases with increasing organic matter. Increased bulk density is an indication of mismanagement, e.g continued ploughing– Could use this a proxy for organic matter. Need lots of samples 20-30.
   Frequency: Pre planting, at planting and at harvesting.
2. **Soil Structure** measures- mean weight diameter – a laboratory test indicating aggregate stability. Loss of OM means loss of structure, aggregate stability is also a good measure of soil structure

and current soil health tests include this. Shatter tests infield can also be used and this will be a good way to see differences- drop from certain height and see how the sizes break up, even distribution of sizes is good. No. of samples for aggregate stability- 20-30 sub samples. An M shape or W shape(of field sampling) is normally used and random samples taken. For trench beds under a smaller area this could be difficult

Soil Chemical properties

Cedara - (KZN) (Limpopo)

4. **Fertility:** NPK Ca, Mg, acidity (acid saturation, cation exchange capacity), near infra-red carbon- soil OM acts a buffer to soil acidity. Samples should be taken to the same lab for a consistent process- to pick up trends. EC does have a soils lab, Fort Cox however its good practice to take samples in the same lab. Comparison will be within sites and not across. Different practices and track changes over different climatic conditions. Samples will all be taken to Cedara for consistency.
5. **Electrical conductivity**: -will be done separately(optional) indicates presence of salts in the soil which is more important from an irrigation perspective. A Chameleon (red, yellow, green) can also be used to measure plant available water. This a usually under irrigation conditions and dry land conditions are not so conducive. They are more suitable in gardening situations .
   The more Ca and Mg in soil the better the cation exchange capacity. Difficult to show that the improvement in OM will also improve the cation exchange capacity. Ca and Mg content in soil can be changed by irrigation.

Soil biological properties

6. **Soil health indicators:** Laboratory work, field tests, microbial biomass. Might be more effective to compare practises with trends over time. TESTS: SOLVITA TESTS/NEMATODE TESTS: check medium term availability of nutrients in the soil, can give recommended on how much to apply on top of what is already available.

Water productivity

7. We need to have weather stations if we will be checking water availability in the soil, weather station must be at the same altitude as field, about 500 m away or at most 5 to 6 km away. (Measures evapotranspiration, models crop growth according to reference evapotranspiration. Also rainfall, windspeed, solar radiation, temperature). Weather stations can be used to model how crops should be growing. Data is needed for water productivity. Water productivity, multifaceted: looks at all different components of a production system and how they interact together, more complicated when intercropping is included. For WRC project it can be looked at, in terms of field crops, data can be used to determine yield values. Water productivity tests will also help determine whether planting in tunnels leads to reduced ET compared to planting in an open field.

Soil moisture

Rainfall +irrigation- runoff -percolation

8. Gravimetric water samples (in field) at different levels(0-10cm, 10-30c, 60cm) will help determine soil moisture levels at different soil depths within a given period of time. Evaporation, high at the beginning and decreases as crop grows. Water productivity does not tell us whether various

practices are applicable to different climatic areas. The results are area specific. You can compare same practices across areas if trials are conducted under the same conditions.

Retention curve: start off in a sand basin, take a soil sample and then subject it to different pressures. Water easily available when soil is saturated, it will get more difficult to extract when the water content decreases. **Equipment**: water mark sensors and physical gravimetric water sampling (comparing difference between dry and wet, different from bulk density which only uses the dry sample).

9. **Water holding capacity:** How does water holding capacity differ? This is also measured using water mark sensors and can be used to compare practices within a site. Sylvester - suggested that we measure amount of water applied vs. yield in each site, i.e. look at how much water was added to obtain a specific yield. Chameleons can be used in the gardens, water mark sensors can be used in the fields.
    - Scenario 1: try idea out in a simple system.
    - Scenario 2: try idea out in single and mixed system.
10. **Run-off plots:** Mostly in field situations to compare effect of different practices.
11. **Crop yields**: Will need to be determined in gardens and fields
12. **Livestock**: Full feed analysis (Cedara). Potentially find na Honours student to focus on cover crops for livestock fodder.

Experimental layout suggestion:

- Control: vegetable garden watered with a watering can
- Treatment 1: micro irrigation in an open field
- Treatment 2: micro irrigation in a tunnel

7.9 Site selection

A decision was taken to focus on the process aspects of introduction of the ideas with new learning groups, where not much implementation has happened as yet and then to focus on the introduction of practices with existing group- so two slightly different facilitation processes.

KZN (Overlap with First rand Foundation sites)

One day training of trainers: 13 November 2017

Process: Thabamhlophe (Lima), Thamela (MDF) - DATE: 4-7 December 2017

Practices: Ezibomvini (MDC- CA)

Team: Phumzile/Tema/Khethiwe/Interns/Mazwi

Measurements (quantitative research): Ezibomvini

Check pension dates: Tema/Phumzile

LIMPOPO

Process intro: Sekororo (Lima), Sedawa Ext, New group (MDF-AWARD) _DATE: 26-30 November

Practices: Sedawa (MDAF-AWARD- CSA)

Team: Nozipho, Tema, Mazwi (Khethiwe), Sylvester

Measurements (quantitative research): Sedawa

Process facilitation for end Nov-Beg December

- 1 day, training of trainers (1st week of December)
- Intro to climate change 1 day
- Ranking and walkabout 1 day

EASTERN CAPE (2-3 days)
(Intro CC, Ranking): Imvutho Bobomi_ DATE: 22-26 January 2018
Team: Lawrence Erna, Sylvester, Tema, Mazwi, Makhethi
Speak to stakeholders in the meantime around formalisation of CoPs, talk about it in the next round.

