Deliverable

4

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.4: Report- CoPs and Demonstration Sites Established
Date: May 2018

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CONTENTS

FIGURES

TABLES

Report- CoPs and demonstration sites established

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

Table 1: Deliverables for the research period; completed

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 4

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:

- Continuation of implementation of the CCA introduction workshops (workshop 1) in KZN (Ezibomvini _18-19 Jan 2018 and EC, Alice_13-15 Feb 2018);

- Initiation of collaborative activities in 6 villages (KZN and Limpopo): Tunnels and drip kits (Thabamhlophe, Ezibomvini, Eqeleni_29-31 Jan 2018 Sedawa, Lourene, Turkey_9-12 April 2018); CSA gardening practices (Turkey_ Jan, March 2018)
- Team planning meeting; including training of trainers (16 March 2018)_ Outline and planning for CCA workshop 2 (Prioritization of practices)
- Implementation of CCA Workshop 2 in 3 villages (KZN and EC): Ezibomvini (22,23 March 2018), Thabamhlophe (17-18 April 2018), Alice (16-17 April 2018).
- Dialogues in climate change adaptation- including prioritization of practices – Limpopo (13-15 March 2018)
- 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); weather stations, run-off plots, gravimetric water sampling, soil health sampling, soil fertility sampling, chameleon water sensors.
- Capacity building and publications:
    - Research presentations and chapters:
        - Khethiwe Mthethwa – Agric Honours(UKZN -Completed cum laude);Investigating the sustainability of adoption of conservation agriculture by small-scale farmers in Bergville, Dec 2017),
        - Mazwi Dlamini – M Phil (PLAAS UWC-yr 2); completed proposal and research methodology
        - Palesa Motaung- M Agric (UP- yr 2); completed proposal and research methodology
    - Newsletter articles: Adaptation Network newsletter, SA Grain Newsletter, African Farming.Com - Feature
    - Rangeland learning exchange visit (UCPP_6-8 Feb 2018), Regenerative Agriculture
    - Conference-Reitz (GrainSA and Landbouweekblad_19-20 March 2018).

2 COPS AND DEMONSTRATION SITES ESTABLISHED

Table 2: CoPs' established in three provinces

Province	Site/Area; villages	Demonstration sites	CoPs	Collaborative strategies
KZN	Tabamhlophe	- 1st CC workshop - Collaborative strategies: -2nd CC workshop	-Farmers w NGO support (Lima RDF)	- Tunnels and drip kits - Individual experimentation with basket of options
	Ezibomvini/ Thamela, Eqeleni	- 1st CC workshop -Collaborative strategies -2nd CC workshop	-CA open days, cross visits (LandCare, DARD, ARC, GrainSA), LM Agric forums, ….	- Tunnels (Quantitative measurements - CA farmer experimentation (Quantitative measurements) – case studies -Individual experimentation with basket of options
Limpopo	Mametja (Sedawa, Turkey,	- 1st CC workshop - 3rd DICLAD workshop - Collaborative strategies:	-Agroecology network (AWARD/MDF)	- Tunnels (Quantitative measurements - CA farmer experimentation (Quantitative measurements) – case studies - Individual experimentation with basket of options
	Tzaneen (Sekororo - Lourene)	- 1st CC workshop - Collaborative strategies		-Tunnels and drip kits
EC	Alice/Middledrift area	- 1st CC workshop -2nd CC workshop	Imvotho Bubomi Learning Network (IBLN) - ERLC, Fort Cox, Farmers, Agric Extension services, NGOs	-Individual and collaborative experimentation with basket of options

3 CSA PRACTICES

A little more work was done on the practices database, providing for a focus on the Agroforestry and Livestock management options and coming up with the first ideas around these two important farming system processes.

Category	Area	Type of practice	Practice	Description	Farming resource that is targeted				
					Water	Soil	Crop	Livestock	Natural res
Water Management	Manage available water	irrigation	drip irrigation	Also called trickle or micro irrigation applying water slowly and directly to the roots of plants through small plastic pipes and flow control devices. Emitters are integral to the functioning where turbulent flow prevent clogging to a large degree.	3	2	2	1	1
Water Management	Manage available water	manage evaporation ,temperature	shade cloth tunnels	Shade cloth structures (40% grey) assist in managing water through reduced evaporation, temperature and pest incidence	3	2	2	1	1
Water Management	Manage available water	irrigation	furrows and ridges/ furrow irrigation	Furrow irrigation is a method of applying water at a specific rate of flow into shallow, evenly spaced, u-shaped channels from the top end of the furrow. Flow occurs because of gravity and the amount of water applied is dependent on soil type, gradient, flow rate, evenness and the number of previous applications.	3	2	2	1	1
Water Management	Manage available water	improved water retention	mulching	Soil cover refers to vegetation, including crops, and crop residues on the surface of the soil, covering ideally the projected surface area of crop roots.	2	2	3	1	1
Water Management	Manage available water	improved water retention	improved organic matter (manure and crop residues)	Increased organic matter enhances the water holding capacity of sandy soils, while it improves the drainage of clayey soils.	3	2	2	1	1
Water Management	Manage available water	irrigation	Greywater management	Irrigation practices involving greywater, including pre-treatment with ash or using sand filters. Specific bed designs for greywater include tower gardens and keyhole beds.	3	1	2	1	1
Water Management	Manage available water	control erosion, water harvesting	Diversion ditches	Channel or furrow made across the main slope with its ridge on the downhill side	3	2	1	1	1

Water Management	Manage available water	control erosion	Grass water ways	Shaped or graded channels with suitable vegetation, designed to intermittently carry surface water runoff at non-erosive velocities to stable outlets.	2	3	2	1	1
Water Management	Increase available water	water harvesting, soil fertility	infiltration pits / banana circles	0.7m-1.5m deep pits/basins dug in water flow lines to control water movement and filled with organic matter for improved soil fertility. Various planting regimes including bananas	3	2	3	1	1
Water Management	Increase available water	water harvesting	rain water harvesting	The collection of run off from rain, roof and other surfaces for productive use in and outside the field. Both infield and storage options are available	3	2	2	1	1
Water Management	Increase available water	water harvesting	tied ridges	Increases the water availability by collecting rainfall from an unplanted sloping basin and catching it with a furrow and ridge. Planting takes place on either side of the furrow where the water has infiltrated.	3	2	2	1	1
Water Management	Increase available water	water harvesting, soil erosion control	Half moon basins	These are small semi circular earth bunds for catching water flowing down a slope	3	2	2	1	1
Water Management	Increase available water	water harvesting	small dams	2m-5m deep pond constructed to catch water during the rainy season with a clay core, a wall (for larger earth dams) and a spillway to let go off excess water	3	2	2	1	1
Soil Management	Control soil movement	control erosion	Contours; ploughing and planting	Ploughing and or planting along the contours of the land in order to minimize soil erosion. Can use line levels, A-frames, dumpy levels etc to mark contours	2	3	2	1	1
Soil Management	Control soil movement	control erosion	gabions	Rectangular baskets fabricated from a hexagonal mesh of heavily galvanized iron, filled with stones/ gravel for erosion control steel wire filled with rock and stacked atop one another to form a gravity type wall.	2	3	2	1	1
Soil Management	Control soil movement	control erosion, water harvesting	Stone bunds	Used along contour lines to slow down, filter and spread out runoff water, thus increasing infiltration and reducing soil erosion.	2	3	2	1	1

Soil Management	Control soil movement	control erosion, water harvesting	check dams	These are small dams constructed across a drainage ditch, or waterway to counteract erosion by reducing water flow velocity and allowing sedimentation of silt.	2	3	2	1	1
Soil Management	Control soil movement	control erosion, water harvesting	Swales	Swales are ditches and bunds constructed on contour to manage water flow and sedimentation. Mulching and planting occurs in both the ditch and on the bunds	2	3	3	1	1
Soil Management	Control soil movement	control erosion, water harvesting	Zai pits	Hand dug 0.6m diameter and 0.3m deep circular holes that collect and store water for crop use	3	2	3	1	1
Soil Management	Control soil movement	control erosion, water harvesting	Terraces	A terrace is a level strip of soil built along the contour of a slope and supported by an earth or stone bund, or rows of old tyres for example	2	3	2	1	1
Soil Management	Control soil movement	control erosion, water harvesting	Stone packs	Like gabions and check dams these are constructed across gulleys or water flow paths to control erosion, slow surface water flow rate and promote sedimentation	2	3	2	1	1
Soil Management	Control soil movement	control erosion, crops, livestock, natural resources	Strip cropping	Strip cropping is a strategy for subdividing single fields on slopes into strips that follow contours; where different crops are planted; a mixture of annual and perennial crops are usually used.	2	3	3	2	1
Soil Management	Control soil movement	control erosion	Pitting	Pitting is carried out in large fields or areas prone to sheet and wind erosion where the whole area is imprinted with small pits- into which sediment and seeds can be blown for germination when it rains.	2	3	2	2	2
Soil Management	Control soil movement	control erosion, soil fertility	Woodlots for soil reclamation	Trees planted in an eroded area will assist with recuding the flow rate of surface water and thus help to prevent further erosion.	1	3	1	1	3
Soil Management	Improve soil fertility	soil nutrients	Targeted application of small quantities of fertilizer, lime etc	Use of site specific fertilizer recommendation and more efficient use of fertilizer (using the right, source, at right time, at right place and applying the right rate) , liming to manage soil acidity (surface liming and incorporation).	2	1	3	1	1

Soil Management	Improve soil fertility	soil nutrients	Liquid manures	Brews are made of animal and plant matter as liquid supplements to soil fertility,	1	1	3	1	1
Soil Management	Improve soil fertility	soil nutrients, livestock fodder	Woody hedgerows for browse, mulch, green manure, soil conservation	Growing leguminous tree shrubs in narrow strips across the slope and material used a green manure	1	2	3	2	2
Soil Management	Improve soil fertility and health	manage water, control erosion and soil health, crops, livestock	Conservation Agriculture	Three main principles of minimal soil disturbance (no ploughing), soil cover (stover, mulching and cropping patterns) and diversity (inter cropping, relay cropping and cover crops) upheld in the field cropping system	2	2	3	2	2
Soil Management	Improve soil fertility and soil health	soil nutrients	Planting legumes, manure, green manures	Use of legumes , manures (improved) and green manures in specific combinations to improve soil fertility and soil health.	1	2	3	1	1
Soil Management	Improve soil fertility and soil health	soil nutrients, crops	Mixed cropping	Managing soil health and pest and disease incidence through crop combinations; mixed cropping, inter cropping, crop rotation	1	2	3	2	1
Soil Management	Improve soil fertility and soil health	soil nutrients, crops	Herbs and multifunctional plants	Managing soil health and pest and disease incidence through crop combinations; using herbs and multifunctional plants - including windbreaks, trap cropping, pest deterrents, bee fodder etc	1	2	3	2	1
Soil Management	Improve soil fertility and health	soil nutrients, crops, livestock	Agroforestry options (multipurpose, fast growing trees and fodder species)	Land use management system in which trees or shrubs are grown around or among crops or pastureland	2	2	3	3	1
Soil Management	Improve soil fertility and health	soil nutrients, crops	Bed design; trench beds, eco circles	Intensive beds dug out and filled with a range of organic matter (dry, wet manure, bones, ash etc) to provide for highly fertile beds with high water holding capacity - e.g. trench beds, shallow trenches, eco-circles	2	2	3	1	1
Soil Management	Improve soil fertility and health	soil nutrients, crops	Understand soil health aspects using visual indicators	Using visual indicators for soil type, soil aggregates, porosity, soil mottles, infiltration etc can assist in planning appropriate soil management structures	1	3	2	1	1

Crop Management	Crop management	Diversification	crop diversification	Addition of new crops to the production system, to fix nitrogen for example.	1	2	3	1	1
Crop Management	Crop management	Pest management (incl weeds)	push-pull technology	Approach in pest management which uses a repellent intercrop and an attractive trap plant	1	1	3	1	1
Crop Management	Crop management	Pest management (incl weeds)	Natural pest and disease control	This is an ecologically based aproach to managing pests and diseases including chemical, boilogical and other regulatory means	1	1	3	1	1
Crop Management	Crop management	Pest management (incl weeds)	Integrated weed management	The use of a combination of weed control practices thus reducing dependency on any one type of control. This includes practices such as close spacing, late season weeding for weeding weeds, soil health management (structure and porosity), composting etc	1	1	3	1	1
Crop Management	Crop management	Improve crop variety	Breeding improved varieties (early maturing, drought tolerant, improved nutrients),	Improve varieties can be more productive, grow in drier years and potentially make better use of nutrients	1	1	3	1	1
Crop Management	Crop management	Improve crop variety	OPV and heirloom varieties	OPV's are seeds where pollination occurs by insect, bird, wind, humans, or other natural mechanisms. Heirloom variety is a plant variety that has a history of being passed down within a family or community	1	1	2	1	1
Crop Management	Crop management	Seed saving	Seed saving	The practice of saving seeds or other reproductive material (e.g. tubers) from vegetables, grain, herbs, and flowers for use from year to year for annuals	1	1	2	1	1
Crop Management	Crop management	Crop rotation	Crop rotation	A series of different crops planted in the same field following a defined order to improve soil health and to prevent the build-up of soil related diseases.	1	2	3	2	1
Crop Management	Crop management	Crops natural resources	Windbreaks	Hedges as shelterbelts and wind breaks in wind prone areas; can use multipurpose indigenous species that also assist in erosion control	1	2	2	1	2

Livestock Management	Integrated crop-livestock management	Integrated systems	Trees and bushes lining fish ponds for optimal pond conditions and fish "browsing"	Trees and shrubs are planted on the edge of the pond to prevent trampling by cattle. Watering points need to be provided if the pond is used for stock watering.	3	1	2	2	1
Livestock Management	Integrated crop-livestock management	Honey	Trees suitable for honey production	Trees suitable for honey production could be planted on field edges and unused areas.	1	1	2	1	2
Livestock Management	Integrated crop-livestock management	Protein rich trees	Production of protein-rich tree fodder on farm/rangelands for cut-and-carry fodder production	Protein rich trees like tree Lucerne could enhance the grazing capacity and assist with soil protection	1	2	2	3	2
Livestock Management	Integrated crop-livestock management	Woodlots	Woodlots for timber, fodder, soil protection, soil reclamation	Appropriate trees planted in an eroded area will assist with reducing the flow rate of surface water and thus help to prevent further erosion. It will also enhance the soil fertility because of the falling leaves.	1	2	2	2	1
Livestock Management	Integrated crop-livestock management	Improved fallow	Woodly legumious crops planted and left to grow during fallow phase to improve fallow	Deliberate planting of leguminous species primarily for fixing nitrogen as part of crop fallow and rotation and secondarily for livestock fodder	1	2	3	3	2
Livestock Management	Integrated crop-livestock management	Shade	Trees planted for shading crops or animals	A plantation of one or more rows of trees for shading purposes. This can enhance the production of dairy cows significantly - if the waiting area is fully shaded.	1	1	1	3	1
Livestock Management	Integrated crop-livestock management	Broilers	Small scale broiler production	Grow broilers in naturally ventilated houses made of iso-wall panels. Free range optional	1	1	1	3	1
Livestock Management	Integrated crop-livestock management	Layers	Small scale egg production	Produce eggs in naturally ventilated houses made of iso-wall panels. Free range optional	1	1	1	3	1

Livestock Management	Integrated crop-livestock management	Dairy	Small scale milk production	Good quality cows are milked by hand or a simple mechanised system. A shade cloth structure is provided for the waiting area to cool cows down before milking. Evaporative cooling can also be utilised.	1	1	1	3	1
Livestock Management	Integrated crop-livestock management	Beef	Small scale intensive cattle farming	Good quality cattle are kept in a partly shaded area where they are fed the normal feedlot fodder with added fodder grown on the farm. The purpose is to enhance the condition of cattle before selling.	1	1	1	3	1
Livestock Management	Integrated crop-livestock management	Goats	Small scale goat production	Hardy goats are grown for meat and other products like hair.	1	1	1	3	1
Livestock Management	Integrated crop-livestock management	Stall feeding	Stall feeding	Feed animals in stalls to reduce energy requirements seeking out grazing; links to agroforestry systems, fallows and improved pastures	1	1	1	3	1
Livestock Management	Integrated crop-livestock management	Creep feeding	Creep feeding	In cases where young livestock do not have adequate access to fodder, or are 'bullied' by older animals, enclosures that are only accessible to younger animals (i.e. small entrances) can be built. High quality fodder is placed in the enclosure that younger animals can feed on.	1	1	1	3	1
Livestock Management	Integrated crop-livestock management	Alternative fodder crops	Cultivation of alternative fodder crops	Use of high value or productive fodder crops (e.g. legumes, napier fodder, improved pastures)	1	1	2	3	2
Livestock Management	Integrated crop-livestock management	Supplementary feeding	Haymaking	Drying, and storage of surplus fodder for winter feeding - often made from high value / high protein fodder crops	1	1	1	3	1
Livestock Management	Integrated crop-livestock management	Harvesting and relocating nutrients	manure harvesting	The collection of manure from stall-fed animals or animals kept in kraals as a fertiliser for crops	1	2	3	2	1

Livestock Management	Veld management systems	Rotational resting	Resting camps for a full growing season	Rotational resting is the practice of excluding a selected area (usually one quarter of the grazing area) from grazing for a full growing season to allow for the recovery of a grassland - has ecological and livestock productivity benefits	1	1	1	3	3
Livestock Management	Veld management systems	Even utilisation	Even utilisation	Introducing systems that prevent a concentration of grazing close to the homesteads where grazing pressure is highest. Usually requires introduction of herders.	1	1	1	3	3
Livestock Management	Veld management systems	Fire	Fire	Application of fire to remove moribund material and improve veld condition. A spring burn after the first spring rains provides an opportunity to improve veld condition.	1	1	1	3	3
Livestock Management	Veld management systems	Supplementary feeding	Protein licks	Protein licks provide supplements to livestock which allow them to make effective use of low value grazing in the winter months.	1	1	1	3	3
Livestock Management	Veld rehabilitation	De bushing and over sowing	De-bushing and over sowing	The practice of controlling alien invader plants and encroaching indigenous plants to allow grazing to re-establish	1	1	1	3	3
Livestock Management	Veld rehabilitation	Rangeland reinforcement	Rangeland reinforcement	The practice of sowing productive pasture / fodder species into grasslands. Best practice is to introduce these species into old lands, which are degraded.	1	1	1	3	3
Livestock Management	Veld rehabilitation	Bioturbation	Bioturbation	Hoof trampling (a form of “bioturbation”) assists with ‘kick starting’ recovery of grassland on these rangelands, through breaking up capped impermeable soil surface, and depositing nutrients and grass seed in manure	1	1	1	3	3

3.1 Further practices suggested by local farmers

The practices mentioned below are to be added into the database of practices

- Spring protection
- Biogas digesters
- Different seed varieties
- Planting calendars
- Drought tolerant and bird resistant varieties
- Lizard hotel
- More on greywater management

4 OUTCOMES OF CC DIALOGUES (WORKSHOP 1): DEFINITIONS, CHANGES, PRESENT ACTIVITIES, IMPACTS

Initial Climate Change dialogues, to explore concepts of climate change, the impacts on peoples' lives and farming activities and to start discussions on potential adaptive strategies in these communities have been undertaken for 7 villages across three provinces. Full reports for a number of these workshops are attached in Appendices 2-5.

