Deliverable

7

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.7: Development of indicators, proxies and benchmarks and knowledge mediation processes

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Interim report: Refined decision support system for CSA in smallholder farming

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, manuals, handouts and other resources necessary for learning and implementation.	31 January 2019
FINANCIAL YEAR 2019/2020			
7	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. Analysis of contemporary approaches to collaborative knowledge creation within the agricultural sector. Develop appropriate knowledge mediation processes for each CoP. Develop CoP decision support systems	1 May 2019
8	Report: Appropriate quantitative measurement procedures for verification of the visual indicators.	Set up farmer and researcher level experimentation. Link proxies and benchmarks to quantitative research to verify and formalise. Explore potential incentive schemes and financing mechanisms Conduct survey of present knowledge mediation processes in community and smallholder settings	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 7

This report includes aspects of both deliverable 7 and 8 and focuses on the development of a Participatory impact monitoring process for the review and re-planning of the CSA implementation and research process at community level, with associated resilience indicators, the refinement of the DSS model through field testing and the development of a facilitation manual.

Farmer level experimentation with practices is ongoing and progress is reported on. A full report on the progress with quantitative measurements and the development of proxies and visual indicators is to follow in Deliverable 8.

The design of the decision support system (DSS) 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, as well as modelling of the DSS;

- **Process:** Through which climate smart agricultural practices are implemented at smallholder farmer level. This also includes the facilitation component, communities of practice (CoPs), 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 incentive based support schemes for smallholder farmers.

Activities in this four- month period have included:

- **Practices activities**: Refinement of the DSS model and run the model for 41 households across three provinces.
- **Process activities**: Conduct CCA farmer training and implementation (Workshop 4) in Swayimane (KZN), CCA workshop 3 in Madzikane (KZN), as well as continuation of farmer level experimentation in the EC (3 villages), Bergville (2 villages) and Ntabamhlophe in KZN. CoP engagement has consisted of a farmer level best practice cross visit and learning session for the Agroecology network, a soil fertility and soil health Farmers' day in Bergville in association with KZNDARD and attendance of a Regenerative Agriculture conference in Reitz, Free State (Farmers Weekly and the Maize Trust). Initiation of a livestock integration farmer level experimentation process in Bergville (fodder production, hay making and supplementation)
- **Monitoring and evaluation:** Design of the participatory impact assessment process and a resilience monitoring process for the DSS

A chronology of activities undertaken is presented in the table below.

Date	Activity	Description	Team
2019/01/21-24	Yearly team planning	Whole team planning session for yearly activities, mentoring and training in CA implementation in Limpopo	Erna, Lawrence, Chris, Mazwi, Lulama, Tema, Phumzile, Samukhelisiwe, Nonkanysio
2019/02/25-03/01	Limpopo review and re-planning	Review and preplanning workshops and monitoring processes for villages in Limpopo (Sedawa, Turkey, Willows, Botshabelo)	Erna, Betty, Andries
2019/02/27	Ntabamhlophe monitoring	Monitoring of CA and gardening CSA practices implementation	Samukhelisiwe and Lindelwa
2019/03/07	Refinement of DSS	Modify input parameters to better suite conditions on the ground and re-run for 41 participants	Erna, Catherine van den Hoof
2019/03/05-08	Implementation progress monitoring	Implementation and monitoring for 3 villages in the EC	Mazwi, Lawrence
2019/03/11,12	Conference	Attendance of Regenerative Agriculture conference in Reitz (FS)	Erna, Phumzile, Lulama, Nontokozo

2019/03/12	Farmers day - Bergville	Jointly organised farmers day in soil health and fertility with LandCare and KZNDARD	Nonkanysio, Thabane Madondo, Bright Mashiyane
2019/03/14	Agroecology network	Farmers cross visit and presentation of best practice ideas; Sekhukhune- Joint event with AWARD.	Betty, Andires, Bigboy, Clayton
2019/04/02-05	Implementation progress monitoring	Implementation monitoring and sharing events Bergville and Ntabamhlophe	Samukhelisiwe, Phumzile and Lindelwa (Lima-RDF)
2019/04/10	Livestock integration w/s; Bergville	Learning workshop on fodder production, hay making and supplementation for the Bergville participants experimenting with fodder production	Brigid Letty (INR), Erna, Mazwi,Phumzile, Samukhelisiwe, Nonkanyiso, Tema, Lulama
2019/04/11	PIA w/s Bergville	Participatory impact assessment workshop for Bergville and Ntabamhlophe	Lindelwa Ndada (Lima RDF), Erna, Mazwi,Phumzile, Samukhelisiwe, Nonkanyiso, Tema
2019/04/11,12	CCA w/s 4 for Madzikane (SKZN	Demonstration w/s for participatory building of shade cloth tunnel, trench beds and initial round of farmer level experimentation with CSA practices	Mazwi, Tema, Nokanyiso

Capacity building and publications:

- Research presentations and chapters:
    - Mazwi Dlamini – M Phil (PLAAS UWC-yr 2); Report for first round of field work activities
    - Samukelisiwe Mkhize- PhD (Human Sciences): Concept note and registration
- Publications: -
- Cross visits:
    - Growing Nations farmer cross visit to Bergville (CA)
- Attendance: -
    - Regenerative Agriculture Conference (Reitz- FS)
- Conference papers and presentations: -
    - Farmers Days: Joint open day events for Conservation Agriculture with LandCare and KZNDARD in Stulwane- Bergville (KZN)
    - Agroecology Network; Cross visit and best practice presentations by farmers; Lower Olifants' and Sekhukhune.

2 COMMUNITIES OF PRACTICE AND DEMONSTRATION SITES

The work with the CoPs and in the demonstration sites is ongoing. The table below summarises the progress to date.

Table 2: CoPs' established in three provinces (October 2018-January 2019)

*Note: Activities in bold under Demonstration Sites, were conducted during this time frame

Province	Site/Area; villages	Demonstration sites	CoPs	Collaborative strategies
KZN	Ntabamhlophe	- CCA workshop 1 - CCA workshop 2 -CCA workshop 3 -CCA workshop 4 -CCA workshop 5 **- Monitoring and PIA**	-Farmers w NGO support (Lima RDF)	- Tunnels and drip kits - Individual experimentation with basket of options
	Ezibomvini/ , Eqeleni	- CCA workshop 1 - CCA workshop 2 - CCA workshop 3 - CCA workshop 4 (training) - Water issues workshops 1,2 -Water issues follow-up -CCA workshop 5 **-Water issues continuation** **-Monitoring, PIA** **- Fodder and supplementation learning process**	-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; monitoring review and re-planning - Livestock integration learning group and experimentation focus
	Swayimane	- CCA workshop 1 -CCA workshops 2 and 3 **-CCA workshop 4** **- Monitoring, review and replanning**	-CA open days -Umgungundlovu DM agriculture forum	- CA farmer experimentation - gardening level experimentation; tunnel, trench beds drip kits etc.
	Madzikane	-CCA workshop 1 **-CCA workshops 2-4**	-CA open days - Madzikane stakeholder forum	-CA farmer experimentation - gardening level experimentation; tunnel, trench beds drip kits etc
Limpopo	Mametja (Sedawa, Turkey)	- CCA workshop 1 - CCA workshop 2 - CCA workshop 3 - CCA workshop 4 -Water issues workshops 1-2 -Water issues follow-up - CCA workshop 5 - Poultry production learning and mentoring	-Agroecology network (AWARD/MDF) -Maruleng DM	-Review of CSA implementation and re-planning for next season Tunnels (Quantitative measurements - CA farmer experimentation (Quantitative measurements) – case studies - Individual experimentation with basket of options -water committee, plan for agric water provision

		-CA learning and mentoring - **Monitoring, review and re-planning**		
	Lepelle	Water issues workshops 1-2	-	-water committee, plan for agric water provision
	Tzaneen (Sekororo-Lourene)	- CCA workshop 1 - CCA workshop 2 - Assessment of farmer experimentation	Farmers learning group	-Tunnels and drip kits
EC	Alice/Middledrift area	- CCA workshop 1 - CCA workshop 2 - CCA workshop 3 -CCA workshop 4 and 5 - **Monitoring, review and re-planning**	Imvotho Bubomi Learning Network (IBLN) - ERLC, Fort Cox, Farmers, Agric Extension services, NGOs	- Monitoring and review of implementation of CSA practices and experimentation - Training and mentoring _CA, furrow irrigation, …. -Planning for further implementation and experimentation and quantitative measurements

Below summary reports for progress in each area is presented.

2.1 **Madzikane_SKZN**

Written by Mazwi Dlamini

2.1.1 **Introduction**

It has taken some time to schedule this process as people have been busy with different commitments including other projects and harvesting field crops. The intention of the day was to run a participatory workshop in construction of a shade cloth tunnel, in a site where three trench beds have already been prepared, to start the process of group experimentation with production in trench beds and tunnels – the two practices that most of the participants in this learning group wanted to try out.

We did discuss the fact that there is only the one tunnel and the group was in consensus that MaMdladla Shozi's household would host the tunnel. The logic behind the decision was because she is a stay at home person with enough time to monitor and take readings; she also has a fenced off garden close to a kraal for access to manure.

We were very ambitious on the day as lots of practices and activities were to be covered; starting with the filling up of the trenches, constructing the tunnel and having the beds planted. We also though it would be nice show the group the drip kit and have that put in as well.

2.1.2 **Workshop day**

(a) Trench beds

Three beds were made on the day; the first one was the deep trench where bones and tins are added followed by organic matter and manure. The seconds was a shallow trench bed with only organic matter and kraal manure and thirdly the raise bed with soil mixed with manure. Here the idea is comparing different types of beds both in and out the tunnel. All these beds were 5m x 1m. The hot sun didn't make it any easier to do these beds but with the help of three elderly women and Mrs Shozi the beds were done in no time.

Right: the three beds from right to left; deep- and shallow- trench and raised bed

(b) The tunnel

Seven participants in total assisted with building the tunnel:

- Bending the hoops for the tunnel using a jig and joining these together to make the arches
- Sewing the various panels of netting onto the arches and sewing the doorway ropes into the netting
- Laying out the tunnel across the three prepared trench beds
- Making the holes for inserting the hoops using a spike designed for the purpose

- And then erecting the arches and pulling the netting over the arches. And attaching the netting.

Above Left: arch constructed after bending the lengths of conduit using a jig Above centre and right – sewing the netting onto the back and front arches.

Right: the four arches erected, with the front and back arches already having the netting sewn on and Far right: The completed tunnel after pulling over and attaching the rest of the netting.

2.1.3 **Conclusion**

This was the first- time participants witnessed the building of a tunnel. They believe this practice is among the best as a strategy against climate change where crops are protected from both the sun and cold. Many participants would like to have a tunnel in their own gardens as well. They were made aware that this one is for experimentation purposes and comes with additional work for Mrs Shozi who agreed to makes beds similar to those in the tunnel, on the outside as well, so as to compare results; she also agreed to water and monitor her irrigation and harvesting.

As per conclusion from the workshop, the rest of the group will meet to start implementing further choices for experimentation including; drainage pits and furrows in big gardens, tower gardens, organic teas and brews as well as seedling production among others.

2.2 Swayimane_SKZN

Written by Temakholo Mathebula

2.2.1 Introduction

Climate Smart Agriculture (CSA) as a concept has been explored at considerable length in workshops with the primary aim to understand farmers' perceptions about the relationship between climate and their agricultural systems. Workshop 1 and 2 aimed to answer the questions around farmers' perceptions on climate change and how they prioritize practices. Gobizembe (a village in Swayimane) farmers noted that weather patterns have become more erratic over time and that mean temperatures are steadily rising.

2.2.2 Tower Garden, Eco-circle, Conservation Agriculture

Workshop 3 focussed on experimentation and included the construction of a tower garden and eco circle as well as mixed cropping as phase one of the experimentation process. The aforementioned practices were chosen by the farmer due to their effectiveness in soil and water conservation, the minimal space they require, low labour intensity as well as affordability. The demonstration was conducted at Mrs Khanyisile Xasibe's house with 90 percent of the group members in attendance. The experiment was to compare crop growth and yield in the tower garden (treatment 1) and the farmer's normal way of planting (control). The farmer planted spinach, kale, Chinese cabbage, beetroot, marigold and leeks in the tower garden and spinach, cabbage, kale and beetroot on the ground.

Right and Far right: CSA practices implementer by Mrs Xasibe; tower garden and eco circle

2.2.3 **Experimentation**

Below is a summary of the experimentation undertaken by Mrs Xasibe, along with her irrigation and harvesting monitoring.

Table 3: CSA Practices implemented by Mrs Xasibe

Practice	Materials Used	How was it implemented	Crops Planted	Irrigation	Amount harvested
Tower Garden	80% shade net, manure, ash, tin, stones, poles	Learning group	Spinach, Chinese cabbage, kale, beetroot, marigold, leeks	10 litre/day when required)	10 bunches of spinach, 5 bunches of kale, 2 kg beetroot
Eco circle	Manure, grass, 2 litre bottle	Learning group	Parsley, coriander, thyme, beetroot, rocket	2 litre bottle filled once a day	Picks a few herbs to use
Raised and flat beds	Manure, mulch	Learning group	Spinach (bed and flat), kale, beetroot (flat)	10 litre /bed three times a week	40 bunches of spinach R10/bunch, 10 bunches of kale
Mixed Cropping	Seedlings	Learning group	Spinach, Chinese cabbage, kale, beetroot, marigold, leeks	10 litre/day	20 bunches of spinach, R10/bunch,10 bunches of kale 2 kg beetroot
CA (modification-addition of manure, cowpeas sole plot)	Manure, MAP, maize, beans, cowpeas, lime, round up, Decis forte	Planted by hand with husband	Maize, beans and cowpeas	Rain fed	Still in the field

(a) Tower Garden

The leafy green crops grew vigorously in the tower garden; which includes spinach, kale and Chinese cabbage. These were all planted on the sides. Beetroot and leeks which were planted at the top did not grow very well. On the ground, most of the crops grew vigorously but at times showed signs of heat stress due to a higher level of evaporation. Mrs Xasibe irrigated the tower garden and the crops on the ground once or twice a day four times a week.

Right: left: tower garden with crops growing, Centre; kale and Right; spinach after the farmer harvested 4 times



During the month of December there were heavy rains which led to an increase in pests, particularly snails which caused significant damage on Chinese cabbage. Other problematic pests included beetles and cut worm and some of the crops, mainly marigolds and beetroot had black marks and showed signs of decomposing. The overgrowth of the kale and spinach may have provided too much shade for the beetroot thus contributing in it not growing well. The pictures below show the tower garden after the farmer had harvested a number of times.

Above: Chinese cabbage severely damaged by pests (left), snail found on the cabbage (centre), beetroot showing signs of grey leaf spot (right)

(b) Control Plot

Vegetables on the control plot included spinach, beetroot, kale and cabbages in planting basins and she also planted spinach on raised beds. The spinach on the ground had the best yield as she planted in basins which she believed contributed to the good growth of her crop by holding water. The kale also grew very well on the ground. The plants on the ground were less severely attacked by pests than those in the tower garden. The picture below is an overall depiction of Mrs Xasibe's garden.

Above left and right: Mrs Xasibe's conventional gardening plots

Mrs Xasibe made an income of R 480.00 from the spinach and kale from the tower garden and the control plot combined. She utilized the rest of the vegetables for household consumption and a few were damaged by pests and diseases.

(c) Eco circle

The eco circle was dug 60 cm deep with alternate layers of manure and grass added together with the soil. A bottle with 16 holes was placed at the centre for irrigation. The farmer planted thyme, coriander, parsley, rocket and beetroot and the herbs grew very well, however rocket outgrew the other herbs and filled half of the circle, shadowing some of the other herbs. It was agreed that since it takes up so much space needs to be planted on its own going forward.

Herbs are not very common in community gardens as they are generally known to be for medicinal uses and not consumption, hence the general belief is that if required they must be purchased from a

traditional healer or collected from the nearby bush. Growing herbs was a way to introduce and create awareness about other types of herbs and their uses. The team discussed the various uses of the herbs with Mrs Xasibe when planting, e.g. use of parsley and rocket in salads, thyme in meat dishes, coriander in curry etc. She harvested the parsley, coriander and thyme to use in soups and salads but did not like the smell of rocket and ended up not harvesting it.

Above: Mrs Xasibe's eco-circle

(d) Conservation Agriculture

Conservation Agriculture (CA) is an approach that provides an alternative to conventional ploughing. CA promotes good agricultural practice through its three core principles:

- Minimum soil disturbance
- Permanent soil cover
- Crop diversification

Mrs Xasibe started implementing CA in 2018 and is now in her second season. She planted the CA experiment in the last week of January 2019 which is more than four weeks later than in the previous season. High temperatures (>32°C) and late rainfall were cited as the main reasons for planting late. In the current season, her husband accidentally put a ripper through her CA plot, nonetheless she continued to plant the intercrop plots of maize and beans as well as maize and cowpeas. She added manure on one of the plots in order to assess its effect on soil fertility and final yield compared to fertiliser.

Right and far right; Mrs Xasibe's CA plots

(e) Past and Present Practices and Lessons

Mrs Xasibe expressed that there has been a decrease in yields and an increase in pest and disease outbreaks in recent years. Stalk borer in maize spreads much faster and has become resistant to Kemprin. The aggressiveness with which it spreads is believed to be a result of persistent high intensity low duration rainfall with alternating periods of high temperatures. In addition, soils have become harder and less friable during summer months as a result of years of ploughing and subsequent erosion, as well as periodical drought conditions. Decreased yields are possibly a direct result of mono-cropping. In both her maize fields and garden Mrs Xasibe normally plants the same crops in the same area repeatedly. The aforementioned challenges were the contributing factor to her willingness to try new practices and in just one season she has started to notice changes in her farming system, shown in the table below.

Table 4: Past practices vs. present practices and lessons

Past Issues	Past Practice	Present Practice	Impact	Lesson
High water drainage	Farmer used to plant vegetables on flat ground	Planting in planting basins or on raised beds	Improved water holding capacity	Better practice results in improved yield
Erosion	Ploughed and disked soil	Conservation Agriculture (planting basins, intercropping), tower garden	More ground cover, soil protection from erosion	Soil disturbance has negative impact on soil structure and fertility.

Maize-uneven growth/ small cobs	Mechanical ploughing, mono cropping	Addition of lime, manure, MAP, Ripping	Pending	Importance of good soil management

Past experience has shown that increasing the resilience of smallholder farming systems requires a multifaceted approach that considers all factors affecting those farming systems. This is proven by the failure of one- dimensional approaches (e.g. mono-cropping) to increase the sustainability of farming systems, but rather have subjected farmers to ever increasing costs of fertiliser and chemicals to maintain high yields. Therefore, it was important for farmers to come up with criteria that considered all environmental aspects (water, soil fertility, crop management, livestock, and natural resources), labour and affordability so as to choose the relevant practices. Looking at different aspects also allowed the farmer to expand their options rather than focusing on one practice as a solution, i.e. it is more effective to integrate a number of practices into a farming system, hence the implementation of tower garden, eco-circle and conservation agriculture. Below is a diagram of Mrs Xasibe's farming system depicting how she incorporated the new CSA practices which are highlighted

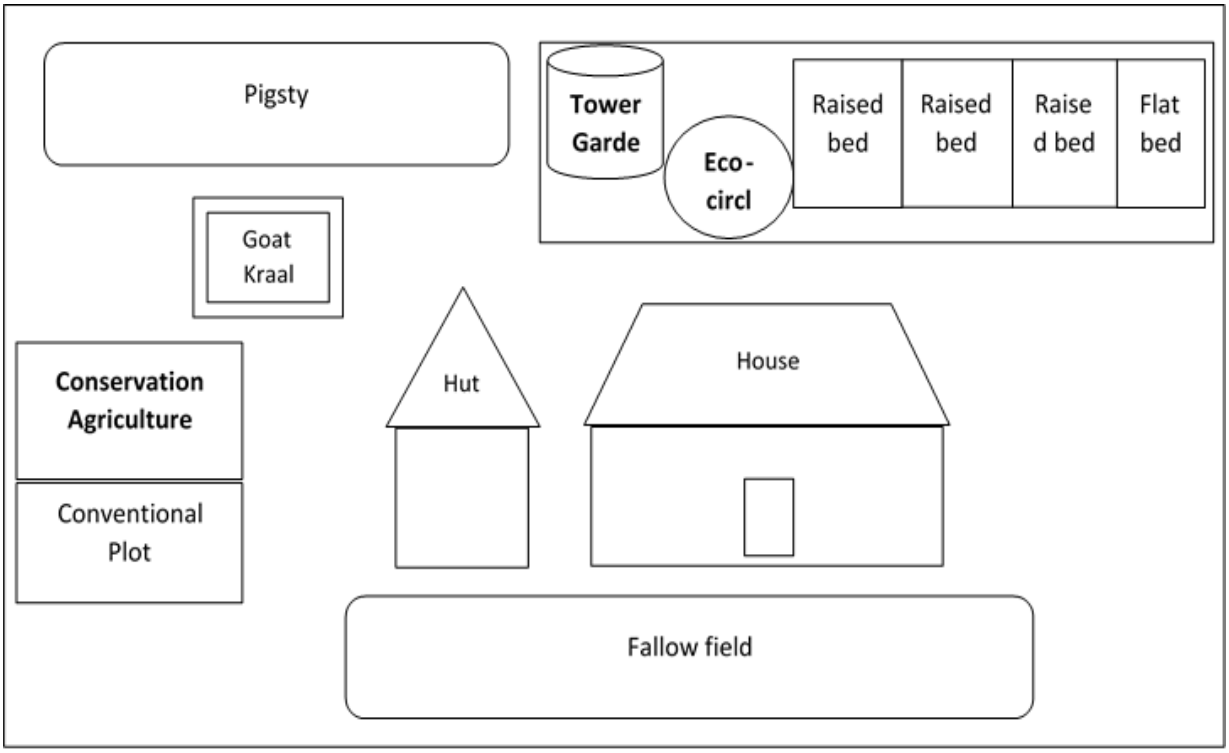


Figure 1: Layout of Mrs Xasibe's Farming System. (CSA Practices implemented in first cycle highlighted in bold)

(f) Shallow and Deep Trench, Mixed Cropping, CA




Demonstration workshops on the practices selected by farmers have been continuing in Natal Midlands. Mrs Lindiwe Zondi opted for the shallow and deep trenches as well as normal raised beds as her treatments, and her normal way of planting (on flat ground) as the control. Planting took place on the 19th of February 2019 and a total of six farmers were in attendance. The deep trench had already been dug and only needed levelling, so the team added the layers and dug the shallow trench.