7.10 ToC for Deliverable 3

Table of Contents Deliverable 3: DSS	**Writing Teams**	**Editorial team**
1. **Introduction: purpose, objectives** etc.	Erna	John
2. DSS for farmers		
3. facilitation		
2. **Process Framework:** tidy up link to	Tema, Mazwi, Phumzile	Lawrence
broader thinking,		
Design methods, tools and processes		
3. **Facilitation; training of trainers**	Erna	Lawrence
4. **Practices:** system appropriate, scale, doable (AF)/Erna	John, Sylvester, Chris	Lawrence
4. Categories, layers		
5. Description, photos (separate section, appendix)		
6. Livestock integration, explain issues?		
5. Site Selection:		
7. Review of quantitative measurements	Sylevester, John	
6. **Communication Strategy**	Lawrence, Tema, Khethiwe	
8. Media information diversity of com strategies		
7. **Capacity building**	Erna, Mazwi, Sylvester	Erna
9. team process	Makhethi, Palesa	
10. Facilitator and community learning		
11. Post graduate		
Round 1: 31 October 2017**,** except communication strategy, process, site selection		
Round 2: 8 December 2017		
Final due date: 15 January 2017		

8 APPENDIX 2: DICLAD MODULES 2 & 3 WITH AGRISI STAKEHOLDERS IN THE LOWER OLIFANTS :24TH TO 26TH OCT 2017

8.1 Overall purpose

To build climate change literacy among stakeholders with regards to climate change adaptation options related to small scale agriculture.

8.2 Expected outcomes

- Re-enforced understanding of climate change impacts pertaining to small scale farming in the Lower Olifants.
- Identification of tenable adaptation options to some of these impacts, particularly those that can be further supported through the AgriSI project and other RESILIM-O projects.

8.3 Agenda

…

8.4 Participants

Botshabelo (13)

Oaks, Finalie, Lepelle (23)

Sedawa, Mametje, Willows (36)

8.5 Recap of concepts covered in DICLAD Module 1

Participants were walked through the concepts covered in the 1st Module

Climate change concepts were expressed using temperature and rainfall seasonality charts. Concepts can be summarised as:

Increased temperatures throughout the year- high certainty

Overall similar amount of rainfall but over a shorter period of time and more variability (intense rainfall events – storms, floods, droughts) – less certainty.

Participants also went through the five fingers concepts of themes for good agricultural practices and examples of practices for each theme were elucidated. Examples given were:

Water management: diversion furrows, contour ditches, greywater management, small dams, drip irrigation, stone lines, garden beds

Control soil movement: reducing run-off, furrows and ridges and planting on ridges (aloes, sweet potatoes)

Soil health/fertility management: trench beds, eco-circles

Crop management: mixed cropping, mulching, shade for crops, natural pest control, increased organic matter, close spacing, tunnels

Indigenous plants: less burning, planting and propagation of indigenous trees, multipurpose plants (windbreaks, fruit, medicine), careful cutting/ pruning for firewood, rather than chopping down whole trees,

At Botshabelo, the workshop was held at the Local facilitator's home (Meriam Malepe) and thus we could do a walk through the garden to review some the practices. This added to the examples participants were giving.

Above left to right: Tunnel with mixed cropping in beds for water soil health and crop management; tower garden for greywater management, soil fertility and mixed cropping; Diversion furrow with sweet potatoes, planted on ridges and bananas and paw-paws planted in the furrow for water management and soil erosion control; and an eco-circle with mulching planted to herbs for water management, soil fertility and pest control. Herbs include lemons balm, parsley, mint, rosemary and thyme.

Left: Inlet furrow, silt trap (where Ancois and Sylvester are standing) and underground RWH tank – circular structure with roof.

One of the main points that came form discussing these CSA practices is that most of them cover a number of the fiver fingers e.g.:

Underground RWh tanks; deal with water management and soil erosion control

Tunnels: deal with water management by reducing evaporation and temperatures as well as increasing soil water holding capacity, with erosion control by having paths laid out on contour and deep organic beds, with soil fertility through the trench beds and with crop management through providing windbreaks, pest control.

Tower gardens: deal with water management, soil fertility and crop management (mixed cropping, intensive planting, pest control)

Furrows and ridges with cross ties: Should also have mulching. Deals with water management by increasing infiltration and reducing run-off, soil erosion control and soil fertility- through incorporating organic matter in the ridges, and adding manure, leaves and mulch to both ridges and furrows.

Participants were then divided into small groups to continue with strengthening their understanding of impact of climate change and to begin to outline potential adaptations that could be implemented.

Activities in small groups:

Outline impacts

Choose goals (around 5) of priority changes or adaptation strategies

Then look at actions/practices to achieve these goals and for those ones we have already tried think about how well they have worked

Outlining impacts

Here cards were used from the mind maps created in the first workshop and the small groups briefly reconstructed a mind map, discussing in detail the potential linkages and importance of the issues

Right: A mind map of CC issues reconstructed by one of the small groups from Okas, Finale and Lepelle.

Water is the over -riding constraint in all cases. Although all participants save some rainwater, mostly in 210l drums or large basins, they feel this is not nearly enough and it doesn't last long. In all three sessions the participants felt that storage of large quantities of rainwater was about their only option for having a reliable supply of water, especially if rainfall decreases further. Municipal systems are unreliable and intermittent at best and individual boreholes are too expensive for most and there are already cases of boreholes drying out or salinizing. Greywater is used extensively, but not all participants were aware of options for 'cleaning' greywater prior to use.

Some mention was made also of community members working together and working more cooperatively with Municipalities to increase the efficiency of water supply in their villages. Examples include:

SUGGESTIONS:

Discussions were held also about improving spring protection in the mountains, that people rely on, as a matter of priority – making small dams with pipes for gravity fed systems, exclusion of livestock and making proper livestock watering facilities.

A major priority is rainwater harvesting. Present options give too little water and are expensive (basins, drums, Jojo's..)

Using the underground RWH storage tanks, or Jo-Jo tanks, to store water provided by municipalities, to allow for intermittent provision. Also storage of water collected by hand form the river

Participants felt that they had no way to access water from the river. They did not seem aware that they could in fact not be allowed to, but were talking more about pumps and pipes.

In Sedawa however , participants suggested committees need to be formed to work with allocation of water from the river (a smaller riverbed- dry for most of the year but with water access in the sand y riverbed) and also the municipality.

Some groups discussed natural resource management in conjunction with the water management – judicious cutting of trees, saving of riverine vegetation, preventing veld fires and communal management of water infrastructure. They felt that the K2C facilitators could also assist in this process along with traditional structures linked to the learning groups

Tunnels featured centrally as helping a lot, as did trench beds and mulching.