Here a summary of some of the outcomes and discussions will be provided.

4.1 Overview

It can be considered that farmers always complain about the weather; especially those reliant on the weather for crop and livestock production. This meant that our first topic revolved around the differences between general weather variability and climate change. This was achieved through role plays, slide shows and discussions.

The situation differs across the provinces:

- In Limpopo; there was consensus among participants that it is generally hotter throughout the whole year than it was in the past (10 years ago) and that they are receiving less rain than before. They feel that the impact of the recent drought has been a lot more severe because of these conditions.
- In KZN; farmers are aware of changes in rainfall patterns. They experience more extreme events (storms, high winds and hail) than before. Temperature variability has also increased with cold weather at unexpected times, snow both earlier and later than usual in the season and excessive heat in spring, summer and autumn.
- In the EC; farmers are aware of changes in rainfall patterns. They experience more extreme events (storms, high winds and hail) than before. They feel that winters are colder than before. There is greater temperature variability from day to day than before.

4.2 Impacts of CC on livelihoods and farming

These impacts were first discussed in general terms, then reviewed in terms of comparing the past present and future and then interrogated using the impacts mind mapping process.
The table below outlines a summary of impacts mentioned for each province

Table 3: Summary of climate change impacts from community level workshops

Climate change impacts on livelihoods and farming			
	KZN	**EC**	**Limpopo**
Water	Less water in the landscape; streams and springs dry up, borehole run dry, soils dry out quickly after rain	Less water in the landscape; streams and springs dry up, borehole run dry, soils dry out quickly after rain	Less water in the landscape; streams and springs dry up, borehole run dry, soils dry out quickly after rain
	Dams dry up	Dams dry up	Dams dry up
	Municipal water supply becoming more unreliable	Municipal water supply becoming more unreliable	Municipal water supply becoming more unreliable;
			Need to buy water for household use – now sometimes for more than 6 months of the year
			RWH storage only enough for household use.
Soil	More erosion	More erosion	More erosion
	Soils becoming more compacted and infertile	Soils becoming more compacted and infertile	Soils becoming more compacted and infertile
			Soils too hot to sustain plant growth
Cropping	Timing for planting has changed- later	Timing for planting has changed- later	Can no longer plant dryland maize
			All cropping now requires irrigation – even crops such as sweet potato
			Drought tolerant crops such as sorghum and millet grow=- but severe bird damage
	Heat damage to crops	Heat damage to crops	Heat damage to crops
	Reduced germination and growth	Reduced germination and growth	Reduced germination and growth
	Seeding of legumes becoming unreliable	Seeding of legumes becoming unreliable	Seeding of legumes becoming unreliable
	Lower yields	Lower yields	Lower yields
			Winter vegetables don't do well - stress induced bolting and lack of growth
	More pests and diseases	More pests and diseases	More pests and diseases
	Loss of indigenous seed stocks		Loss of indigenous seed stocks
Livestock	Less grazing; not enough to see cattle through winter	Less grazing; not enough to see cattle through winter	Less grazing; not enough to see cattle through winter
	More disease in cattle and heat stress symptoms	More disease in cattle and heat stress symptoms	More disease in cattle and heat stress symptoms
	Fewer calves	Fewer calves	Fewer calves
	More deaths	More deaths	More deaths

Natural resources	Fewer trees; too much cutting for firewood	Fewer trees; too much cutting for firewood	Fewer trees; too much cutting for firewood
	Decrease in wild animals and indigenous plants	Decrease in wild animals and indigenous plants	Decrease in wild animals and indigenous plants
	Increased crop damage from wild animals such as birds and monkeys	Increased crop damage from wild animals such as birds and monkeys	Increased crop damage from wild animals such as birds and monkeys
	Availability of indigenous vegetables has decreased		No longer able to harvest any resources due to scarcity
			Increased population puts pressure on resources
Social	More diseases	More diseases	More diseases
	Increased poverty and hunger	Increased poverty and hunger	Increased poverty and hunger
	Increased crime and reduced job opportunities	Increased crime and reduced job opportunities	Increased crime and reduced job opportunities
			Increased food prices
			Increased conflict
			Inability to survive

Although many of the impacts are similar across the three provinces, the severity of these changes are a lot more obvious in Limpopo. Where comments like “we will all die”, “we will need to move from here to the cities” and “it feels like the end of the world is coming” were not uncommon.

In all the provinces, but more so in KZN and Limpopo people felt that they are being punished by God for the disintegration of their social fabric. They mentioned that people no longer follow the old rules or keep to their traditional beliefs and taboos, people do not care properly for their families and immorality, violence and theft are all too common. There is thus a tacit understanding that these social problems exacerbate their ability to survive well into the future.

5 POTENTIAL ADAPTIVE MEASURES

These were discussed as an outcome of the impact mind map and participants discussed in small groups possible practices and ideas which could help them adapt to the changes and reduce the negative impacts of these changes.

Being practically minded, most of the participants moved straight from impacts to practices – so strategies were not really discussed. Some of the groups had many ideas, some of which were gleaned from working with support organisations and NOGs. Those groups where no external support is available, such as Thamela (KZN) did not have many ‘new” ideas, but focussed more on doing what they are currently doing better.

Below are two examples of this discussion:

- for the Sedawa extension village – Turkey in Limpopo (with limited external support)
- for Thamela in Bergville (where participants were in doubt as to whether CC exists and have received very limited external support)

Table 4: An example of potential adaptive measures from the Turkey (Limpopo) climate change dialogue process

Turkey CC workshop; December 2017

Impacts	Description and linkages	Outcomes	Potential adaptive measure
GROUP 1			
Reduced water availability	Dams dry out, boreholes provide less water, rivers dry out, less rain	Reduced production, hunger, diseases, no jobs, poverty, crime, death	More boreholes, more dams, water management, irrigation in evenings and early morning, mulching, trench beds (keep moisture in and soil cool)
Drying of environment	Soils are hotter and drier, drought, plants wilt, increased pests		Save plant residues for animals, buy fodder, control pests on animals
Reduction of resources	Deforestation, Fruit trees die, livestock, wild animals die		Planting of trees after they have been cut down; make use of paraffin stoves and electricity, government involvement in solving the problem,
GROUP 2			
Extreme heat	Early fruiting, trees wilt	Poor crop health	Shade netting
Shortage of water	Rivers dry out, municipal supply only once per week. Boreholes dry out	Lack of education towards saving water	NGOs and government to assist Trench beds, mulching, save water in dams, drip irrigation, irrigate in evening, boreholes, greywater
Reduction of resources	Less grazing, seed shortage, trees are removed, indigenous animals are no longer there		Donations for/of seed Rather use paraffin stoves than firewood. Only chop down mature trees to allow others to grow, planting trees, government intervention Taking care of indigenous plants Plant fodder for livestock
Soils	Poor cultivation practices, soil erosion, dry soils, sandy soils		Using crop residues and manure
Social repercussions	Less or no food, health problems, no jobs	Burning of buses, divorce, separation of families, poverty, crime	Getting access to health care, parents must work
Shortage of implements			Setting up cooperatives for government support, use animal drawn traction- oxen and donkeys, improvise, make our own tools, make use of hand hoes

Table 5: An example of potential adaptive measures from the Thamela (KZN)) climate change dialogue process

Thamela CC workshop; Dec 2017	
Impact	**Adaptation**
Reddish soils	Weeding, they leave it in the plots, because it helps cover the soil but others they take it out of their plots
Pests	Chemicals
Increased temperatures our yields decrease	Their crops need soil fertilizer, o Fertilizer increase soil fertility o Lime lasts for 3 years o Manure

Livelihoods are affected there is more hunger	
When temperatures are high they become dizzy and diarrhoea, human diseases increase	They take remedies, such as castor oil and garlic
High temperatures affect their livestock and crop fields	They inject the livestock when they are ill They give them supplements and vaccination and dip them
They don't receive much produce from the fields to sell	
Water	They fetch from the local springs but they mentioned its far and are able to fetch 20l per trip (some springs dry out some don't) RWH for household chores
Potato seed	They buy on pay days
Increase in prizes for farming equipment	Savings grouping and bulk buying

When these two tables are compared to a community who have been involved in a support programme, such a Sekoroo where Lima RDF have been running a Food security and livelihoods improvement programme, the differences in suggestions clearly indicate some ideas gleaned from the facilitating organisation

Table 6: An example of potential adaptive measures from the Sekororo (Limpopo) climate change dialogue process

Sekororo; CC workshop November 2017			
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 rains destroy infrastructure,	Food shortages, animals die due to lack of grazing,	Water harvesting, earth dams, grey water and management of existing water, diversion furrows
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

Based on the adaptive measures suggested a selection of the CSA practices summarised as 1 pagers were introduced to each group. This process was easy for groups that have had some exposure to agroecological practices and support in implementation and a lot harder where little outside support has been available.

6 CONTINUATION OF CC DIALOGUES (WORKSHOP 2): POTENTIAL ADAPTIVE MEASURES, PRIORITISATION OF PRACTICES AND EXPERIMENTATION PLANNING

An outline has been designed for this process and is presented in the table below.

Table 7: 2nd CC workshop agenda outline

Community level climate change adaptation: Prioritisation and planning workshop outline					
DAY 1					
Time	**Activity**	**Process**	**Notes**	**Materials**	**Who**
9:00am	**INTRODUCTION**				
9:00-10:00am	Community and team introductions	In pairs, take 5 minutes to talk to each other. Each person names one practice they know or are doing that is good for CCA - a CSA practice. OR one they would most like to try out.	Practices to be summarised on a flip chart.	**Attendance register** - with column for CSA practices - in English and Zulu/Pedi. **Name tags;** stickers, kokis	**Preparation: Facilitation: Recording:**
	Purpose of the day	Introduction of the organisation/s and purpose of this workshop-Review of understanding of CC, Impacts and adaptive measures. Introduction to CSA principles	Summarise from report of 1st workshop - Use the 5 categories - summarise measures under each. Use two PP slides attached	Flip stand, newsprint, kokis, camera- and one person to undertake to take **photos** throughout the day. Extra batteries for camera and sim card	**Preparation: Facilitation: Recording:**
10:00am	**Prioritization of practices**				
10:00 to 11:00am	Review practices mentioned in detail - both community level and presented from 1pgers	Divide into small groups - for prioritization matrix; Use five categories (Nat res, soil, water, crop, livestock). Supply with cards where all prioritized practises are written. They then prioritize these in a list under each category, based on what to try first, second and so on - make sure the criteria used for these choices are recorded. Come back in plenary, present and get overall choices summarised for all small groups	See Community level prioritization of practices Excel worksheet	Flipchart paper, kokis, cards with all prioritized practices written out, pres-stick	**Preparation: Facilitation: Recording:**
11:00 - 11:30am	**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			**Preparation:**

11:30	**Demonstrations and learning**				
11:30-2:30pm	Learning and practical demonstration session on a selection of practices - start with gardening practices (appropriate for present season)	Presentation to group - discussions etc , then practical demonstrations in an appropriate garden - preferable a household garden. Choose 1-4 practices: e.g. trench bed, mulching, liquid manure, intercropping	Facilitators to come prepared with handouts and learning materials. Also materials for doing the practical demonstrations such as mulch, manure, seed, seedlings, tools, and other e.g. shade netting, poles, gravel and ash for tower gardens - depends on practices and must be planned for		**Preparation:** **Facilitation:** **Recording:**
2:30pm	**Individual experimentation**				
2:30-3:00pm	Individual choice of practices for household experimentation	After the demonstrations - Make a list for individuals to choose experiments to try out. Headings are practises. Each participant writes their name under the practices they will try - it can be one, a few or all.	facilitators to discuss how an experiment works - ie the farmer compares the new idea to her usual practice. For example if she will do a trench bed, she has to make a bed new to it the same size the way she usually does and plant both in the same way on the same day.. This way she will be able to see the differences in growth and yield from her practice. She needs to monitor how it is going and be able to report back to this group what has happened.		**Preparation:** **Facilitation:** **Recording:**
3:00pm	**LUNCH** Local catering groups to provide meals - ~R45 per head (Rice and stew with one veg… or something similar-)				**Preparation:**

Initial Climate Change dialogues, to explore concepts of climate change, the impacts on peoples' lives and farming activities and to start discussions on potential adaptive strategies in these communities have been undertaken for more than[1] 7 villages across three provinces.

Table 8:Climate change dialogues; workshops 1 and 2.

Province	AREA	VILLAGE	No of participants: Workshop 1: CCA	No of participants: Workshop 2: Practices
Limpopo	Mametja	Turkey	74	
		Sedawa	24	
	Tzaneen	Sekororo	30	
KZN	Bergville	Thamela	15	2
		Ezibomvini/Eqeleni	21	27
	Estcourt	Tabamhlophe	19	15

[1] The IBLN in the EC covers +/- 10 villages

EC	Alice/Middledrift	Imvotho Bubomi Learning Network (IBLN) - across a number of villages	15	42

6.1 Ezibomvini (KZN) CCAworkshop 2

Below is a summary of some of the discussions undertaken for the 2nd CC dialogue workshop undertaken in Ezibomvini (23 March 2018)

The second workshop, aiming at prioritizing practice options enlisted in the first work shop and thereafter starting a farmer's level experimentation process.

Right: 29 Participants in the 2nd CC dialogue workshop in Ezibomvini (KZN), 23 March 2018

CCA practices that are familiar to farmers

An introduction session over five minutes took place where farmers were to introduce each other and their farming activities. Following is the summary of the results from the discussions:

- The use drip irrigation to retain moisture for a long time in the soil.
- Grey water harvesting practice.
- Use of cow manure
- Mulching
- Intercropping
- Bed design
- Rain Water harvesting
- Watering the garden before sunrise and after sunset
- Blue death as pest and disease control measure
- Conservation Agriculture (CA).
    - CA farmers receive more yields, the level of pests such as stalk borer and cutworm has decreased. Farmers are saving on inputs.

Review of participants understanding of Climate change

Farmers still remember that previously there was discussion that historically there is a change in climate as compared to the current situation. The level of rainfall is now lower and temperatures are high. The increase in temperature has a negative impact on crop growth. There is the high level of wind which dries the soils. Historically it was only windy in winter and presently it is windy throughout. There are no wetlands anymore because there is no rain and people are building houses where there were wetlands.

The impact of Climate Change on farmer's livelihoods

- **The outbreak of pests and diseases**

There is an outbreak of pests such as aphids, termites, and cutworms, which farmers do not know how they can solve this problem. Some farmers have ants in their gardens and they used blue death.

- **Shortage of animal feed**

The high temperatures lead to dry conditions, therefore there is a minimum vegetation growing and available for livestock to graze on the grazing lands.

- **Burning of Grazing veld**

Different farmers have the different reason to burn the veld, some burn it to dispose of the straws left after grazing so that the field can be ready for the following spring, and some burn it for soil fertility and health purposes. At the end of the day burning of fields leads to disease outbreak to livestock. Previously our great grand fathers were creating fire banks so that fires do not spread all over, in nowadays males are lazy and they do not do that.

- **Shortage of grazing lands**

The population is increasing at an alarming rate, more people are building houses and this has led to the building of houses in the grazing lands.

CSA practices that were suggested by farmers on the previous workshop

The following table outlines the practices and their categories

Table 9: Suggested practices for farmers, categorised into the 5 primary themes.

	Natural RM	Soil	Water	crops	Livestock
1. Tunnels			★	★	
2. Bed design		★		★	
3. Mulching		★	★		
4. Natural pest and diseases				★	
5. Rainwater harvesting			★		
6. Trench bed		★			
7. Composting		★			
8. Fodder crops					★
9. Underground water tank			★		
10. Mixed cropping				★	

11. Conservation of wetlands and streams	★				
12. Burying of disposable pampers	★				
13. Reducing burning of grazing veld	★				
14. Greywater Harvesting			★		

Group Prioritisation of practices

After a presentation of practices, farmers prioritized practices as a team. Due to drought conditions problems the group chose underground water tanks as the first priority. Due to harsh weather conditions farmers chose tunnels as their second option. The following table shows farmers how farmer prioritised practices.

Above: Tema facilitating the prioritization of practices

Group Priority

1. Underground water tanks
2. Tunnels
3. Trench beds
4. Mulching
5. Pest and disease control
6. Mixed cropping
7. Compost
8. Fodder crops
9. Conserving wetlands and streams

Individual choice of practical household experimentation

Farmers were given a variety of seeds. All farmers were given sachets with the amount 5ml (teaspoon) seeds. The seeds were given to farmers so that they can experiment some of the practices shared among them in their household.