Right: The demonstration workshop, preparing of the shallow and deep trench beds

All three beds were 5x1m in size and an extra 1x1m bed of herbs was planted. Mrs Zondi also made the eco-circle similar to the one that was demonstrated at Mrs Xasibe's house and she planted beetroot and lettuce on it. The farmer was given a monitoring form to record observations regarding plant growth, pests and disease and also how often the crops are irrigated.


Above: Planting of the different beds, to a similar mixture of mixed crops.

The above figure is a depiction of the beds after planting. Mrs Zondi continued to plant on the normal raised bed and on flat ground on her own.

The beds are irrigated with 10 litres of water/bed once a day except on rainy days. Common pests consist of snails and cutworm which she controls using Ampligo a non-selective pesticide. Marigolds were also planted to repel insects especially beetles, snails and nematodes. Although some of the insects were present, the damaged they caused was minimal. The table below presents a description of Mrs Zondi's garden.

Table 5:Mrs Zondi's CSA experimentation process

Practice	Materials Used	How was it implemented	Crops Planted
Trench bed	Rusted tins, newspapers, dry grass, maize stalks, cattle manure, straws, soil	Learning group	Red lettuce, leeks, spinach, marigolds
Shallow Trench	Dry grass, wet grass, goat manure, soil	Learning group	Green Lettuce, leeks, spinach, kale, Chinese cabbage, marigolds, beetroot, rocket
Normal Raised bed	Soil	Individually	Kale, lettuce, turnips, spinach, leeks, marigolds
Normal ground	Soil	Individually	Leeks, lettuce, spinach and kale
Eco circle	Soil, manure, grass, 2litre bottle	Individually	Beetroot, lettuce
CA	Lime, MAP, maize, beans, Round Up, Decis Forte	Individually	Maize and beans

(g) Trench bed

Trench beds are an effective way to increase soil fertility especially in areas where soil has been mismanaged. The addition of layers of biodegradable material is a form of composting which improves the quality of soil as well as its water holding capacity. An added benefit of trench beds is their durability as a trench bed can last for up to five years. Trench beds were chosen as one of the practices as they are cost effective and moderately labour intensive. Below is Mrs Zondi's Trench bed where she planted red lettuce, green pepper, leeks and marigolds.

Mrs Zondi's trench bed

(h) Shallow Trench

The shallow trench is similar to the trench bed but is dug 30 cm deep with alternating layers of grass and manure. It consists of less materials than the deep trench and in theory is 'less beneficial' than the deep trench in terms of improving soil fertility. In this case, the shallow trench was layered with dry straws, decaying grass material and goat manure instead of cattle manure which was used in the deep trench. The crops planted included kale, leeks, Chinese cabbage, parsley, marigolds and spinach, i.e. mainly green leafy vegetables.

Right and far right: Views of Mrs Zondi's shallow trench bed

According to Mrs Zondi this bed was by far the best in terms of crop growth and yield as she had already harvested kale and spinach twice in a space of five weeks and the vegetables were still growing. The fact that the grass was already decomposing when it was added might explain the rapid growth of the crops, coupled by the use of goat manure which is believed to contain more nitrogen than cattle manure. Parsley and leeks were overshadowed by the kale but appeared to be growing well nonetheless.

(i) Normal Raised bed

The normal raised bed is a raised bed with no composting material added**.** Benefits of the raised include increased aeration, reduced weeds, better water holding capacity and protection of crops from insects such as snails. Mrs Zondi planted turnips, leeks, marigolds on the normal raised bed, however the spacing was slightly wider than on the other two beds and some of the seedlings dried out. Crop growth was moderate when compared to the other two beds. Some of the bare soil on the raised bed was washed out when the rains came which made it appear flatter than when it was first made.

Right: Normal raised bed with no composting material added

(j) Control Plot

The control plot is the plot Mrs Zondi planted the way that she usually plants. It was planted on the ground. There was no composting material added. Crops planted include spinach, lettuce, leeks and kale. The crops were growing well however, some of the spinach and kale were damaged by cutworm. The control plot was planted two days after the treatment plots.

Right: Mrs Zondi's control plot – with no composting material added

(k) Herbs

Mixed cropping entails including different types of crops with the aim of increasing diversity and herbs were introduced for this reason. Herbs are easy to grow and contain a wide range of benefits which include acting as cures for various ailments, uses in condiments and various dishes and they also function as preservatives. Herbs are also great companion plants as some are natural insect repellents. The herbs planted in Mrs Zondi's garden include thyme, coriander and parsley. Some of the coriander was damaged by insects.

Right: Bed with herbs planted

(l) Eco-Circle

The eco-circle was planted by Mrs Zondi after seeing the demonstration. She planted spinach and beetroot. She made the eco-circle as she wanted to compare which practice would give her the best yield.

Right: Mrs ZOndi's eco-circle

(m) Conservation Agriculture

Field crops are an important part of Mrs Zondi's farming system as this is where she derives income. She started implementing CA in 2018 and is now in her second growing season. One of the biggest challenges with her soil is acidity and poor soil structure from years of erosion. She incorporated CA as an alternative to mono cropping and also with the hope of improving the condition of her soil. She planted two 200 m^2 plots of maize and beans this season. The plot that was previously intercropped with cowpeas appeared to be growing more vigorously than the plot that had maize and beans. However, the overall germination and growth of beans was poor. She will plant winter cover crops comprising of sodbuster radish, forage peas and black Sia oats in the blank spaces as a way to increase soil cover and improve soil fertility.

Right and Far right: CA Trial (left) maize and bean plot, (right) maize and bean plot which previously had cowpeas

Mrs Zondi selected practices that leaned more towards soil fertility, water conservation and crop management as these were the main areas where she identified issues. Moreover, practices selected were those that could easily be incorporated into her farming system. Below is a diagram of Mrs Zondi's farming system.

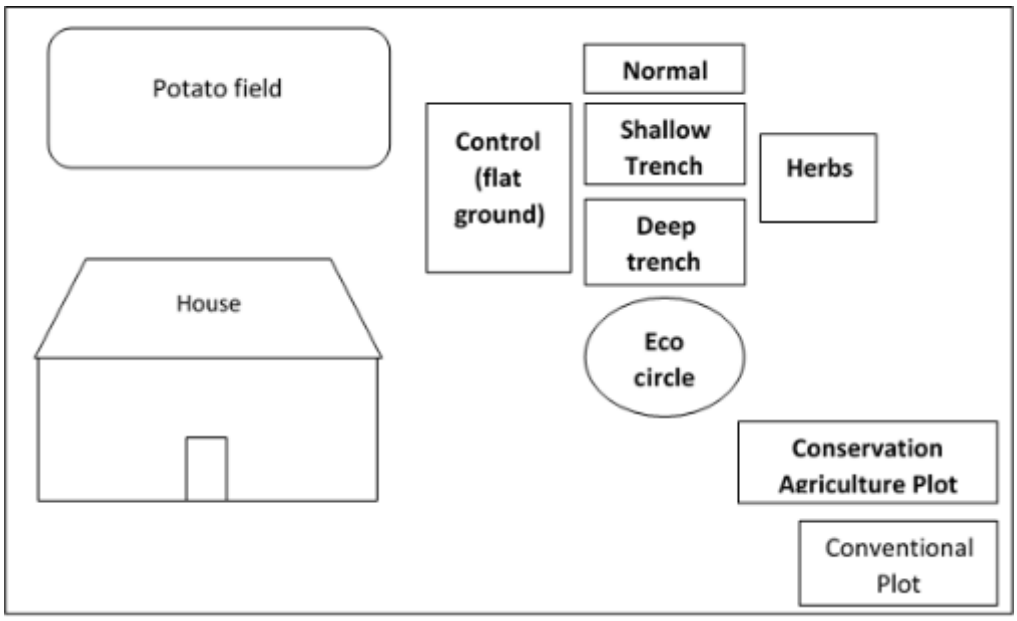


Figure 2: Layout of Mrs Zondi's farming system. (Climate Smart Agriculture (CSA) Practices implemented

2.2.4 **Additional Participants**

The participants were provided with some seedlings and seed to plant in their homestead garden. Mrs Rita Ngobese took some marigolds, thyme, parsley and basil to try out in her garden and they grew well. Two participants stated that their seedlings were damaged by pests. The rest of the participants that were also given seed said they will plant at the beginning of the winter season.

Right: Mrs Rita Ngobese's garden

Below is a small table summarising the different practices tried out in Swayimane

Table 6: CSA Practices and their relevance to water, soil fertility, crop management, livestock and natural resources

Name of Practice	Water	Soil Fertility/health	Crop Management	Livestock Management	Natural Resources
Tower Garden	✓	✓	✓		
Eco-circle	✓	✓	✓		
Shallow, deep, normal beds	✓	✓	✓		
Mixed Cropping	✓	✓	✓		
Conservation Agriculture	✓	✓	✓	✓	

2.3 **Ntabamhlophe (Estcourt-KZN)**

Written by Samukelisiwe Mkhize

Mahlathini Development Foundation is working with 23 participants from Emdwebu, Enkunzini and De Klerk villages in Ntabamhlophe, with Lindelwa Ndaba an agricultural development officer from Lima RDF who works with the farmers on a more regular basis, monitoring their garden practices and now assisting with CA 'maize and beans' crop growth monitoring. Conservation Agriculture was initially introduced through the WRC Climate change adaptation programme aimed at identifying best

practice options for Climate-smart agriculture practices as well as soil and water conservation for local smallholder farmers. Conservation Agriculture was chosen by the farmers as one of the practices to experiment with to overcome issues with soil erosion, increased prevalence of pests and diseases as well as seasonal shifts of rainfall and increased temperatures affecting not only agricultural production but household food security due to decreasing yield and crop growth potential. The farmers would experiment to assess how the soil cover, intercropping and minimum soil tillage would help to overcome these issues over time.

Ntabamhlophe is characterized by harsh winter conditions, very cold in winter and often affected by frost conditions limiting agriculture activity during winter months, the winter months are also characterized by limited rainfall. During this year's planting season, farmers have expressed that the dry and windy drought conditions within lesser rainfall than the past season has lessened maize crop growth potential and late January rains have revitalised the crops affected by excessive heat stress. However, farmers believed that late planting has minimised the sun damage during November and early December months. Nonetheless, this group of optimistic and passionate farmers, are glad the Conservation Agriculture programme began this season and eager to continue with in forthcoming seasons.
The table below serves to summarise the CA experimentation undertaken in Ntabamhlophe.

Table 7: CA experimentation undertaken in Ntabamhlophe in the 2018-2019 season

Village	Trial experiments	Trial size	Inputs provided	Participants who planted
Emdwebu (year 1) 14 participants	Maize and bean intercrop	100m^2	28 kg MAP, 6 kg PAN 53 maize seed, 7 kg uncertified 7 kg, beans seed, 2 bags of lime (100kg), 140 ml of decis	12
DeKlerk (year 1) 8 participants	Maize and bean intercrop	100m^2	16 kg MAP, 4 kg beans, 4 kg maize seed, 100kg of lime, 80ml decis	8

Participants received 500g of PAN 53 maize seed and 500g of an uncertified bean seed variety because PAN 148 or Gadra was unavailable locally. While the certified bean seed is not the generally supplied variety to farmers, the team relied on the local input suppliers' knowledge of its suitability to local conditions. During the monitoring process, it was great to see that the seed provided good germination and some canopy cover with a few of the participants, in its early growth stages. Most of the farmers had already planted traditional maize varieties in their fields and had space enough for one plot but they did express interest in expanding their experimental plots after seeing the results of this season's experimentation. Unfortunately, during monitoring of the demonstration plot the farmers expressed that this plot was taken over another farmer in the village and they could not continue there.

(a) Sibongile Zuma

Right: Mama Zuma standing in her maize and beans field.

Sibongile Zuma is 68 years old woman from De Klerk village. She is very passionate and hard-working, farming mainly farming vegetables and maize. She has a 1500m^2 field and 400m^2 garden where she plants her crops throughout the year. This season she planted traditional maize in her control plot and she intercropped PAN 53 maize seed and uncertified locally sourced beans seed on the 13th December provided by MDF on a 100m^2 trial plot without prior application of herbicide (**see pictures below**). She opened basins and furrows and applied micro-doses of MAP fertilizer with 50cm spacing between both her maize and beans. Her spacing is slightly more than what is recommended in order to develop a canopy cover during early growth stages. The maize germination percentage was 65% and grow stage at 4 and half weeks with 6 rows 10 metres long. She believes that the growth potential of her crops would have been much better if it were raining like past seasons, she hopes that once it starts raining and applies LAN fertilizer growth will improve. She has not applied LAN fertilizer yet because the soil has been dry because of the low rainfall in December and January. Beans germination at 60%, without any signs of wilting, yellowing or pest infestation. Crops are growing considerably well with in spite of this season's drought conditions with no weeds during monitoring. Before monitoring, she weeded once on 30th December and noticed a few weeks namely blackjack and couch grass.

Right: Close up views of the maize and bean intercropped CA plots

(b) Thabsile Mzolo

Thabsile Mzolo is a 65 year old woman living in Emdwebu with her 3 children and 3 siblings. She is unemployed and the head of the household. In her control plot she planted yellow maize on 7th November, maize has been affected by the hot and dry weather conditions during the critical growth stages during November and December Her trial looks good; she believes the reason is that it was planted later on the 14 December, without prior application of herbicide. It was good to see that like Sibongile Zuma's trial the uncertified bean variety has vigorous growth, despite slight prior concerns. She has 50cm spacing between her maize and 25cm beans. At the time of monitoring 6 weeks later, the maize germination percentage was 70% with 4 rows 11 metres long, showing good growth with no weeds. Beans germination at 70% without any signs of wilting, yellowing or pest infestation. She hand- weeded once, two weeks after planting, with mainly three types of weeds; couch grass, black jack and amaranthus.

Above left and Right: Thabisile Mzolo's CA maize and bean intercropped plot

(c) Gabisile Sithole

She is a 36 year- old woman living in Emdwebu village with 10 children and 2 adults who are all under her care. She works as an employee under a Department Public Works community work programme working on a temporary basis and is a member of a garden learning group experimenting with climate-smart practices. She sustains her family's livelihood by selling some of the vegetable and maize harvest to locals and keeps livestock (5 goats and 10 indigenous chickens) in case she needs to eat or sell them.

Her CA experiment is an intercrop of PAN 53 maize seed and uncertified locally sourced beans seed planted on the 20th December on a 100m^2 trial plot without prior application of herbicide. She used the same method of planting as the rest of the participants mentioned, except 60 spacing between her maize and 25 cm beans. The maize germination percentage was 60% at 5 weeks with 6 rows 10 metres long. Beans germination was 70% without any signs of yellowing or pest infestation. She weeded her trial once, noticing a few grass and amaranthus weeds. During monitoring there were no visible weeds.

Above left and right: Gabisile Sithole's CA plot of intercropped maize and beans

Above Left and Right: The garden in her homestead and learning group working together in the garden.

2.4 Alice/King Williams Town- EC

Written by Lawrence Sisitka

2.4.1 **Climatic Context and Farmer Participants**

The area in which the Eastern Cape group of farmers operates lies between Berlin in the east and Middledrift in the west and includes both peri-urban and rural situations. The climate is transitional between the summer rainfall and winter rainfall zones, and the weather is essentially quite unpredictable, with wide and rapid variations in temperature and precipitation, sometimes on a daily basis. The past few years have been characterised by long periods of drought broken by spells of sometimes heavy rain. This, together with the fact that the once fairly predictable spring rains have fallen later and later each year, arriving only in January this year, thus reducing the growing season considerably, has played havoc with normal planting and harvesting routines. These shifts in weather patterns have negatively affected basic food production to a major degree, with, for example, few households in the area able to guarantee their annual supply of maize, especially this year when the rains have come too late.

The Eastern Cape farmers participating in the WRC/CSA project are somewhat unusual in that they have, in most cases, long been involved in the implementation of agro-ecological practices. They have learned of these practices through their involvement in a number of initiatives and networks and with organisations with strong agro-ecological leanings. One of the key organisations operating in this area is the Zingisa Education Project, which works with farmers on a range of agro-ecological practices, from which they have learned the value of natural methods, such as the improvement of soil health through mulching and composting, and avoidance of inorganic fertilisers and pesticides. They have also long been practicing mixed and intercropping, and crop rotation. To this understanding has been added knowledge of the importance of efficient use of available water, especially rainwater. This was promoted through another WRC project; the Amanzi for Food Rainwater Harvesting and Conservation (RWH&C) project lead by the Environmental Learning Research Centre (ELRC) at Rhodes University. The farmers are also well connected through a range of networks, such as the Rural Women's Assembly (RWA), the African Centre for Biodiversity (ACB) and more recently the Imvotho Bubomi Learning Network (IBLN) of the Amanzi for Food project. They have therefore a strong tradition of sharing with and learning from each other. They are also very open to experimentation with different practices.

The introduction of CSA practices in such a context simply added to the farmers' already quite strong understanding of alternative, natural approaches to crop production and the rearing of livestock. Their main concern, given the unpredictability of the climate (see above), is to cushion their food production against the extremes of hot and cold, and wet and dry, and extend the growing season as much as possible.

While the already strong understanding of agro-ecological practices and willingness to experiment are very positive attributes in relation to the farmers' uptake of CSA practices, they also pose something of a problem in measuring changes in production in relation to specific practices. In other words, it is very hard for them to identify a 'before' CSA, as they have been using related practices for years in most cases. In addition, almost none of them have conducted any real quantitative measurements of production, either in terms of weight or in numbers of bunches or similar. Indications of increased production are therefore mostly anecdotal, and always tempered with the reality of the negative impacts of the recurring droughts, making year-on-year production comparisons impossible. However

they are all convinced that the agro-ecology related practices including CSA[1], have been beneficial to their farming and their productivity. Another area in which most farmers have been active is in trying different crops, including herbs, companion plants (such as marigolds) and 'exotic' crops such as okra and groundnuts.
For one respondent in particular, Edmore Parichi of the Zingisa Education Project in Berlin, the focus is on using the practices to train others rather than to actively produce (although there is real production), and no production comparisons have been possible.

2.4.2 **Individual Summaries**

There follow brief summaries of the key points raised by the farmers during the monitoring visits. Further details of the outputs from the visits are recorded in the Monitoring Report Forms, and, where appropriate, in the Resilience Snapshot worksheets.

(a) Ms Aviwe Biko

Ms Biko farms on 900m² of a cooperative irrigation venture situated by the Dimbaza dam. However the irrigation system was developed based on the use of a diesel pump to abstract the water from the dam, and for some time this has not been functional. Ms Biko is therefore reliant on the erratic rainfall for watering her crops. The 900m² is the area which she farms individually, and on which she conducts her agroecology practices. The 1ha collective farming area with which she is also involved is not included here. Ms Biko also has a 400m² homestead garden on which she runs her chickens as she explains: 'I can't run the chickens and the vegetables in the same area'.
Ms Biko uses only basic gardening equipment, but grows a wide range of crops, including most conventional vegetables together with okra, millet, groundnuts and brown rice; 9 types of herb; and wild olive, aloe and African tobacco for use in medicines and natural pesticides. She implements a variety of soil and water management practices, including composting, mulching, mixed cropping, green manures, crop rotation, raised beds, trench beds, tower garden, eco-circle and diversion furrows (the last 3 from the CSA project). She is also involved in seed saving (particularly indigenous maize and celery), and is a seed activist with the Rural Women's Assembly and the African Centre for Biodiversity (ACB). Ms Biko claims that apart from providing almost all the food needed by herself and her 2 children, together with other family members, she loves the physical activity f gardening, and would not like to be anywhere else. However she has recently been recruited as a TB counsellor (a post she has held previously) for an NGO operating in her area, and this, together with the drought has forced her to reduce the area she is cultivating.

[1] It should be noted here that CSA, and in particular the Conservation Agriculture (CA) component, are considered by many agro-ecologists the very antithesis of agro-ecology, as they condone, and even promote the use of inorganic herbicides in lieu of tillage.

Right: Ms Biko with her Millet

Far right:Ms Biko's Eco-circle and Diversion Furrow (lettuce, beetroot and onions had already been harvested)

Ms Biko is very concerned about the changes to the climate she is witnessing, and says that: 'It is disturbing nature'. It is also impacting on her garden and limiting the area that she can effectively manage. Her analysis of the impact of the various practices she is using is as follows (from the monitoring report):

Practice (what is there)	Diversification: Crops planted (livestock kept)	Productivity	Water use and conservation	Soil conservation, fertility, health
1.Raised beds	No real impact on diversity	Limited impact on productivity	Tend to dry out so not good for water conservation	No real impact here
2.Trench beds	Allow for some diversification	Increases this	Good for this	Very good for this
3.Tower garden	Some diversification	Can be very productive in small space	Probably requires more water	Depends on how it is constructed
4.Eco-circle	Some diversity possible	Very productive	Efficient use of water	Good for fertility and soil health
5.Diversion Furrow	No real impact	Helps with this	A key practice for this	Probably not much impact, although reduces drying out
6.Composting	Allows for diversity	Essential for this	Very helpful here	Great for the soil
7.Mulching	Some impact on diversity	Certainly good for productivity	Saves a lot of water	Good for the soil
8.Mixed cropping and crop rotation	Strong focus on diversity	Increases productivity	No real impact here	Should help the soil
9. Seed saving	Part of diversity	Not really	No	No real impact

10.Natural pesticides	Increases diversity by use of companion plants	Should increase productivity	No real impact	Probably helps with healthy soil

Ms Biko is the only farmer in this group who has clear quantitative data on production of some crops. This is, she says, because of the various agro-ecological practices she has been able to produce enough to secure a contract with a local Boxer supermarket to provide 100 bunches of spinach (@R12/bunch) for every month from October to January, and 100 bunches (approx. 1kg each) of beetroot (@R12/bunch) per month throughout the year. She also supplies 'an Indian shop' with bunches of coriander @R10/bunch, throughout the year. The money from these sales and the sales of a few eggs go into a savings account.

As with all other farmers in this group, Ms Biko is very keen on both learning from others, including her fellow farmers, and sharing whatever understanding she has with others. These included her local community, local schools and the clinic at which she is now working.

Although she is generally of a positive disposition, Ms Biko says that the implementation of the agro-ecology practices, including the CSA practices, together with her interactions with other farmers, and people from the various projects and institutions has strengthened her mindset, which is now more positive despite the ongoing challenges presented by life and the weather.