8.5.1 Botshabelo CSA practices

ACTION	CONSTRAINTS	HAS IT WORKED	FUTURE; NEXT STEPS
GOAL: Improve water use efficiency and increase access to water			
Grey water	White soap build up on soil level, crusting	Yes; works well with trees, but not tomatoes and ibece, where the plants become more prone to diseases	-More grey water management practices like loosening soil, tower gardens Experiment with different kinds of soaps and their effect on plants -try out moringa seed to clean water
Mulching	If it's too dry mulching doesn't work Hard to find enough material	Yes; retains soil moisture and crops look better	-Infiltration pits, -Making compost
RWH : Underground tanks	Not done: lots of labour Expensive	Yes (for few demonstrations). Now it is possible to use multiple sources of water for the tank – rain, river and municipal)	-We should save towards these tanks and maybe implement in a step by step way over time to make them more affordable -On slopes can have gravity fed systems that can also irrigate by gravity

			-Allows for planning for off season when there is no rain
RWH: 201l drums, basins		Yes; but the water is little and does not last long	
Spring protection		Yes, but only few individuals and limited attempts	-Need to store a bit of water at the springs to feed the pipes -Need water and social management structures to deal with pipes and taps and rules
Boreholes	Too expensive	Yes- some 'richer' individuals- but some are drying up and water yield is sometimes too low to justify costs	Not an individual homestead solution
Farm smaller areas		Yes; participants adapt the size of land they use to the amount of water they are likely to have available.	
GOAL: decrease dry, hot soil			
Trench beds	Hard to find enough organic matter	Yes, many have tried this. Provides for excellent growth of crops and very good moisture retention,	-Planning to do more trenches -Collect the materials when they are available to pack the trenches later
Tower gardens	Need shade cloth and many participants still unaware of this process	Yes; good growth, good use of greywater and easy to do	Buy a big roll of shade cloth together to make it cheaper- making the net available will allow for participants to try this out.
Tunnels/shade cloth structures	Some participants have dug the trenches as requested (3x5x1m) but have not received the tunnel kits	Yes; work very well for crop growth, cooling of soil, water retention, windbreaks, and pest control	-supply more kits as promised -participants can save together to buy the kits which are quite cheap -Train each other in how to construct as there are small teams in each village who know how -Perhaps set up a system where participants contribute 50% of finances and MDF or support organisation contributes the other 50%
Soil fertility		Yes; increase organic matter, trenches, tower gardens, furrows and ridges, using more manure	Continue with soil fertility improvement
GOAL: Improve crop productivity			
Growing trees for shade		Yes; a few participants	Plan for afternoon shade as temperatures increase
Liquid manure	Most participants are somehow unaware of the liquid manure. Thought you could not do it without bananas		
Drought tolerant crops	Indigenous fruit trees take too long to fruit and are no longer eaten on a daily basis Mangos are more heat tolerant but need to be well fenced-	Yes; tried the bird resistant sorghum and millet in the CA plots- worked well and participants harvested seed. Indigenous crops and trees such as Marula work well	Plant mangos in furrows to ensure enough water supply as it gets hotter Want more seed of bird resistant sorghum and millet

Pest control; traditional practices (apply powder of dried insects), natural pest control brews, pest repellent plants and mixed cropping		Yes- traditional practices work adequately Marigolds are pretty and work against nematodes and wilting problems in vegetables With mixed cropping see fewer pests and fewer holes in spinach plants for example	Continue with traditional practices Increased mixed cropping Using natural pest control brews in the tunnels – this is enough do not need chemicals.

8.5.2 Lepelle, Oaks and Finale CSA practices

ACTION	CONSTRAINTS	HAS IT WORKED	FUTURE; NEXT STEPS
GOAL: Improve water use efficiency and increase access to water			
RWH : Jo-jo's, 210ldrums, basins	Building bigger concrete tanks- Not done: lots of labour Expensive	Yes; short time, too little water	Find types of tanks that use local labour for construction to make it cheaper Store more water Find partners to assist
Mulching		Yes; doesn't work when it's too hot – still need water to break down the mulch	Methods of incorporation of organic matter into soil may work better than mulch
Greywater; drip kits, ash		Yes; but not on food crops. Helps with pests in the soil Bucket filter clogs up over time	-Methods for cleaning greywater
Spring protection	Not for access for everyone- used for religious purposes		N/A
Boreholes; communal and home	Too expensive	Irrigation water in Finale is salty. In Lepelle water quality is good	This is an expensive option, but is easy and reliable Information about how to deal with borehole water of bad quality for irrigation
Minimum tillage	Plough smaller and manageable areas	It works well, it saves water, but might not work without some shading – plants still wilt at some point	Timing, tunnels, decisions to be made by observation
GOAL: soil management			
Increase organic matter; incorporate leaves, crops, ash, manure Trench beds		Yes, but will want to see also how these perform under optimal conditions	Set up these with drip irrigation
Erosion control; contour bunds, diversion furrows		Yes; requires regular maintenance- sometimes they get blocked	Combine this with some of the water and crop management techniques
GOAL: Livestock/ grazing management			
Reduce livestock numbers and plant fodder	We are going to need water	Planting fodder works well under irrigation - good idea as it feeds both animals and people	Find ways to harvest the seed of the fodder species so as to plant again

			The fodder radish is good for people (morogo) and animals- grows quickly can be a good idea.
GOAL: Improve crop productivity			
Mixed cropping- vegetables and herbs		Yes, fewer pests where mixed cropping was tried Heat tolerant crops: parsley, millet, watermelon, butternut, different types of greens- e.g. the kale introduced Bird resistant sorghum quite good.	Find better ways (and more) to do mixed cropping Do experiments with different heat tolerant crops to check Cross visits to other learning groups to see what they have planted and what is possible Three plantings per year of different greens to have continuity in production
Pest control; traditional practices (apply powder of dried insects), natural pest control brews, pest repellent plants	Do not have access to the plants; chilli and garlic	Yes- only a few people tried, but for those it worked well	Learn more pest control remedies Continue with traditional practices Increased mixed cropping Using natural pest control brews in the tunnels – this is enough do not need chemicals.