Out of 29 farmers who were present, 20 farmers considered trench beds as their priority. Farmers who chose trench bed will therefore also try out mixed cropping and mulching. Most of the farmers

from the nine left already has trench beds in their homesteads. The following is the list of participants who considered a trench bed as their first priority.

Table 10: Individual volunteers for trench bed experimentation in KZN (Bergville)

Name	Village Name
1. Jabulile Nkabinde	Ezibomvini
2. Fikile Hlongwane	Ezibomvini
3. Nonhlahla Zikode	Ezibomvini
4. Landiwe Gamede	Ezibomvini
5. Gcinekile Zikode	Ezibomvini
6. Hlengiwe Ndaba	Ezibomvini
7. Busisiwe Zikode	Ezibomvini
8. Alfred Gumede	Ezibomvin
9. Velephi Zimba	Ezibomvini
10. Sizeni Dlamini	Eqeleni
11. Lndokuhle Hlongwane	Ezibomvini
12. Conastance Hlongwane	Thamela
13. Thulile Zikode	Eqeleni
14. Sibongile Zikode	Eqeleni
15. Dambi Ntuli	Thamela
16. Zanele Hlongwane	Thamela
17. Thokozile Mpambo	Eqeleni
18. Nomalanga Khumalo	Eqeleni
19. Mvelo Zikode	Ezibomvini
20. Sdudla Sibiya	Ezibomvini

Conclusion and Recommendations

- As mentioned earlier, the weather was not favourable for the workshop field demonstration, therefore the activity was not done. Demonstrations will be done in the small group within the individual community. This means that the demonstration will not be done in a collective group of Ezibomvini, EQeleni, and Thamela, but there is going to be an individual demonstration for each community.
- On the individual prioritization, most farmers demonstrated an interest in trying trench beds. It is assumed that most farmers are hoping that if they prepare trench beds they will be in high chances to get a tunnel, more clarity should be made to farmers regarding tunnels availability after having trench beds.
- Farmers have expectations to be given free tanks, and it was further clarified to them that the program is based on transferring knowledge.
- Farmers are not certain about individual priorities, therefore, there is a need for an assessment of individual's needs.
- More demonstrations and workshops are still needed to strengthen farmers understanding on Climate change and Climate Smart Agriculture Practices.

6.2 Alice (Eastern Cape) CCA Workshop

This workshop was intended to explore further the particular CSA practices in which farmers were interested, and with which they wished to experiment with the support of the WRC-CSA project team. While this aim was achieved to a considerable degree, the large numbers of participants (42 people registered), many of whom had not been involved with Phase I required that some time was spent introducing the whole concept of CSA. Of the 42 registered participants, in addition to 17 farmers, there were numbers of students some of whom did not remain throughout the day. However, the attendance by the Head of Department for Crop Production at Fort Cox, and the Agribusiness Diploma Course leader together with several of their students, suggests a very strong interest in the concept of CSA in the college. There were also 5 members of the Eastern Cape Department of Rural Development and Agricultural Reform (DRDAR) extension services in attendance.

Given the difference in context between the Eastern Cape situation, where the project is working with a broad network (the IBLN) of agricultural practitioners, including some commercial-scale emerging farmers, as opposed to in other provinces where the WRC-CSA project works almost exclusively with small-scale and household farmers, the programme followed was an adaptation of that followed elsewhere and outlined in Table 7, above. However, the same key features were covered, and it included a highly participatory practical activity.

The purpose and scope of the WRC-CSA project was explained, including the farmer experimentation approach which would require close monitoring of both areas subject to CSA practices and control plots without these practices.

The first session laid the ground for a group activity in which the participants divided into 4 groups, each with a computer and the pdf version of the WRC- CSA Practices document. Their brief was to go through the document and identify which practices they would consider most appropriate in their contexts and why. Each group provided feedback on the outcomes of their discussions with the practices they had identified captured on Newsprint. There was discussion concerning the scales at which specific practices might be appropriate and it transpired that although most practices were initially considered as only relevant at smaller scales, they could be scaled up in different ways to become relevant on a larger scale.

Right: EC Group discussion on CSA Practices

Table 1, below, represents the outcomes of this activity, combined with the numbers of individual participants who later identified specific practices in which they were interested in the register.

Table 11:CSA Practices: Prioritization by groups and individuals

NOTE: Groups in this case are the small groups in the workshop setting consisting of homestead gardeners, cooperative members and more commercial farmers

Practice	**Scale(s)** (**S**mall – homestead, **M**edium <1ha, **L**arge >1ha)	**No of Groups**	**No of Individuals**
Swales	All	1	3
Greywater	Small	1	
Small Dams	S/M	1	
Fertility Pits	S/M	1	
Contours	M/L	1	
Terraces	ALL	1	
Furrows/Ridges	All	0	1
Infiltration pits/ Banana Circles	Small	1	2
Raised Beds	All (considerable discussion here, with some saying just S/M)	1	
Trench Beds	S/M	1	
Tower Gardens	S	1	3
Tunnel	All	1	2
Basins/In-field	All	1	1
Mulching	All	4	4
Close-spacing Intercropping Mixed Cropping	Considered to be very closely related All – in different ways	3	3
Crop Rotation	All	1	
Minimum Tillage	All	1	
Herbs	All	2	
Liquid Manure	All	2	
Bucket Drip	All (Drip, although buckets for just Small scale)	3	5
Underground Storage	S/M	1	
Rainwater Harvesting (general)	All	1	1

What was perhaps most interesting about these outcomes was the great difference between the practices selected by the different groups, with only mulching being identified by all 4 groups, and just the Bucket Drip and the combination close/mixed/inter-cropping practices by 3 out of 4. Essentially almost all the practices listed in the document were selected by one or another group. The individual preferences as recorded in the register were similarly diverse with a similar concentration on (bucket) drip, mulching and close/mixed/inter-cropping. Swales, tower gardens and tunnels were also identified as being of specific interest to several participants. Only one participant identified large-scale furrows and ridges and infield RWH as being of interest to them, although the hosts at Mavuso village during the Phase 1 workshop are also interested in these practices.

The outcomes of this exercise suggest that there is certainly scope for the WRC-CSA project team to establish support programmes for a number of the farmers in the Eastern Cape.

The Practical Activity

As no specific practices had been previously identified as being of particular interest to the farmers, and the nature and condition of the land being made available by the College for the activity was not known, the preparations for the activity consisted of the purchase of a range of vegetable and herb seedlings. It was also ascertained that tools and mulching materials would be made available by the college.

The site allocated by the College farm manager was part of an experimental site used also by the WRC Amanzi for Food project. There was a choice between a small portion of a recently ploughed land, which had become heavily weed infested, and an area which had been long untilled and had reverted to grassland. The lecturer responsible for the demonstration site suggested that the untilled area might be more suitable, and this was agreed.

The practices agreed on for the site were: minimum tillage; close cropping; intercropping; herbs; and mulching, the idea being to try and develop a mixed area of cabbage, lettuce, carrot, and onion, with inter-planting of parsley, mint and coriander. The choice of vegetables and herbs had been constrained by what had been available at the nursery, and while this was not ideal, the principles underlying these practices could at least be demonstrated to some extent. It was, however, recognised that a considerable risk was being taken in planting into a grassland, especially as winter approached.

One major advantage of this site, though, was that 2 postgraduate interns, who would stay at the college for a full year, were given the responsibility to water and maintain the site.

Above left and right: Preparing the ground for minimum tillage and watering the mixed planting of vegetables and herbs

Conclusion

The meeting concluded after lunch with individual farmers identifying specific practices with which they would like to experiment (as recorded in Table X, above). This information would be shared with the WRC-CSA project team members in KZN who would be visiting the Eastern Cape in August September to initiate the experimental phase of the project in the province.

7 BASELINE INFORMATION

Initial Climate Change dialogues, to explore concepts of climate change, the impacts on peoples' lives and farming activities and to start discussions on potential adaptive strategies in these communities have been undertaken for more than[2] 7 villages across three provinces. In addition, baseline information was gathered from aa number of these groups. This consisted of individual interviews and village walkabouts and speaks to providing information for the farmer typology and aspiration parts of the decision support process as outlined below.

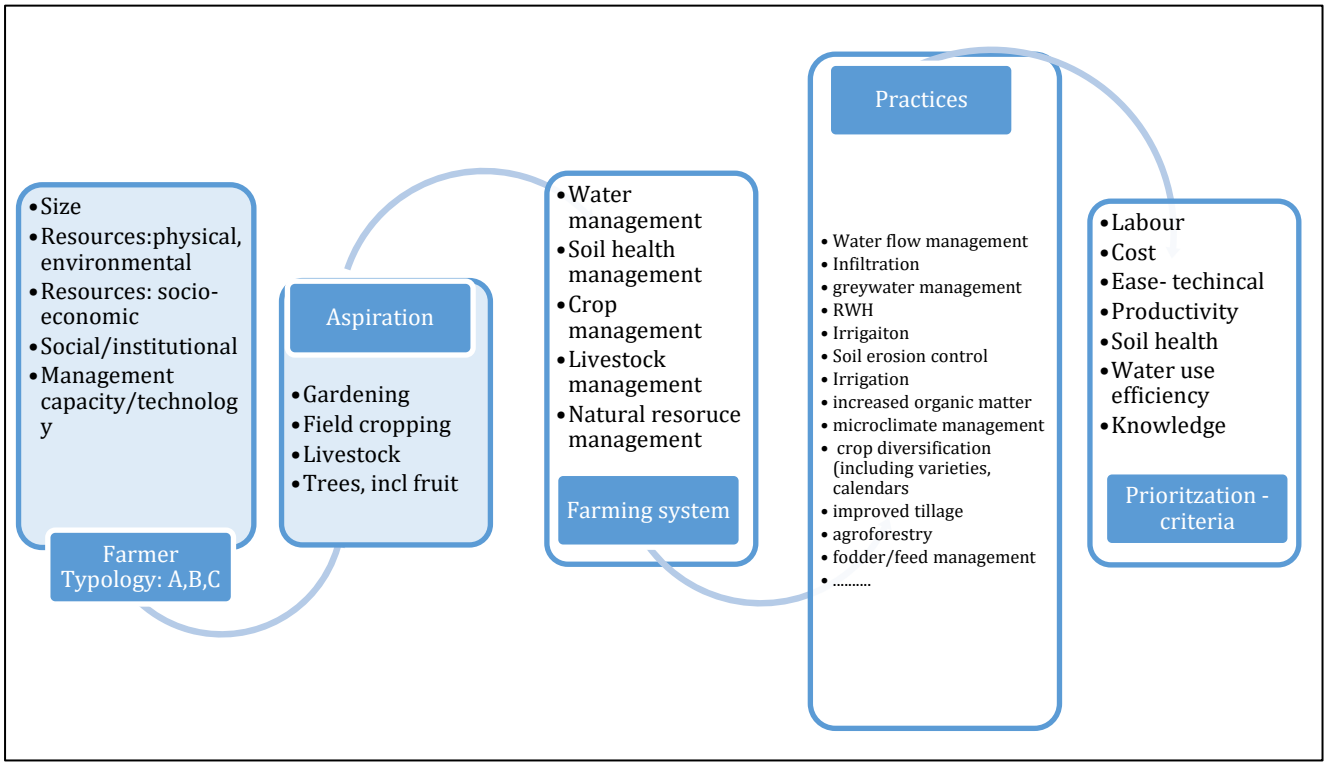


Figure 1: The Smallholder decision support system process

7.1 Household level questionnaires

As a part of the initial community level interactions household interviews are conducted while doing a village based "walkabout" for the following purposes:

1. To glean information for the DSS around farmer typologies and farmer aspirations; - *through a household questionnaire*
2. To assess climate related stressors in the environment; thus to do a basic qualitative assessment of availability of resources, stress on those resources, farming activities and vulnerability of households; *through more general discussions and photographs.*

[2] The IBLN in the EC covers +/- 10 villages

Household level questionnaires (see APPENDIX 1 for an outline of the questionnaire) were administered to 6 participants in each province (KZN, Limpopo and EC) as a pilot of the process. The 6 participants in each case were randomly chosen or volunteered and were participants of the climate change dialogue and impact workshops conducted in these areas.

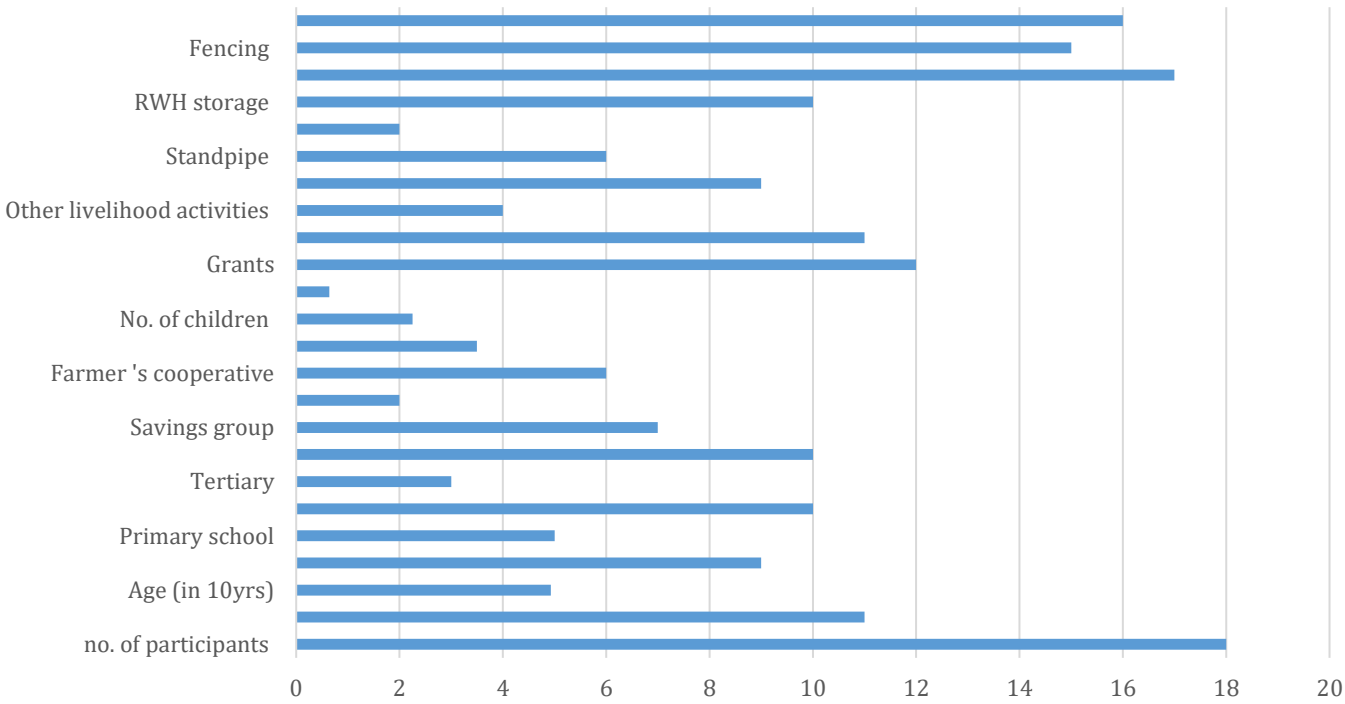
These participants are not seen as representative of the broader community, but are seen as representative of the interest group in the community willing to tackle the issues around their farming practice and work towards improvements.

The questionnaires touched on a range of topics to assist with a farmer typology classification and also to assess available resources, farming activities and vulnerabilities of the participants including:

- Basic socio-economic and household information
- Access to services and infrastructure
- Social organisation
- Learning and access to information
- Livelihoods and faming activities
- Income and
- Market access

The socio- economic data for the interviewees has been summarised in the figure below. From the figure we can make the following observations:

- 61% of respondents were female (n=18) and the average age of respondents is 49 years.
- The average household size is around 5 members and the dependency ratio for this groups is 66. This is significantly higher than the national average of 44,5. Dependents in this case include both children under 15 years of age and pensioners.
- The level of education of these participants is Primary school level – 28%; High school level - 56% and tertiary level – 16%. This generally higher level of education is reflected also in the inclusion of younger adults in this group of participants
- 80% of participants belong to social organisations; including learning groups Village Savings and Loan Associations, school gardening groups and cooperatives
- Regarding incomes, 67% of the households from this group receive social grants and 61% receive salaries. The average monthly household income is however still low at R3 992. For households without employment this is MUCH lower at R947/month.
- Access to electricity is common (89%), but access to water is much more restricted with access to municipal water through household taps and communal standpipes being 50% and 33% respectively. This does not mean water is freely available, especially in KZN and Limpopo where municipal systems fail often and for extended periods of time.
- 56% of these participants have some form of rainwater storage; drums or Jo-Jo tanks (2000l) are the most common and 11% have their own boreholes (participants from Limpopo only)



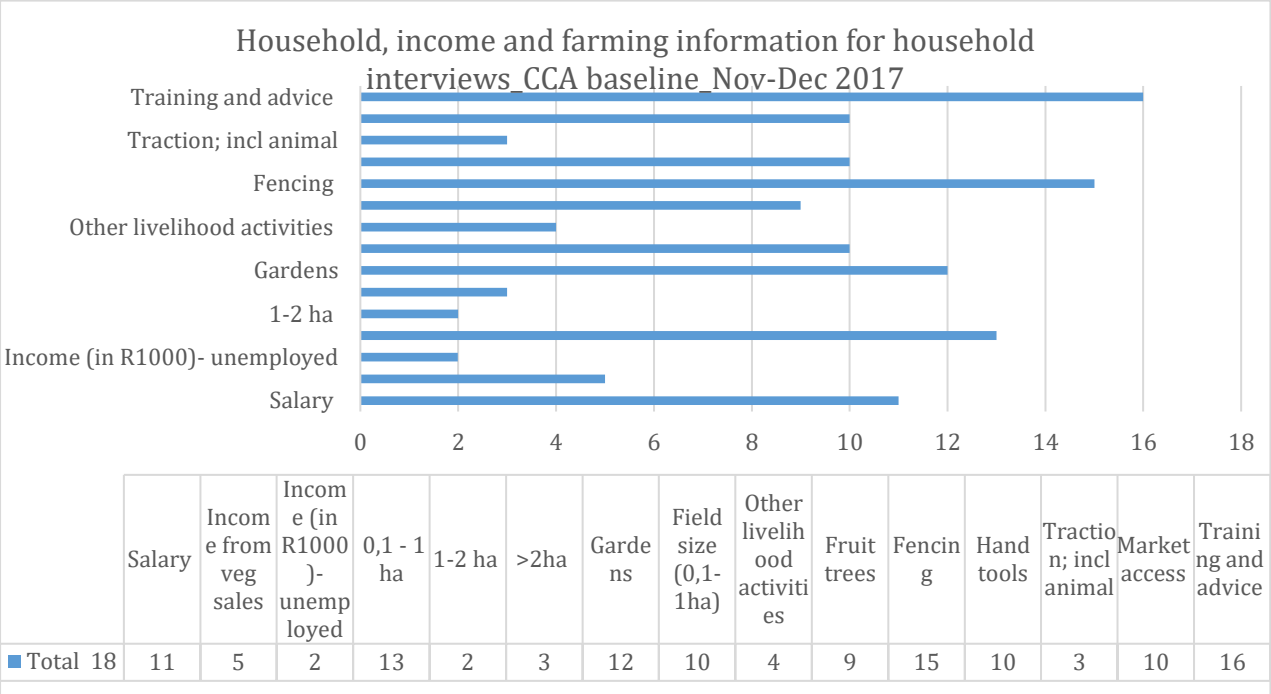
	no. of participants	Gender (F)	Age (in 10yrs)	Household head	Primary school	High school	Tertiary	Learning group	Savings group	School gardening group	Farmer's cooperative	No. of adults in HH	No. of children	Dependancy ratio	Grants	Salary	Other livelihood activities	Tap water	Standpipe	Borehole	RWH storage	Electricity	Fencing	Training and advice
Total	18	11.0	4.9	9	5	10	3	10	7	2	6	3.5	2.25	0.6	12	11	4	9	6	2	10	17	15	16

Figure 2:Baseline information for CCA workshop participants

An important component of the information, for the purposes of the farmer typologies and the DSS is the scale of operation. This is different depending on the local situation in the villages – for those that have undergone betterment planning with tightly laid out villages and fields a distance from the homestead (Limpopo, EC) - most households only have access to small household gardens; for those within communal tenure areas that have developed independently provide household gardens and homestead fields between 0,1-1ha). Larger fields are generally only accessible though more formal arrangements such as cooperatives.