(b) Nomasomi Mjacu

Ms Mjacu is mostly unemployed although receives a small stipend from an NGO for whom she does occasional training. She is completely passionate about agro-ecology and implements a wide range of practices on a large, 1500m², plot close to her family homestead in Quzini. She says that gardening makes her feel; complete and that: "…a day without working in the garden is not a real day".

She works with just basic gardening equipment augmented occasionally by drip irrigation pipes, and 2litere bottles for drip irrigation. She has her 'office' in the garden where she does her teaching, especially with learners from the local primary school.

Right: Ms Mjacu in her 'Office' (Her family homestead and kraal in the background)

Ms Mjacu grows a very wide variety of vegetable and herbs, some 30 different types in total, although they are not always present at the same time. She also has a few chickens and has recently acquired

a beehive, which is situated at some distance from the garden in a clump of bushes. She has not harvested any honey to date, but expects to do so before the winter sets in.

Right: Ms Mjacu's Beehive

Ms Mjacu implements a range of practices, but tends to focus on raised beds in a variety of shapes, including the 'Mandela Bed' in the shape of an M. There are also deep trenches and diversion furrows in her garden. Soil improvement is through the use of kraal manure, mostly from her chickens and the neighbour's cattle, compost, and the use of dry grass for mulching. She says that everyone knows she likes to have this grass, and when they are cutting they bring it to her. In addition Ms Mjacu practices mixed cropping, crop rotation the use of natural pesticides and seed saving. She is a seed saving trainer for Zingisa Education Project. Her analysis of the impact of the various practices is as follows:

Practice (what is there)	Diversification: Crops planted (livestock kept)	Productivity	Water use and conservation	Soil conservation, fertility, health
1.Composting and mulching	Possible helps a bit with diversity	Increases productivity	Essential for efficient water use	Great for soil fertility and health
2. Raised beds	Don't really make much different here	Not necessarily	Can actually be worse for this as they dry out easily	Probably easier to manage with compost and mulch, so might help here
3. Trench beds	Provide opportunity for more diversity	Definitely increase this	Make good use of available water	Great for this
4.Drip irrigation	Not really	Probably, but on limited scale	Efficient and effective use	Stops erosion
5.Diversion furrows	Not directly	Probably but hard to quantify	Makes more water available	Can avoid erosion in some areas
6.Mixed cropping and crop rotation	Definitely increases diversity	Good increase	Probably not much effect on this	Helps keep soil fertile and healthy
7.Natural pesticides	Allows for greater diversity	Almost certainly	Little impact on this	Maybe some impact here?
8. Seed saving	Greater diversity of crop types	Maybe if they are more tolerant of the conditions	Not really	Possibly, not sure

Ms Mjacu has never really quantified the amount she grows, but claims that she doesn't need to buy much food, especially vegetables and she also provides the family with eggs and occasional chicken.

Her main problem is with water, and when there is a drought she has to reduce the area she cultivates so that she can use what little water she has more effectively. She does have a Jojo tank on her house, but that is used for domestic purposes as there is no connection to the municipal supply in her part of the village. She is negotiating with the municipality to clean out an old dam, and she plans then to run her drip irrigation system from that.

She is generally quite concerned about climate change and suggests that this is why she has had to reduce her cropping area, because of drought. She also says that animals, such as rats frogs and snakes cannot find food in the bush, so they move into the homesteads and cause trouble. The lack of water is also causing problems as children are developing rashes from the water brought by the municipal trucks

She has long been part of various networks, including the Zingisa project and the IBLN, and loves learning from other farmers and sharing her knowledge with them. She is particularly concerned with teaching young people about the importance of good farming, and runs workshops in her garden for local learners. She also learns from older ladies with older cultural practices, such as drying of traditional foods, which she is now starting to do. For Ms Mjacu, with her history of agro-ecological practices, the CSA ideas are not really new, but she is happy to incorporate them in her farming.
While usually a positive person, she is finding the ongoing drought quite a challenge, and is currently growing few vegetables. Her mindset has not really changed much since inaugurating the CSA practices.

(c) Phindiwe Msesiwe

Ms Msesiwe cultivates a very productive garden covering some 875m² at her homestead in Quzini. She is unemployed but keeps herself very busy with the garden, which she also says she loves, with her church and membership of numerous associations, such as the indigenous goat association and the IBLN. She has long been implementing agro-ecological practices and the new CSA practices she has introduced, including a tower garden, an ecocircle and diversion furrow, fit in well with her approach.

Ms Msesiwe practices soil management through deep trenching, composting and mulching, with mixed cropping and crop rotation to control pests. Her membership of the IBLN has motivated her to introduce more water conservation practices, including drip irrigation. She harvests water from her roof, although does also have a municipal supply in the house. Some of the beds are irrigated using 2 litre drip bottles, while others are irrigated using buckets. Ms Msesiwe also practices green manuring using legumes, and has a range of different bed designs, including raised beds and trench beds. She makes compost, which is augmented by the manure from the livestock, all of which are kept in pens, with only the chickens allowed to roam freely for part of each day.

As with the other farmers in the group Ms Msesiwe grows a wide range of vegetables and herbs, and some plants such as aloe, wormwood and wild garlic for pest control. She also has a range of fruit, including strawberries, bananas, apricot, peaches, oranges, apples and figs.

She has a small pond, fed by a diversion furrow, and has recently erected a shade-cloth tunnel, which she uses as her nursery and to grow a variety of different lettuce types.

Right: Ms Msesiwe's pond, banana plant and shade-cloth enclosure

Ms Msesiwe has a range of livestock, including chickens, goats and pigs, and these with the vegetables produce most of the food needed by the family. She makes a small income from occasional sales of vegetables and other produce, although she did not quantify this. She is also involved in running a soup kitchen for the elderly people in the village, and uses much of her own produce for this.

Ms Msesiwe's analysis of the impact of the various practices is as follows:

Practice (what is there)	Diversification: Crops planted (livestock kept)	Productivity	Water use and conservation	Soil conservation, fertility, health
1.Composting	Helps with this	Increases productivity	Can save a bit on water	Improves fertility and soil health
2.Mulching	Can help with this	Increases productivity	Saves water	Also improves fertility
3.Trench beds	Good for diversity	Increases productivity	Uses water well	Good for fertility and soil health
4.Raised beds	Not much difference	About the same	Can dry out too much	No real effect on this
5.Tower Garden	Can help here	Increases productivity	Can dry out, needs quite a lot of water	Can create good soil
6.Eco-circle	Provides opportunity for this	Very productive	Holds water well	Makes good soil
7.Small dam	No direct impact	Can help with productivity	Useful source of extra water	No real impact here
8.Diversion furrow	No direct impact	Can help	Brings extra water in	No direct impact
9. Drip irrigation	Not really	Can increase productivity	Effective use of limited water	No real impact
10.Natural Pesticides	Provides more diversity	Helps increase this	No obvious impact	Avoids poisoning the soil
11. Greywater	Just helps a little with watering	Possibly helps with this	Certainly helps here	Not much impact

As a member of many different associations and networks, Ms Msesiwe is constantly learning from others and sharing her understanding with them. She is a passionate educator about the value of good farming, and about doing the physical work herself. Her understanding of climate change is quite

sophisticated and she agrees with the other famers that the main problem is the rains coming late, and then being very unpredictable. She is also concerned that the wild insects and animals are coming more into the homesteads and becoming pests. She cites the example of ants now being in the house constantly, and how she needs to keep everything very clean and food locked away, in the fridge if possible to keep the ants out of it.

Generally a very positive person, Ms Msesiwe has found her confidence growing with her interactions with different farmers, associations and networks, and says that she is much more positive then before she started on her agro-ecology journey.

Right:Ms Msesiwe's Ecocircle, Bottle circle and Tower garden

(d) Tshembela Nadathini

Ms Nadathini is employed in the Zingisa offices for 2 days each week, and from there has learned many agro-ecological practices which she has implemented in her 400m² garden in uMzantsi near Dimbaza. She has always been keen to try new ideas, particularly ones that might help her use the little water she has more efficiently. She would like to install a Jojo tank to collect her roof water, but the costs of the tank and the associated guttering and piping are beyond her reach.

Using just basic gardening tools Ms Nadathini grows a variety of the usual vegetables, together with some herbs including mint and thyme, and pest control plants, such as wild garlic, comfrey, marigold and aloe. She uses sunlight soap to control aphids, and ashes for slugs. The garden also contains an apple tree, an apricot tree, and an orange tree which has not yet produced fruit. She also keeps a few chicken (4 at present), and 1 pig. The pig is permanently penned but the chicken roam freely. The pig manure is used to augment the compost she makes, and is also used directly in the soil.

As her garden is on a slope, Ms Nadathini has put in some contour bunds to prevent soil erosion and reduce water run-off. She employs a range of practices, including mixed and inter-cropping, composting and mulching, all of which she claims enable her to grow some vegetables year-round, which she was not able to do before implementing these practices.
The majority of the produce is consumed by the family, and she also gives or exchanges some vegetables with her neighbours, and very occasionally sells a bunch of spinach or a cabbage. She is very pleased that the garden helps reduce the family's food costs, and she also really enjoys the physical exercise involved in the gardening.

Ms Nadathini's analysis of the impact of the various practices is as follows:

Practice (what is there)	Diversification: Crops planted (livestock kept)	Productivity	Water use and conservation	Soil conservation, fertility, health
1. **Contour bunds**	No real impact	Probable increase, but not quantified	Reduces run-off	Stops loss of soil through erosion
2.Composting and mulching	Enables greater diversification of crops	Certainly increases productivity	Reduces loss of water and need for watering	Increases fertility
3.Natural pesticides	Part of pest control is intercropping, so greater diversity	Reduces losses	No real impact	Probably little impact
4. Intercropping and crop rotation	Greater crop diversity	Increased productivity	Little impact	Reduces loss of fertility

Right:Ms Nadathini by one of her contoured beds

Ms Nadathini first learned gardening from her mother, but says it was very different then, when the garden had to be kept very clean and neat and everything such as the weeds and crop residues were thrown away, and you could only grow 1 crop in a bed. She says it was quite hard for her at first to do things differently, mixing her planting, using all the weeds and crop residues for compost, and not minding too much if the garden didn't look as neat. She shares what she is learning with others, and wanted her church to set up a garden like hers, but she says that: "They thought that it would be too much hard work, and didn't want to do that."

She realises that there are changes in the way the weather operates, with the rains coming late, and being much more unpredictable. There also seem to be more very hot days. She pointed out that after a long period of drought, followed by some rain, her apple tree had produced some blossoms, probably as a result of it thinking that it was spring. This was an interesting observation, which has bene reinforced in other places, and by the sight of jacaranda blooms in the late summer.

Right:Ms Nadathini's Apple tree blossoming in March

Me Nadathini feels that her mindset is more positive than before she started working with the agroecology and CSA practices, although she would feel better if she could afford the Jojo tank.

(e) Mr Edmore Parichi for Zingisa Education Project

Mr Parichi is a training co-ordinator for the Eastern Cape section of the Zingisa Education Project, and the garden he manages in Berlin is essentially a training site for agro-ecology practices. As such he is not a farmer in the conventional sense, and is not growing crops for his own or his family's consumption, or for sale, but rather as training demonstrations and practical exercises. The team he leads comprises 6 staff, including administrative and cleaning staff and 4 interns from Fort Cox Agricultural and Forestry Training Institute. The garden covers 0.9ha and includes a wide range of different practices including trench beds, raised beds, minimum tillage, composting, mulching, mixed cropping, crop rotation, use of natural pesticides, water harvesting and seed saving (beans, maize and herbs). Many of the other farmers in the CSA group have received training through Zingisa, and their practices reflect what they have learned here.

A wide range of vegetables are grown, including some less common types such as watermelon, okra and sweet potato. Various herbs, including mint and thyme, together with plants used for natural pest control such as wild garlic, comfrey (also as a soil conditioner), and wormwood. Fruit includes pomegranate, guava, peach and orange. Vetch is grown as a leguminous cover crop. No livestock is raised. In addition to the usual basic gardening equipment they have hosepipes, a shade-cloth nursery, a shade-cloth tunnel, a raingauge, a drip irrigation container and pipes, and 3 soil water testing chameleons (the last 5 items as part of the CSA project experimentation).

Mr Parichi admits that the initial experiments set up for the CSA project were not successful, primarily, he says, as there was initially trouble sending the chameleon data to the centre in Pietermaritzburg. Then they were not provided with sufficient data for the smart-phone to send the information, and finally the intern responsible for this activity has left. There is now another inter who will be with Zingisa for 18 months, who will be taking this over. A second experiment has been set up with comparative trench beds, one inside and one outside the shade-cloth tunnel planted with broccoli at the same spacing on the same day. It is intended to measure the production of these beds carefully.

The drip-irrigation experiment has been provisionally abandoned as it is intended to extend the area under irrigation, and this will require a larger container, set higher from the ground, and extensions to the pipes. Once again it is intended to compare production on this to a control plot.

Right: Temporarily abandoned drip irrigation experiment at Zingisa

Far Right: Broccoli planted on comparative beds (one inside shade-cloth tunnel) with chameleons

With regards to the chameleons it appears that while these were read regularly (although most data could not be sent through to the central computer) the information from them as not really used to determine the levels of watering required, as this was determined through the more conventional process of just looking at the plants and at the soil.

Despite this faltering start with the CSA experimentation it is intended to pick this up and conduct some rigorous experiments comparing shade-cloth and non-shade-cloth; trench beds and normal beds; drip irrigation and normal watering.

Mr Parichi's analysis of the impacts of the practices which they are implementing are as follows:

Practice (what is there)	Diversification: Crops planted (livestock kept)	Productivity	Water use and conservation	Soil conservation, fertility, health
1. Trench beds	Can increase potential for diversity	Increase	Help with this	Good for this
2. Raised beds	No real impact	Not necessarily	Can be counter-productive (drying out)	No real impact
3. Minimum tillage	Some potential for increased diversity	In the longer term perhaps	Should certainly help with this	Definitely beneficial here
4. Composting	Can help here	Definite increase	Certainly helps	Very good impact
5. Mulching	Some increase possible	Definite increase	Very useful	Good impact
6. Mixed cropping and crop rotation	Increases diversity	Definite increase	No real direct impact	Helps with soil health
7. Water harvesting (tanks, drums etc.)	More potential for diversity	Certainly helps	Very important	No direct impact
8. Natural pesticides	Requires greater diversity	Positive impact	Not really	Stops poisons in the soil
9. Seed saving and propagation	Can lead to greater diversity	Not directly, but encourages more production	No direct impact	No direct impact

As a training organisation Zingisa's mandate is to share information with farmers, and this is the main focus of Mr Parichi's work. They also share through various networks such as the IBLN and Ilizwi Lamafama, and are linked to more national and regional networks including Rural Women's Assembly and he African Centre for Biodiversity.

Climate change is seen as a reality, with one of the main effects being a shortening of the growing season, through the late arrival of the spring rains. Mr Parichi suggests that growing short-season varieties, for crops such as maize, may be part of the solution, however he cautions that these are often lower-yielding than conventional full-season varieties. Zingisa's approach is very much that good agro-ecological practices are in themselves more robust and adaptable than the conventional commercial approaches, and should help farmers be more resilient in the face of changing climatic conditions.

(f) Xolisa Dwane for the Mxumbu Youth Co-operative

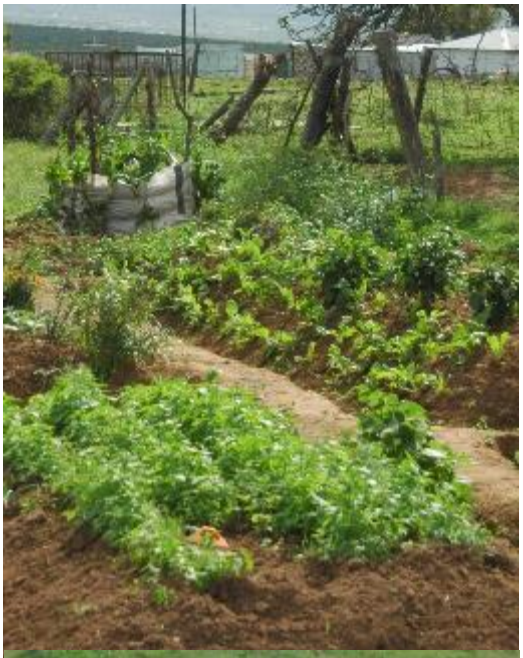
Mxumbu Youth Group started up in 2015 with 21 members. Currently there are 9 active members. They started with a clean slate of having no land at all under cultivation, but since them they have brought 2ha of vegetable garden associated with different homesteads (although most is connected to Mr Dwane's home) under cultivation. They have also negotiated with the local leadership access to 14.2ha of commonage, previously terraced under the homeland 'betterment programme', of which they have so far planted some 2ha. They are avowedly commercial in intent, and are determined to make a successful business out of their farming activities. In addition, they are already involved in training people in other communities, for which they sometimes receive payment.

Although the group is relatively new to farming, they have learned a great deal from other farmers, the Zingisa Education Project and other NGOs including World Vision, and the IBLN network. Their approach from the beginning has therefore been inclined towards agro-ecological and water conservation practices, and they are always keen to experiment with new practices and new crops. Their association with the CSA project is therefore a natural extension of this, and they have wholeheartedly taken up some CSA practices.

In the garden area they grow a large variety of mostly conventional vegetables, but also a range of herbs and pest control plants, and some peaches and bananas. These are grown under a range of different practices, including trench beds, tower garden, circles, no-till (CSA), tied ridges (CSA), trickle irrigation and furrow irrigation (CSA). Mulching and composting are practiced as standard across the garden.

Mr Dwane, himself raises numbers of livestock with other members of his family. The livestock currently include 33 goats, 11 chicken, 4 sheep and 1 pig, all of which are in pens or 'hocks' with the goats and sheep grazing on the commonage during the day. At one time Mr Dwane and another Mxumbu member tried to set up a more intensive chicken rearing business, but the cost of food, and losses to disease defeated this attempt. They are, however, determined to learn from this experience and try again.

They sell produce almost continuously from the garden, especially spinach, beans, green peppers and carrots. They also have a growing market for onion seed and other seeds which they have started saving. They are also looking for a market for some of the herbs which are growing profusely.



Right: Mxumbu Youth Group: Rocket (in foreground), spinach and green pepper plants on raised beds with tower garden in background

In the cropland they prepared contour ridges on which they planted a range of crops: maize (which failed entirely due to a long drought following the planting); beans (which did produce a small amount to sell); pumpkin and butternut (which also managed to produce some saleable produce); and watermelon (which somewhat surprisingly was the most successful crop and has produced a large number of watermelons the sale of which they are negotiating). Their lesson from this experience is that multi-cropping is likely to be more effective than mono-cropping in these difficult circumstances, as, had they only planted maize, they would have had nothing.

Right: Mr Dwane with watermelon dominating the cropland

Mr Dwane's analysis of the impact of their practices is as follows:

Practice (what is there)	Diversification: Crops planted (livestock kept)	Productivity	Water use and conservation	Soil conservation, fertility, health
1.Mulching	Use on all crops	Increases productivity	Saves water	Improves soil
2.Composting	In garden for trench beds and others	Good for productivity	Holds water in the ground, so save water	Improves soil
3.Ridges/furrows	Used in garden and in field	Not sure, but helps with intercropping and irrigation	Helps with irrigation	Not sure
4.Trench beds	Can plant good diversity	Definitely good for productivity	Helps with this	Very good for fertility and health

5.Circles	Also good for diversity	Produce a lot in small space	Good for this	Certainly helps with soil fertility
6.Tower Garden	Can plant a lot in small space	Good productivity in beginning	Needs a lot of water	Not sure
7. Raised beds	Little impact on this	Little increase, but easier to work	Dries out quickly	Not on its own – needs composting and mulching
8. No Till	No impact	Not sure	Possibly	Probably
9.Mixed cropping	Greater diversity including herbs	Increases productivity	Maybe takes more water, but keeps ground covered	Might help
10.Crop rotation	Not much impact here	Should increase productivity as reduces pests	Probably not much impact	Should help especially with green manures
11.Natural pesticides	No impact	Should help here	No impact	Should help

To date the Group have not kept records of production or sales, but Mr Dwane realises that this is something they will need to do if they wish to become fully professional in their farming activities. All they can say at the moment is that they are constantly increasing production, and now producing and selling year-round. This is perhaps mostly due to their diligence and energy together with their adoption of appropriate and effective farming practices.

The Mxumbu Youth Group are deeply involved in both learning themselves, from anyone who is willing to share their knowledge, and teaching and motivating others, particularly youth from other communities. They are linked through most of the networks in their immediate area, and are branching out to provide support in other areas.

In terms of understanding climate change and its implications; Mr Dwane and the other Mxumbu Youth Group members have gained considerable understanding from their networks and various initiatives, such as the WRC Amanzi for Food and CSA projects, with which they are involved. Their main concern, as with the other farmers, is that the rains are coming later, shortening the growing season, especially for maize, which is the most important staple crop. They believe that the agro-ecological practices which they are implementing will help them withstand many of the impacts of climate change.

Mr Dwane himself has a very positive approach to everything he does, and this remains undimmed despite challenges with drought and some difficulties in marketing some produce.

2.5 Eqeleni and Ezibomvini- Bergville-KZN

Written by Samukelisiwe Mkhize

2.5.1 **Participatory Monitoring and Evaluation Process**

The project aims to assist farmers in making decisions with their farming systems and to evaluate and identify best practice options for Climate Smart Agriculture. The monitoring approach involves farmers in a cyclical learning process; to provide for meaningful participation of farmers in the process of investigating improvements in water and soil management in both garden and field farming activities.

This involves involving taking experimental actions, observing and continuously reflecting on changes taking place in their garden and field experiments. This process has been emphasised during the monitoring process holding brief discussions in the field or garden about the importance of noting information such as pest and disease incidence, water usage, crop growth and harvesting.

It was then critical to explain to them that this is a learning process, it is not just for us but for them as well. This has been and continues to be reinforced through discussing what the data means with them, how its relevant to what they are doing as well as, validating their thoughts and observations by acting through experimentation.

This would not be possible without building trusting relationship with the farmers in which they felt open to be honest with us about all decisions they are making especially, water management. Farmers think that vegetable production requires a lot of water for crops to mature and grow quickly. This acts as a barrier in assisting farmers to develop into water managers. Farmers prefer to use their visual assessments of the soil moisture instead of the chameleons (visual decision support tool) with robot system (green, blue and red feedback signals.

Right: A chameleon installed in a gardening plot in Ezibomvini

In practice, the issue seems to be integrating technologies/practices with people, not just practices/technologies with the environment. Initially participants did not have a good understanding of the significance of this tool and the use of it was something too scientific for them. This led to participants not always using the chameleons themselves but instead asking other household members (younger) to assist with its use. The farmer was not using the chameleon signals to make water usage decisions. It was explained to the farmers that getting assistance is not wrong, but the issue is that the chameleons were not used for its intended purpose.