This exercise was followed by doing an "Impact matrix " where we asked the question "How do you decide whether a practices is working, what criteria do you use? And then discussed the overall question of how well did these practices work using those criteria.

Summary of criteria from two workshops

Botshabelo	Oaks, Finale, Lepelle
Water efficient	Good water management
Increased soil fertility/ organic matter	Better soil fertility
Better growth/health of crops	Better growth
Increased yield	More food
Cheap	
Easy/labour efficient	Easy to do
Knowledge	

Oaks, Finale, Lepelle: Impact of CSA practices								
SCALE: 1=low; 2 = medium, 3= high (agreement between participants)								
CRITERIA ⇨ PRACTICES ⇩	**Easy to do**	**More food**	**Better growth**	**Good water man**	**Better soil fertility**	**Score**	**Rank**	COMMENTS
trench beds	1	3	3	3	3	13	5	Very good for growth, soil health and water management. The best practice- but difficult to dig
mulching	3	3	3	3	3	15	2	Less irrigation providing more food

furrows	2	2	3	3	3	13	4	more moisture, better growth, carries some fertility in the water
rock bunds	2	3	3	3	3	14	3	deep irrigation, catches more fertile soil
adding organic matter to the soil	3	3	3	3	3	15	1	easier than trench beds
Crop varieties	1	1	1	1	1	5	7	we do not have the knowledge-but will be easy once we know
Planting times	2	1	1	1	1	6	6	would be nice to have a calendar to remember.

Participants commented on the scores and ranking and suggested that these could be used to decide what practices to start with – such as mulching, adding organic matter to the soil as the quickest and easiest, then moving on to rock bund, furrows and trench beds, and so on.

8.5.3 Sedawa CSA practices

ACTION	CONSTRAINTS	HAS IT WORKED	FUTURE; NEXT STEPS
GOAL: Improve water use efficiency and increase access to water			
RWH : Jo-jo's, 210l drums, basins, small dams, underground tanks	Jojos are easy but expensive – in digging for dams labour does not cost so that could help Increases mosquitos	Yes; Small dams have been dug by few- if not lined they lose a lot of water. Water in Jojo only lasts about 1 month- so it is not enough for gardening	Plan to do roof structures and gutters properly If we do joint saving we can work together to buy Jojos There are some challenges with savings groups, but we are used to them from burial societies etc We can harvest water form the road for the underground tanks
Keep riverine vegetation	People are still chopping down trees next to the river for firewood	There is knowledge about pruning trees rather than chopping whole trees	Need to work with traditional authority to ensure we keep riverine vegetation
Prevent veld fires	No		Can work with the traditional authorities and spread the word through our learning groups
Infiltration pits/areas/ reconstructing wetlands	NO	We can get some reeds form other wetlands to get the process going	These are joint activities through community meetings- but there is now more cohesion through the learning groups, so it can be possible
Water infrastructure management	No		Would like to set up an awareness campaign in the area, so that all community members take care of infrastructure
Planting in beds with Mulching Trench beds		Yes; reduces watering form every day to every 2-3 days. Contributes also to soil fertility, carrots grow nice and straight	Provide shade for these beds – potentially using maize stover to keep them cool.

Greywater; drip kits, ash	No- more a supplementary activity when there is no other water	Yes; works at household level in gardens if you use ash to clear the water. The ash residue with soap then goes into the toilet to reduce smells	-Impact not that great, but worth doing.
Irrigation methods		Timing- am or pm to save water	This is a standard practice
GOAL: soil management			
Increase organic matter; incorporate leaves, crops, ash, manure Trench beds, eco-circles		Yes, The new bed types hold water for a very long time if you can start by saturating them. Eco-circles are easier than trench beds and work just as well	Plan for continuity in different circumstances
Erosion control; stone lines contours, diversion furrows	No- not aware of line levels and how to measure contours	Yes; plant just below the stone lines or furrows as there is more water and fertility there. Diversion furrows are good, but difficult to dig.	-If you add infiltration pits below the stone lines it works very well – can plant in that. -It is easier to make furrows and ridges in the garden than diversion ditches -Continue with improved furrows and ridges- on contour, with mulching and planting various crops.
GOAL: Crop management			
Trees in the garden		Yes – afternoon shade is important	
Close spacing – linked to minimum tillage (CA)	No- not many participants are aware yet of this option	Yes; close spacing in field crops gives quick canopy cover – cooler and wetter, it also helps with erosions control and there is still enough air movement	Include bird resistant sorghum and millet as good harvests can be realised from these drought resistant crops. Cowpeas can be harvested twice in a seons.

8.6 **Learnings**

These are summarised in point form below:

- Planting trees for shading crops
- Some trees help with pest control
- We are realizing how most of the things MDF has covered fits into CCA- for example the tunnels
- Some of the practices such as mixed cropping are good; one can see the results you are working towards
- There are good ideas in terms of practices for CC and extreme temperatures- but it is not enough
- We learnt about heat tolerant crops from each other, and also when to plant.
- We learnt about promoting pest predators- lizard hotel
- We learnt about the erosion control furrows and what to plant now
- We learnt about planning according to quick wins (from the matrix that was done)
- Water saving techniques – including tower gardens
- Harvesting water from the road using diversion ditches

- Garden refuse as mulch rather than burning it

8.7 Future CC actions

- **More focus on access to water (all three workshops)**
- **More CSA techniques and deepening the implementation of the present ones (in all three workshops)**
- **Tunnels and trench beds have worked particularly well (All three workshops)**
- Can grow the dryland crops in summer, but need water in winter for vegetable production
- Can try layers; but cost of feed is an issue and access to clean water. Sunflowers and sorghum can be grown for the chickens. Indigenous chickens are no longer kept - as they are not very productive and destroy crops
- For broilers there are already a number of projects in the area, but can still do this competitively – can do chicken pieces as a value add.
- Need also to deal with livestock - the effects of CC on livestock production
- We shouldn't end here. We tried these ideas under the worst situations (drought) – they may do a lot better now in a better year
- One of the highlights has been the cost-benefit analysis in our learning sessions; where more inputs could mean a much better yield- rather than low inputs and low yields.
- Savings can be introduced
- **Planting calendars: CC based crop choice calendars (all three workshops)**
- -Make a committee to continue to explore options for spring protection and efficient management of water from them.
- Need now to implement the improved erosion control measures that have been introduced.
- Once water is sorted there needs to be more focus on commercial production
- Bulk buying for Jojo tanks- MDF to find potential discount options
- Bring DRD representatives on board with the NGOs already working in these areas (Sedawa) to see if more things can be brought.
- Also work with the municipality – improve the relationship with the councillors and then set up a joint strategy with community and NGOs working together
- NGOs must make sure they keep their promises as community members cannot trust them otherwise
- NGOs need to take more care to help support local produce when catering and also local caterers.