For this sub-group of participants 72% have access to 0,1-1ha of land, 11% have access to 1-2ha of land and 17% have access to >2ha. Those that have gardens make up 67% of the participants. 61% of participants keep livestock, but only 16% own cattle.

Farming related information is summarised in the figure below.



	Salary	Income from veg sales	Income (in R1000)- unemployed	0,1 - 1 ha	1-2 ha	>2ha	Gardens	Field size (0,1-1ha)	Other livelihood activities	Fruit trees	Fencing	Hand tools	Traction; incl animal	Market access	Training and advice
Total 18	11	5	2	13	2	3	12	10	4	9	15	10	3	10	16

Figure 3: Household, scale of farming and income information for CCA participants

Most of the participants farm by hand, or rent tractors or oxen. Those with direct access (ownership) are only 17% - and these participants invariably come from households where members are employed.

Overall vulnerability in farming is HIGH as people have access to small pieces of land, generally rely on dryland cropping, farm by hand and own small numbers of livestock. Cattle ownership is becoming less common with only around 16% of households owning cows. Participants farm mostly for food production to feed their families, and only around 28% sell produce.

7.2 Farmer typologies

Rural dwellers in South Africa, most of whom live under communal tenure arrangements comprise around 19 million people – around 34% of the South African population. The vast majority of these people are not actively farming -around 85%. There are presently only around 35 000 commercial farmers still active.

There are a number of different models for approaching farmer segmentation and a few examples are already available. Smallholder farmers fall within different categories of resource availability, capabilities and aims for their farming. The segmentation approach sets out the basis for providing targeted support to the different segments of the farming community; according to their own aspirations and abilities. Such models can be useful in the DSS being developed.

One such model has been developed for the GrainSA Smallholder Farmer Innovation Programme in Conservation Agriculture. The outline of this typology is presented in the table below. By far the largest category of rural dwellers are the non- commercial and semi-commercial smallholders who make up around 2,5 million people. Commercial smallholders in loose value chains make up around 250 000 people and those in tight value chains only around 10 000.[3]

Table 12: Farmer segmentation in the Bergville smallholder farming system

Category	Non-commercial smallholders	Semi-commercial smallholders	Commercial smallholders in loose value chains	Commercial smallholders in tight value chains
% of people in each category	72	23	5	-
Farmer priorities	Most production consumed by the household and additional food is bought in	Production is intensified. Selling becomes more significant and supplements household income.	Consumption and sale in various percentage mixes but moving to more sales.	Primarily for sale-working within existing well defined commodity value chains
Gender	Mostly women (89%)	Mostly women (96%)	Women, men (40% ♀ 60%♂)	Mostly men
Resources	Low external input systems are used with a minimum of bought inputs	Mixed (low and external) input systems are used with a minimum of bought inputs	Mixed (low and external) input systems are used with greater reliance bought inputs	Mostly high external input systems
Traction	Hand cultivation	Hand cultivation, animal traction	Animal traction, tractors	Tractors
Land size	≤ 0.1ha	0.1-1ha.	1-2.5ha	>2ha
Farm productivity, including labour access	Extremely low	Low to high	Low to high	Low to high
Access to improved agricultural tech and information	Very limited	Limited	Limited	Good
Access to financial services	Very limited if at all	Very limited if at all	Very limited	Informal and some formal through buyers
Local organisation	Almost non existent	Almost non existent	Informal farmers groups	Farmers associations and cooperatives
Agribusiness support	Very limited.	Very limited.	Informal but growing	Reasonable

[3] Cousins, B. (2015). Through a glass darkly: towards agrarian reform in South Africa, in: Ben Cousins and Cherryl Walker (eds), 2015. *Land Divided, Land Restored. Land Reform in South Africa for the 21st Century*. Auckland Park: Jacana (250-269).

Engagements with markets	Very little; entirely informal	Limited and still informal for the most part	Both informal and formal	Can be good due to value chain farming bundles
Environmental performance	Generally not considered	Generally not considered, some adoption of conservation and sustainable practices	Generally not considered, some adoption of conservation and sustainable practices	Some adoption of conservation and sustainable practices
Crop mix	Staple crops Crop livestock mixes focussing on 4-5 commodities	Staple crops, some cash crops, crop livestock mixes – focussing on 3-4 commodities	Staple crops, some cash crops, crop livestock mixes – focussing on 2-3 commodities	Mostly cash crops – focusing on 1, maybe 2 commodities
Livelihood (Food Security, Total monthly income, assets, poverty likelihood, perceived well being)	Food Security: low Monthly Income: R0-R2000 Assets: minimal Poverty Likelihood; High	Food Security: low-medium Monthly Income:R2001-R4000 Assets: minimal-starting to build Poverty Likelihood: medium	Food Security: medium-high Monthly Income:>R4000 Assets: reasonable Poverty Likelihood: low	Food Security: high Income: Assets Poverty Likelihood

This model provides a good starting point for the development of a farmer typology for interventions in climate change adaptation and similar categories have been used in our process.

The CC baseline survey provides for a number of vulnerability indicators. As a starting point an analysis of incomes of the interviewed households is summarised in the table below

Table 13: Baseline information related to incomes

		MONTHLY INCOMES (in Rands)				
Village	**Name & Surname**	**Grants**	**Salary**	**Income from veg sales**	**Total income**	**Ave per village**
Sekororo/ Lorraine	Chenne Mailula			R2 000,00	R2 000,00	
	Lydia Sechube	R1 600,00			R1 600,00	
	Dimakatso Thobejane	R380,00			R380,00	
	Masine Morerwa		R15 000,00		R15 000,00	
	Mdimi Shai	R1 760,00	R4 740,00		R6 500,00	
	Flora Maimela	R1 600,00			R1 600,00	**R4 513,33**
Tabamhlophe	Winnie Dlamini	R380,00	R4 620,00		R5 000,00	
	Zanele Ngobese		R8 000,00		R8 000,00	**R6 500,00**
Eqeleni	Ntombakhe Zikode	R1 140,00			R1 140,00	**R1 140,00**
Ezibomvini	Nombono Dladla	R600,00			R600,00	
	Zodwa Zikode	R600,00			R600,00	

	Phumelele Hlongwane	R1 530,00		R730,00	R2 260,00	**R1 153,33**
Alice/Middledrift area (+/- 10 villages)	Pheza Makisi		R9 000,00	R1 000,00	R10 000,00	
	Bongiwe Mxonywa	R380,00			R380,00	
	Xolisa Dwane			R7 000,00	R7 000,00	
	Mncadi Mabandla	R1 140,00	R4 000,00	R860,00	R6 000,00	
	Mandisa Mama	R760,00	R1 040,00		R1 800,00	
	Siyabulela Gungqceni	R760,00	R1 240,00		R2 000,00	**R4 530,00**
AVERAGE MONTHLY INCOME (excluding zero incomes)		**R971,54**	**R5 955,00**	**R2 318,00**	**R3992,00**	

From the table above the following points come to the fore:

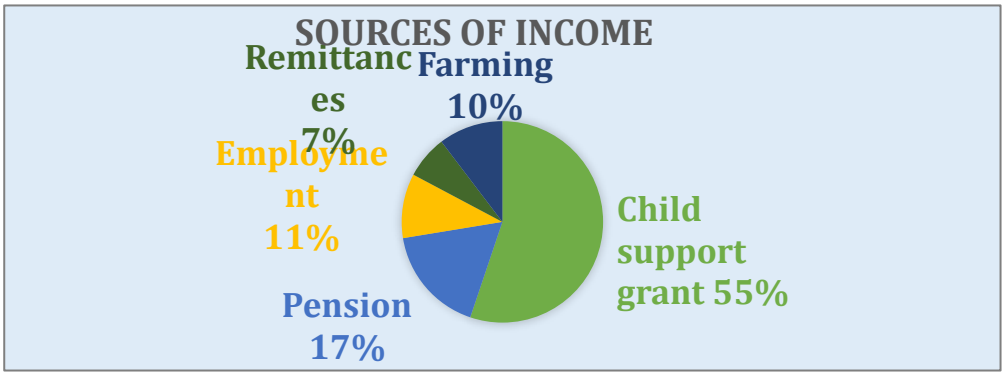
1. 72% of Households interviewed receive social grants and this is the only household income for 33% of these respondents. The average 'income' from grants is R972/ month
2. 44% of Households interviewed receive a salary as part of their monthly income. The average household income from salaries is R5 955/month. The number of households where there is employment in this interview groups is proportionally much higher than the average in rural communities around South Africa, where reliance on grants can be as high as 70-80%.
3. Even so only 28% of these respondents earn an income from farming, with 11% (or two individuals of 18) earning their entire income from farming. Average income from farming (both sale of vegetables and field crops) is R2 320/month.
4. Corroboration of information from project related baseline surveys (see the textbox below) indicate average income in Tabamhlophe to be around R1 567/month per household. This is similar to the data obtained for the Bergville area – which is close by. For Bergville there is a whopping 89% unemployment among the project participants and 72% rely entirely on grants for their income and 75% of households earn between R0-R2 000/month.
5. In the villages in Limpopo and EC where there is a somewhat higher proportion of employment, the average monthly incomes are around R4 500/month per household

LIVELIHOODS SURVEYS IN KZN (2017)

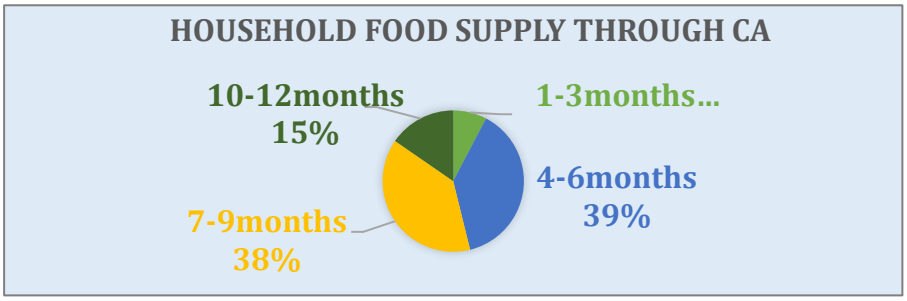
In Tabamhlophe, the Lima RDF fieldworker, Lindelwa Ndaba conducted a baseline survey with her 13 participants in the Food Security learning group she is training and mentoring. From this survey the average monthly income for these participants is R1 567.

In Bergville (which includes Eqeleni and Ezimbomvini) the MDF fieldworkers led by Phumzile Ngcobo conducted a seasonal review of the Conservation Agriculture support programme in August 2017. This survey includes information about income sources and incomes for these participants. For a sample of 21 participants the following information was summarised:

- Income sources are social grants (72%), employment (11%), remittances (7%) and **farming (10%)**



- Overall incomes per household are extremely low, with 75% of households earning **between R0-R2000/month**. The remaining 25% earn >R3 000 /month. The average income is R1875/hh/month – a reduction from last year which was around R2450/hh/month
- Maize and beans used for hh food supply; **53%** of participants now have enough **for 7-12months**, increased from around 33% last season



The information around incomes indicate a HIGH LEVEL of vulnerability for rural dwellers engaged in farming activities. Only about 1/3 of participants make any income from their farming activities and these incomes are generally subsidised from social grants or other employment.

The WRC baseline survey further explored incomes for male and female headed households. A third category consisting of both male and female headed households of working age (thus having no old age grants) emerged. The small table below summarises the incomes

Average monthly income per household	
Male headed (39%)	R7 071
Female and male headed (33%)	R 2 068
Female headed (28%)	R 940

Thus, female headed households in these rural areas labour under a VERY HIGH LEVEL of vulnerability due to their very low levels of income (ave R940/hh/month). Households that cannot access old age grants make up another category of vulnerability (ave R2 068/hh/month). With an average household size of 5 members, it is clear that the ability of these households to commit resources towards climate change adaptation would be severely limited.

The inclusion of other livelihood and vulnerability indicators then assisted us to build a tentative and initial farmer typology for the smallholder farmers involved. This typology is outlined in the table below.

Both typologies A and B can be considered to have a HIGH LEVEL of vulnerability. Typology C indicates a much smaller group of smallholder farmers who have better or more reliable access to infrastructure and support, are generally better educated, have access to larger fields and more livestock and farm primarily for income generation purposes. They fund these farming enterprises primarily through incomes earned from employed members within the household, or a combination of employment and social grants (including pensions). These farmers are also more likely to belong to cooperatives and farmers associations and to have access to formal market linkages.

Table 14: Farmer typology for the WRC-CCA process

FARMER TYPOLOGY		**A (44%)**	**B (18%)**	**C (39%)**
Basic socio-economic and household information	*Gender*	100% Female farmers	80% Female farmers	5-15% female farmers
	Age range	33-66yrs	27-48yrs	31-78yrs
	Household head	Female	Female/male	Male
	Dependency ratio	0,7	1	0,5
Livelihood activities	*Employment*	Unemployed	Unemployed/ employed	Employed
	Small businesses	80%(Selling in schools, sewing etc)	0%	0%
	Grants	1-3	1-3	1-3
	Farming activities	Gardens, fields, livestock	Gardens, fields, livestock	Fields, livestock
	0,1- 1ha	100%	100%	
	1-2ha			50%
	>2ha			50%

Levels of income (per hh/month)	*R0-R1999*	R940		
	R2000- R4999		R2 100	
	>R5000			R7 000
Access to services and infrastructure	*Electricity*	80%	80%	100%
	Water -taps (hh)	0%	50%	100%
	Standpipes (100-400m)	80%		
	RWH	30%	67%	67%
	Farming infrastructure	Hand tools	Hand tools	Tractors, planters
Social organisation	*Groups (for learning, school gardening etc)*	80%	80%	80%
	Saving clubs	100%	60%	
	Cooperatives			100%
Learning and access to information	*Level of education*	Grade 4-Grade 12	Grade 7-grade 12	Grade 11- Diploma
Market access	*Informal*	15%	15%	67%
	Formal	0%	0%	83%
Farming income	*Food only*	100%	40%	
	Food plus income		60%	
	Mainly income			100%

This typology is specific for people actively involved in rural development programmes/projects.
A few interesting points come to the fore:

1. TYPOLOGY A: Woman headed households are by far the most vulnerable. In this survey all the most vulnerable households are woman headed households; where the household head is unemployed, farming only for food production (0,1-1ha, both gardens and fields), have limited access to water and engages also in other small business activities such as sewing. All the members of this group belong to savings clubs and have a slightly lower average level of education than the other two groups.
2. TYPOLOGY B: This category consists mainly of economically active women without access to old age pensions in their households. They rely on grants and some employment within the household for their income and have somewhat easier access to water and farm for both food and income (0,1-1ha, both gardens and fields) – although these incomes are quite low.
3. TYPOLOGY C: This group consists primarily of gainfully employed households with reasonable incomes and can thus afford membership of cooperatives that provide access to larger fields and irrigation (1-2ha and >2ha fields). They farm mainly for income generation, have better access to markets and a higher average education level than the other two categories.

Categories that do not vary much across the typologies includes:

- Access to tools and farming equipment - a very few individuals in Typology C own tractors and implements, but most participants rely on hand tools and some animal traction.
- Access to electricity is the same across all three typologies
- Farmers engage in gardening, field cropping and animal husbandry across all three typologies.

- Participants across all three categories have equal access to social grants
- The dependency ratio (no of children and pensioners compared to the number of working aged adults in a household) is quite a bit higher than the national average for 2016 which was 44,5, at 66. There are however fewer children living in these households than would be expected, but more economically dependent adults. Again, this situation is the most severe for Typology A; the poorest households.