For this reason, an alternative measure had to be sought which included regular monitoring of data recorded and a workshop going through the theoretical and practical significance of the use of the chameleon devices. The role of the chameleons was also discussed as a device installed to enable them to make informed decisions regarding water usage and thereafter determine how much water is used, in chameleons installed both in the trench bed inside the tunnel and outside the tunnel.

Thereafter, the farmer should record water usage, harvesting data, pest and disease incidence and heat resistance of the outside tunnel production versus inside tunnel production. Following this a new data collection tool, discussed and agreed upon with the farmers, was devised to assist the farmer to have a more visual representation of the chameleon readings and relating this to water applied and produce harvested using a tally system. The tally system was specifically introduced to assist all the farmers, both literate and illiterate, to have a system to monitor these gardening practices. The role of local facilitators has also been illuminated, because the process relied on them to assist other members with the concise recording of data. We are working closely with this process and steadily making some progress.

Right: An example of the new monitoring form filled in by one of the farmer participants; which indicates watering, harvesting for each of the crops, the chameleon readings and a column for comments at the end

During the process, farmers are continually sharing their experiences, including pests and diseases issues with the team; what they think they are and the causes of the infestation. Phase two of the tunnel experiment included mix cropping of onions, green peppers and Chinese cabbage. According to the farmers, onions seedlings did not survive because the Chinese cabbage and green pepper tree leaves covered the onions seedlings preventing growth. The onions were out competed. Farmers also shared issues with pest and diseases specifically with Chinese cabbage. They believe that the infestation is caused by their soil type (clay).

Right: Small holes caused by pests feeding, with subsequent rotting of the stems, in Chinese Cabbage

The team shared that the reason could be that the hot and dry conditions of this past season did not favour the crop. During this upcoming cool season, we will repeat experimentation with the crop which is predominantly a cool season crop during this winter season.

2.5.2 **Water issues- Ezibomvini**

Farmers in the Ezibomvini village of Bergville encounter various issues in relation to water and accessibility where their predominant water source is local springs. These springs are usually quite far from their

homesteads and their use is shared with other people from the village as well as livestock.

Spring protection will enable farmers to have a secure and reliable water source which can help them to focus more on their gardening; which was previously not as widespread due to the unavailability of required water close by. This issue has been discussed in both Ezibomvini and Eqeleni. In the latter village not much momentum has been gained for participants to work together to solve their water issues locally.

A recent follow-up meeting was held with Ezibomvini farmers to discuss their commitment toward the implementation of the spring protection plan to allow for easier access of water at household level.

Farmers present at meeting Ezibomvini- 20 February 2019

Name	Surname
Nombono	Dladla
Mantombi	Mabizela
Cabangani	Hlongwane
Landiwe	Dlamini
Lungile	Sithole
Ntombenhle	Hlongwane
Halalisiwe	Mthonti
Phumelele	Hlongwane
Balungile	Mkhwanazi
Zodwa	Zikode

At the meeting the total cost of implementation and activities were outlined (as proposed by Chris Stimie after his visit to the area). Farmers felt that it would cost a lot, but that they would also be very willing to carry out some of the activities themselves (to reduce labour costs) and seek alternative assistance from local leadership (e.g. digging using –Tractor loader backhoes-TLB) in order to decrease the total costs. While there were other members not present at the meeting who would like to be involved in the process, the group present expressed that a total 10 households were committed to investing in this process and resolved to contribute R 1000.00 per household towards the materials required to protect the spring and connecting pipes.

Between our last meeting and the recent one, they dug up a small dam for a spring to feed into and attempted to channel that water with a furrow to one of the homesteads. Although this process did not work, they have decided that this particular spring would work better for their purposes and have also decided to have the main header tank at a different household to what originally discussed.

2.5.3 Tower Gardens

Tower gardens were introduced across three Bergville villages. These were demonstrated at Ezibomvini, Thamela and Emabunzini. The tower gardens were introduced primarily to out scale

climate smart agriculture practices with the aim to increase climate change adaptation. In each of the demonstrations a few participants from each learning group were present. It was important to use materials that are easily accessible as alternatives for recommended materials such as, sacks in place of shade netting. A practical approach was taken to introduce the practice; the farmer will now assess and manage the practice and report on its water management benefits etc. The participants are collecting materials for keyhole gardens to compare with the tower gardens.

Village and participant

Village	Participants name
Ezibomvini	Phumelele Hlongwane
Emabunzini	Valindaba Khumalo
Thamela	Constance Hlongwane

Materials:

- Soil, kraal manure (goats or cow manure), wood ash, dry grass, greens, 50 kg /80 kg sack, tin cut open on both sides and stones

Seedlings:

- Mustard spinach, regular spinach, kale, cabbage, parsley, spring onions, leeks and regular onions.

Step 1: Collection and mixing of materials

Step 2: Placed opened tin at centre of 50 kg bag & Fill open tin with stones


Step 3: Filled sides of bag with mix of materials and raise tin once the filling reaches top of the tin (repeat till bag is full, watering the bag at alternate layers)


Step 4: Open staggered holes on sides of sack, plant seedlings through the holes and/or on top of the sack



Step 5: Final product

2.5.4 Conservation Agriculture monitoring in Bergville

For the CA experimentation the bulk of field work and monitoring are conducted under the auspices of the Maize Trust Smallholder Farmer Innovation project. Here, we report some of the relevant monitoring information.

The table below outlines the villages, numbers of participants and experimentation processes for the present learning groups in the Bergville area.

Table 8: Activities and numbers of farmers involved, per village for October 2018-September 2019.

BERGVILLE				
Villages	**Learning group No**	**2017**	**2018 (planted)**	**COMMENTS**
Emabunzini	13 (4)	13	9	1st and 2nd level experimentation; intercropping
Emangweni-Engodini	13	16	5	1st and 2nd level experimentation; intercropping
Emangweni-Emaqeleni	13	14	1	1st and 2nd level experimentation; intercropping
Eqeleni	23	24	15	1st, 2nd , 3rd,4th, 5th level experimentation; intercropping, crop rotation, SCC
Ezimbovini	25	17	17	1st, 2nd , 3rd,4th, 5th level experimentation; intercropping, crop rotation, SCC
Magangangozi	23	21	6	1st and 2nd,3rd level experimentation; intercropping, ???
Mhlwazini	23	20	10	1st and 2nd,3rd level experimentation; intercropping, SCC
Ngoba	13	13	13	1st and 2nd,3rd level experimentation; intercropping, SCC

Nsuka-Zwelisha	11	4	3	1st and 2nd level experimentation; intercropping
Okhombe	23(7)	17	14	1st and 2nd level experimentation; intercropping
Stulwane	18	14	14	1st, 2nd , 3rd,4th, 5th level experimentation; intercropping, crop rotation, SCC, fodder crops
Stulwane (Emahlathini)	12	12	12	1st and 2nd level experimentation; intercropping
Thamela	16	13	13	1st and 2nd level experimentation; intercropping
Thunzini	26	17	13	1st and 2nd level experimentation; intercropping
Vimbukhalo	21	28	6	1st and 2nd level experimentation; intercropping
Ndunwana	25	20	17	1st and 2nd,3rd level experimentation; intercropping, SCC
Emazimbeni	22(3)	16	17	1st and 2nd,3rd level experimentation; intercropping, SCC
Emafefetheni	12		10	1st level experimentation; intercropping
Emadakaneni	12		10	1st level experimentation; intercropping
Grand Total	**286**	**279**	**205**	**15,2 ha trials;**

In this season, due to the localised drought in Bergville and the difficulties in procuring and delivering inputs 259 participants across 19 villages were provided with inputs for conducting farmer level trials. Of these 205 participants planted their trials. Of these 14 were new participants for the season 2018-2019.

(a) Progress snapshots

(i) Gravimetric soil water content assessment – soil sampling at Bergville

This season only one set of soil samples were taken for gravimetric soil water assessments, given the time- consuming nature of this activity. These samples would give an indication of soil water content at different depths (30cm, 60cm, 90cm and 120cm), at different stages of crop growth, during the season. Samples are taken at planting, 4-6 leaf stage, tussling and harvesting.

Samples were taken in Ezibomvini (Phumelele Hlongwane) at planting on the 7th of November 2018.

Above Left and Right: taking the gravimetric soil samples in Phumelele's CA trial plot

Below is Phumelele Hlongwane's 1000m^2 trial plot layouts(2018/2019) and points or plots where gravimetric sampling was done.

Plot 5 M	Plot 4 M+B	Plot 3 M+CP	Plot 2 M+CP	Plot 1 SCC
Plot 6 M+B	Plot 7 M+B	Plot 8 M+B	Plot 9 M	Plot 10 LAB LAB

(ii) Participatory monitoring

A total of 7 villages have rain gauges installed in their homesteads with the responsibility of recording of data entrusted upon the participants along with assistance from members where participants are illiterate.

In the previous season, participants did not record the rainfall data very well and in this season, they were provided with more in depth monitoring and assistance to do so. In Thamela the rain gauge was moved to a different homestead.

The table below indicates present homesteads where rain gauges have been installed.

Table 9*:* Rain gauge installation and member responsible for collection of data

Village	Name of participant	Person responsible for data collection
1. Ndunwana	Boniwe Hlatshwayo	Boniwe Hlatshwayo
2. Stulwane	Nelisiwe Msele	Nelisiwe Msele
3. Ezibomvini	Phumelele Hlongwane	Phumelele Hlongwane
4. Eqeleni	Ntombakhe Zikode	Cebisile Zikode
5. Emangweni	Thembisile Mazibuko	Thembisile Mazibuko
6. Thamela	Constance Hlongwane	Constance Hlongwane
7. Mhlwazini	Phumzile Zimba	Nompilo Zimba (Grand-daughter)

From the above table villages 1-4 also have runoff pans installed and the participants are also responsible for recording this data, as these two sets of data are directly related. It was stressed that after each rainfall event rain gauge and runoff data should be recorded together

.

Above Left: Thamela: Mam Constance Hlongwane orientated about reading rain gauge measurements. Above Middle and Right: Mam Phumelele Hlongwane from Ezibomvini taking run off pan measurements

In the installation of run off pans, attention needs to be given to the slope of the field in question; which should not be more than 5%. In addition, the pan itself needs to be level, to allow the un-off to drain properly into the catching bucket, installed underground below the pan.

Right: measuring the level of the run-off pan on installation

For each of the four participants a number of run-ff pans were installed. For example, 5 pans were installed for Nelisiwe Msele in Stulwane.

Plot 10 M+B	Plot 9 M+CP	Plot 8 BEANS	Plot 7 MAIZE	Plot 6 SCC

She has a 1000m^2 trial and a control plot of equal size the diagram below indicates the plots where run-off plots were installed.

Plot 1 M+CP	Plot 2 M+B	Plot 3 MAIZE	Plot 4 BEANS	Plot 5 MAIZE

Trial-1000m^2

Control plot 1000m^2

MAIZE

Boniwe Hlatshwayo in Ndunwana had two run-off pans installed; one in her CA trial plot and one in her control plot, as she is still in her 2nd-3rd year of experimentation with a 400m^2 trial plot.

Right: Installation of run-off pan in Boniwe's CA trial plot

Trial 400m^2

M+CP	M+B	M+CP	M+B

Control 400m^2

MAIZE

(iii) Rainfall and run-off data

The table below outlines the rainfall data kept by the volunteers nad Local facilitators in the 5 viallages. From this information, it is painfully obvius how little rain there has been for this growing season.

Table 10*:* Rainfall data recorded from rain gauges across five villages in Bergville 2018-2019

	Stulwane	Ndunwana	Ezibomvini	Eqeleni	Thamela
Month	**Rainfall (mm)**				
May-18	1	2			
Jun-18	4	3			
Jul-18	1	0			
Aug-18	8,4	9,2			
Sep-18	1,3	5,9	5,0		
Oct-18	3,3	2,6	6,0		
Nov-18	10,6	10,6	11,0	6,0	3,7
Dec-18	4,6	3,6	13,0	5,8	4,3
Jan-19	5,7	20,5	5,5	19,9	4,2
Feb-19	7,8	12,8	17,2	20,0	16,6
Total Nov-Feb	28,6	47,4	46,7	51,7	28,8

Total May-Feb	47,5	70,1			

Run-off data was also collected and these are summarised below.

Table 11: Run-off data collected for CA trial and control plots across five villages in Bergville; 2018-2019

	Stulwane		Ndunwana		Ezibomvini		Eqeleni	
	Runoff Trial(ml)	Runoff Contol (ml)	Runoff Trial(ml)	Runoff Contol (ml)	Runoff Trial(ml)	Runoff Contol (ml)	Runoff Trial(ml)	Runoff Contol (ml)
Nov-18					566	413		
Dec-18	663	379	11	7	13	10	593	710
Jan-19	2567	750	19	22	971	214	1000	1275
Feb-19	944	588	25	36	4190	6905	929	821
Total Nov-Feb	4173	1716	55	64	5174	7129	2521	2806

In general, the run-off from both the CA trial and the conventional control plots was extremely high for the amount of rainfall, although somewhat less for the CA trial plots in 3 of the 4 villages. This is quite different from the results obtained in previous years and points towards surface soil compaction or sealing, as a result of continued hot and dry conditions in the area.

(iv) Cover crops

Cover crops play an important role in the providing soil cover limiting the exposure of soils to weather extremes. They also contribute to improved soil health conditions in the soils. In the current 2018/2019 growing season a total of 61 participants in the programme are experimenting with summer cover crops across 9 of the villages in Bergville. Participants received a 5 mix of summer cover crops; sunflower, sunhemp, babala (millet), vetch and turnips while some received a 3 mix of sunflower, sunhemp and millet- all these at 250g per variety.

Table 12: Showing cover crop experimentation across Bergville villages

Village	Number of participants
Ezibomvini	07
Eqeleni	10
Stulwane	15
Vimbukhalo	10
Emazimbeni	06
Ndunwana	01
Thamela	04
Emabunzini	02
Ngoba	06
Total	**61**

(v) Crop growth monitoring

Fieldworkers and interns used the new e-survey format (in Pendragon) to do the crop growth monitoring and provided hard copies of the forms to the 3 local facilitators who are assisting in the monitoring this season.

Thus far 61 crop growth monitoring forms have been completed across 13 villages. A sample of participants in each village was used (between 3-7 per village.

(vi) CA trial information

- **Average residue cover** is around 9,5% for participants from 1st-6th year of implementation. This is quite low, given the ubiquitous practice of livestock grazing stover in the winter months. The percentage residue cover ranges from 0%-30% and depends more on the dedication and attention given by the individual farmer than on the years of implementation.

Right: Nombono Dladla from Ezibomvini(3rd yr) with around 30% residue cover. Nombono is trying out the Haraka planter and Far Right: Dudu Ndlovu from Emafefeteni (1st yr) with 55 residue cover. The heat stress in her maize is visible here

- **Average germination of crops** this season was only around 66% and canopy cover at about 2,5 months after planting only around 20% on average. This attests to the extreme conditions in this cropping season;

Above Left: Phumelele Hlongwane's crop growth in mid- January 2017 compared to Right: Phumelele Hlongwane's trial growth in mid- January 2019. She is one of the most dedicated farmers. The extreme heat and drought at the beginning of the season has reduced her crop growth considerably.

Right and far Right: crops for Bangeni and Zweni Ndaba respectively from Emazimbeni (Loskop area), also showing signs of heat and drought stress.

Right and far right; Maize growth for Khishiwe Cebekhulu and Nomavila Ndaba in Eqeleni recovered somewhat in January, although the patchy germination is evident from earlier drought stress. This kind of recovery appears to be localised as rainfall differs somewhat across villages.

2.5.5 **Fodder production experimentation process in Stulwane, Eqeleni and Ezimbovini**

This season a number of participants decided to plant small plots of different kinds of livestock fodder; including Teff, turnips, lab-lab beans (Dolichos) white and red clover and Lucerne.

Replanting of plots was done in January 2019, after complete crop failure from the November planting due to drought and heat. Some success with growing of Teff was reported- the other crops again failed to germinate.

Right: A few white clover plants germinated and Far Right; a respectable looking patch of Teff grass growing in Mtholeni Dlamini's fodder trial plots

(a) Fodder and supplementation learning workshop

A learning workshop on fodder, supplementation and hay making was held on the 10th of April for the livestock interest group from these three villages (26 participants).

Topics covered:

- Why are livestock thin in winter and why does it matter
- What to feed and how much
- Supplementation
- How can we tell if it's making a difference (rating sheet)
- Making hay
- Experimentation
-

Why is extra fodder and supplementation important

Loss of weight in livestock caused by lack of grazing, but also presence of parasites and diseases. In winter the sour veld areas (high elevation, high rainfall, cold winters) the grass is not nutritious in winter as the grasses draw the nutrients into their roots for the winter period – there is no protein in the grass. Also, milk cows such as Jerseys are not well adapted to grazing on veld and will not do well. Bulls and oxen are generally fatter then the cows.

Thin cows can't be sold, have difficulty getting pregnant and lose their calves. They are more prone to diseases and die easily.

Nutrition for livestock

- Feed a protein supplement
- Make sure there is grass/ hay
- Deworm before winter
- Wean the big calves
- Plant fodder
- Target the animals that need food

The major issue in winter, or more generally is protein. Carbohydrates can be found in grass and maize. The type of grass makes a difference; Themida (Rooigrass) is good, other grasses such as Ngongoni (Aristida), Mtshiki and Uqunga are not very palatable.

Urea supplementation; Premix 450, Voermol LS33 and protein licks. One is a powder supplementing the fodder livestock re given, the other is a liquid that is mixed with feed.
When using these supplements it is important that they do not get wet- as the urea will dissolve in the water and if cattle drink this they can die from it.

Supplements

Supplement type	Quantity	Cost
Premix 450 (powder)	1-2 cups/day mixed with the fodder	R230/50kg
Voermol LS 33 (liquid)	2 cups with 2 cups water mixed with 20kg of hay will feed 4 animals for one day. This needs to be repeated every day – as the urea evaporates	R160/20l
Protein block	1 block/ cow (for 3 months). Or 1 block/week for 20 cattle. Generally they are put in the kraal, but it is difficult to ensure younger animals also get access	R150/25kg
(Molasses meal – just sugar, no protein)		

Fodder crops and Making hay
Grass needs to be cut while it is green (and high in nutrients) and dried quickly, so that it doesn't get mouldy. For the fodder high in nitrogen such as Lucerne – it needs a long time to dry as the stalks are quite tough. When grazing Lucerne, it can only be done for an hour or so in a day. If they get too much the livestock will bloat.
Participants were adamant that they could v=cut the grass using sickles and did not feel the need to have brush cutters for this purpose.

With all the fodder crops, it is better to grow these in summer and keep for winter. One needs to cut them before they seed to ensure the highest level of nutrients in the fodder.

Teff; grows fast and is better for baling than grazing, as it is quite soft and gest easily trampled by the livestock. Teff can regrow in the same place if left to seed. If it is cut at the right time, it is good quality fodder and doesn't need the LS33.

Ryegrass; this is what dairy farmers grow in winter – but it would need irrigation. There are annual and perennial ryegrass species

Oats; this is much easier to grow than ryegrass and is a better fodder
Clover, vetch; Normally these are mixed with grass species – so that it can be grazed safely. Vetch comes back year after year and stays green in winter. It can be a bit difficult to establish and also is difficult to plough into

Crop residues; such as maize and bean stover. These are improved by addition of LS33

Japanese radish/ fodder radish/ turnips; Good fodder

The small table below outlines the nutritional value of common fodder

Fodder type	% protein	% Fibre
Maize grain	1-10	8
Mazie stover	5	42
Kikuyu	10-17	33
Eragrostis hay	6-18	40
Oats (pasture)	12	35
Fodder turnip leaves Roots	15-25 9-16	23 9
Vetch	20	25

Fibre intake should be as low as possible

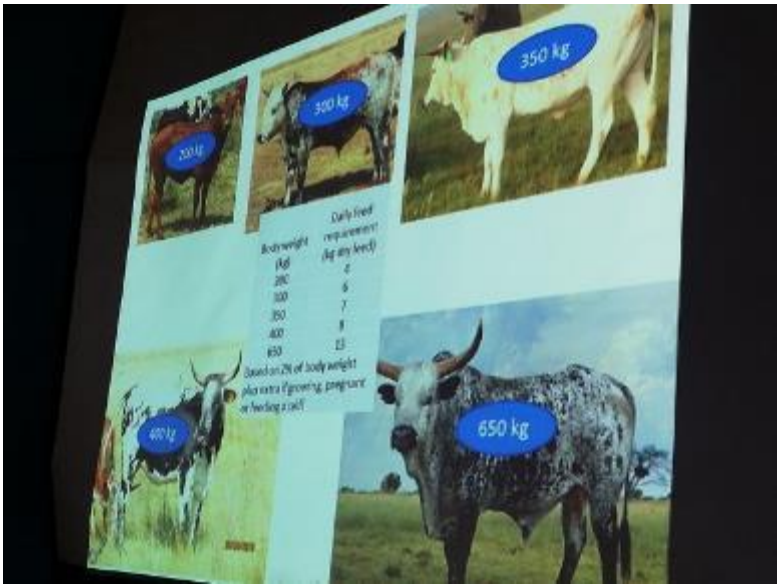
Adult cattle need > 8% protein in their feed If it is < 8%, then add the LS 33.

Maize grain is high in energy – so it is good for young and growing animals. The grain should be fed with Premix450 or LS 33.

How much feed is required

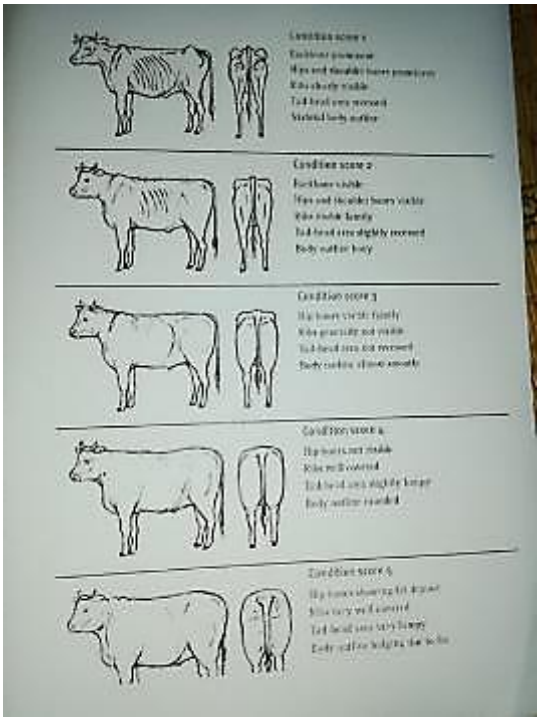
This is worked out as 2% of body weight of the animal, for dry feed. Wet feed is x5 more

Body weight (Kg)	Dry feed (kg)
200	4
300	6
350	7
400	8
650	13



Condition scoring

This is an easy way to check how well the supplementation and feeding is working. The score sheet provides an indication and is used to compare cows that are being feed and given supplements, with those that are not.