8.8 Planning for DICLAD-AgriSI Module 3 (2018)

- The following themes were suggested for Module 3.
    - Planting calendars, and how climate change could change these (e.g. should we stop growing maize or look at ways to assist the growth of maize?)
    - Introducing new varieties of crops that are more resilient to the expected impacts of climate change
    - Consider the option of livestock grazing – although this would require a long-term intervention
    - Consider the option of poultry production

- We should include in the design of the process the farmers' own knowledge, namely, changes that they have observed that confirm the reports from the scientists. Information is needed from both sides.
- The following questions were raised which will determine the framing of the project within climate change.

    - We need to consider the following two focus points to guide our activities for 2018.
      How is climate change changing *what we can do*, i.e. what options / alternatives we have?
      versus
      How is climate change impacting *what we are currently* doing, i.e. vegetable gardening?
    - Specifically for DICLAD, we need to consider its role.
      Is DICLAD used for integration? Then, how can we use it to integrate the science into what we are doing?
      Or
      Are we using DICLAD as a "planning tool"?

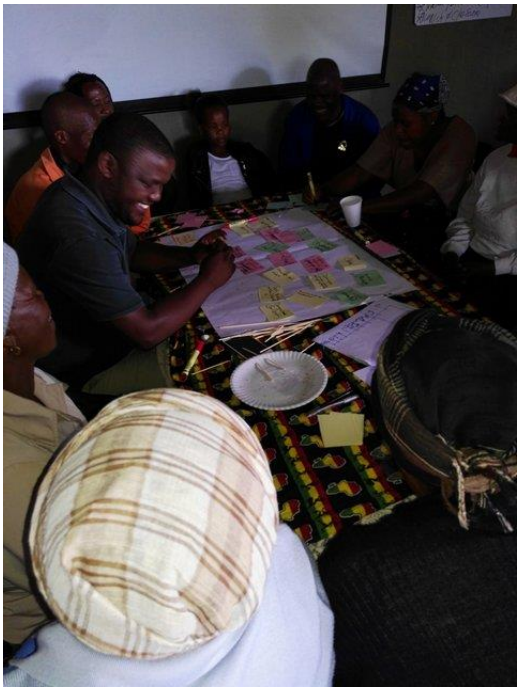
    - Overall, we (DICLAD team, AgriSI project manager and Mahlathini) will have to engage in further discussions to clarify the roles and responsibilities of each entity. For example, it was proposed for Mahlathini to focus on implementation at the local level, for the DICLAD team to open up conversations with climate change as the focus point, and for the AgriSI Manager to take on an oversight role and link these two. This still requires further discussion.
- It was proposed to develop learning materials on climate change for farmers – something tangible we can give them. DICLAD has an allocated budget for this. We can consider developing a process next year to design such materials with inputs from the farming communities. The process should be fun and in their preferred local language.
- There was some discussion questioning the usefulness of providing planting calendars to farmers, as these often just re-affirm what they already know. Perhaps the real question is how climate change could impact these planting seasons, and then the repercussion for planning. Also, we need to ask what do farmers exactly mean when they ask for calendars. Would farmers still plant high value crops even when conditions become too unsuitable? What approach should we follow when farmers for example choose to grow irrigated GMO maize which has short-term benefits but in the long-term has challenges with high heat and limited water resources?
- We also discussed the usefulness of sharing technical information on maps related to climate change, e.g. shifts in the geographical areas where maize can be planted. Seasonal forecasts can also be considered, but these are more relevant for dry-land crops and not vegetable gardens (which *always* require water).
- We must encourage and improve information sharing within the clusters. (Reference here was made to the use of bird-resistant millet seed which Mahlathini introduced.)
- We can start by introducing drought-resistant crops. (Mahlathini has used a round-robin process in previous projects to introduce seeds for fruit, vegetables and medicinal plants.)
- We also need to create awareness of resource management at the landscape level, e.g. considering our rivers and trees. This would require the involvement of local Indunas.

9 APPENDIX 3: WRC-CCA COMMUNITY WORKSHOP: SEKORORO (LIMA)_20171128-29

Participants: 30
Village: Lorraine,
Organisations: Lima (Karabo, Mishgirl, Silas), MDF (Sylvester, Erna, Nozipho, Tema)

The issue begins with climate then leads to social problems. We need to keep on trying different solutions

With all that we are trying out, it is never enough and never solves all the challenges we have



9.1 Introductions

30 participants in Lima's food security programme supported by Wesbank attended this workshop. Most have been active in gardening with Lima for just on one year and have had introductions to a number of practices; such as trench beds, eco circles, liquid manure, mulching, mixed cropping and natural pest and disease control.
A couple of participants are members of communal gardens who are marketing produce, but most have household gardens and grow a range of vegetables primarily for household use; cabbage, spinach, beetroot, butternut, and also have fruit trees such as mangoes, avocados and litchis and indigenous fruit and shade trees such as marula and moringa.

Right above and below: Sylvester and Karabo facilitating small group discussions

9.2 Impacts of CC

9.2.1 What is CC

- CC caused by green house gases, lots of livestock also cause that
- There is a change in rainfall
- It means a change in weather patterns over a long time
- Unexpected floods and droughts
- Big winds and increases in evaporation
- Hail

9.2.2 Impacts

- Increased evaporation means plants wilt easily- lower yields
- Pest outbreaks (such as cutworm) have become worse
- Water scarcity; makes it almost impossible to work – household water is prioritized over using water for irrigation. Also with municipal water using it for irrigation is frowned upon.