7.2.1 Scale of operation

This appears to be more dependent on the area and presently:

- In Limpopo all participants were working in gardens only
- In KZN most participants worked in both gardens and fields depending on the type of village- in the more urban, planned villages with smaller demarcated plots – only gardens and in areas where communal tenure arrangements have allowed for fields close to home – then gardens and fields
- In EC; A 10ha cooperative plot shared by 6 individuals producing crops under irrigation (vegetables and field crops)

Table 15:Summary of scale of operation for present participants in the WRC-CCA process

Province	Village Name	Description	Scale of operation	Livestock	Ave income for village	Ave monthly income from farming
Limpopo	Sekororo	Village + fields (further away)	0,1-1ha Gardens only	None	R4 513 (2/6 employed)	R2000 (1/6)
KZN	Tabamhlophe	Village (no fields)	0,1-1ha Gardens only	Chickens	R6 500 (2/2 employed)	R0
	Eqeleni	Informal village (fields around homesteads)	0,1-1ha Gardens Fields (0,1-1ha)	Chickens, goats, cattle	R1 140 (1/1 unemployed)	R0
	Ezibomvini	Informal village (fields around homesteads)	0,1-1ha Gardens Fields (0,1-1ha)	Chickens goats, pigs, cattle	R1 153 (3/3 unemployed)	R780 (1/3)
EC	Alice	Cooperative ~10ha - irrigated	Fields (0,1-1ha, 1-2ha, >2ha)	Chickens, goats, pigs, cattle	R4 530 (4/6 employed)	R2954 (4/6)

This points towards the main category of farmers to be supported through the DSS being those with access to household gardens and small livestock such as chickens, goats and pigs and those with access to small (0,1-1ha) dryland fields.

Other categories that still need some attention in terms of a coherent set of CSA practices are

1. Irrigated fields and
2. Grazing management for livestock (cattle)

7.3 Walkabouts

Walkabouts in this context are informal village walks consisting of the facilitators of the process and volunteers or key informants from the local community who have been engaging the climate change dialogues and can broadly be considered a Rapid Rural Appraisal process.

The village walks included in the CC baseline survey fulfil a number of purposes:

- To provide facilitators with a perspective on the general state of resource availability, access and use in a locality (soil, water, natural resources, infrastructure)
- To provide a qualitative assessment of the potential impacts of CC in the area
- To assess the local farming practices and
- To record and assess potential good practice (indigenous / traditional practices) for climate smart agriculture
- To review the implementation of CSA practices in the area (if relevant) and
- To interview individual householders for vulnerability and livelihood information

Below are a selection of household visits during walkabouts in Tabamhlope (KZN, Ezibomvini (KZN) and Mavuso (EC). The full reports can be found in Appendices 2,3 and 4.

7.3.1 Tabamhlophe

Below are images illustrating the walkabout in Mrs Ntuli's household. She has recently moved into the area and has joined the farmers' learning group in the community. What has driven Mrs Ntuli in participating in this learning group was that she has a son who is not well and the doctors have recommended that she gives him fresh vegetables to boost his health. She also attends a church in the community that feeds the homeless people; this has played a huge role in her life as it encourages her to take care of her garden so she can give to the needy people within her community. She also began to keep chickens with an intention of selling to generate income as her husband is the only one working in the household.

Right: Mrs Ntuli next to her shade house which contains 6 trench beds where she produces, spinach, carrots, tomatoes, peppers and beetroot


Above left and right; She uses submerged 2litre bottles for slow subsurface irrigation in her shade house and keeps a small flock of broilers for sale in corrugated iron hut constructed for the purpose.

The second household we visited was Mrs Dlamini's. She has been part of the LIMA learning group since inception and has made trench beds in her home garden and intercropped her vegetables. She grows cabbages, lettuce, carrots and beetroot in her trench beds. Mrs Dlamini uses 2 litre bottles to water her garden by burying them half way into the soil. She has a Jo-Jo tank for RWH.

RIght: Mrs Dlamini's Jo-Jo tank. Ditches are evident to try and deal with run-off and erosion close to the house.
Far right: In intercropped trench bed with 2l bottles for slow even irrigation


7.3.2 Ezibomvini

Household 1: Mrs. Phumelele Hlongwane

A 38 year old mother of 6, Mrs Phumelele Hlongwane is passionately involved in her farming activities. In her garden she grows a variety of crops inclusive of; cabbages, spinach, tomatoes, potatoes, and green peppers. She also keeps livestock inclusive of, 6 goats, 2 pigs and a flock of indigenous chickens. Apart from her household garden she also plants in her field of 1 ha where she grows potatoes, sweet potatoes and maize. Mrs Hlongwane joined the CA learning group in 2014 and is currently a community facilitator of the learning group. From her vegetable produce she sells the surplus to her community members.

Right; The pig pen Far right: A patch of beans struggling in the hot dry conditions prevalent this season

Below is a case study done for Phumelele Hlongwane that has been published in "SA Grain" the February 2018 edition of the GrainSA newsletter, as well as the Adaptation Network Newsletter (January 2018)

Case Study GrainSA SFIP: Conservation Agriculture builds a better life for Mrs Phumelele Hlongwane (Bergville)

Authors: Phumzile Ngcobo[1], Erna Kruger

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Phumelele Thembisile Hlongwane is a 38 year old woman and a mother of 6 from Bergville Emmaus- Ezibomvini village. She says her passion stems from agriculture's ability to enable her to be self reliant, in her case the key is diversification. She has a vegetable garden in her homestead planted to a wide variety of crops including brassicas, cabbage, spinach, tomatoes, potatoes and green peppers. She owns livestock; 03 cattle, 6 goats, 2 pigs and a flock of indigenous chickens. She also plants her fields to field crops such as potatoes, sweet potatoes, maize, dry beans and soy.

"Maka Ndoza", as she is affectionately known joined the Grain SA CA project in 2014 and is now the community facilitator of her Ezibomvini learning group. She is a member of the village savings and loan association, along with other members of her learning group. Here the save and take small loans for inputs and other livelihood necessities. She is also one of the pioneers of the programme's local farmer centre model which she runs jointly with her sister in law Zodwa Zikode, who is also a member of the learning group.

Phumelele Hlongwane shares that the primary aim of the farmer centre is to be able to provide production inputs to farmers in quantities and at costs they can afford. The farmer centre providing seed, fertilizer and chemicals has really come into good use as according to her the rates of agriculture activity in her community have improved because quantities sold at the farmer centre start from as little as 1 kg up to entire bags of seed/ fertilizer. “Many people in the village had stopped planting because they could not afford inputs” said Phumelele further supporting the importance of the farmer centre.

The returns derived from the farmer Centre are not large and are also quite seasonal. To date they have made a profit of around R300-R600/ month from sales, most of which has been re-invested to continue to buy stock.

Right: Offerings form the local farmer centre also includes some local produce, to augment the sale of inputs in the slow periods

The small table below indicates sales and shows also the seasonality of these

Table 1: Ezibomvini farmer centre records from December 2016 to April 2017

Date	Fertilizer	Herbicide	Top dresser	Seed	Total
December 2016	R2758	R1400	R480(LAN) R630(UREA)	R1161(maize) R80(beans)	R6509
January 2017	R0	R280	R1692(UREA)	R360(beans) R72(maize)	R2404
February 2017	R24	R0	R336(UREA)	R80(beans)	R440
March 2017	R0	R0	R36(UREA)	R0	R36
April 2017	R0	R0	R0	R0	R0

While her vegetable garden yields some income for her, this is periodic because she only sells surplus, leaving her predominant source of income to social grants for five of her six children. Field crops also are primarily for household consumption.

Right: Phumelele’s vegetable garden (November 2016)

Conservation Agriculture Experimentation

Phumelele's trials were continued in this season. The layout of her plots are shown below for the 2016/2017 season. She is practicing crop rotation as well as intercropping and planting of cover crop mixes; both summer (sunflower, millet, sunn hemp) and winter (saia oats, fodder rye and fodder radish).

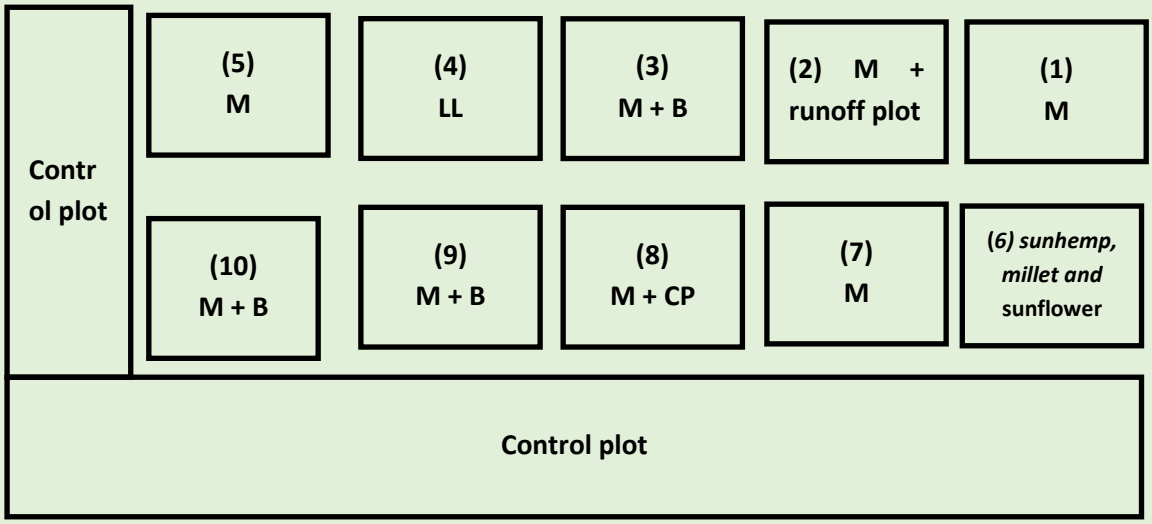

Figure 1: Phumelele Hlongwane's plots layout for 2016/2017 growing season

Yield results

In the 2015-2016 season, Phumelele out performed almost all the other smallholders and managed to get rather impressive yields at a time when most other farmers' crops failed. She experimented with a number of different crop combinations in her CA plots. Her maize control was also a CA plot, but with use of her own fertilizer and seed options. Her experimental plots included:

- Intercropping of maize with beans
- Intercropping of maize with cowpea
- Planting cover crops in between rows of maize (relay cropping)
- Intercropping maize with lablab
- Planting a single crop of maize (control)
- Planting a single crop of Lab-lab (Dolichos) beans and
- Intercropping of maize with Lab-lab beans

Phumelele followed with a rotation schedule of the same experiments in the 2016-2107 season.



Left to right: Phumelele standing in front of her maize and bean intercrop plot, taken on 17 Jan 2017. Her Lab-Lab plot and a SCC plot where she grew sunflower separately and millet and sunn hemp together.

The table below shows yield comparisons for Phumelele's experimental plots.

Table 2: Maize yields from different experimental plots in Phumlele Hlongwane's (Ezibomvini) field

	2015/2016 season			2016/2017 Season	
Plot no	**Crops Planted**	**Maize Yields (t/ha)**	**Crops planted**	**Maize Yields (t/ha)**	**Change in yield (t/ha)**
10	Maize +Beans	8,3	Maize + Beans	8,8	0,5
9	Maize +Cowpea	8,7	Maize + Beans	8,9	0,2
8	Maize + Beans	10,4	Maize + Cowpea	7,7	-2,7
7	Maize +Cowpea	6,9	Maize	6,5	-0,5
3	M +SCC+WCC	8,7	Maize + Beans	10,1	1,4
1	Maize +Beans	6,9	Maize	6,2	-0,7

The small table below indicates yield averages over the last two seasons.

Table 3: Summary of different crop yields in Phumelele Hlongwane's experimental plots.

t/ha	2016	2017
Maize (Control)-CA	7,8	9,7
Maize Trial CA - combined	6,93	8,3
Beans	0,25	1,81
Sunflower	0,3	0,8

NOTE: Yield increases in 2017 were achieved despite reduction in fertilizer application. She did not apply basal MAP, only top dressed with LAN

Table 4: Rainfall and runoff relationship from Phumelele Hlongwane's plot

Control plot -Conventional tillage				Trial plot -Conservation Agriculture		
Rainfall event (mm)	Runoff (mm)	ratio	% rainfall converted into runoff	Runoff (mm)	ratio	% rainfall converted into runoff
14	4	3,5:1	28.6	2.5	5,6:1	17.9
22	2.5	8,8:1	11.4	1.5	14,7:1	6.8
9	1.25	7,2:1	13.9	1	9:1	11.1
20	3.25	6,2:1	16.3	2	10:1	10.0
13	5	2,6:1	38.5	2.25	5,8:1	17.3
21	2.5	8,4:1	11.9	1.5	14:1	7.1
AVERAGE	**3,1**		**20,1%**	**1,1**		**11,7%**

Phumelele's production is very impressive, with yields on a par with or somewhat better than commercial yields in the area

Run-off results

Two run-off plots were set up for Phumelele; one in her trial plot and one in the conventional maize control plot. Measurements were taken by her. Runoff data was collected for those rainfall events where run-off could be correlated to rainfall dates. Not all data was useable as there were times when she forgot to take readings after one rainfall event and thus run off was conflated over a number of rainfall events. Or the bucket was left for quite a while and then emptied at a point that did not correlate with a rainfall event. These readings were not included.

Right: A view of the run-off plot set up in Phumelele's CA trial plot planted to maize early in the production season (December 2016)

In general, there was more runoff in the conventional tillage plot compared to the CA trial plot. The runoff average for the control plot was 3,1mm per rainfall event and that for the CA plot averaged 1,1mm. results are shown in table 6 below.

The percentage of rainfall converted into runoff, ranges between 11.36% and 38.46% under conventional tillage, while it ranges between 6.82% and 17.86 % in the CA plot. Again the

average percentage of rainfall converted to runoff is almost double on the conventional tillage plot at 20,1%, while that for the CA plot was 11,7%. This shows that conservation agriculture significantly reduces run-off in a short period (2-3 years) even without the increased soil cover usually associated with CA systems.

In addition, the run-off collected from the CA plots were a lot 'cleaner' with less silt and soil than for the conventionally tilled control plot. The two photographs below are indicative.

Right: Run-off collected in the bucket for the CA plot is clear while that for the conventionally tilled plot (far-right) is full of silt. These photographs were taken in mid-December 2016, on the same day, after a small rainfall event.

The presence of such programmes in rural communities not only contributes toward the introduction of practices for improved productivity and resilience as well as increased food security but also contributes to a large extent to community building and social agency. Phumelele's story is a good example of a local person who is willing to work hard so that she not only feeds her family and makes an income for herself, but also plays a role in mentoring other women in her village to say that "poverty should never be an excuse if you are able to work. Whatever little you may have can go a long way if one is willing to learn and work with others". Her greatest wish is that her children also learn that they can make a living for themselves from farming.

Household 2: Ms. Zodwa Zikode

She joined the CA learning group in 2014 when it was first introduced in Ezibomvini. She is a widow and head of her household and stays with her granddaughter. She earns a living by selling snacks in schools and the foster care grant for her granddaughter. She mentioned that her cabbages don't grow heads and she does not know what the cause could be, but suspects the very hot weather conditions they have had.

Above left and right: Zodwa Zikode in her vegetable garden. Water has to be carried by hand form a spring almost 1km away and her CA intercropped plot of maize and beans showing signs of heat stress

Household 3. Ms. Ntombakhe Zikode

Mrs Ntombakhe Zikode is a 50 year old hard working woman. It has been 4 years since she joined the CA learning group. Apart from farming activities, she works on the Zibambele program under the Department of Transport and also does sewing to generate more household income. Below are pictures showcasing her garden, yields of maize and farming infrastructure and tools she has at her homestead.

Above left and right: Nombakhe's vegetable garden- mostly unplanted due to hot dry conditions and her maize field showing very patchy germination – again due to hot dry conditions at planting.

7.3.3 Mvuso (Alice) EC

The walkabouts took place in Alice at a co-operative (NPO Youth Development and Co-operative) land that has 6 members. Two of the members were present; Mrs Mandisa Mama and Mr Mncedi Madleni. The land is used mainly for maize production and currently the area planted is 4ha. They have dragline sprinkler irrigation and use animal traction for weeding. They do top dressing with LAN although there is inconsistency in spraying. Fertilizer used is kraal manure and they use OPV yellow maize seed.

Challenges they encounter;

- Capital not enough to buy better (ie Hybrid) seed
- Weeds
- Erosion
- Soil is too loose

They planted cover crops (legumes and fodder crops to protect the soil). It is their first time planting as a coop and they are interested in growing herbs as well because they believe herbs make more profit than maize. For now the coop members do all labour by themselves with a wish to hire more labour in a long run. The Department of Agriculture does the ploughing for them.

Maize after harvest is stored in tanks and during harvest time they hire people in the area to assist them, for a period over a month. The maize grows out to be uneven due to the issue of fertility. The

planted area is affected by erosion – soil being deposited on grassed water way, soil losing nutrients, depth of soil decreases over time which results in decreased in production. The germination was not so good due to high temperatures. Stover sold for silage - this is done for economic benefit. They rotate the maize with herbs and cabbage.
The farmers were advised to do furrow irrigation to evenly distribute water and allow for the use of rain water.


Above left and right: The irrigated maize plots for the cooperative members. Uneven germination and yellowing is visible – one due to high temperatures at planting and the other due to run-off and soil loss.

Each one of these walkabouts have through discussion, generated ideas for CSA practices that would be useful at that site. These are then presented to the focus group for discussion and combined with other suggested practices, including local or traditional practices noticed for prioritization by the participants.

For future use, a form has been designed for summarising information from the walkabouts- See appendix 5

8 COMMUNITY LEVEL PRIORITIZATION OF PRACTICES FOR EXPERIMENTATION

This exercise concludes the 2nd day of the first Climate Change dialogue workshop at community level and provides for an action plan and some initial farmer experimentation ideas. This is then be followed up by a 2nd workshop session where more in-depth prioritization is done and each individual in the group chooses a basket of CSA practices to work with.