Baling of hay

Brigid Letty from the INR, assisted by providing a home-made manual baler to the learning group for experimentation purposes. A second one is available. They are easy to construct and can be made locally. The men in Stulwane have undertaken to make their own balers; materials and tools can be provided for this.

Experimentation

MAKING BALES: 2 bales/week/ cow; thus around 20-30 bales for each cow (June, July, August). 3x50kg bags of grass makes one bale.

Right and Far right – making a bale of hay – the baler basically compresses the grass into a block with the tying twine in place. Once compressed, there is a 'door' at the front and the bale is removed through the door.

Experiment	Names	Comments
Bales with LS33	Mtholeni Dlamini Delzakhe Hlongwane Simon Dlamini Khulekani Dladla Phumelele Hlongwane Ntombakhe Zikode	June; Buy premix, LS 33 and blocks and supplement with veld. Start feeding bales in July July- August – bales +LS 33.
Bales with Premix 450	Mtholeni Dlamini Delzakhe Hlongwane Simon (Thulani) Dlamini Khulekani Dladla Phumelele Hlongwane Ntombakhe Zikode	

Teff Bales	Ntombakhe Zikode Mtholeni Dlamini	Baling of the Teff they have grown
Residue with LS33	Thulani Dlamini Khulekani Dladla Phumelele Hlongwane(maize and bean stover mixed)	Maize stover
Veld with protein blocks	Lungile Dladla Matholozane Gumbi Zodwa Zikode Phasazile Sithebe	
Veld with Premix 450	Ntobmi Dlamini Fikile Hltashwayo Hlupizile Zondi Thulile Zikode Hlanganise Hlongwane Phumelele Hlongwane	

Participants undertook to do the following:

- Collect monies for the supplements
- And have these supplements, as well as rolls of twine for the bales available through the farmer centres
- Set up and participate in condition scoring days for the livestock; the first one in mid-End June
- Ensure that they have a viable experiment; cattle in the experiment and cattle not in the experiment.

2.6 Sedawa, Turkey, Mametja - Limpopo

Written by Erna Kruger and Betty Maimela

Most of the fieldwork and monitoring are conducted under the AWARD AgriSi programme. Below a snapshot is provided of some of the CCA related aspects pertinent to this process.

Learning processes conducted are summarised in the table below.

Table 13*:* Summary of learning sessions conducted: January-April 2019

Turkey 1 and 2, Sedawa, Mametja, Botshabelo,	2019/01/24,25 2019/02/10	CA demonstrations; legumes, cover crops, and fodder production	28,11,6	-All participants provided with seed samples for individual experiments on CA
Sedawa, Turkey, Willows (x2)	2019/01/31 2019/02/21 2019/02/26; 2019/03/05	Planning and review sessions	28,16,23,12	
Sedawa, Turkey	2019/03/08	Natural pest management workshop (HH)	5	LF's and 2 lead farmers attended
Turkey	2019/03/06	Installation of small layers unit in Turkey	9	The Phedisang Turkey DIC group and a few members of learning group, Mazwi Dlamini

Turkey, Sedawa, Mametja, Botshabelo	2019/03/12	Agroecology network- farmers learning event	12	Participants prepared posters for the vent on the 11th of March
Turkey, Willows	2019/03/19,21	Gardening practices revision workshops and P&D control - new ideas, Five fingers review	19, 8	Review of liquid manure, shallow trenches, new ideas for P&D control, plus revision Five fingers principles in Willows
Sedawa, Turkey	2019/04/03	Post production workshop at Hlokomela	12	Workshop for participants involved in the organic marketing process
Sedawa, Turkey	2019/04/15	Procurement workshop at Hoedspruit Hub	16	Workshop for participants involved in the organic marketing process

2.6.1 **Planning and review sessions**

Two of the learning groups, Sedawa and Turkey have asked for regular (monthly) planning and review sessions to ensure better communication and implementation coherence. The first of such sessions has now been conducted for both groups.Below, the session for the turkey group is summarised.The meeting was suggested in order to revise activities, assess progress and plan future activities for the group to really build resilience and ensure food security for our households and make an income from farming.

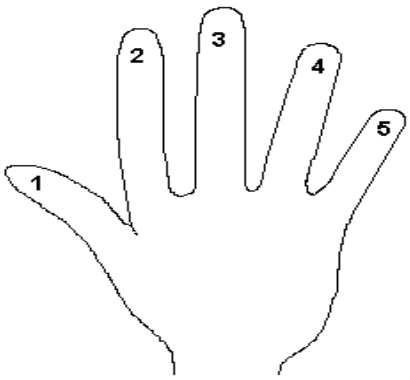
(a) Garden practices

The five fingers thematic principles for implementation of practices were reviewed. And farmers implementation of practices was linked to this and assessed. Quite a few of the farmers have not implemented much and have forgotten the bulk of learning workshops. This revision process was thus an important reminder.

1. GO KAONAFATŠA TAOLO YA MEETSE
GOOD WATER MANAGEMENT
Diversion ditches- to carry water to beds
Mulching -
Improved furrows and ridges
Greywater management and use;
Drip kit
Tunnels
RWH storage tanks

2.GO FOKOTŠA KGOGOLEGO YA MOBU
CONTROLLING SOIL MOVEMENT
Cut off drains – ditches across a contour at top of garden/slop
Contours- measured with line level
Stone lines/bunds- made on contour

3. GO KAONAFATŠA HLOKOMELO YA DIBJALWA
CROP MANAGEMENT
Mixed cropping- incl intercropping
Pest control brews - Planting of herbs – Mixing herbs and veg
Seed successions- Seed saving
Conservation Agriculture; minimal soil disturbance, soil cover, crop diversity
Planting to maximise shade – in



4. GO NONTŠA MOBU
KEEP THE SOIL FERTILTY/HEALTHY
Dedicated paths and beds
Soil fertility management- manure (incl improved manure), compost, green manures, legumes, liquid manure
Bed design -trench beds, shallow trenches, eco-circles,

5. HLOKOMELO YA DIMELA TŠA TLHAGO
TAKE CARE OF INDIGENOUS PLANTS
Small nurseries-propagation of fruit and indigenous crops and trees
Planting- windbreaks, hedges, multi-functional plants, inter cropping

The learning group decided not to implement some practices because they didn't have water and subsequently forgot about them.
Below are summaries of the discussions for each theme

(i) Good water management

- Participants could not list one practice that they could implement in order to manage water use. Mr Rackson Magobatlou said for water management he mulches using dry leaves and he has witnessed that the practice helps in slowing down evaporation. He implemented mulching because he doesn't have water, he fetches water from his brother using a wheelbarrow, and he thought if he started mulching, he wouldn't have to fetch water every day, which really worked.
- Mr Malatjie added that mulching also adds to soil fertility.
- Sarah Madire has implemented mulching in her garden and she experienced pest problems (ants were in her garden feeding from mulching material and damaging her crops). She then decided not to mulch anymore.
- Participants with tunnels received three bucket drip kits to use inside the tunnel, yet none of the participants who were attending the meeting are using them (Sarah Madire and Lydia Shai) and they don't have the reason why they are not using them.

(ii) Controlling soil movement

- Participants have forgotten a lot about practices that they can implement to prevent soil erosion. The only thing they could remember was that planting sweet-potatoes in raised beds and furrows helps with movement of water in the garden and that it prevents soil erosion.
-

(iii) Crop management

- Participants implemented mixed cropping in their gardens. Portia Shai has been planting spinach and garlic on the same eco-circle; she plants spinach in the middle and on the outside, she plants garlic to help with pest control.
- Lydia Shai has been planting herbs (coriander and parsley) together with vegetables; the smell of the herbs helps control pests and diseases.
- In terms of pest and diseases control they use ash and a brew made from chilli and soap.
- Other participants said nothing, they normally don't use any practice for pest control even when they have pests' problems in their garden, and they understand that materials used to make brews for pests' control are easily accessible, some they can find in their garden but they don't have time to make the brew.
- In terms of crop diversity, they have been practicing without understanding that it is part of crop management and also helps in pest control.

(iv) Improving soil fertility/soil health

- They have done and they are still doing trench beds to fertilise the soil. These beds provide good harvests, and fresh quality vegetables and work a lot better than the traditional way of planting.
- Mr Rackson Magobatlou also pointed that he harvested big quantities of spinach that he managed to sell in the community out of his three trench beds.
- Angelina Malatji uses dry leaves mixed together with cow- chicken- and goat manure when planting.

- Portia Shai implemented the eco-circles in her garden and found that they improved crop growth and yields substantially, as long as one has water for irrigation. Magdalena and Lydia Shaai also added to Portia they have planted spinach, green beans and herbs on the eco-circles and they are very happy with the results.
- Sarah Madire and Samuel Mogale have been making compost that they use in their garden to fertilise the soil. Their compost materials are dry leaves, wet leaves, ashes, manure (they all used goat and cow manure) and water, but when they started having water issues, they started fertilising their soil using dry leaves mixed with manure (cow and goat manure) then add to their soil and they have harvested good quality vegetables from their garden.

(v) Looking after indigenous trees

- Most participants don't understand the importance of continuation of planting indigenous plants One person only, Angelina Malatji has a nursery for indigenous trees, fruit trees and flowers. She sells mangoes and Ogogoro at R35.00/tree.

The table below indicates the ranking of practices int terms of implementation by the group.

Table 14: Traffic light assessment for implementation of practices in Turkey: Feb 2019

List of practices		Traffic lights: red/yellow/green		
Water management	Cut off drains and swales	🔴		
	Diversion ditches	🔴		
	Greywater	🔴		
	Water harvesting and storage (check dams, gabions, drums, basins, small dams and jo-jo tanks)			🟢
	Drip irrigation	🔴		
	Mulching		🟡	
Control soil movement	Contours, diversion ditches, swales, bunds	🔴		
	Stone lines	🔴		
	Furrows	🔴		
Soil Health	Bed design (trench beds, ridges, dedicated beds and paths, terraces and raised beds			🟢
	Compost, improved manure, green manure and legumes		🟡	
Improved crop management	Mixed cropping			🟢
	Crop rotation		🟡	
	Seed saving	🔴		
	Nursery/propagation		🟡	
	Continuity- seeding production	🔴		

	Natural pests and disease control practices			
Looking after indigenous plants	Indigenous or medicinal plants			
	Indigenous fruit			
	Other indigenous plants; including windbreakers, hedges			
	Bee fodder, pest and disease control practices			

(b) CA review principles implemented

How many have tried using CA principle when planting maize and cover crops after the CA demonstration?

- Participants clearly stated that by the time they attended CA workshop, they had already planted their maize and field crops and had no space to try planting using CA principles.
- Sarah Madire stated that she also had already planted maize but what she did was to open lines in between her maize and planted beans to cover the soil.

(c) Traditional poultry training

From the training received what have you done?

- We loved the training because we have indigenous chickens but the cost that goes with having chickens where you have to buy chicken feed and buy water without having a market to sell is too risky. Mr Michael Magobatlou even added that if they have to do a survey to see how many people are willing to buy indigenous chicken, he will find no one in the community who wants to buy indigenous chickens.

Do any of the participants have poultry? When did it start and how is it going?

- No one in the learning group has poultry.

(d) Organic Mango production training

- Those who attended the training have not done anything that they were taught from the training. They said it was late to implement some of the practices, but they didn't try to use ways to control diseases and pests in their orchards, which was the practice they could have tried, or composting. After harvesting recently, they also didn't prune their trees they said they will do that after harvesting from all the trees.

(e) Market progress and how it will work this year

The market is starting month end of February beginning of March. We will be doing the Box Scheme with Hoedspruit Hub like we were doing last year, but with farmers upfront more than Betty and Andries. There will be a workshop on the first week of April for the farmers participating in the market, which will be held at Hlokomela garden.

(f) Water issues

Last year October Turkey learning group took the initiative to start looking at options for getting water for irrigation. They started having meetings where they discussed how they will go about raising cash to have boreholes for the group. They agreed on contributing R500.00 per household for the borehole, starting from the 23rd of October to the 31st of January 2019. To this date no one has contributed. They

are dragging their feet on this matter. On the 21st of February 2019 they all agreed to extend with another three months and take it from there, the new closing date is the 21st of May 2019.

2.6.2 **Water issues follow-up (Sedawa)**

(a) Rain gauge information

Rain gauges have been installed at three participants' homesteads – Sedawa, Mametja and Botshabelo. These initially were linked to run-off plots, but the latter have subsequently been removed due to two seasons of lack of rain. The rain gauges are monitored so that participants can have a good indication of the amount of rain for a given month and period and the results are reviewed during planning and review sessions.

The results are shown in the table below. Results for Miriam Malepe form Botshabelo, are again slightly unreliable, and those for Christina and Koko correlate well.

Table 15: Rainfall data from 3 community- based rain gauges: Oct 2018-Feb 2019

Village, name	Date	Rain mm	Total mm	Village, name	Date	Rain mm	Total mm	Village, name	Date	Rain mm	Total mm
Botshabelo	17/10/2018	5,6		Sedawa	17/10/2018	9,9		Sedawa	17/10/2018	8	
Miriam Malepe	01/11/2018	7,3		Christina Thobejane	01/11/2018	5		Koko Maphori	01/11/2018	3,9	
	10/01/2019	37, 4			21/11/2018	4,9			21/11/2018	8,1	
	13/01/2019	27, 0			05/12/2018	4,9			05/12/2018	8,7	
	15/01/2019	17,3			11/12/2018	30,2			11/12/2018	32,2	
	25/01/2019	34,9			28/12/2018	48			28/12/2019	50	
	27/01/2019	30			10/01/2019	8			30/01/2019	32	
	05/02/2019	22			13/01/2019	5,1			10/01/2019	10,2	
	13/02/2019	30	**147,1**		15/01/2019	10,1			13/01/2019	4	
					25/01/2019	47			15/01/2019	11	
					28/01/2019	1			25/01/2019	52,6	
					30/01/2019	38			28/01/2019	1,5	
					05/02/2019	19			05/02/2019	21	
					13/02/2019	31,3	**262,4**		13/02/2019	27,6	**270,8**

When comparing this rainfall data kept locally with a weather station in the locality the following small summary table indicates the similarities between the data sets.

Month	Weather station (mm)	Rain gauges (average)
October 2018	5,5	7,8
November 2018	18,9	9,7
December 2018	43,8	87
January 2019	64,5 (until 15th)	100
February 2019		50

(b) Continuation of water issues in Sedawa

During the monthly planning and review session held in February 2019, it was decided that the group would go ahead with the option of installing boreholes (1-3) for agricultural water provision for their group members. The water committee needed to meet and work through a number of points including:

- Deciding which borehole to start on
- Working out which members paid from each of the three sub areas, and who still needs to contribute
- Assessing whether the contribution made thus far in tandem with the matching grant to be provided by MDF is enough for drilling the borehole, setting up a collection tank and or setting up feeder pipes to the participants' homesteads.

To enable the water committee to work through these issues a summary document was put together to help them make their decisions.

3 RESILIENCE SNAPSHOTS

Individual impact assessment questionnaires have been designed and linked to a resilience snapshot questionnaire. These have been tested for 6 participants per province. As a result, the impact assessment questionnaire has been streamlined and can now be more widely use. The questionnaire is presented in Attachment 4 to this report.

Below a case study for the 6 KZN participants is presented.

3.1 Resilience snapshot case study for KZN

Summaries of the responses to specific questions are summarised in bullet point and tables.

3.1.1 Learning and change

(a) What have you learnt about dealing with CC and climatic extremes?

- I have learnt that practices such as trench beds and CA provide good growth and yields, despite difficult weather conditions. Also, these practices are cheap. We get more food than we did before and will now be able to continue farming
- Adaptive practices like mulching help to deal with increased heat and water stress
- Practices such as trench beds, eco-circles, mulching and mixed cropping enables the soil to hold moisture for longer and withstand the heat and dry spells.

(b) What is your experience regarding the impact of CC on your life?

- This season we had drought; the beans did not grow and maize is stunted. I fear will not have enough food
- Cattle have been negatively impacted- more disease and deaths as grazing diminishes
- The climate is changing; low rainfall during the planting season and high temperatures are affecting farming activities

- I have not experienced climate change – I do not have water issues (participant in Midlands of KZN)
- Climate change has destabilised our planting patterns and has created a lot of uncertainty about planting dates for both summer and winter crops

(c) Do you share your knowledge and experiences with the learning group or community members?

- Yes, I talk to my neighbours about the gardening practices, so that they can also try and revive their gardens
- Yes, I have talked to neighbours, some come and visit to see the garden and experiments and some have even taken pictures.
- Yes, I talk to my neighbours and friends and invite them to the learning group sessions if they are not members yet.

(d) How do you share the knowledge gained with other members of your community?

- Discussions at savings meetings, at the springs when we collect water
- When people visit, I show them my garden

(e) What helps you to learn more about new innovations and information?

	No (N=6)	**Comments**
Listening to other farmers experiences and experiments	6	I get motivated by other farmers' work, get new ideas such as planting potatoes in bags
By doing and experimenting in own garden	4	This helps me to know how good the practices area, have tried a no of experiments and included my own ideas
Motivated by other farmers work and experiences	5	Learnt about raised beds in Msinga
Learning workshops	5	I find them useful because I always hear new information and experiences form the facilitator and farmers

(f) What new things have you added into your practices? How has it worked?

- I have not tried anything else new, outside of the practices we were taught; CA, trench beds, mulching, mixed cropping, RWH, greywater management, seedling production
- I have tried a u-shaped garden which helps to collect water, helping plants to grow better.
- I have used some of the maize and sunflower seed I grew in the CA trials to feed my indigenous chickens; this has helped for a better survival rate and even the ability to sell a few.

3.1.2 **Climate smart practices**

(a) Impacts and lessons learnt

	Past issues	**Past Practice**	**Present Practice**	**Impact and lessons**
Livestock	Low production	Bartered indigenous chickens	Selling indigenous chickens locally	

	Feed too expensive to buy	Fed chickens' scraps	Feed of sunflower and crushed maize seed from own production	More chickens survive and grow well making sales possible
Gardening	Low yield and dry beds	Raised beds	Trench beds and raised beds	Better growth and yield, increased water holding, beds remain moist during hot periods, beds hold water for a long time fewer pests and diseases,
		Fetched water from communal taps and springs	Also RWH and grey water use (unfiltered)	Saves water and time in fetching water to irrigate
			Mulch (dry grass)	Mulch retains moisture, but can encourage termites
		Buy seedlings	Seedling production	Increased number and types of crops;
		Standard veggies	New veggies and herbs	There is demand in the village for the new crops; kale, Chinese cabbage, carrots, More and different food for longer periods in the year
		Short season for planting, or no planting due to lack of water	Winter planting	Grow crops in garden and in the fields (sweet potatoes, potatoes)
Field cropping			CA	Increased water holding and less run-off, increased ability to withstand drought
			Intercropping	Increased availability of more types of food,
			Legumes	Increased yields
			Cover crops	Increased soil health, Feed availability for livestock

(b) Assessment of impact for CSA practices tried out using local indicators

-1 = worse than normal practice

0=no change

1=some positive change

2=medium positive change

3= high positive change

	Name of practice	**Soil**	**Water**	**Productivity**	**Labour**	**Pest and disease control**	**Cost and maintenance**	**Livelihoods**	**Adaptation**
1	Trench beds	2	2	3	-1	2	0	2	3
2	RWH	0	3	1	-1	0	-1	1	3
3	Mulching	2	2	3	0	3	0	1	2
4	Tower garden	2	3	3	2	0	0	2	2

5	Planting basins	0	2	2	0	0	1	1	1
7	Raised beds, with mulch	1	2	2	1	0	1	0	1
8	eco-circle	2	3	2	-1	1	0	1	1
9	CA; w intercropping, legumes, cover crops	3	2	3	1	1	0	2	2
1o	Using goat manure (composted in a kraal)	3	1	2	0	1	0	1	1

(c) Resilience snapshot

A summary table of the results for all 6 participants is presented below, followed by the more in-depth

Resilience indicators	Rating for increase	Comment
Increase in size of farming activities	Gardening – 18% Field cropping – 63% Livestock – 31%	Cropping areas measured, no of livestock assessed
Increased farming activities	No	Most participants involved in gardening, field cropping and livestock management
Increased season	Yes	For field cropping and gardening- autumn and winter options
Increased crop diversity	Crops: 12 new crops Practices: 8 new practices	Management options include; drip irrigation, tunnels, no-till planters, JoJo tanks, RWH drums,
Increased productivity	Gardening – 72% Field cropping – 79% Livestock – 25%	Based on increase in yields
Increased water use efficiency	25%	Access, RWH, water holding capacity and irrigation efficiency rated
Increased income	13%	Based on average monthly incomes
Increased household food provisioning	Maize- 20kg/week Vegetables – 7kg/week	Food produced and consumed in the household
Increased savings	R150/month	Average of savings now undertaken
Increased social agency (collaborative actions)	2	Villages savings and loan associations and learning groups
Increased informed decision making	5	Own experience, local facilitators, other farmers, facilitators, extension officers
Positive mindsets	2-3	More to much more positive about the future: Much improved household food security and food availability

RESILIENCE SNAPSHOT		(6 participants)					
Date	Feb-19						
Province	KZN	Bergville, Midlands					
Village	Ezibomvini, Eqeleni and Gobizembe						