9.3 Past, present future of farming activities in the area

9.3.1 Past:

- More rain, more farming
- Enough rain for dryland cropping, we were using oxen to plough- now have no more oxen
- Monkeys were not a problem
- No use of chemicals- healthy food
- Livestock used to roam freely as there was more grass
- Less diseases (in plants, animals and people)
- Everyone grew and had food- less crime
- Had larger yields- even sent maize for storage, used to make ibece jam.
- Grinding of maize was done manually- so meal was more wholesome as a food.
- There was less money

9.3.2 Present

- We have moved from producing most of our food locally to having to buy everything
- The lack of water makes doing anything at all very difficult
- With the municipal water, we can not use that for irrigation as household needs are more important. In this village the municipal water is only available for 1 day /week
- Now we have to feed livestock – in the past they could just roam – there is not enough grass. There are too many cows to be maintained by the environment
- Monkeys are moving into the households – there is nothing to eat out there
- With hotter temperatures there are more and different diseases
- With the training from Lima we are feeling more confident and are able to produce with those methods
- With the bad production years we lose our seed stocks and now have ot buy seed

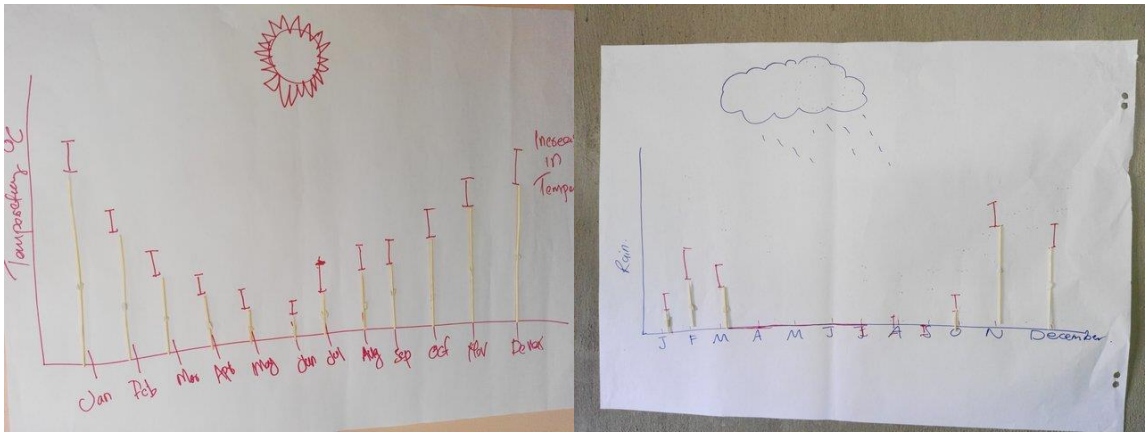
- There is increased theft of produce even off the field
- Even borehole pumps are getting stolen
- There are "super pests' resistant to chemicals
- Birds used to go for millet and sorghum, now they're even going for maize – we stopped planting millet and sorghum a long time ago – no longer have seed.
- Droughts are more severe than before
- Deforestation and soil erosion, linked also to bush encroachments
- People are dying younger

9.3.3 Future

- Death
- More drought
- People get more sick
- More hunger
- No jobs
- Shortage of seeds
- Increased crime
- Teenage pregnancy increased
- Soil degradation
- There should be opportunities for those who can continue to farm – as there will be fewer farmers – those who can could make reasonable incomes
- People will get more educated and hopefully come with solutions
- Opportunity for things to get much better and much worse at the same time
- Land has been wasted in the land claim areas – those people don't even know about farming
- There is a lack of interest from youth, but if they were to be interested we as communities could invest in their education so that they can help us plan
- Having a vision of what you want to see is important
- We need to protect and save whatever there still is left to be able to preserve our future.

9.4 CC predictions and understanding

Presentation of scientific predictions for the area. And then small group seasonality diagrams for temperature and rainfall, including an analysis of how these are changing.



Above left: The seasonality diagram produced in Sekororo looking at temperature – the red lines indicate increased temperature for every month of the year
Above right: the seasonality diagram looking at rainfall and changes. There the red lines indicate decreased rainfall leaving Aug Sept and Oct almost entirely dry

Comments from the groups agree that temperature is increasing throughout the year. With rainfall the distribution has changed and because of heavy rains erosion has increased. Overall, distribution has decreased- fewer months of rain. There is now a delay in harvesting wild leafy vegetables (morogo) as this used to be in November. Now that it is drier and hotter, the supply has decreased considerably. The rain is definitely more unpredictable. Crops like mustard spinach used to be grown in winter, but with the hotter temperatures it is no longer doing well. It feels as if there is no winter anymore. Planting dates have shifted and instead of being able to plant in September, we need to wait sometimes until January for enough rain to plant.
There is a change in crop types that can be planted. Heat tolerant crops are now preferred. These include: chillies, onions, cowpeas, peanuts, jugo beans, sugar beans, sweet potatoes
And also in planting methods – planting now works better in controlled environments such as greenhouses.

9.5 CC impact mind mapping

This exercise is designed for participants to explore all the impacts on their farming systems and livelihoods as a starting point to beginning to identify potential adaptive measures.

Right: The mind map produced by one of the small groups in Sekororo

Participants mentioned impacts such as:

- More drought and floods
- Heavy winds and more storms
- Increased veld fires
- Scarcity of water; drop in boreholes and rivers drying out.
- Decrease in wetlands and natural vegetation – specifically trees.
- Having to produce crops in smaller areas
- Condition of roads deteriorate rapidly.
- More wild animals moving into the homesteads
- And social issues such as increased hunger, increased crime, lack of jobs, increased domestic violence, theft, divorce, no money to pay lobola, increase in death rate

The table below summarises the impact, linkages and potential adaptive measures mentioned by the two small groups of participants.