The table below outlines the practices mentioned by each group, those introduced by the facilitation team as options (in red) and also those prioritized for experimentation by members of that learning group (community of practice)

Community Level Prioritisation of Practices_ Learning and experimentation											
Province	**Area**	**Village**	**Natl resources/ landscape**	**Water (manage and increase available water)**	**Soil health and fertility (incl Manage soil movement)**	**Crops**	**Livestock**	**Other**	**EXPERIMENTATION**	**MEASUREMENTS**	
KZN	Bergville	Thamela		RWH		Mulching		Savings groups	CA: intercropping,	Yields, crop growth monitoring, seasonal review	
	No previous exposure to improved practices					Manure and fertilizer		bulk buying			
KZN	Bergville	Ezibomvini		Spring protection	Compost	Natural P&D control	Plant fodder		CA: Intercropping, crop roataion, cover crops-summer and winter	Yields, crop growth monitoring, seasonal review	raingauges,runoff plots, weather station, gravimetric soil samples, soil fertility, soil health
	CA learning groups; 3-4yrs (MDF)			RWH storage tanks; Jo-jos	Furrows	Tunnels			Tunnels	Yields, crop growth monitoring, seasonal review	Chameleon water mark sensors, irrigation applied
				infield rainwater harvesting	Contours	Mulching			Dripkits	Yields, crop growth monitoring, seasonal review	Chameleon water mark sensors, irrigation applied
				dripkits	Diversion ditches				Trench beds		
				greywater; tower gardens	Line levels				Mulching		
				infiltration pits/ banana circles	stone bunds				Mixed cropping		
				small dams							
KZN	Estcourt	Thabamhlophe	River cleanups	RWH storage; Jojotanks	contours	Natural P&D control	Buying fodder, licks	Fencing			
	Food secruity learning groups 1-2yrs (LimaRDF)		Planting trees	Greywater man	stone bunds	mulching	Vaccintation, deworming	Soil testing			
			Windbreaks	Tower gardens and keyhole beds		CA, incl cover crops		Social: Nutrition, mobile clinic			
				Dripkits		Tunnels		Discourage planting nad slae of marijuana			
				Diversion ditches		Crop diversificaiton					
				Swales		New varieties; incl traditional crops					
						Manure, woodash					
						Compost					
						Trenchbeds					
						Seed saving					
						Liquid manure					
						Intercropping and crop rotaiton					

Province	Area	Village	Natl resources/ landscape	Water (manage and increase available water)	Soil health and fertility (incl Manage soil movement)	Crops	Livestock	Other	EXPERIMENTATION		MEASUREMENTS
EC	ALICE	UBLN	Remove aliens	RWH storage	Furrows and ridges	Trenchbeds	Conserve fodder (hay)	Value addition(cooking and preservaiton			
	A4F lerning network 2-3yrs		Plant vetiver	Dripkits		Multipurpose plants incl flowers	Decrease stock nos	Crop diversity for nutrition			
						Intercropping nad crop rotation	Vaccination				
						Mulch					
						Drought resistant crops					
						Natural P&D control					
						CA					
LIMPOPO	Tzaneen	Sekororo	Plant trees	RWH storage	Furrows and ridges	Mulching	Cotrolled grazing	Entrepreneurship			
			Manage cutting of trees	Grey water man: towergardens and keyhole beds		Intercropping and rop rotation	Decrease stock nos	Job creation			
				earth dams		Natural P&D control	Save fodder (hay)	Savings groups			
				diversion ditches		Multipurpose plants, incl flowers	Growing fodder for livestock	biogas digesters			
				Undergounrd RWH storage		Tunnels		Planting calendars - winter(for bolting)			
				Dripkits		Heat resistant cultivars					
						Indigenous varieties					
						Liquid manure					
						Trench beds					
						Eco-circles					
						Herbs					
						CA					
						Shallow trenches					
						Seed saving					

Province	Area	Village	Natl resources/ landscape	Water (manage and increase available water)	Soil health and fertility (incl Manage soil movement)	Crops	Livestock	Other	EXPERIMENTATION	MEASUREMENTS	
LIMPOPO	Mametje	Turkey (Sedawa Ext)	Plant trees	More boreholes and dams	Furrows and ridges	Tunnels	Plant fodder for livestock	Rather use electricity than firewood	CA: Intercropping, crop roataion, cover crops-summer and winter	Yields, crop growth monitoring, seasonal review	raingauges,runoff plots, weather station, gravimetric soil samples, soil fertility, soil health
	No previous exposure to improved practices		Manage cutting of trees	Greywater management	Stone bunds	Trenchbeds	Save stover for fodder	NGOs and Govt to assist	Tunnels	growth monitoring,	Chameleon water mark sensors, irrigation applied
			Manage fires	Drip irrigation	Use crop residues and manre	Mulching	Buy fodder	Donations of seed	Dripkits	growth monitoring,	Chameleon water mark sensors, irrigation applied
			take care of indigenous plants	Tower gardens and keyhole beds		CA		Access to healthcare	Trenchbeds		
			Propagation of trees			gardening techinques		Set up Coops for Govt support	Mulching		
								Use animal traction	Mixed cropping		

For each village/group – a combined set of practices to be introduced, both through learning and mentoring and farmer experimentation has been compiled from all the information in the group sessions as well as the walkabouts. This is also negotiated with other stakeholders in each area and includes organisation presently implementing a project/programme. This means that the climate smart agricultural component can be overlaid onto existing rural development projects to increase the depth and scope of these programme.

The table below summarises these practices for each of the 7 villages.

PRACTICES TO BE INTRODUCED								
Province	**Area**	**Village**	**Natl resources/ landscape**	**Water (manage and increase available water)**	**Soil health and fertility (incl Manage soil movement)**	**Crops**	**Livestock**	**Other**
KZN	**Bergville**	**Ezibomvini**	Spring protection	diversion ditches/ furrows	Infiltration pits	CA, incl cover crops, legumes	Growing fodder	Saving for buying Jojo tanks
		Done- April 2018	Conservation of wetlands and streams	swales / cut off drains	Mulching	Liquid manure		Fencing
				Greywater man: tower gardens, keyhole beds		Tunnels		Reducing of burning of veld
				RWH storage - Jo-jos and underground		Intercropping		Burying disposable nappies
				Dripkits		Seed saving		
						trench beds		
						Natural P&D control		
						Crop rotation		
						Compost		
						New varieties		
KZN	**Estcourt**	**Tabamhlophe**	Windbreaks	diverstion ditches/ furrows	Mulching	CA, incl cover crops, legumes	Growing fodder	Saving for buying Jo-Jo tanks
		Done- April 2018		swales / cut off drains		Liquid manure		Fencing
	Pactices prioritized by the group			Greywater man: tower gardens, keyhole beds		Tunnels		Nutrition

				RWH storage - Jo-jos and underground		Intercropping		Bulk buying
				Dripkits		Seed saving		River clean -ups
						trench beds; shallow trenches		Discourage growth and sale of marijuana
						Crop rotation		
						Natural P&D control		Mobile clinic
						Compost		
						New varieties		
EC	**Alice**	**IBLN/Mavuso**		Drip irrigation	Erosion control	Organic farming		Chameleons, run-off plots
				RWH		Planting herbs		
	Suggested practices for learning and experimentation support			Furrow irrigation		Tunnels		
						CA; with cover crops		
LIMPOPO	**Tzaneen**	**Sekororo**		Drip kits	Furrows and ridges	Tunnels	Fodder production for livestock	Savings groups
	Suggested practices for learning and experimentation support			Underground tanks		CA; with cover crops		Biogas digesters
				Other RWH structures		Planting herbs		
						Planting calendars		

						Shallow trenches		
						Natural P&D control		
						Seed saving		
LIMPOPO	**Mametje**	**Turkey**		Drip kits	Furrows and ridges	Tunnels	Fodder production for livestock	
	Suggested practices for learning and experimentation support				Infiltration pits	CA; with cover crops		
					contours, wales, diversion ditches	trench beds, eco-circles, shallow trenched		
		Done- April 2018				Natural P&S control		
						Liquid manure		
						Tower gardens		
						Soil fertility management		
						Seed saving and seedling production		

8.1 Collaborative activities in learning groups

The intention is for participants to implement new CSA ideas in their farming practices and to jointly assess the efficacy and impact of these ideas. Monitoring, both using visual and qualitative criteria as well as some quantitative measurements to provide for benchmarks to be used in some of the qualitative assessments are thus called for.

As these new ideas would invariably be ideas that farmers have not tried before, these techniques would need to be introduced through learning sessions and demonstrations. Many of the easier ideas such as mulching, mixed cropping and the like can be introduced in training and demonstration sessions for individuals to experiment with at their homesteads. There are however some practices/techniques that require both higher levels of skill and inputs to implement. Some examples here would be conservation agriculture, shade cloth tunnels for vegetable production and furrow irrigation. In addition introduction of practices are season specific in a number of instances.

A process has thus been put in place to set up demonstrations for the learning groups to pilot some of these ideas. These community level demonstration sites also provide a good opportunity for implementation of the quantitative measurements.

Below is an updated table indicating the demonstrations as they have been implemented during the reporting period.

Table 16 : Participants in quantitative measurements for trials; KZN and Limpopo

Province	Category	Name of participants	Name of village	Date of planting
Limpopo	Field cropping (CA)	Koko Maphori	Sedawa	05/12/2017
		Lerato Lewele	Mametja	06/12/2017
		Seemole Malepe	Botshabelo	07/12/2017
	Gardening (Tunnels, drip kits – trench beds, mixed cropping, mulching)	Christina Tobejane	Sedawa	11 – 15 Dec 2017
		Norah Malepe	Mametja	11 – 15 Dec 2017
		Mariam Malepe	Botshabelo	11 – 15 Dec 2017
		Matshego Shai Mabiletse Mogofe Sarah Mohlala	Turkey	9-12 April 2018
		Cheune Mailula Josias Shai Lydia Sechube Rosina Mahlungu	Lourene (Sekororo – LimaRDF)	9-12 April
KwaZulu-Natal	Field cropping (CA)	Ntombake Zikode	Eqeleni	20-24 Nov 2017
		Phumelele Hlongwane	Ezimbomzini	20-24 Nov 2017
		Phumzile Zimba	Mhlwazini	20-24 Nov 2017
	Gardening (Tunnels, drip kits – trench	Ntombakhe Zikode	Eqeleni	29-31 Jan 2018
		Phumelele Hlongwane, Zodwa Zikode, Nombono Dladla	Ezibomvini	29-31 Jan 2018

	beds, mixed cropping, mulching)	Thembi Xaba, Zanele Ngobese/Winnie Dlamini, Gugu Majola/Nokuthula Sibisi	Mdwebu – Tabamhlophe _LimaRDF	29-31 Jan 2018
		To Ntuli (Uthando LukaGogo Group)	Good Homes-Tabamhlophe-LimaRDF	29-31 Jan 2018
EC	Field cropping (CA, furrow irrigation	Ms Mandisa Mama and Mr Mncedi Madleni Xolisa Dwane Siyabulela Gcungqami	Mavuso Mxumbu Mxumbu	Aug-Sept 2018
	Gardening Tunnels, drip kits – trench beds, mixed cropping, mulching) Infiltration pits Swales Contours	Lingiswa Mangaliso Xoliswa Mangcola Xolisa Dwane Siyabulela Gcungqami Busisiwe Mgangxela Bulelani Jantjie Sibusiso Globinampku Aviwe Biko Abongile Mfecane Nomasoma Njacu Phindiwe Msesiwe	Alice Healdtown Mxumbu Mxumbu Mqayise Mayipase Ilizwi lamafama Ilizwi lamafama Ilizwi lamafama Ilizwi lamafama Ilizwi lamafama	End April 2018, Aug-Sept 2018

8.1.1 Experimentation with vegetable production and tunnels

Criteria for selection of the participants who would implement these demonstrations, at their homesteads, but with and for the groups were discussed with the learning group participants and the following criteria were used:

- Should be likeable
- Should be a volunteer
- Should be home most of the time
- Must be an active gardener
- Must reside in the close proximity of a source of water
- The source of water should somewhat be reliable
- Must be good with people
- Must have a vision for the benefit of the group
- Willingness to make tunnels

Training sessions in building of the shade cloth tunnels were held in KZN (end Jan 2018) and Limpopo (mid April 2018). The organisation Socio Technical Interfacing assisted with supply of the kits for the tunnels and drip irrigation as well as providing the three- day training in construction. A total of 8 demonstration tunnels, with 3 sets of drip kits each have been built in each province.

A few pictures are shown below indicative of the three- day process for each group. The report for the Bergville tunnel construction process in included in Appendix 7.


Above Left: On of the 4-6m tunnels completed by community members. Black plastic has been used to temporarily cover the three long trench beds constructed inside the tunnel. Above right: One of the drip kits set up outside the tunnel (another is inside for comparative purposes.

A further session was held with each of the learning groups to provide learning and mentoring in the experimentation process related to each tunnel – including construction of trench beds, mulching, mixed cropping and liquid manure. The experiment consists of setting up this process inside and outside the tunnel for comparative purposes. Chameleon water sensors have been installed for three participants in KZN and Limpopo respectively and a qualitative monitoring process has been put in place for the smallholder participants.

8.2 Individual experimentation

8.2.1 Conservation Agriculture experimentation- Limpopo

The first round of planting farmer level CA trials/experiments, was organized as a training workshop where participants worked together to plant a trial after theoretical and technical details for this process were introduced and discussed. Attending participants were given seed at the end of each session to go and plant their own individual field trials (maize, beans, cowpeas, sunflower, millet and winter cover crops (black oats, fodder rye and fodder radish).

The experimental sites were established in Sedawa, Mametja and Botshabelo. Below is a list participants who have planted CA trails in the 2017/2018 growing season.

Table 17: Participants in the individual CA farmer experimentation in Limpopo

Name of participants	Village name	Date	Replanted (Yes or No)
Khomotso Malepe	Sedawa	14/12/2017	Yes

Maakopila Malepe	Sedawa	14/12/2017	Yes
Makgale Malepe	Sedawa	14/12/2017	Yes
Alex Mogopa	Sedawa	14/12/2017	Yes
Nthara Seotlo	Sedawa	14/12/2017	Yes
Nkone Maphori	Sedawa	14/12/2017	Yes
Mpelesi Sekgobela	Sedawa	14/12/2017	Yes
Refilwe Mogale	Sedawa	14/12/2017	Yes
Mmago Mimi	Sedawa	14/12/2017	Yes
Victoria Malepe	Sedawa	14/12/2017	Yes
Tash Masete	Sedawa	14/12/2017	Yes
Joyce Masete	Sedawa	14/12/2017	Yes
Josphina Malepe	Sedawa	14/12/2017	Yes
Joyce Mongadi	Sedawa	14/12/2017	Yes
Meisy Mokwena	Sedawa	14/12/2017	Yes
Norah Malepe	Sedawa	14/12/2017	Yes
Thamara Malepe	Sedawa	14/12/2017	Yes
Christina Thobejane	Sedawa	14/12/2017	Yes
Lethabo Sekgonbela	Mametja	17/12/2017	No
Selina Sekgonbela	Mametja	17/12/2017	No
Melta Sekgonbela	Mametja	17/12/2017	No
Nancy malepe	Mametja	17/12/2017	No
Lerato Lewele	Mametja	17/12/2017	No
Manteng Mametsa	Mametja	17/12/2017	Yes
Francinah Shai	Mametja	17/12/2017	Yes
Rebecca Mmola	Mametja	17/12/2017	Yes
Jenny Mmola	Mametja	17/12/2017	No
Andronica Morema	Mametja	17/12/2017	No
Monica Malepe	Botshabelo		Yes
Mariam Malepe	Botshabelo		Yes
Alex Mogopa	Botshabelo		Yes
Seliki	Botshabelo		Yes
Koko Mokgotho	Botshabelo		Yes
Toakele	Botshabelo		Yes
Nthara Nthlamo	Botshabelo		Yes

The rainfall records from the experimental sites have shown that the total precipitation from early December to mid-January was 20 mm. This has resulted in poor or zero germination in most of the CA plots. In early January, we replanted the CA experimental trials in Sedawa and Botshabelo and discontinued the experimental trial in Mametja and moved it to the other side of Sedawa. At each of the meetings seed was distributed to attending participants to go and replant their CA trails.

Some of the participants planted, while others kept the seed for the next season. Those who replanted experienced the same problem, seed did not germinate, and where it germinated the germination was patchy. There were no rains in January and February in the area, again this has resulted in crop failure in both experimental plots and baby sites in homesteads

Above left and right: Seomole Malepe's field in Botshabelo showing patchy germination and very little growth at the end o Jan 2018

However, the situation was different for those who have access to irrigation, their crops have germinated and grown very well. There was no replanting done at Turkey village.

Above left to right Mpelesi Sekgobela's homestead in Sedawa village – Her intercrop trial early in the season -showing maize-bean and maize-cowpea intercrops, her maize singe crop block later in the season and Mrs Sekgobela standing in an intercrop plot of maize and summer cover crops (millet and sunflower)

In addition 3 researcher managed trial plots were also established to take samples and set up instrumentation for more quantitative measurement. The trials were established in 3 fields, situated in Sedawa (Koko Maphori), Mametja (at Lerato Lewele) and Botshabelo (Seemole Malepe).

The trials were planted by members of the learning group, and this was organized in the form of a workshop of CA as the trial sites are to be used as demonstration sites. Soil fertility samples were taken at these plots, as well as gravimetric water soil samples. Run-off plots and rain gauges were also installed.

The trial sizes were kept at the same size for all three participants and the layouts are as shown in the diagrams below. The size of individual plots is 10 m^2 and the total trial size is 1000 m^2.