Increased in farming (Size)		**Before (Size in sqm)**	**Now (Size in sqm)**	**Comment: Percentage increase**			
	Gardening	76	93	18%			
	Field cropping	1400	3767	63%			
	Livestock	22	32	31%			
	Trees nat resources	4	4	0%			
Increased diversity in farming		**Y/N before**	**Y/N now**	**Comment:**			
	Gardening	1	1	Most participants undertake activities in all four farming categories			
	Field cropping	1	1				
	Livestock	1	1				
	Trees, nat resources	1	1				
Increased diversity (1)		**Management and practices before**	**No b4**	**No now**	**What has changed; new crops**	**What has changed; new practices**	**What has changed; , new management**
	Gardening	raised beds; use of ash and kraal manure	1	4	Kale, chinese cabbage, carrots, mustard spinach, Coriander	mulching, trenches, seedling production, more crops, tower gardens, eco circles, raised beds, planting basins,	RWH (Jojo tanks and drums), greywater and organic gardening, tunnel, drip irrigation,
	Field cropping	traditional planting of maize	1	4	Maize, beans, cowpeas, Lab-Lab, sunflower, sunnhemp, millet, potatoes, sweet potatoes	CA, intercropping ,legumes, cover crops, rotation	
	Livestock	extensive foraging	1	1	sunflower, maize	Feeding of poultry - crushed maize and sunflower	
	Trees nat resources						

		Types	BEFORE: Quantity (KG, No)	NOW: Quantity (KG,No)	Percentage increase		
Increased productivity	Gardening	Spinach	7,8	15,3	49%	(Amount in kgs/tonnes, 10,20,50kg bags/containers, no of meals (for a family)	
		Cabbage	5	8	38%		
		Potatoes	10	20	50%		
		Carrots	0	10	100%		
		Green pepper	0	30	100%		
		Chinese cabbage	0	8,5	100%		
		Chilli	5	7	29%		
		Onions	5	8	38%		
		Beetroot	4,3	11,3	62%		
		Kale	0	15	100%		
		Mustard spinach	0	30	100%		
		Coriander	0	30	100%	**72%**	
	Field cropping	Maize	99,3	257,8	61%		
		Beans	4	16,8	76%		
		Cowpea	0	5	100%	**79%**	
	Livestock	Chickens	15	20	**25%**		
	Trees nat resources						

	Increase Access	Inc RWH	Inc water holding	incr water productivity (irrigation)	SCALE
Increased water use efficiency (incl RWH, water holding, water access, water productivity)	1	1	2	1	0= same or worse than before; 1= somewhat better than before, 2= much better than before

	Income before (ave monthly in Rands)	Income now (Ave monthly in Rands)	Comments
Increased livelihood security (income)	1433	1650	

	Food types (staples, veg, livestock, fruit)	Quantity/ week (kg)	No of times/ week (1-7)	Sales/week (in Rands)	Comments
Increased livelihood security (Household provisioning and food security)	maize	20	7	0	6 of 6
	Veg (Spinach, chillies, green pepper)	10	5	225	2 of 6
	Veg(spinach, chinese cabbage, tomato	10	3	0	6 of 6
	Veg (beetroot, chilli)	1	1	0	6 of 6
	Chicken	2	2	0	1 of 6
	Pigs (kg of meat)	10	1	2500	1 of 6

	Cattle (no sold/yr)	1		10000	1 of 6
	Fruit	1	1		1 of 6

Increased livelihood diversity/options	**Income options Before**	**Income options Now**	**Comment; name new options e.g. which crops, etc**	**Scale**
	1,4	1,3,4	Small incomes form farming now possible	1=social grants; 2= remittances; 3=farming income;4= small business

	Amount per month Before	**Amount per month Now**	**Use of savings**	**Scale**
Savings (safety, security, achievement)	0	R150	2,3,4	1=food; 2=household use; 3=education; 4= production; 5=other

Increased growing season		**Yes/no Before**	**Yes/no Now**	**Comment**
	Gardening	0	1	Now grows crops in winter in garden and fields
	Field cropping	0	1	
	Livestock	0	0	
	Trees nat resources	0	0	

Collaborative actions/social agency	**Activities in groups Before-name**	**Activities in groups Now**	E.g. savings, church, learning groups, coops, farmers associations, work teams, selling, inputs, farmers centres water committees …
	Stokvel	VSLA	
		Learning group	

Informed decision making	**Information used to choose activities Before**	**Information used to choose activities Now**	E.g. Other community members, learning in groups, written info, radio, facilitators, extension officers, etc
	Own experience	Own experience	
	Extension officer	Extension officer	
		Learning group members	
		Local facilitator	
		Facilitator	

Positive mindsets	**Rate your mindset Before**	**Rate your mindset now**	**SCALE:0=less positive about the future; 1=the same; 2=more positive about the future; 3=much more positive**
	0	2-3	Much improved household food security and food availability.

4 PARTICIPATORY IMPACT ASSESSMENT (PIA)

4.1 **Background**

A specific framework for monitoring of impact of the CSA practices on livelihoods and vulnerability is required to be able to assess increased resilience. This framework works alongside the more conventional process, output and outcome indicators. '

For this process the PIA framework has been used to outline the indicators used at community level and provide for a qualitative assessment of increased resilience by community members. A group process has been designed and tested, as has an individual survey instrument. Both will be reported on here.

In PIAs there are three basic questions:

1. What changes have there been in the community since the start of the project/process
2. Which of these changes are attributable to the projects
3. What differences have these changes made to people's lives

Impact indicators measure changes that occur in people's lives and can be qualitative or quantitative Impact indicators look at the end result of project activities on people's lives. Ideally, they measure the fundamental assets, resources and feelings of people affected by the project. Therefore, impact indicators can include household measures of income and expenditure, food consumption, health, security, confidence and hope.

Community impact indicators may be quantitative, such as income earned from crop sales, or qualitative, such as improved skills, knowledge or social status.

Therefore, tracking changes in food, income and expenditure can often be a useful way of measuring impact against community indicators of impact and against coping strategies.[2]

4.2 **PIA workshop outline**

1. Recap climate change impacts
   - Explore what people have noticed about impacts and make lists under headings: natural, physical, economic, human and social

Group level brainstorming of ideas; written on cards under the headings given, with arrows for increase or decrease

2. Recap adaptive strategies/ practices
   - What have people been doing to adapt to this, fix the problems, make things better?
   - What can be done? (first look at hat has been done and then any further ideas of what can be done)

[2]Catley A, Burns J, Adebe D and Suji O. 2014. Participatory Impact Assessment: A Design Guide. Feinstein International Centre. Tufts University, Somerville, USA.

- Elucidate adaptations for each category: natural, physical, economic human, social

*Group level brainstorming; write on different cards (those done and those thought of) and place next to the impact, indicate with a * which of these have been facilitated or introduced (and by whom) – this can be other farmers, projects, extension officers….*

3. Practices: Recap 5 fingers and list all practices under each category

- Re-introduce the 5 fingers concept – and include a further category of the whole hand – which is the social and personal
- Which practices have been implemented (introduced and other)?

Go around in the circle and each person mentions what s/he has done (productive, economic, social, personal actions) and what she would still like to try

- Add these practices to the five fingers diagram

Make an A1 diagram of the five finger and then add practices on cards

- Go through practices recommended through the DSS

Use cards with ranked practices from the DSS- describe and show the ones that people are not familiar with.

- Rank practices for next round of implementation

Rank the list of practices by a show of hands.

4. What have been the changes or benefits from each practice

- What changes have there been?

Brainstorming changes – an interrogate to get to the more

- How important are these changes to your lives? How do you decide? Which criteria would you use to decide?

Do a matrix ranking: changes (in columns), criteria (in rows) – Use proportional piling, working down each column by asking "how important is this practice for the criteria" and comparing the practices with each other (to an extent) as you go down the list…. Exercise is done in small groups of 5-8 participants

Below is an example of how this could look

	food	income	Soil, water	Access, ease,	knowledge
Trench beds					
Tunnels					
CA					
Cover crops					
Legumes					
Other crops; potatoes, sweet potatoes					
Savings					
Subsidised inputs					
Saving for inputs					

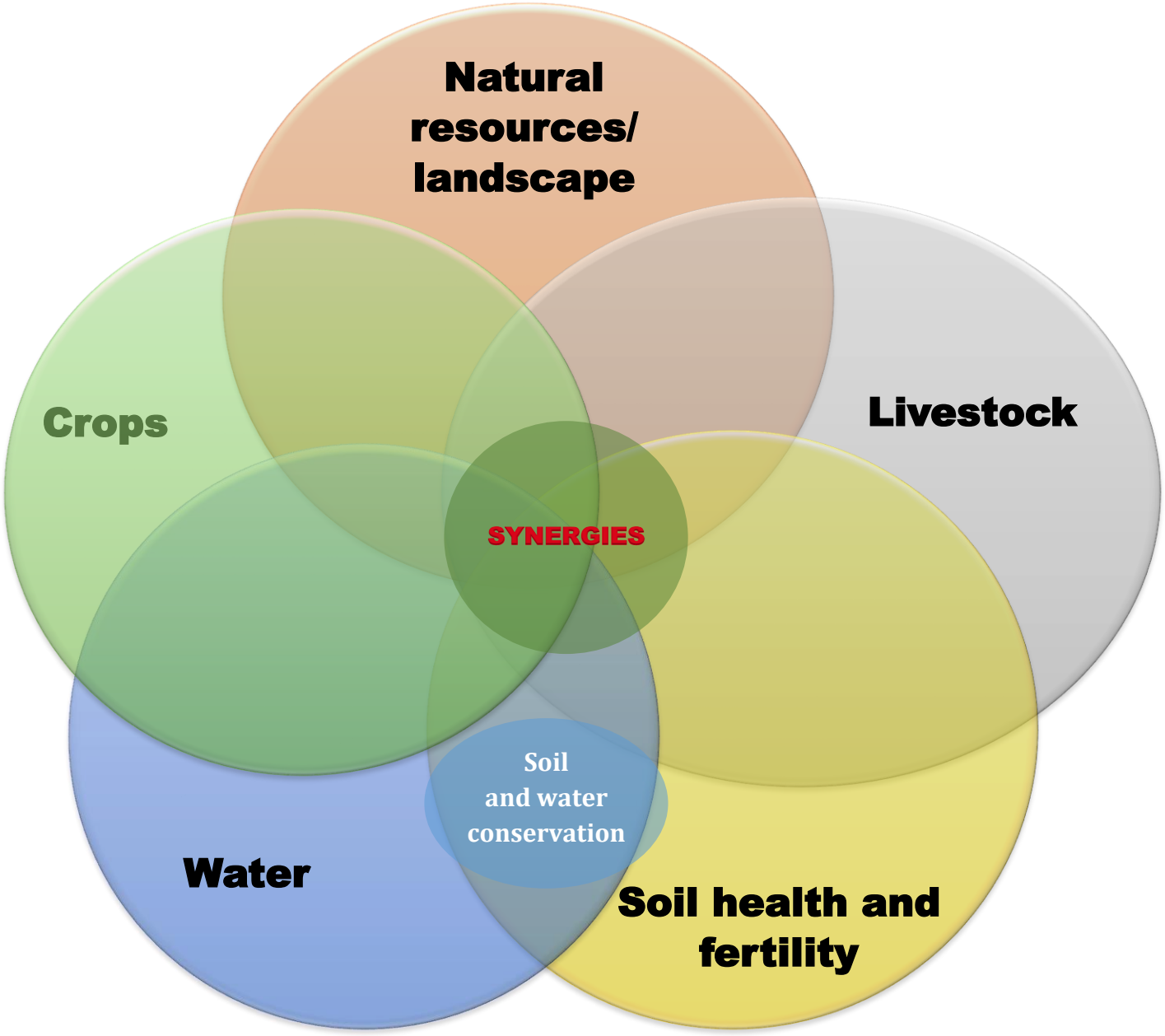
Farmer centre					
Small businesses					
Learning group					
Water committee					

6. Expanding on practices

- Introduce new practices for each of five fingers
- Participants assess each practice (after deciding on criteria for how you decide this practice is useful?)

Eventually the whole exercise can be summarised in the table below

	Natural	Physical	Economic	Human	Social
CC impacts					
Adaptive strategies					
Actions/ practices					
Changes due to practices					
Importance of these changes to your livelihood					


Natural resources/ landscape
Crops
Livestock
SYNERGIES
Soil and water conservation
Water
Soil health and fertility

4.3 PIA workshop Bergville 2019/04/11

4.3.1 Attendance

30 participants were invited; A selection of participants from learning groups in 8 villages: Stulwane (8 participants), Thamela (1 participant), Nthabamhlophe - Estcourt (2 participants), Eqeleni (4 participants), Ezibomvini (10 participants), Emazimbeni (3 participants) and Emabunzini (2 participants).

These participants represent those in the villages actively pursuing and experimenting with some of the CSA practices introduced and those most engaged in the mixed farming systems typical in the area.

Right Above and Below: Bergville and Ntabamhlophe participants in the PIA workshop

Facilitators; Lindelwa Ndaba (from Lima-RDF) joined the MDF team with one of her local facilitators from Ntabamhlophe, to learn about this process, for incorporation into her work in Food Security in her organisation.

4.3.2 Climate change

Here participants summarised their observations as an introduction into the process of assessing the impact of CSA practices:

- Less rainfall
- Late rains
- Greater intensity of storms and strong winds
- Increased heat in spring, summer and autumn

4.3.3 Climate change impacts on farming and livelihoods

This exercise was repeated, partly to assess whether people's perception of changes and impacts have shifted, now that they are more aware to the issues at hand. It also provided an opportunity for participants across villages and from different areas to engage with each other around their understanding and perceptions. This exercise was conducted at the beginning of the process as well.

For this exercise the impacts were divided into the 5 livelihood categories and is summarised in the table below.

Natural (environment and farming	Physical (infrastructure, environment)	Economic	Human (Skills, knowledge, agency)	Social (organisation, cohesion)
Earthworms disappear	Water shortages; reduced flow in streams and springs, boreholes dry up	Food shortages	Increase in diseases in humans	No progress here
Degradation of veld and reduced grazing	Severe erosion of roads and damage to houses by heavy rainfall	Water shortages at household level	Farming is done by older people; the younger people are lazy	People don't work together
Livestock break into fields and eat crops	Dongas are increasing in number and size	Farming inputs and services are very expensive	Water borne diseases from drinking dirty water	Traditional leadership is no longer respected
More diseases in cattle, requiring purchase of medication and vaccines and more deaths	Damage to wetlands from people building there, overgrazing and other uses.			Other community members steal farmers' produce
Contours in the fields, that were made many years ago have not been maintained and now there is erosion in the fields	Severe erosion due to denuding of land, followed by heavy rainfall			Learning groups; some conflict in some of the learning groups has reduced participation.
More crop damage from birds than before	SOME GENERAL ADAPTIVE MEASURES PROPOSED - Savings - Rotational group saving for buying and putting up fencing - Small businesses - Buying fencing - Request support for fencing and ask Government support as well – although with the latter participants are aware that Government support is unlikely. COMMENTS ON PLANTING DATES -People who planted in November- have struggled with lack of germination - More germination for those who planted in December - Spraying with Decis (pesticide against cutworms and stalk borer) helped with germination and growth (more pests were present) and reduced eating of seed by birds - A few participants even planted in January – and this worked quite well in this last season - One participant in Thamela mulched her whole field and planted in November and has had promising germination and growth from this -Participants also noted that beans did not grow at all, but the cowpeas have done reasonably well, even under these difficult conditions. It is difficult to make decisions about planting dates now that the climate is more unpredictable. The importance of crop residues to maintain soil moisture cannot be under-estimated			
Dry soil				
Seeds don't germinate				
Extreme winds that damage vegetation and crops				
More veld fires				
More pests in crops and new pests that were not present in the past				
Fertilizer is ineffective in hot, dry conditions				
Planting times for crops are changing in unpredictable ways				
There are small water sources in some people's				

homesteads, which they refuse to share with others	

General comments about this discussion:

1. The participants'' understanding of the contribution of CC to the erosion issues in their villages shows a good grasp of the process. They have commented on the process of denuding of the environment due to heat, drought and grazing pressure, followed by heavy storms and the increased damage caused to the environment due to this. They are also aware of the reduction in water from boreholes, wetlands and springs and how the climate variability, along with bad management practices have exacerbated this process.

Right: An outline of CC impacts put together by the participants

2. Participants discussed the fact that there are only about 30% of community members in each of the villages who are farming. The rest of the inhabitants do not respect people's efforts and do not cooperate in terms of managing their livestock. They have even been known to take their cattle to the fields to graze and to steal some of the crops. The traditional authorities and Local Municipality are not focused on peoples' problems and do not seem to care. They do not assist. This has now led to an increased feeling for the need to fence their fields. Round 23% of participants present, have already fenced their fields.
3. Fencing is expensive and people suggested joint savings and implementation options to spread this burden. They would also like to request assistance, but know that they are unlikely to find support in the short term. They do however believe that they can ask for assistance form the department of Agriculture. A further suggestion is that they club together to fence one large piece of land and then work there together – as this should be cheaper than fencing each person's field separately.
4. There was a long discussion on the merits of soil cover from crop residues and how this can assist with the problem of deciding on a planting date related to weather variability. One person went a far as mulching her whole field- which has had very promising results for her- given that her November planting of field crops was successful, whereas it was not for others. This also links into the discussions held about production of fodder crops and fencing of fields, as management of crop residues for soil cover will then become a possibility.
5. Participants do not believe that the lack of interest in farming is because of climate change, but is a broader societal issue; where people and especially the youth have become lazy, with high expectations of support and prefer not to be active at all, than to put in effort into activities with low returns.

4.3.4 **CSA practices**

Here participants described practices they are using under the five fingers (soil, water, cropping (gardening and field cropping, livestock and natural resource management. We decided also to include a further category - social agency, or what they described as people management

Soil	Water	Crop (garden and field)	Livestock	Natural Resources	People
Making compost	Drip irrigation	Diversified crops in gardens; beetroot, Chinese cabbage, carrots, parsley, thyme,	Vaccinations		Savings
Use of goat and cattle manure	Mulching	Shade cloth tunnels	Dipping		Small businesses
Canopy cover and legumes (Lab-Lab)	Infiltration pits	Beds: raised beds, trench beds, eco-circles	Proper feed; including from fodder produced		Farmer centres
Diversified crops to hold soil and prevent erosion	Garden layout with shallow furrows for water harvesting and retention	Tower gardens – fertility and greywater management	Addition of supplements		Selling chickens
	Greywater management	Conservation agriculture; including management of residues	Limiting burning of veld		
	Improved irrigation practices	Inter cropping and crop rotation	Planting grass; ungwengwe and kikuyu		
	Rainwater storage in JoJo tanks and drums	Diversified crops in fields; different varieties of maize, sorghum, millet, legumes (e.g. cowpeas, beans, Lab-lab), cover crops			
	Spring protection	Use of Decis Forte (Pyrethrins) for pest control in fields			
	Buying JoJo tanks – and negotiating with water trucks to fill these	Liquid manure			
		Mixed cropping in gardens			

From this table it can be seen that participants have implemented a wide range of practices in cropping and gardening and have also started to focus on livestock production and management. They have given no attention to natural resources management, erosion control, or soil and water conservation in grazing management.

Right: An analysis of practices related to the "five fingers' concept

In addition, participants specifically mentioned the benefits of trench beds:

- These beds produce very high yields
- They keep the soil fertile for a long time and
- They hold a lot of water – saving on irrigation needs.

In addition, although agro-ecology is promoted and organic gardening demonstrated and promoted, the use of pesticides such as Blue Death (Carbaryl) and Bulala Zonke (Malathion) in the gardens, is common.

In addition, in the Conservation Agriculture experimentation process participants have been using Decis Forte (pyrethrin) to control both cut worm and stalk borer. Contrary to expectations that the need for this pesticide would reduce over time, participants feel that it is becoming more important with the changing weather conditions as the stalk borer load in their fields has increased. They also believe that spraying this pesticide reduces the incidence of birds feeding on their seed.

4.3.5 **Changes and benefits from CSA practices**

This exercise consisted of doing a matrix ranking of practices farmers have used in the past year; incorporating gardening, field cropping, livestock management, soil and water conservation and water issues (access, availability).
Impact indicators for this exercise were developed in 2 small groups by asking participants to outline how they make decisions about which practices to use and what changes they would observe.

Below is a summary of the Matrix for each of the 2 small groups. A process of proportional piling was used for the scoring of each practice and indicator – where 100 counters were provided for each indicator and the small group decided how these would be placed proportionally for each practice. In this way participants can comment on; more or less, and how much more or less. The outcome of the exercise is quantifiable in terms of gauging percentages.

The 3rd group conducted an exercise in comparing different water saving practices

(a) Matrix 1

For this matrix the practices were conflated to encompass all specific practices within that category.

- Conservation agriculture; minimal tillage, soil cover, crop diversification
- Savings: Village saving and loan associations, rotational saving in small groups towards specific infrastructural needs, personal savings
- Livestock; fodder production, vaccinations, dipping, supplementation
- Gardening; bed design (trench beds, eco-circles, raised beds, tower gardens, tunnels, mulching, mixed cropping, crop diversification, inclusion of herbs, infiltration pits and water conservation furrows.
- Crop rotation; 3-4 crop rotations in field cropping
- Intercropping: grain-legume and grain -cover crop intercropping options in field cropping
- Small businesses; including agricultural and non- agricultural businesses; sale of snacks in schools, sewing, baking, poultry production, maize milling etc.

The impact indicators developed by this group are of particular interest as they are multi-dimensional talking at least two different aspects for each indicator Additionally, the exercise was run so that each practice is compared with the other practices when considering one of the indicators or criteria. This greatly increases the value and reliability of the scores provided by the group.

	Soil; health and fertility	**Money; income and savings**	**Productivity; acceptance of practice, saving in farming – equipment, labour**	**Knowledge; increased knowledge and ability to use**	**Food; how much produced and how healthy**	**Water; use and access**	**Social agency; Support, empowerment**	**Total**
Conservation Agriculture	22	21	26	28	18	23	18	156
Savings	6	15	14	15	12	11	15	88
Livestock	19	11	18	7	5	12	11	83
Gardening	14	15	12	13	15	17	21	107
Crop rotation	16	12	13	12	12	15	10	90
Intercropping	12	13	15	12	11	11	9	83
Small businesses	11	17	15	10	20	11	9	93

Comments:

- The overall impact on livelihoods (which is seen as the combination of the indicators chosen by the group) is shown under the 'total" column. From this, the participants clearly consider the Conservation Agriculture (CA) process as the most significant, followed by gardening, small businesses, savings and livestock – in decreasing order

- The practices of crop rotation and intercropping fall under the ambit of CA. the comparison of these two practices by community members has shown some very interesting learnings and conceptions;
    - Crop rotation is considered to be better at increasing soil health and soil fertility than intercropping – showing an internalisation by the group of the positive effects of rotation of the main grain crops with legumes and cover crop combinations, as well as an observation that this works better than intercropping by itself. This observation is clearly supported by academic evidence.
    - Income, savings and productivity are considered to be somewhat higher for intercropping; again, a very astute observation from the group. Generally, participants prefer crop rotation over inter-cropping, but are able to appreciate the increases in productivity and potential income due to intercropping options.
    - Water use and access is considered by this group to be quite a bit better for crop rotation, when compared to intercropping. They have noticed the potential of intercropped grain and legume plots as well as grain and cover crop plots to show signs of water stress and competition for water (and potentially nutrients) between the crops. Although, academically this is not the case in well managed fields, it is quite likely in more infertile plots.
    - Regarding social agency; group participants are more easily able to relate to the concept of crop rotation as they find crop management in the single cropped blocks a lot easier (including weeding and harvesting) and do not have difficult decisions to make in terms of choices of timing of harvesting and extended harvesting periods.