Impacts	Description and linkages	Outcomes	Potential adaptive measure
GROUP 1			
Heat	Plants wilt and die	Lack of grazing, livestock ide	Mulching, controlled grazing, reduce stock, save/store fodder – leaves and grasses for dry season
Water shortages	Rivers drying out, boreholes drying out		Greywater, purification using moringa seeds, water storage for dry season
Soil	Soil erosion (more dongas), soil fertility decreasing,	Deterioration of roads- making access difficult	Planting in tyres, keyhole beds, tower gardens,
Crop production, resources	Lower yields, more pests, veld fires, reduction of indigenous trees Common pests: cutworms, millipedes, centipedes		Natural pest and disease control, mulching (but this can increase some pests), inter cropping, crop rotation, use of multi- purpose plants (e.g. marigolds) Use the wild cucumber (yellow inside) dry, grind and spray on crops to control nematodes and soil pests Manage cutting of trees and plant more Plant in tunnels
Livestock	Lack of grazing, more diseases, more damage of crops	Livestock decreasing, not healthy	Control grazing,
Social repercussions	Poverty, diseases, hunger	Crime, murder and theft, domestic violence, divorce, increased death rate, no money to pay lobola	
GROUP 2			
Extreme heat	Veld fires		Use of tunnels, plant heat resistant cultivars, irrigate in early mornings and evenings
Lack of water	No grazing, drying of natural vegetation and bushes, wilting of plants, trees do not fruit, extreme	Food shortages, animals die due to lack of grazing,	Water harvesting, earth dams, grey water and management of existing water, diversion furrows

	rains destroy infrastructure,		
Soils	Organic matter content is low, dry soils, roots are exposed, soil erosion, also due to use of mechanisation - ploughing		Liquid manure, make use of animal manure, trench beds and eco-circles Plant sweet potatoes to hold soil, plant across the slope, plant indigenous crops such as cowpeas, Make use of hands and oxen to plant using conservation agriculture Loosen the soil to avoid water logging and yellowing of plants
Crops	Reduced production increased pests, medicinal herbs destroyed in drought and heat		Plant colourful flowers and plants to attract pest predators and bees, companion planting, making brews form marigolds Plant medicinal species in controlled environments with the vegetables 9tunnels)
Social repercussions	More diseases and health problems, poverty food shortages, low education standards (because schools are free)	No transfer of knowledge, crime	Plant herbs and vegetables, entrepreneurship, job creation, plant your own crops instead of always buying

9.5.1 Assessment of potential practices

A few practices were selected from the mind map and were further explored in terms of participants' understanding of how well they would/might work

Practices	Does it work	How well does it work
Tower garden	Yes, works well	Lack of access to materials for making the towers; leads to growing in small areas- too little production
Diversion furrows	Yes, facilitates good infiltration	Only works when you have lots of water and need to learn to use line levels to make them
Rainwater harvesting	Yes, we use 210l drums and basins	Not very much water saved – need opt think of ways to increase this

Eco-circle	Yes, works well	Hard work, but it lasts and gives good quality crops
Tunnel	Yes works well	No one has tunnels as it requires lots of money

A short discussion was also held around the question: *What do we need to do that will make a bigger impact in our lives to adapt to CC?*

- We need bigger storage tanks- we are not presently saving enough rainwater
- Due to a lack of employment getting inputs is a challenge. We need to use our own labour and local resources, maybe savings groups can help, but also need assistance
- Biogas digesters could be an idea to get our own energy without paying.
- Practical demonstration of practices will help us to remember, understand better and implement more of the ideas mentioned.

9.6 Practices

Discussion on adaptive measure to CC impacts leads in to a discussion of possible practices (local and new ideas) that can help with these issues. This is supported by having pictures and descriptions of a range of potential practices available and discussing those that make sense

In this case it was also supported by a community walk to participants who volunteered their gardens, doing interesting things trying innovative techniques etc.
Participants also commented that the methods/practices they have learnt about in training and workshops are useful.

PRACTICES WE ARE ALREADY FAMILIAR WITH: mulching trench beds, furrows and ridges, intercropping, planting herbs, diversification (ore different kinds of crops planted together), small dams, compost.
Further comments made by the group include:

- Mulching is done, but is not so popular, because of lack of materials
- Earth dams are dangerous for children
- Jojos are expensive - we are using drip irrigation (2nd hand from commercial farms)
- Hybrid seeds are expensive and unreasonable even though they have given very positive results

PRACTICES GLEANED FROM COMMUNITY WALK: small earth dams, planting grass in eroded areas, planting and keeping seed of old and traditional crops such as shallots, cowpeas, awa indigenous greens such as cleome, using kitchen scraps in shallow trenches, compost pits, banana circles, management of mango trees by some pruning, planting green beans under shade of trees rather than sugar beans as the latter does not pod well in the shade., protecting litchis from birds using netting, learnt about pollination processes for mangoes- did not know about male and female flowers. Normally when we see brown patches on the mango leaves we did not think that this can affect the fruiting. With the age of the trees, quality and quantity of fruit deteriorates
Bees for pollination – and talking about bee fodder plants, drip irrigation for saving water, diversion furrows for protecting soil and crops

Above left to right: Local innovations: small dam, shallots grown and seed kept, banana circles with compost and furrows and ridges for planting beans

PRACTICES CHOSEN FROM NEW IDEAS: tunnels, underground tanks, and bigger rainwater harvesting structures more generally, drip kits, growing fodder for livestock, conservation agriculture furrows and ridges, shallow trenches, natural pest and disease control, seed saving, savings groups, biogas digesters.

We would like to see practical demonstrations of these practices as just talking about them briefly is not enough for us to go and try them. Due to lack of employment getting inputs is a challenge.

FURTHER COMMENTS ON PRACTICES:
We want more information on planting dates; We have already adapted to some extent, especially with the crops that are possible for summer. We are however battling with the winter crops- they are not doing well, bolting early etc. We want to know about winter vegetables that can deal with drought and variable temperatures. But with some of these new vegetables we are not used to eating them and do not know good cooking practices- so we may grow them but then we don't use them. Also with the new crops, new pests come in that we don't know how to deal with. We've been taught about using black jack seeds and sunlight soap. We need more remedies for different situations

Some examples discussed were; turnips, leeks, open headed cabbages and leaf cabbages, rape, kale, kohlrabies, mustard spinach, Chinese cabbage.