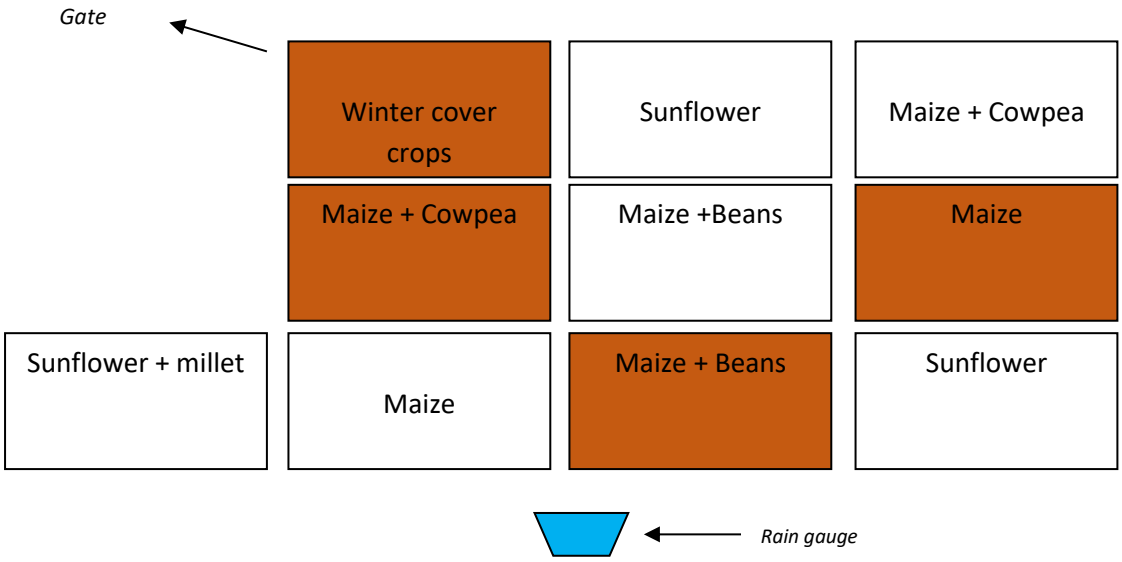

Figure *4*: CA trial layout for Koko Maphori's field (Plots highlighted in brown is where runoff plots have been installed)

There was good germination of cowpeas, maize and beans, respectively. However, due to high temperatures and low rainfall during December, the maize wilted in some of the plots and only cowpeas were visible. Winter cover crops did not germinate at all. These plots were replanted in January – to no avail, as even less rain fell during January-February.

8.2.2 Tunnel and gardening experimentation _KZN- Ezibomvini

During the second CC workshop at community level the learning groups further prioritized, as a group and as individuals some of the e[practises they would experiment with.

As an example the Ezibomvini learning group worked with gardening experimentation linked to their tunnels and doing farmer level trials both inside and outside the tunnels and including, trench beds, mixed cropping (including herbs) and mulching. These practices were introduced and demonstrated.

Out of 29 farmers who were present for the Ezibomvini learning group (23 March 2018), 20 farmers considered trench beds as their priority. Farmers who chose trench bed will therefore also try out mixed cropping and mulching. Most of the farmers from the nine left already has trench beds in their homesteads. The following is the list of participants who considered a trench bed as their first priority.

Table 18: Individual experimentation with trench beds, mixed cropping and mulching for the Ezibomvini Learning Group

Name	Village Name
21. Jabulile Nkabinde	Ezibomvini
22. Fikile Hlongwane	Ezibomvini
23. Nonhlahla Zikode	Ezibomvini

24. Landiwe Gamede	Ezibomvini
25. Gcinekile Zikode	Ezibomvini
26. Hlengiwe Ndaba	Ezibomvini
27. Busisiwe Zikode	Ezibomvini
28. Alfred Gumede	Ezibomvin
29. Velephi Zimba	Ezibomvini
30. Sizeni Dlamini	Eqeleni
31. Lndokuhle Hlongwane	Ezibomvini
32. Conastance Hlongwane	Thamela
33. Thulile Zikode	Eqeleni
34. Sibongile Zikode	Eqeleni
35. Dambi Ntuli	Thamela
36. Zanele Hlongwane	Thamela
37. Thokozile Mpambo	Eqeleni
38. Nomalanga Khumalo	Eqeleni
39. Mvelo Zikode	Ezibomvini
40. Sdudla Sibiya	Ezibomvini

Farmers were provided with sample quantities (small packets_5ml) of a variety of seeds including new winter vegetable varieties and herbs for their experimentation. The seed and seedlings provided were lavender, Aloe Vera, moss curl parsley, flat leaf parsley, coriander, garlic chives, leeks, Chinese cabbage, Kale, and spring onions.

These experiments are to be monitored by both the farmers and the facilitation team and a review of this process held by the end of the growing season. The process will also be implemented in the other villages where CoPs' have been set up.

9 CAPACITY BUILDING AND PUBLICATIONS

Capacity building has been undertaken on three levels:

- Community level learning
- Organisational capacity building
- Post graduate students

9.1 Community level learning

This has been discussed at length in previous sections. In summary learning workshop have been conducted in 7 villages across three provinces (EC, KZN and Limpopo) with a total of 208 participants including a number of topics including; scientific and community level understanding of climate change and weather variability, impact of climate change on production, adaptive measures, introduction to a range of CSA practices, farmer level experimentation and practical learning for a range of CSA practices

9.2 Organisational capacity building

Within 3 NGOs (MDF, Lima RDf and AWARD) capacity of field staff to facilitate and work with climate change concepts and facilitation of CSA at community level has been enhanced through:

- Collaborative design of workshop outlines and facilitation processes
- Training sessions in CC and CSA facilitation, including appropriate CSA practices
- Mentored facilitation of CC and CSA workshops
- Field staff managed facilitation of learning events
- Setting up of CoPs and
- Attendance at stakeholder CoP processes related to this work (Agroecology network in Limpopo, Rangeland management cross visit with UCPP in Eastern Cape and regenerative agriculture symposium in the Free State.
- In addition inputs have been provided for the Conservation Agriculture policy document for DAFF

9.3 Post graduate students

Below is a summary of the postgraduate studies and progress made for 2017-2018

- Finalisation of theses:
    - Sanelise Tafa: Agric Economic Masters- University of Fort Hare; July 2017. *Farm level cost-benefit analysis of conservation agriculture for maize smallholder farmers in Okhahlamba Municipality in Kwa-Zulu Natal Province, South Africa.*
        - Paper: Farm Level Cost-Benefit Analysis: *The evaluation of economics of conservation agriculture in Bergville Town in Kwa-Zulu Natal Province of South Africa* (Invitation to present: Center for Integrated Agricultural Systems (CIAS) at the University of Wisconsin- “The Agroecology of Development: Community Solutions in Post-Apartheid South Africa” event on November 9th, 2017)

- Khethiwe Mthethwa: B Agric Honours – Univeristy of KwaZulu Natal. November 2017. *Investigating the sustainability of adoption of conservation agriculture by small-scale farmers in Bergville*

- Progress: Final proposals and research methodology
  - Palesa Motaung: M Agric -University of Pretoria. *Evaluating the restorative effect of conservation agriculture on the degraded soils of the upper Drakensburg area of Bergville, KwaZulu-Natal using qualitative versus quantitative soil health indicators*
  - Mazwi Dlamini: MPhil - UWC_PLAAS. *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*
- Progress: Initial proposals and research methodology
  - Khethiwe Mthethwa: M Agric – University of KwaZulu Natal; January 2018. *The contribution of Climate Smart Agriculture (CSA) practices in adapting to climate change: The case of smallholder farmers in KwaZulu Natal.*

9.3.1 Sanelise Tafa:

Summary of Paper

On-farm economic benefits between conservation and conventional agriculture are not thought to be very 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 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

He used the following conceptual framework for his economic analysis

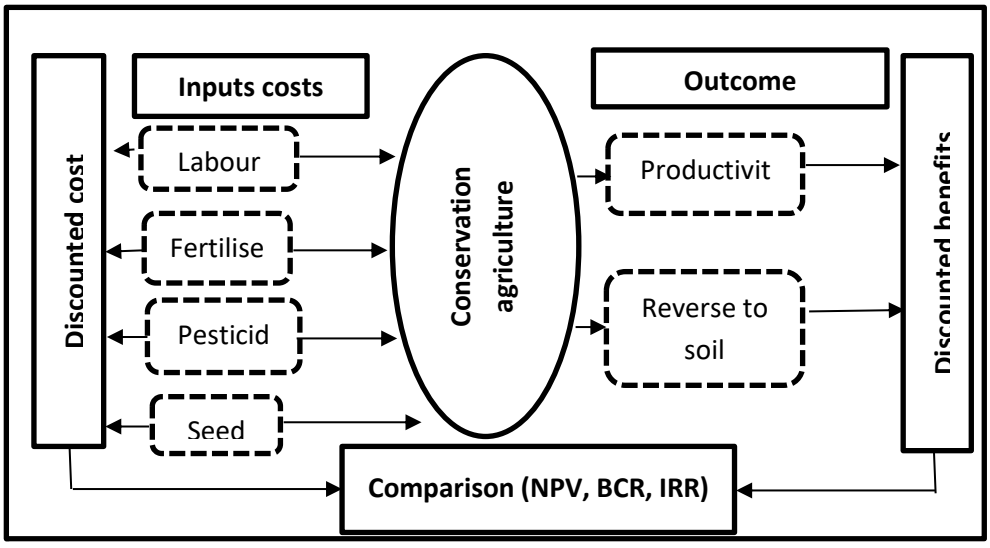

Figure 1: conceptual framework on cost benefit of conservation agriculture
Source: Adapted from Pannell *et al.* (2014)

Using interviews with 6 smallholder farmers in the Bergville area as well as quantitative and qualitative data from Mahlathini's GrainSA conservation Agriculture, smallholder innovation programme he achieved the following results – as indicated in the three tables below

Table 1: The average yield from the sampled respondents of 2013-2015

Year	Conservation agriculture (t/ha)	Conventional agriculture (t/ha)
2013	3.26	3.39
2014	4.12	5.4
2015	4.45	3.05

Source: Kruger (2016)

Table 2: Comparison of Cost and Benefits of trial plot and control plot

Variable cost	Trial Plots (Rands/0.14ha)				Control plots (R/0.8ha)			
	Q	P/Unit	Total Cost	% of cost	Q	P/Unit	Total Cost	% of cost
Maize seed	3.5	104	364	16%	4.8	104	499,2	11%
Fertiliser	35	9.2	322	14%	93	5	465	10%
Herbicide	0.42	109	45,78	2%				
Pesticide	0.014	875	12,25	1%				
Ploughing					0.8	645	516	11%
Labour	5	250	1250	56%	10	250	2500	53%
Discing					0.8	537.5	430	9%
Sowing	5	50	250	11%	0.8	376.25	301	6%
Sub-total			**2244,03**	**100%**	**Sub-total**		**4711,2**	100%
Contingency at		4%	89,7612	Contingency at		4%	188,448	
Total Cost			**2154,2688**	**Total Cost**			**4522,752**	
Gross Revenue	3,94	2500	9850		3,35	2500	8375	
Gross Margin			**7695,7312**				**3852,248**	

Source: Author's own computation

Table 3: The results of CBA

Tillage system	Parameter	10-year period Discounted at 8%	10-year period Discounted at 10.5%
Conservation agriculture	NPV	52694	46550
	IRR	25%	25%
	BCR	3,85	3,78
Conventional agriculture	NPV	20446	18177
	IRR	35%	35%
	BCR	1,56	1,55

Source: Author's own computation (NPV=Net Present Value, IRR=Internal rate of return and BCR=benefit cost ratio)

From these results Mr Tafa concluded that "Conservation agriculture is an amalgamation of a number of sustainable practices developed over the last century, packaged under the three guiding principles; viz., no-tillage, mulching, and crop rotation. Conservation farming is an arrangement that incorporates the three guiding principles to run concurrently and generate both physical-biological and socioeconomic benefits to the farm system. Yet, these benefits of CA are not without challenges. For instance, yield benefits take long time to materialize of which smallholder farmers cannot afford income sacrifices in the short term, even if there is a promise of greater benefits in the long run.

Although in the smallholder setting, CA has high initial investment costs compared to conventional agriculture, CA holds a high gross margin (GM) compared to conventional agriculture. There are many factors that contributed to the level of GM in all the tillage systems practiced, one being the lowest operating cost in CA compared to conventional agriculture.
When using appraisal indicators (NPV, BCR, and IRR) the study projected a 10-year period at 8% and 10.5% discount rates. All the appraisal indicators confirmed the viability of CA over the conventional agriculture".

9.3.2 Khethiwe Mthethwa:

Summary of paper

Khethiwe's abstract for her Honours paper is presented below:

"Conservation Agriculture is one of the concepts that have been introduced as a way of promoting a sustainable agricultural system. Whilst Conservation Agriculture (CA) is being promoted but its adoption rate among smallholder farmers has been very slow. Even after adoption, there are concerns that farmers may not be able to sustain its adoption. This study set out to investigate the sustainability of adoption of CA by small-scale farmers in Bergville community - Ezibomvini. This study adopted both qualitative and quantitative approach. Additional data for this study was collected through Focus Group Discussions (FGDs). The quantitative data was analysed through the use of SPSS, while qualitative data was analysed through emerging themes from the data. The study found that farmers have gained necessary skills and knowledge to be able to sustain the adoption of the CA, 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 innovation, which is technology and knowledge-intensive like CA to small-scale farmers who are not educated. It is recommended that more research be undertaken to find out the accurate result if farmers are willing to extend mixed cropping in their plots. Further research also needs to be conducted to find out more about factors which were influencing small-scale farmers to abandon CA practices".

Her problem statement and objectives for her study were defined as the following:
"The role of Non-Government Organization (NGO) inputs support is assumed to be a catalyst in the initial CA uptake, especially by poor and vulnerable households. A number of farmers who had adopted CA during the active promotion of CA eventually abandon the innovation in the absence of support from NGOs. Though, there is substantial evidence that CA results in improved soil health, fertility and yields over time. The response of smallholder farmers to CA is still not clearly defined. Therefore, it is necessary to conduct a study that looks into the adoption of CA to better inform policymakers regarding challenges faced by adopters of CA but more important about the factors that increase CA adoption.

Research Objectives:

- Farmer's knowledge and skills based on CA practice
- Farmer's perspectives towards the benefits to adoption of CA

Sub-problem:

Four research sub-problems were developed to address the research questions.

- What are the characteristics of sample farmers?
- Are selected farmers skilled and knowledgeable about CA?
- Do selected farmers follow the CA principles?
- What are the experienced advantages of practicing CA?

Some of the results she obtained from her study are presented below as examples

Regarding knowledge and skills to continue CA implementation, most farmers strongly agreed that CA training improved their knowledge in CA, a few number of farmers agreed that CA improved their knowledge and a few were neutral (Refer to figure 1.1). This shows that CA training played a huge role in improving farmers' knowledge in CA. Most farmers are confident that their knowledge has improved through CA training and this means they have gained required knowledge to sustain CA practice.

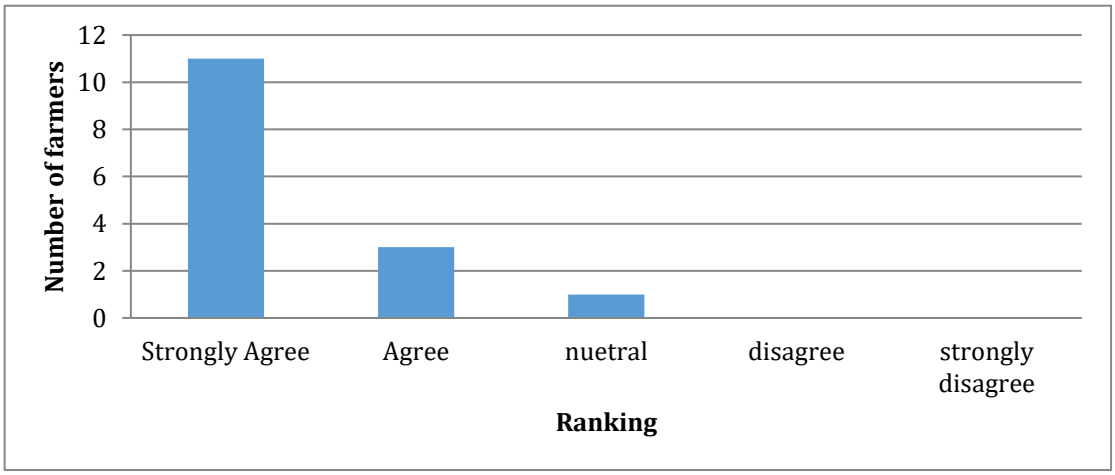

Figure 1: The Graph showing ranking of effectiveness of CA training in improving farmer's knowledge on CA (Survey output, 2017)

Regarding the benefits of CA, most farmers reported that CA increases yields (Figure 1.2). A few farmers are able to tell if the soil is fertile or not. Soil colour is one of the characteristics which farmers

use to determine soil health in the soil. In terms of fertilizer and herbicides application, all the farmers observed that CA improved their soil fertility due to the fact that their yields have increased.

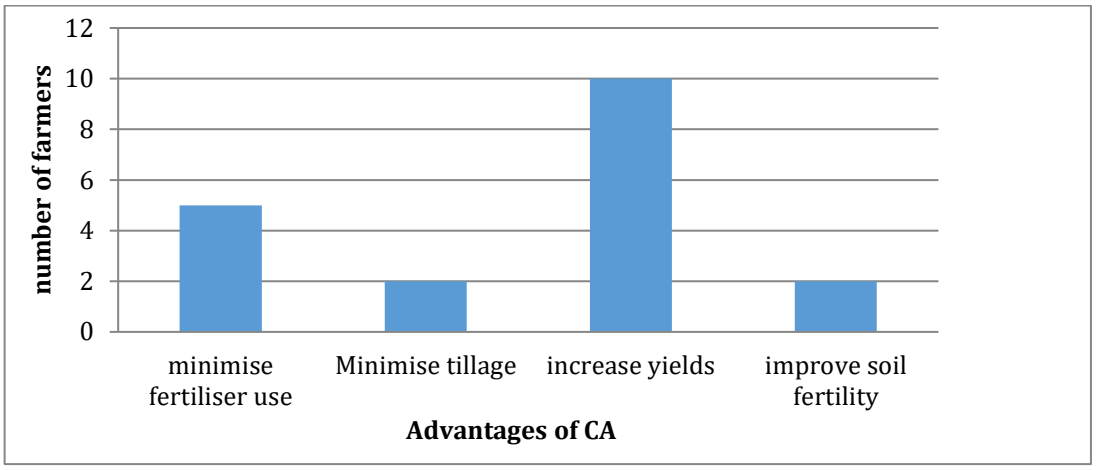

Figure 2: Figure 5.2: The graph showing CA knowledge gained by farmers (Survey output, 2017)

Further advantages mentioned is better weed control. The small pie chart below indicates the farmers' responses.