(b) Matrix 2

	Money	Food	Fertility	Saving water	Total
Mulching	8	13	26	23	**70**
CA; Maize and bean intercrop	11	23	20	15	**69**
Pipes for channelling water to households	17	24	6	12	**59**
Trench beds	19	7	18	19	**63**
Using animal traction	13	19	6	15	**53**
CA; crop rotation	23	11	18	9	**61**
Tower gardens	9	4	6	7	**26**

(c) Matrix 3; water practices ranking

This group Ranked the practices, rather than the criteria and discussions revolved primarily around water management in gardens.

Practice	Ranking	Criteria
JoJo tanks	5	Good healthy food, water supply, safe clean water, increased moisture holding, reduced conflict among neighbours, and reduced costs
Grey water	1	
Infiltration pits	1	
Mulching	1	

Comment: The JoJo tanks assist the most, but in winter, they need to be filled from water tankers supplied by the Municipality, which can be expensive.

Comments:

- JoJo tanks are considered a good investment for increased water security at household and gardening level, much more so than any of the in- situ water conservation practices such as infiltration pits and mulching.
- Interestingly, participants from both Bergville and Estcourt mentioned that they have persuaded the operators for the water tankers from the municipality to fill up their JoJo tanks for a fee. This is a win-win situation for both the participants, who can now have access to a lot more water than is usually supplied to them through the municipality and the municipalities themselves, who can now offer water to selected households and feel that they are "doing their work".
- At a systemic level however, this is an extremely alarming trend. The water tankers are meant to be a back-up plan for municipalities where their water supply falls short in terms of servicing people and for emergencies. It has however become the main way in which water is provided and is unfortunately part and parcel of the broader defrauding of government coffers and state capture. It is possibly the most expensive way to supply water that was ever conceived and allows certain interests to benefit disproportionately- namely the companies providing and maintaining these tankers, which predictably are linked to the government officials themselves. One tanker is said to cost around R35 000/ day to run and maintain, but only carries around 20 000l of water- and if used to fill up JoJo tanks, can only supply around 5-10 people in a day. The fees paid to the tanker operators are also bribes, rather than an official process, making the entire procedure extremely questionable.

4.3.6 **Expanding on CSA practices**

Participants have suggested that they will continue expanding the CSA practices and have outlined strategies for each of the villages. What this shows is that there is substantial potential for horizontal expansion and learning within the communities themselves and that if a careful, fully participatory process is used for introduction and support of CSA practices, that quite complex processes can be talked. The community members who are still engaged in farming have a "hunger' for farming systems that are more productive and that would better support their livelihoods and take on new ideas.
It also indicated the clearly that farmers learning from other farmers is the most successful and the most likely to build a sustainable framework of implementation that the participants can build on.

Village	New practices	COMMENTS
Stulwane	-Fencing of fields -Grazing management -Making hay bales -Fodder production - Supplementation with protein in winter (licks, pre-mixes and liquids)	There is a lot of interest in the tunnels and participants have agreed to save towards buying shade netting and putting up their own structures- as the provision of further tunnel kits through this process is not possible.

	-Saving for shade netting tunnels	
Eqeleni	-Fodder production- Continue with planting different fodder types -Making of hay bales -Supplementation -Saving for shade netting tunnels	Interest in fodder production, making of hay and supplementation for livestock is high and interestingly also something that a number of women have volunteered to become involved in – especially in Ezibomvini and Eqeleni. Emazibeni and Emabunzini are areas where participants have come across the work done in other villages and have asked to be brought on board. They are learning about CSA from these groups and individuals.
Ezibomvini	-Spring protection -Making of hay bales -Supplementation -Saving for shade netting tunnels	
Thamela	-Eco-circle -Saving for shade netting tunnels	
Emazimbeni	-Fencing of fields - Tower gardens - Planting pottoes in bags -Saving for shade netting tunnels	
Emabunzini	-Trench beds -Saving for shade netting tunnels	

4.3.7 **Evaluation of the workshop**

Some significant comments made in closing by participants included:

- We learnt a lot by bringing people from different areas together
- We have been provided with information on how to implement different practices such as different types of beds in the garden and water management
- We have also seen the proof of these practices here in Phumelele's garden
- We are grateful that Mahlathini has not forgotten the farmers

5 CSA PRACTICES / DECISION SUPPORT SYSTEM

Written By Erna Kruger and Catherine van den Hoof[1]

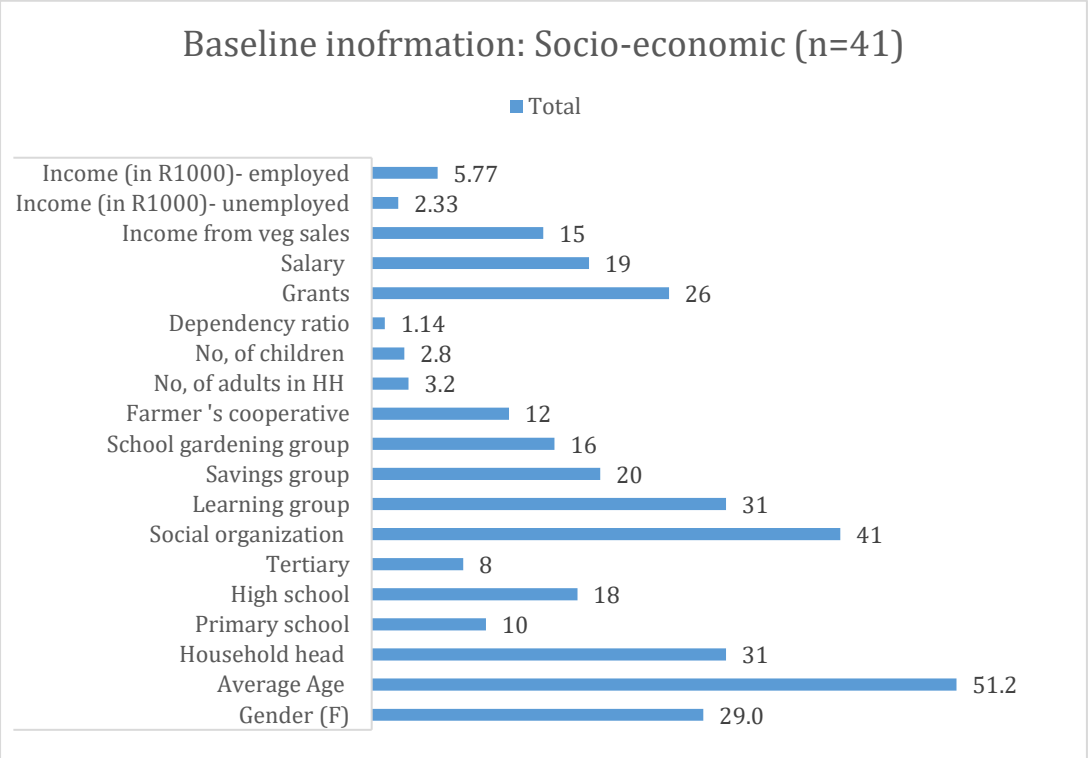
[1] *Post- doctoral fellow at the global change research and sustainability Institute, WITS.*

The initial modelling process designed has now been refined and updated. A few of the input parameters have been changed to more clearly reflect the local conditions in South Africa and more baseline interviews have been conducted and compiled to run a more accurate simulation of the model

5.1 Baselines and DSS refined

A total of 41 baseline interviews have now been conducted across 7 villages across Limpopo, KZN and EC.

The number have been increased to; increase the reliability of the summary information, 'ratify" the farmer typology suggested and provide input for the DSS modelling process to test the design for coherence.

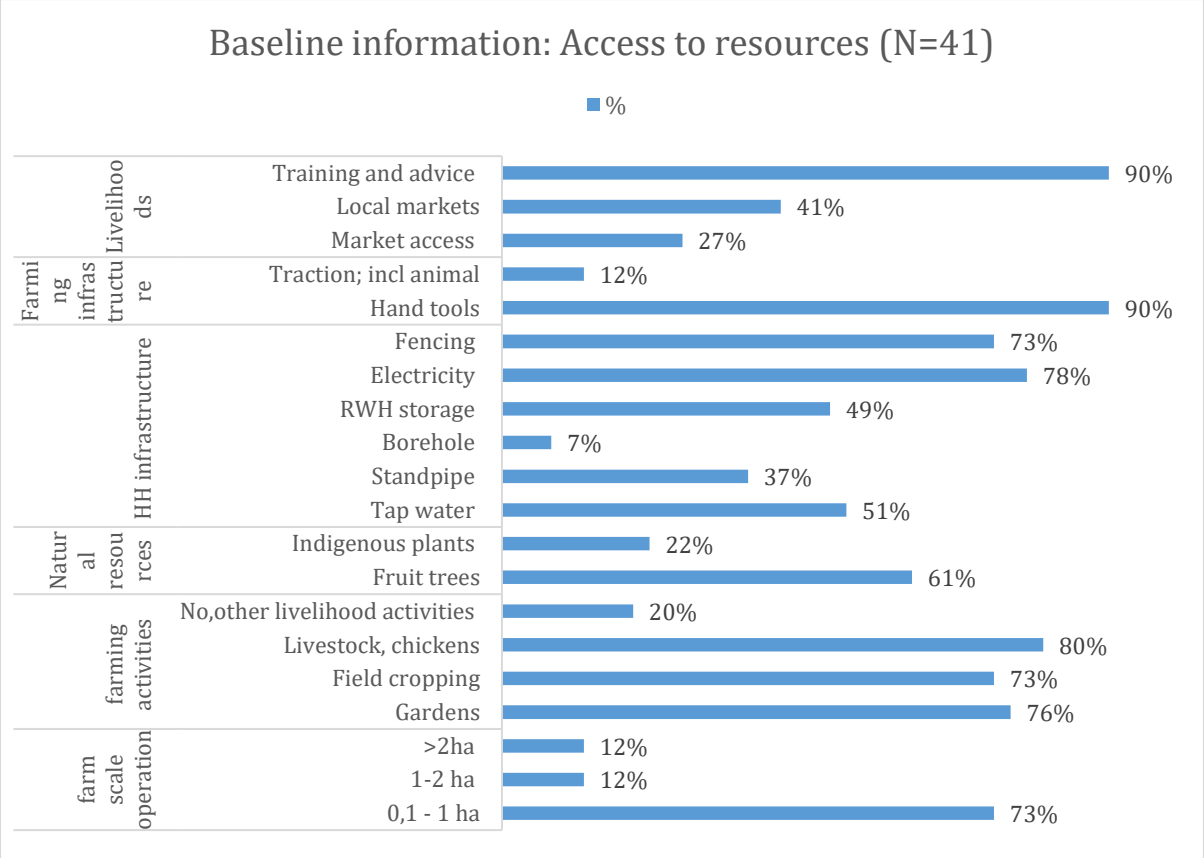


From this summary table it is possible to build a 'profile' of the community members who have been engaging on a voluntary basis in this climate change adaptation learning process:

- Around 71% of the participants in this process are women and the average age of participants is 51 years.
- Female headed households consist of 63%, and in general 76% of participants are heads of their household.
- All participants belong to social groups linked to livelihood activities in the following order of prevalence: learning groups, savings groups, school gardening groups and cooperatives.
- Average household size is 6 people, with slightly more adults on average, than children in each household
- The dependency ratio is 1,14
- Income is received from grants for 63% of households, from salaries for 46% of households and from sale of produce for 36,5% of households

- Average income for unemployed households (no-one in the household is employed) is R 2330/month and for those households where 1 or more members are employed is R5770/month.
- Severe disparity in income potential between male and female headed households, linked to a higher dependency ratio indicating care for more children, in female headed households indicate the high level of vulnerability of these households. This is summarised in the small summary table below.

Household head	Ave hh income	Dependency ratio
Male headed	R 6 730	0,89
Female headed	R 1 361	1,21



The picture for access to resources indicates that:

- A large proportion of participants (73%) have access to small areas of land (0,1-1ha) for gardening and cropping,
- Around 80% of participants undertake mixed farming (gardening, cropping and livestock husbandry), with 20% engaging in further livelihood activities,
- Around 88% of participants have access to municipal water for household use (albeit very limited amounts. None of the participants have access to agricultural water,

- Around 90% of participants have access only to hand tools and around 12% are engaged in animal traction. None of the participants own tractors and
- Around 41% of participants have access to local markets and 27% have access to more formalised markets.

From this summary information, it is clear that support CSA needs to focus in mixed farming systems, low external input and sustainable options and livelihoods stabilisation – food first, then income. A focus on microfinance options such as savings, micro-loans and small businesses is also important.

The next section gives an indication of the proportional levels of poverty for the participant group

5.2 Typologies

Smallholder farmers fall within different categories of resource availability, capabilities and aims for their farming. A typology (segmentation approach) for the smallholder participants was developed earlier in this process. With the additional participant baselines and assessments, this typology has been ratified and an indication of the proportion of participants belonging to each category has been gleaned. The typologies are briefly summarised below

TYPOLOGY A: (2,5million); Female, farm for food only, very low incomes – mostly unemployed, access to small plots, no hh level access to water, lower education levels and no access to formal markets.
Belong to VSLAs, engage in other livelihood activities

TYPOLOGY B: (250 000) Male and female, farm for food and sell surplus, slightly higher incomes, some access to hh level water, somewhat higher education levels and no access to formal markets
Belong to VSLAs

TYPOLOGY C: (10 000); Male, farm mainly for income, much higher incomes from employment in hh, good access to water, higher education levels and access to formal markets.
Belong to cooperatives or farm individually

The table below indicates the typology for each of the participants interviewed for the baseline assessment

Table 16: Typologies for participants in baseline survey, 2019

Province	Village	Name and Surname	Typology A	Typology B	Typology C
	Sekororo	Chenne Mailula	0	1	0
	Sekororo	Lydia Sechube	1	0	0
	Sekororo	Xhukwane	0	1	0
	Sekororo	Masine Morerwa	0	0	1
Limpopo	**Sekororo**	Mdimi Shai	0	1	0

	Sekororo	Flora Maimela	1	0	0
	Swayimane	Khanyisile Xasibe	1	0	0
	Swayimane	Thandazile Mathonsi	0	1	0
	Swayimane	Constance Mcanyana	1	0	0
	Swayimane	Busisiwe Khoza	1	0	0
	Swayimane	Lindiwe Zondi	1	0	0
	Swayimane	Gugu Ximba	1	0	0
	Ntabamhlophe	Winnie Dlamini	0	1	0
	Ntabamhlophe	Zanele Ngobese	0	0	1
	Eqeleni	Ntombakhe Zikode	1	0	0
	Eqeleni	Thulile Zikode	1	0	0
	Eqeleni	Sibongile Zikode	1	0	0
	Eqeleni	Nomalanga Khumalo	1	0	0
	Eqeleni	Balungile Mkhwanazi	1	0	0
	Eqeleni	Sizeni Dlamini	0	1	0
	Ezibomvini	Nombono Dladla	1	0	0
	Ezibomvini	Zodwa Zikode	1	0	0
	Ezibomvini	Phumelele Hlongwane	0	1	0
	Ezibomvini	Sdudla Sibiya	1	0	0
	Ezibomvini	Fikile Zikode	1	0	0
	Ezibomvini	Gcinile Zikode	1	0	0
KZN	**Ezibomvini**	Nonhlanhla Zikode	0	1	0
	Mxumbu	Pheza Makisi	0	0	1
	Mxumbu	Bongiwe Mxonywa	1	0	0
	Mxumbu	Xolisa Dwane	0	0	1
	Mxumbu	Mncadi Mabandla	0	0	1
	Mxumbu	Mandisa Mama	0	0	1
	Mxumbu	Siyabulela Gungqceni	0	1	0
	Mxumbu	Thangolomuzi Hogana	0	0	1
	Dimbaza	Aviwe Biko	1	0	0
	Nowawe	Jack Mphangeli	1	0	0
	Xhukwane	Jende Monwabisi	0	1	0
	Dimbaza	Tshembela Nadathini	0	0	1
	Ginsberg	Parichi Edmore	0	1	0
	Quzini	Msisiwe Phindiwe	0	0	1
EC	Quzini	Nomasomi Mjacu	0	0	1
TOTAL			**20**	**11**	**10**

From this table, 49% of participants fall under typology A, 27% under typology B and 24 % under typology C. The proportions are somewhat different to a broader assessment of typologies for rural

smallholder communities; which indicate 72% in typology A, 29% in typology B and 5% in typology C (Cousins B, 2015)[3] .

The proportion of participants in the different segments of typologies, for this study, indicate a good spread of people across all three typologies and indicate that the methodology and decision support process is appropriate for all three typologies.

5.3 Refinement of the DSS Model

All information, except the physical environment; i.e. climate, soil and topography, and the resources and management strategies, were derived through the use of a range of participatory processes. Data on the physical environmental conditions have been taken from datasets freely available online. This information can however be customised by the DSS user, in case more appropriate information is available for the specific farmer concerned.

The first round of modelling consisted of using the baseline information of 26 HH across KZN, EC and Limpopo to assess the fit of the model. The output of the model is a list/basket of practices for each farmer based on the physical environment, farming system and farmer typology.

- Variables in the physical environment include: the agroecological zone, soil texture, percentage organic carbon, and slope
- Variables in the farming system include: gardening, field cropping livestock management and natural resources/trees
- Within each farming system the resources to manage are assessed- as further variables using the following criteria:

Resources and management strategies												
water (quantity)			soil (fertility)		crop/tree resistance and efficiency				Livestock resistance and efficiency			
harvesting	retention	use efficiency	conservation	improvement	water	heat	nutrient	disease	water	heat	nutrient	disease

[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).

Four types of resources have been identified: water, and in particular quantity (1), soil, in particular fertility (2), crops (3) and livestock (4), in particular efficiency and resistance, as represented in Figure 4. Efficiency refers to the conversion of water, nutrients or land into the required output, such as biomass per unit area of land cultivation or seed generation of the plant itself. Resistance relates to crops or livestock that are for example better adapted to drought or heat conditions or better protected against diseases, etc.

- Variables in the farmer typology include: gender of household head, dependency ratio, level of education, employment status, income, electricity or tap water in the household, access to markets, reason for farming and farm size (These are the independent variables extracted from the baseline survey for each farmer).

5.3.1 **Assumptions made**

The information provided in this section as well as the section above has been compiled and used to build Table 3. The justification for managing the different resources in our DSS is as follows:

- Semi-arid warm: in this environment water is limited and the temperatures can be hot. Water and heat stress are the main limiting factors. Pests and diseases in plants and animals are present.
- Sub-humid cool: in a more humid environment, weeds grow well and can create a competing environment for nutrients. Plants and animals are also more prone to diseases.
- Sandy soils: those soils have poor structures, with low water and nutrient holding capacity. They heat up fast. Certain practices are not suitable in sandy soils and more specifically sandy soils in semi-arid regions, where rainfed crops and trees can be difficult to establish and maintain.
- Clayey soils: high level of clay can increase the probability of erosion due to crusting, in particular under semi-arid environment. Water and OC retention in clay soils are important management principles.
- OC: soils with less than 1,5% OC are considered to be of low fertility. %OC in sandy soils is inherently lower and more difficult to build up than in high clay soils.
- Slope: above 5% sloping, agricultural production becomes sub-optimal due to erosion and run-off, in both semi-arid and sub-humid regions. Slope above 15%; agricultural production is not suitable under all conditions, due to water and nutrient run-off.

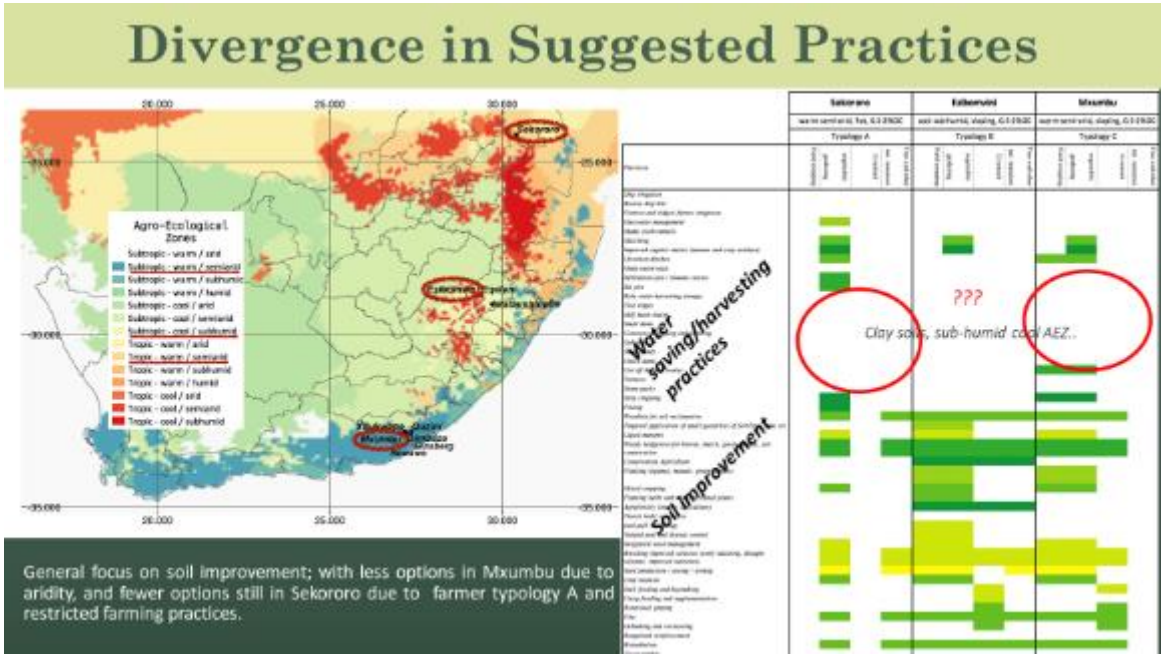
Table 9 allows us to identify, for each farming HH, the resources to manage and the related strategies within each farming system taking the environmental conditions into account. It thus combines the proxis for the physical environment, farming systems and management strategies.