9.7 Criteria for assessing practices

- Availability of material
- Increased water infiltration and water holding capacity (water use efficiency)
- Increased availability of water
- Costs- cost efficiency, cost-benefit

- Labour (labour vs benefit)
- Crop quality (germination, growth)
- Fewer pests

The beginnings of a matrix ranking exercise was put together to give people an idea of the process, which would be followed up in subsequent sessions

Practice	Availability	Water use efficiency	Increased water	cost	labour	Crop quality	Fewer pests	Score
Tower garden	2	3	1	2	3	3	3	17
Eco circle	3	3	1	3	2	3	3	18
Underground tanks	1	3	3	1	1	3	3	15
Trench bed	3	3	1	3	1	3	3	17
Mulching	2	3	1	3	3	3	2	17
Lizard hotel	3	1	2	3	2	3	3	17
Diversion furrow	3	3	1	3	1	3	2	16

COMMENTS ON THE MATRIX

- Eco-circles are the practice that most participants have tried
- Underground tanks are not really done as they are expensive and difficult to do. They do however have a huge potential to make a significant difference
- Savings groups could be a way to help with the issue of money
- The matrix is a very useful method for decision making
- It is good to do a number of different things
- The more knowledgeable participants will help the others to try these practices.

10 REFERENCES

Ahead, G. (2005). *Advantages and disadvantages of visual aids.* http://www.getahead.uk.com/gwpr07-advantages-of-visual-aids.htm.

Amanzi for Food. (2015). *Navigation Tool.* Environmental Learning Research Centre Rhodes University: WRC Project K5-2277.

AWARD. (2017). *Dialogues on Climate Change and Adaptation (DICLAD): Facilitators Agenda.*

Banda, M. (2016). *Creating channels, connections, and communities: Experimenting with virtual rural agricultural learning communities in Nkhotakota district, Malawi.* Malawi, Nkhotakota: RUFORUM Working Document Series (ISSN 1607-9345) No. 14 (1): 363-369.http://repository.ruforum.org.

Benset, G. (2010). *Animation: What is Participatory Video .* Retrieved from INsightshare.org: https://www.youtube.com/watch?v=seOstch03j8):insightshare.org

Bligh, D. (1998). *The teaching professor.*

Brandt, P., Kvakić, M., Butterbach-Bahl, K., & Rufino, M. C. (2017). How to target climate-smart agriculture? Concept and application of the consensus-driven decision support framework . *Agricultural Systems 151*, 234-245.

Corner-Dolloff, C. (2015). *CCAFS Climate Smart Adaptation Prioritisation (CSAP) Toolkit.* CIAT.

Devesh, T. M. (2017). WHATSAPP FOR FARMERS: ENHANCING THE SCOPE AND COVERAGE OF TRADITIONAL AGRICULTURAL EXTENSION. *International Journal of Science, Environment and Technology, Vol. 6, No 4, 2017, 2190 – 2201*, 2191-2201.

Dick, S. N. (2011). *Use of community radios to communicate agricultural information to Zimbabwe's peasant farmers.* Pretoria: Depaertment of Inforamtion Science.

Duveskog, D. M. (2002). *Harnessing Indigenous Knowledge and Innovation in Farmer Field Schools.* Indonesia: International Workshop on Farmer Field Schools.

FAO. (2014). *Communication for Rural Development: Guidelines for Planning and Project Formulation.* Food and Agriculture Organisation of the United Nations.

Guffey, M. R. (2011). *Business Communication.* Birchmount Road, Toronto, Ontario,: Nelson Education.

Hamza, M. (2012). *Training material development.* Swedish: Swedish Civil Contingencies Agency.

Hancock, J. (1997). *Extension Education Conducting Effective Agricultural Demonstrations.* USA, Lexington: Cooprative Extension services.

Hartley, J. (2000). Radiocracy:Sound and Ciitizenship. *International Journal of Cultural Studies*, 156-157.

Karzner, H., & Belack, C. (2010). *Managing Complex Projects.* John Wiley & Sons.

Khanal, S. R. (2011). Role of radio on Agricultural development: A review. *An interdisciplinary journal*, 201-206.

Kruger, E. (1995). *Farmer-to-Farmer: A story of Innovation and Solidarity.* Natal, South Africa: The Natal Printing and Publishing Company.

Kumar, A. (2000). *Extension Education for human resource development .* INDIA.

Mayank, J. (2013). *How to Make a Handout for School.* http://www.ehow.com/how_8302821_make-handout-school.html.

Mwongera, C., Shikuku, K. M., J, T., P, L., E, A., A, V. A., . . . A, W. L. (2016). Climate smart agriculture rapid appraisal (CSARA).A tool for prioritizing context-specific climate smart agriculture. *Agricultural Systems 150*.

Oakley, P. G. (1997). *Guide to extension training.* UK: Agriculture Extension and Rural Development Centre, School of Education, University of Reaing.

Ramsing, L. (2009). *Project communication in strategic internal perspective. .* Retrieved from http://www.emeraldinsight.com/doi/full/10.1108/13563280910980113 Consulted 5.12.2014

Richardson, J. G. (1999). *Extension education: Process and Practice.* NC State: NC.

Saya, S. K. (2012). *Appreciative Inquiry to Promote Local Innovations among Farmers Adapting to Climate Change: Facilitators Guide.* Chagrin Falls, USA: Taos Institute,.

Semakula, E. M. (2011). Effectiveness of the farmer-to-farmer extension model in increasing technology uptake in Masaka and Tororo Districts of Uganda. *South African Journal of Agricultural Extension*.

Tonge, R. (2010). *How to wite training manuals.* Australia.

Ulrichs, M., Cannon, T., Newsham, A., Naess, L., & Marshall, M. (2015). *Working Paper 108 -Climate change and food security vulnerability assessment toolkit for assessing community level potential for adaptation to climate change.* Bioversity International & Institute of Development Studies, CGIAR/CCAFS.

Yang, K. (2016). *Chapter2: Participatory Video in Practice.* Retrieved from Springer: HTTP://WWW.SPRINGER.COM/978-981-10-1048-4

Ylitovia, F. (2015). *Internal Communications in Project Management-Case Company X.* Turktu University of Applied Sciences.

Zulch, B. G. (2014). *Communication: The Foundation of Project Management 2014. .* Published by Elsevier Ltd. Peer-review under responsibility of the Organizing Committees of CENTERIS/ProjMAN/HCIST 2014.