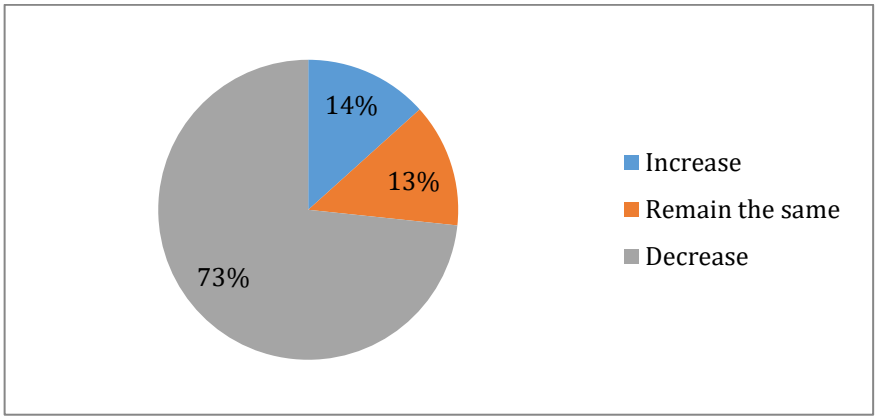

Figure 3: A pie chart showing the contribution of mixed cropping to weed control (Survey output, 2017)

But even given this response, not all farmers were prepared to continue and expand their mixed cropping practices (inter cropping of maize with legumes and cover crop planting) as shown in the small table below. Only around 535 of participants would continue with mixed cropping although 73% have noted positive changes in both yield and weed control

Table 1: Showing the willingness of farmers to extend mixed cropping in their fields (Survey output, 2017)

		Frequency	Percent
Valid	yes	8	53.3
	no	7	46.7
	Total	15	100.0

She concludes that the selected farmers have a capability to maintain the practice of CA now and in the future. Generally, the selected farmers have a better knowledge and skills of CA, indicating likelihood that farmers can sustain the CA practice. Considering the principles of CA: minimum soil disturbance, leaving soil residues and crop diversification, farmers indicated that they are comfortable with these principles as they minimize the use of inputs, save time and reduce soil erosion.

She recommended that further research needs to be conducted to find out communication strategies that can be used to communicate new innovations, which are technology and knowledge-intensive such as CA, to small-scale farmers who are not educated. More research needs to conducted with farmers who have abandon CA, to find out more about factors which influenced this decision.

Khethiwe's Masters proposal outline

Research Topic
The contribution of Climate Smart Agriculture (CSA) practices in adapting to climate change: The case of smallholder farmers in KwaZulu Natal.
The specific objectives are:

- To understand the historical experience regarding production calendar compared to current situation.
- To assess the CSA practices that are currently can be employed by small-scale farmers in response to the changes.
- To assess the factors influencing the selection of these practices
- To determine the benefits of employing CSA practices regarding climate change adaptation.

Research Methodology
The literature review will be conducted to guide the study through drawing researchable relationships. Both qualitative and quantitative data will be collected and analyzed. Seasonal Map, Timeline, Individual field visits, questionnaires and focus group discussions will be used to collect data. The study will be conducted in Bergville and Ntabamhlophe of KwaZulu Natal. There are three communities from Bergville which is Ezibomvini, Eqeleni and Thamela. There are two communities in Ntabamhlophe, which is Good homes and Mdwebu community. A total number of 50 respondents will be selected, 30 respondents from Bergville and 20 respondents from Ntabamhlophe. The study will investigate small-scale farmers who are practicing a wide range of practices in their homestead garden as a result of improving food security for households.

9.3.3 Mazwi Dlamini

Masters proposal outline and methodology.

Mazwi's abstract for his proposal reads as follows: "Subsistence agriculture continues to play a pivotal role in rural areas across developing countries in the world as means to food production and income generation. South Africa is no exception with white maize a staple food for more than 70% of the population in the country and yellow maize mostly used for livestock feed, livestock is a big part of smallholder agriculture (DoA, 2004). Maize plays a big role in South African diets contributing

35% of carbohydrates, 15% fat and 31% of proteins (Mqadi, 2005). Maizenis mostly produced at the expense of natural resources; soil erosion, poor soil health; coupled with high costs and poor yields threatening food security. Conservation Agriculture has been introduced as an alternative through resource saving, efficiency of inputs, improved use of natural resources, livestock integration and increased yields (Silici, 2010). Despite efforts in spreading CA there has been issues with adoption, this study attempts to identify factors influencing farmers' decisions the adoption and non-adoption of CA and impacts those decisions have on livelihood activities for food security. This research is informed by the Sustainable Livelihoods Framework where questionnaires and focus group interviews will be administered on 30 participants"

A summary of Mazwi's data collection tools and research questions is provided in the table below.

Table 1: Summary of data collection tools and analysis

Research question	Sources of data to answer the question	Research methods for collection and analysis of data
1. Which CA practices are mostly adopted by smallholders in the Bergville area?	Quantitative data on adoption and non-adoption of the CA package promoted by MDF	Questionnaire survey of 30 farmers, 20 adopters and 10 non-adopters; analysis using SPSS
2. What factors influence the adoption and/or non-adoption of CA in smallholder farming systems?	Qualitative data on views of farmers	In-depth, semi-structured interviews with 12 farmers (6 adopters, 6 non-adopters); thematic analysis Two focus group discussions, one with adopters (6 participants) and one with non-adopters (6 participants); thematic analysis
3. What adaptations do smallholders make to CA, if any, and what are the reasons for these?	Quantitative data on adoption and non-adoption of the CA package promoted by MDF Qualitative data on views of farmers	Questionnaire survey of 30 farmers, 20 adopters and 10 non-adopters; analysis using SPSS In-depth, semi-structured interviews with 12 farmers (6 adopters, 6 non-adopters); thematic analysis Two focus group discussions, one with adopters (6 participants) and one with non-adopters (6 participants); thematic analysis
4. What are the measurable impacts of CA on productivity in smallholder farming systems?	Data from MDF or Grain SA or other source?	Summary of existing data from MDF or Grain SA or other source?
5. What are the potential impacts of CA on the livelihoods and food security of rural households in the Bergville area?	Quantitative data on existing sources of livelihood and food security status Qualitative data on views of farmers	Questionnaire survey of 30 farmers, 20 adopters and 10 non-adopters; analysis using SPSS In-depth, semi-structured interviews with 12 farmers (6 adopters, 6 non-adopters); thematic analysis Two focus group discussions, one with adopters (6 participants) and one with non-adopters (6 participants); thematic analysis

He has finalised his literature review on his methodology and will spend the upcoming year in gathering and analysing data.

9.3.4 Palesa Motaung

Masters proposal outline and methodology

Palesa's hypothesis aims and objectives for her study are outlined below:

Hypothesis

Null Hypothesis:
CA is seen as a method that can build up or restore degraded soil. This process is known to take 7 years. However, a mixed type of cover cropping system rotated with a cash crop may shorten the entire process of rehabilitation and restoration to a period of 3 to four years

Alternative Hypothesis:
A leguminous inter-cropping system under yearly rotation may be as effective at increasing the pace at which a multi-specie cover cropping system restores degraded soil.

Aims of the study

1. The aims of study are to determine the impact of inter-cropping sugar beans-maize and cowpeas-maize on selected soil physical, chemical and biological properties as a minimum data set
2. Assess the sensitivity of qualitative and quantitative soil quality indices to determine overall soil health

Specific Objectives Include:

- To select the best combination of crops and management systems that can improve soil physical properties
- To select the best combination of crops and management systems that can improve soil chemical properties
- To select the best combination of crops and management systems that can improve soil biological properties

The study spans across 8 villages all within the Bergville area. These villages were chosen because they;

- Are all under the CA-Farmer Innovation Programme to introduce CA to smallholder farmers
- Are host to farmers who adopted CA either in 2014, 2015 or 2016.
- Are hosts to farmers who are practicing conservation alongside conventional tillage on maize plots
- Are hosts to farmers who are inter-cropping maize with a legume (soybeans or cowpeas) and rotating their plots yearly.

Within each village, farmers were selected who planted at least one plot of maize + beans, maize + cowpeas and maize only plots in the 2016/17 year.
Treatments were chosen for the following reasons:

a) These were the treatments most widely practiced and available amongst the chosen farmers; i.e. a high proportion of the chosen farmers planted 2/3 or 3/3 of the chosen treatments in the previous planting season.
b) The chosen treatment allows us to investigate the CA practice of intercropping maize and a legume versus the conventional practice of mono-cropping
c) An "uncultivated" soil sample will be taken adjacent to the cultivated plots which will serve as a benchmark for the areas natural soil status.

d) Information on whether the farmers have planted cover crops has also been collected and it may be used to add insight into the possible findings on the soil status

The table below indicates her participant selection.

Table 1: participant selection and criteria

			Conservation Tillage			Conventional Tillage	(control)	Yield (t/ha)			Other Treatments
Year	**Village**	**Farmer**	**m+b**	**m+c**	**m**	**maize**	**undisturbed adjacent plot**	**maize (CA)**	**maize (CT)**	**beans**	**cover crops**
2014	Ezibomveni	Phumelele Hlongwane	3	1	4	900m^2	Yes	8.27	9.69	1.818	1
2014	Ezibomveni	Nthumeni Nkabinde	5	1	2	560m^2	Yes	2.77	2.05	0.62	0
2014	Mhlwazini	Zimba Mantombi	4	4		350m^2	Yes	5.588	4.089	0.34	2
2014	Vimbukhalo	Sbongile Mpulo	1	1	2		Yes	*515 kg		1.76	0
2015	Ndunwa	Zondo Matozo	2	1	1	600m^2	Yes	3.79	1.9375	1.02	0
2015	Stulwane	Getty Miya	2	1	1		Yes	1.39	*129.99 kg	0.48	1
2015	Ngoba	Sebenzile Hlongwane	1		1	810m^2	Yes	2.95	0.34	0.22	1
2015	Ndunwa	Shiwiye Mazibuko	4	3	2		Yes	2.26	*109.2 kg	0.49	1
2016	Ezibomveni	Ntombenhle Hlongwane	2		2		Yes	5.82	167.2 kg	2.34	0
2016	Ezibomveni	Mantombi Mabizela	3	1			Yes	2.61	143.39 kg	5.64	0
2016	Cornfields	Miya Mdumeni	2	3		2236m^2	Yes	0.271	1.34	0	0
2016	Nsuka-Zwelisha	Busi Hlatshwayo	2	2			Yes	4.76	109.83 kg	2.44	0

She is to work with a number of quantitative and qualitative soil health indicators within the following experimental design.
This study will be a field experiment with 5 treatments:

- 2 management systems: conventional and conservation tillage,
- 2 inter-cropping systems; bean-maize and cowpea-maize,
- Mono-cropping versus inter-cropping,
- Uncultivated plot serving as a benchmark for degradation

Arranged in a factorial arrangement of a split-plot design. Each treatment is replicated 12 times on 5m × 5m blocks

Quantitative soil quality indicators to be used are summarised in the table below

Table 2: Soil quality indicators

Soil Function	Relative Weight	Quantitative Soil Quality Indicators	Type of Indicator	Relative Weights	Test	Link between Indicator and Soil Process/Function
Nutrient Cycling	0.2	Available P	Biological	0.5	Olsen-P	Extractable Phosphorus is a measure of phosphorus (P) availability to a crop. P is an essential plant macronutrient, as it plays a role in photosynthesis, respiration, energy storage and transfer, cell division, cell enlargement, and several other process in plants (Moebius-Clune, 2016).
		pH	Chemical	0.5	pH-KCl method using a pH meter	Soil pH is a measure of how acidic the soil is, which controls how available nutrients are to crops. If pH is too high, nutrients such as phosphorus, iron, manganese, copper and boron become unavailable to the crop. If pH is too low, calcium, magnesium, phosphorus, potassium and molybdenum become unavailable (Moebius-Clune, 2016).
Filtering and Buffering	0.2	Soil Organic Matter	Transcends all 3 indicators	0.7	Percent organic matter is determined by loss on ignition, based on the	Soil organic matter (OM) is where soil carbon is stored. OM acts as a long-term carbon sink, and as a slow-release pool for nutrients. It contributes to ion exchange capacity

					change in mass after a soil is exposed to high temperature (500 °C or 932°F) in a furnace (Moebius-Clune, 2016)	(nutrient storage), nutrient cycling, soil aggregation, and water holding capacity, and it provides nutrients and energy to the plant and soil microbial communities (Moebius-Clune, 2016). SOC is one of the most important constituents of the soil due to its capacity to affect plant growth as both a source of energy and a trigger for nutrient availability through mineralization (USDA-NRCS, 2009).
		Electrical Conductivity	Chemical	0.3	Electrical conductivity meter	EC does not directly affect plant growth but has been used as an indirect indicator of the amount of nutrients available for plant uptake and salinity levels (USDA-NRCS, 2011).
Physical Stability and Support	0.2	Bulk Density	Physical	1.0	The Cylindrical Core Method (NCRS Soil quality test kit guide)	Bulk density is an indicator of soil compaction. Bulk density typically increases with soil depth since subsurface layers have reduced organic matter, aggregation, and root penetration compared to surface layers and therefore, contain less pore space (USDA-NRCS, 2011).
Biodiversity and Habitat	0.2	Soil Respiration	Biological	1.0	[Solvita - CO_2 Burst Method]	A measure of the metabolic activity of the soil microbial community. It is measured by re-wetting air dried soil, and capturing and quantifying carbon dioxide (CO2) produced (Moebius-Clune, 2016).

Water Relations	0.2	Available Water Capacity (AWC)	Physical	0.5		Soil porosity and particularly macro-porosity (the number of large pores) influences the movement of air and water in the soil. Soils with good structure have a high porosity within and between (USDA-NRCS, 2011).
		Water stable aggregates	Physical	0.5		Measurement of soil aggregate stability gives a useful index of the susceptibility of the soil to structural degradation and visual assessment of the soil profile is a valuable method of assessing the need for physical remediation (Cameron et al, 1998).

Qualitative soil quality indicators:

The farmers in Bergville who have adopted CA into their farming practices use a Visual Soil Assessment Manual for Conservation Agriculture developed by Grain SA with Mahlathini Development Foundation. The manual looks at properties such as soil type; soil crusting; soil structure; porosity; depth; presence of mottles; presence of tillage pans and earthworm count. The manual uses a score between 0 and 2. 0 indicates poor conditions while 2 indicates good conditions. Table 3 below is a typical checklist found on the Mahlathini Visual Indicator manual.

Table 3: Mahlathini Visual Indicator checklist. Mahlathini Development Foundation

Visual indicator of Soil Quality	**Visual Score (VS)** 0 = Poor conditions 1 = Moderate conditions 2 = Good conditions	**Weighing**	**VS Ranking**
Soil Structure		X3	
Soil porosity		× 2	
Soil colour		× 2	
Number and colour of soil mottles		× 1	
Earthworm counts		× 2	

Soil cover		× 3	
Soil depth		× 2	
Run-off		X 2	
Ranking Score (sum of VS rankings)			

Table 4 allows the farmer to rate the condition of their soil by assigning each indicator a score out of 2. Each indicator is then multiplied by a weight which indicates importance or influence of the indicator to overall soil quality. The scores are summed to give a soil quality assessment. Table 6 below is an example of such a checklist. For instance, a soil sample that received scores of 2/2 (Good Condition) for all 8 categories above would receive a score of 34 (>25), meaning that the soil quality is "good".

Table 4: Soil Quality Assessment Table. Mahlathini Development Foundation

Soil Quality Assessment	**Ranking score**
Poor	< 10
Moderate	10 - 25
Good	> 25

The full manual can be found in the appendix section. (Appendix 1).

The Mahlathini Visual Soil Assessment Manual will be used in this study as a qualitative assessment tool. This tool will be used to evaluate soil quality in-field and assign soil quality scores to each sample. Samples will then be ranked for comparison with the results form Objective 1: Quantitative soil Quality Assessments.
The relationship between qualitative and quantitative methods of assessing soil quality will be established using the Kendall Rank Correlation Coefficient.

Palesa has finalised her literature review and methodology and is to commence with field work in May-June 2018.

9.4 Publications and networking

- Publications:
    - Adaptation network newsletter; 2 articles – CA SFIP and CSA impact
    - SA Grain Newsletter; CA SFIP, 2 smallholder case studies (Ixopo, Bergville)
    - Africanfarming.com; Feature - CA in smallholder farming systems
- Cross visits:
    - DARD and MDF: Lesotho – cross visit _CA
    - GrainSA FDP and ARC- SGI_CA and implementation methodology
    - USAID, Ukuvuna, SANBI _Community based CCA in Mametje
- Attendance:

  - Rangeland Management learning exchange_UCPP_Matatiele
  - Regenerative Agriculture_ GrainSA_Reitz
- Presentations:
  - CA learning groups and farmer centres presentation – Ubuhlebezwe LM Agricultural Forum, DRDLR (KZN), Umgungundlovu DM, GrainSA farmers days (x5)
  - Madzikane stakeholder forum, Agroecology network, Unmovtho Buboni Learning Network,