Table 17:Criteria to define the resources to manage and related strategies (version 1)
Note: * (solely in semi-arid zone)

			Resources and management strategies												
			Water (quantity)			soil (fertility)		crop/tree resistance and efficiency				Livestock resistance and efficiency			
			Harvesting	retention	use efficiency	conservation	improvement	Water	Heat	nutrient	disease	Water	Heat	nutrient	disease
Proxies for physical environment	AEZ	Tropics semiarid warm													
		Subtropics semiarid warm													
		Subtropics sub-humid cool													
	Soil texture	Sandy soils													
		Loamy soils													
		Clayey soils				*									
		Silty soils													
	Soil OC	<0.5%													
		0.5-2%													
		>2%													
	Slope	<5%													
		5-15%	*	*	*	*									
		>15%													
Farming system		Field cropping													
		vegetable gardening													
		Livestock													
		Tree and other nat. resources													

5.3.2 **Practices recommended (Round 1) for 26 HH**

Based on the above assumptions and proxies a list of practices were recommended for the initial 26 household baseline. These lists have been "reality tested" against the facilitation team's general experience in the areas. It was found that soil and water conservation practices were under represented when using this version of the model. This outcome is summarised in the slide below (as presented at the Agroecology Networking session in December 2018)



5.3.3 **Refinement of the DSS model (Version 2)**

Three changes have been made:

1. It has been assumed that water (harvesting, retention and use efficiency) is important for all farmers (thus=1 for all)
2. It has been assumed that soil conservation is important for all farmers (thus=1 for all)
3. Certain restrictions for soil texture and slope have been removed. Water (harvesting, retention and use efficiency) and soil conservation are no longer restricted to the semi-arid zone only, as was the case in the first round.

The table 9 above has thus been changed as shown in table 10 below. Basically the *s have been removed

Table 18: Criteria to define the resources to manage and related strategies (version 2)

			Resources and management strategies											
			Water (quantity)			soil (fertility)		crop/tree resistance and efficiency				Livestock resistance and efficiency			
			Harvesting	retention	use efficiency	conservation	improvement	Water	Heat	nutrient	disease	Water	Heat	nutrient	disease
Proxies for physical environment	AEZ	Tropics semiarid warm													
		Subtropics semiarid warm													
		Subtropics sub-humid cool													
	Soil texture	Sandy soils													
		Loamy soils													
		Clayey soils													
		Silty soils													
	Soil OC	<0.5%													
		0.5-2%													
		>2%													
	Slope	<5%													
		5-15%													
		>15%													
Farming system		Field cropping													
		vegetatble gardening													
		Livestock													
		Tree and other nat. resources													

Minor changes were also made to some of the excel formulae used in the model.
These changes have broadened the practices recommended for most of the participants, as shown in the examples below; one participant each from KZN, Limpopo and Eastern Cape. The practices highlighted in brown are new practices included in version 2 of the model, a further 9 practices related to soil and water conservation. This version is considered a better fit for conditions on the ground.

Table 19: Basket/list of practices recommended for version 1 and 2 of the DSS

Province	**KZN**		**Limpopo**		**EC**	
Village	**Ezibomvini**		**Sekororo**		**Mxumbu**	
Name and Surname	**Phumelele Hlongwane**		**Chenne Mailula**		**Xolisa Dwane**	
DSS versions	**Version 2**	**Version 1**	**Version 2**	**Version 1**	**Version 2**	**Version 1**
Drip irrigation	0	0	0	0	0	0
Bucket drip kits	0	0	0	0	0	0
Furrows and ridges/ furrow irrigation	0	0	0	0	0	0
Greywater management	1	0	1	0	0	0
Shade cloth tunnels	1	0	1	0	0	0
Mulching	1	1	1	1	0	0

Improved organic matter (manure and crop residues)	1	1	1	1	1	1
Diversion ditches	1	0	0	0	0	0
Grass water ways	0	0	0	0	0	0
Infiltration pits / banana circles	1	1	1	1	0	0
Zai pits	1	1	0	0	0	0
Rain water harvesting storage	1	0	1	1	1	1
Tied ridges	0	0	0	0	0	0
Half moon basins	0	0	0	0	1	1
Small dams	0	0	0	0	0	0
Contours; ploughing and planting	1	0	0	0	0	0
Gabions	0	0	0	0	1	1
Stone bunds	0	0	0	0	0	0
Check dams	0	0	0	0	1	1
Cut off drains / swales	0	0	0	0	1	1
Terraces	0	0	0	0	0	0
Stone packs	1	0	0	0	0	0
Strip cropping	1	0	0	0	0	0
Pitting	1	0	1	1	0	0
Woodlots for soil reclamation	1	1	0	0	0	0
Targeted application of small quantities of fertilizer, lime etc	1	1	0	0	0	0
Liquid manures	1	1	1	1	0	0
Woody hedgerows for browse, mulch, green manure, soil conservation	1	1	0	0	0	0
Conservation Agriculture	1	1	0	0	0	0
Planting legumes, manure, green manures	1	1	0	0	0	0
Mixed cropping	1	1	0	0	0	0
Planting herbs and multifunctional plants	1	1	0	0	0	0
Agroforestry (trees + agriculture)	1	1	0	0	0	0
Trench beds/ eco circles	1	0	1	0	0	0
push-pull technology	1	1	0	0	0	0
Natural pest and disease control	1	1	0	0	0	0
Integrated weed management	1	1	1	1	1	1
Breeding improved varieties (early maturing, drought tolerant, improved nutrients),	1	1	1	1	1	1
Seed production / saving / storing	1	1	1	1	1	1
Crop rotation	1	1	1	1	1	1
Stall feeding and haymaking	0	0	0	0	0	1
Creep feeding and supplementation	1	1	0	0	0	0
Rotational grazing	1	1	0	0	1	1

De-bushing and over sowing	1	1	0	0	1	1
Rangeland reinforcement	1	1	0	0	1	1
Bioturbation	1	1	1	1	1	1
Tower garden	1	1	1	1	0	0
Keyhole beds	1	1	1	1	0	0
No of practices recommended	**35**	**26**	**16**	**13**	**14**	**15**

For the KZN participant, this means that around 88% of the list of practices have been recommended for her. She already had the largest number of recommendations (in version1) being a farmer in Typology B (fewer restrictions) and engaging in gardening, cropping and livestock production. Although this is quite high, it is understood that the farmer level ranking is still to take place and these practices can then be prioritized and narrowed down further. For the Limpopo and EC participants, around 1/3 of practices have been recommended in their basket of options.

A general analysis of practices for the 41 households shows that only 5 practices have been recommended for all (opposed to 4 in version 1):

- Improved organic matter
- Integrated weed management
- Breeding improved varieties
- Seed production / saving / storing
- Rainwater harvesting storage

And a number of practices have been recommended for none of the 41 HH:

- Drip irrigation
- Bucket drip kits
- Furrows and ridges/ furrow irrigation
- Stone bunds
- Terraces
- Tied ridges
- Grassed waterways
- Stall feeding and haymaking

These practices are constrained by land size, typology and slope of the most part, but are not considered inherently unsuitable for smallholder farmers. They could still be presented to learning groups in special cases, where their applicability is considered suitable.

5.3.4 **Ranking of suggested practices based on score provided by the facilitator**

Based on scores provided by the facilitator (the generic score used in the DSS) the basket of practices can be ordered by preference. In the table below, a ranking based on facilitator's scores, is provided

for the farming HH 'Phumelele Hlongwane' located in Ezibomvini, KZN. According to the facilitator, improving organic matter, pitting, Conservation Agriculture and Agroforestry are the most appropriate interventions (having the highest score). are the most appropriate practices suggested by the DSS for this HH. This is followed by keyhole beds, tower gardens, woody hedgerows, Zai pits and infiltration pits.

Table 20:Ranking of suggested practices by 'the facilitator' for Phumelele Hlongwane (DSS version 2)

E. Score provided by facilitator for suggested practices that are not constrained				Practices
Field cropping	gardening vegetable	Livestock	nat.resources Tree and other	
0	0	0	0	Drip irrigation
0	0	0	0	Bucket drip kits
0	0	0	0	Furrows and ridges/ furrow irrigation
0	5	0	0	Greywater management
0	8	0	0	Shade cloth tunnels
0	9	0	0	Mulching
11	11	0	11	Improved organic matter (manure and crop residues)
9	9	0	9	Diversion ditches
0	0	0	0	Grass water ways
0	10	0	0	Infiltration pits / banana circles
10	10	0	0	Zai pits
9	9	9	9	Rain water harvesting storage
0	0	0	0	Tied ridges
0	0	0	0	Half moon basins
0	0	0	0	Small dams
0	0	0	0	Contours; ploughing and planting
0	0	0	0	Gabions
0	0	0	0	Stone bunds
0	0	0	0	Check dams
0	0	0	0	Cut off drains / swales
0	0	0	0	Terraces
9	9	0	9	Stone packs
11	0	0	0	Strip cropping
11	0	11	11	Pitting
9	0	9	9	Woodlots for soil reclamation
8	0	0	0	Targeted application of small quantities of fertilizer, lime etc
0	7	0	0	Liquid manures
10	0	10	10	Woody hedgerows for browse, mulch, green manure, soil conservation
11	11	11	11	Conservation Agriculture
8	8	0	8	Planting legumes, manure, green manures
9	9	0	0	Mixed cropping
9	9	0	0	Planting herbs and multifunctional plants
11	11	11	11	Agroforestry (trees + agriculture)
0	9	0	0	Trench beds/ ecocircles
7	0	0	0	push-pull technology
7	7	0	7	Natural pest and disease control
7	7	0	7	Integrated weed management
7	7	7	7	Breeding improved varieties (early maturing, drought tolerant, improved nutrients),
6	6	0	6	Seed production / saving / storing
9	9	0	0	Crop rotation
0	0	0	0	Stall feeding and haymaking
0	0	7	0	Creep feeding and supplementation
0	0	9	0	Rotational grazing
0	0	9	0	Debushing and oversowing
0	0	9	0	Rangeland reinforcement
9	9	9	9	Bioturbation
0	10	0	0	Tower garden
0	10	0	0	Keyhole beds

5.3.5 Ranking of suggested practices based on score provided by the farmer

A participatory impact monitoring process for the KZN participants (Bergville and Tabamhlophe) provided an assessment of practices **actually tried out and prioritized for impact on livelihoods**. This gives us an opportunity to compare the outcomes of the computer based DSS with a real case study.

The table below summarises the practices according to those recommended through the DSS, but not yet tried, those not recommended but tried and practices tried out that are not in the DSS list of practices.

Table 21: Analysis of CSA practices implemented in KZN (Bergville, Tabamhlophe) – 2017-2019

Practices recommended not yet tried	Practices tried, not recommended	Not in recommendations
Zai pits	Bucket drip irrigation	Making compost
Contours; ploughing and planting		Improved irrigation practices
Stone packs		Spring protection
Strip cropping		Limited burning of veld
Pitting		Vaccinations and dipping
Agroforestry		
Natural pest and disease control		
Breeding improved varieties		
Seed saving		
Integrated weed management		
Rotational grazing		
De-bushing and over-sowing		
Rangeland reinforcement		
Keyhole beds		

The facilitated DSS process is designed to be cyclical and seasonal, to allow smallholder farmers to prioritize and experiment with a couple of prioritized practices at a time and to build on these, over time. The results above indicate the work to date over 2 seasons. Practices blocked in green are those that have already been planned into the coming growing season. These include strip cropping, natural pest and disease control, seed saving and keyhole beds.

The practices not recommended by tried out by farmers, are those that should still be included in the DSS and will be considered in the 3rd and final version of this model

Overall there is a very good coherence in practices recommended by the computer- based model and those recommended through the facilitated process.

6 DEVELOPMENT OF MATERIALS AND MANUALS

At present work on the facilitation manual for the DSS in Climate Smart Agriculture is underway. It will cover the theoretical underpinnings, methodologies used and detailed facilitation outlines for the climate change adaptation workshop series (workshops 1-3) designed to facilitate this process. A linked booklet of resources is to be produced for use during the workshops.

The first draft of the manual is presented in Attachment 2 to this report.

Farmer level learning materials have been adapted from existing learning materials:

- Kruger E. 2015. **Introduction to Conservation Agriculture**. Produced by the GrainSA Conservation Farmer Innovation Programme, with financial support provided by The Maize Trust
- Kruger E and Wigley J. 2011. Composting and Manure Utilization: natural methods for improving soil fertility. Produced by the Empowerment for Food Security Programme, KwaZulu Natal Department of Agriculture, environmental Affairs and Rural Development with financial support provided by FICA.
- Kruger E, de Lange M and Stimie CM. 2009. Agricultural Water management in Homestead farming Systems: A resource Kit for Farmers, Farmer Trainers and Facilitators. Produced by the Water Research Commission.

These learning materials are available in both English and isiZulu.
siPedi translations have been made for the following handouts (for use in Limpopo):

- Farmer level experimentation
- Soil
- Methods for improving soil fertility
- Bed design for soil fertility
- Bag and tower gardens
- Keyhole gardens
- Seed saving
- Natural pest and disease control
- Fruit production and natural pest control

These handouts are presented in Attachment 3 to this report.

(a) Cropping calendars

As changes in planting times and changes in crops suitable for planting is a substantial part of the climate change adaptation process, a participatory process was undertaken in Limpopo, in conjunction with the AWARD agricultural Support Initiative to design cropping calendars suitable to the area under climate change conditions. A calendar has been produced for both dry land cropping and vegetable production. They are shown in the 2 diagrams below:

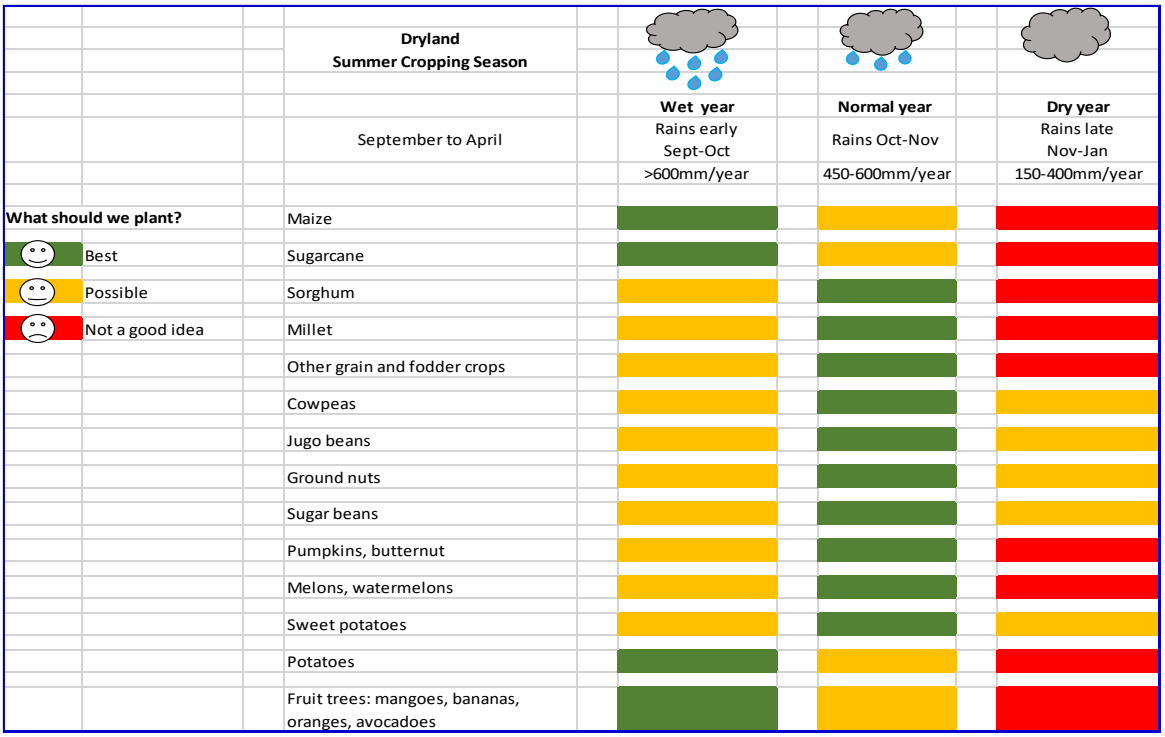


Figure 3: Dry land cropping calendar for Lower Olifant's in Limpopo, March 2019

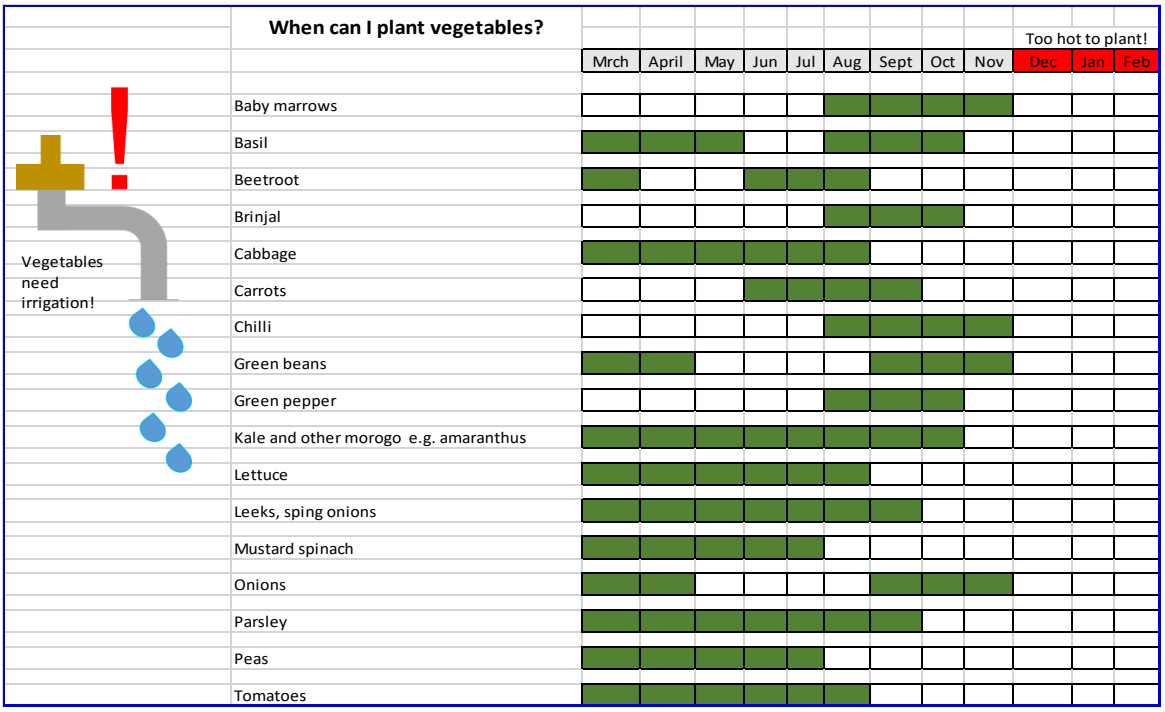


Figure 4: vegetable production calendar for the Lower Olifant's in Limpopo, March 2019

7 CAPACITY BUILDING AND PUBLICATIONS

Capacity building has been undertaken on three levels:

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

Community level and organisational capacity building have continued within this reporting period.

7.1 Post graduate students

A number of changes have occurred within the postgraduate students. Two students have withdrawn from this process:

- Sylvester Selala has withdrawn from registration of hi PhD concept and has left the employ of MDF. He will not pursue a doctorate at this time.
- Khethwie Mthethwa has found permanent employment and is not presently registered for her second year of an MSC. This is mostly due to the fact the UKZN only offers 1 year of fee remission for Masters candidates and the director of MDF was not made aware of this fact in time.

Another student has re-registered and is presently self-funded:

- Palesa Motaung has suffered in her registration process due to the ARC not paying bursaries as awarded to postgraduate students. She has now paid some of her own fees and commenced with her field work.

And a new PhD candidate has come on board as an intern at MDF

- Samukhelisiwe Mkhize has recently registered for a PhD in Social Sciences (Policy and Development Studies). The topic of her concept proposal is *An investigation into the factors limiting and promoting the adoption of CSA in smallholder systems in South Africa* (See some of her notes linked to her concept proposal in Attachment 4)

Progress: Research methodology and initial field work:

- 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.*

In the last five months Mazwi has commenced with his field work and has undertaken a number of focus group discussions and started on the individual interviews- which is the first round of the research process. He is presently writing up the findings as a chapter of his thesis.

7.2 Networking and presentations

7.2.1 Joint farmers day with KZNDARD in Bergville (12 March 2019)

The day consisted of a field visit to a liming trial that was conducted with KZNDARD on the CA plot for one of the programme participants in Mahlathini (Stulwane), Bergville. Thereafter, all participants joined for presentations on

- Best practice in liming (Mr Mashiyane – Landcare KZNDARD),
- Cultivation and benefits of soy beans (Mr Johns, Cedara, KZNDARD) and
- Soil health benefits of Conservation Agriculture (Miss Zondi, MDF)

Right: Mr Mashiyane discussing the advantages of incorporation of lime in the soil vs broadcasting and
Far Right: Miss Zondi presenting results of soil health analysis in participants' plots

7.2.2 Agroecology Network: Agro-ecology smallholder farmers open Day (12 March 2019)

Attendees: Smallholder Farmers, Traditional authorities, NGOs, CBOs, RBOs, Universities & Research Institutions, Private Sector, Donor organisations, Municipalities, Government Organisations and any other individuals or organisation with interest in working with smallholder farmers in Mopani, Sekhukhune and Capricorn Districts

The purpose of this shared learning event was to;

o Provide opportunities for sharing of experiences and agroecological good practices and challenges amongst smallholder farmers in Capricorn, Mopani and Sekhukhune districts, Limpopo Province, South Africa

o Enable smallholder farmers to showcase their achievements of practising agroecology as a strategy for climate change and adaptation

o Demonstrate the impact that AWARD/RESILIM O's Agriculture Support Initiative (AgriSI) is having on the lives of smallholder farmers within the Olifants' river sub catchment of the Limpopo basin.

Participant farmers collated posters with photographs and comments for their CSA practices to present on the day.

Right: Farmers survey their CSA practice posters.

On the day the following visits were conducted:

- Extensive clinic garden run along agroecology principles in Groblersdal
- 2 Youth projects in the area
- A CSA garden in Tafelkop and
- A seed saving initiative in Monsterlus

At this venue farmers also presented their best practice options and discussed their progress.

Right: Christinah Thobejane from Sedawa (Lower Olifants') presenting her CSA practices.