Deliverable

9

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.9: Interim Report. Results of pilots Season 2

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ABBREVIATIONS

AEZ	Agroecological Zones
CA	Conservation Agriculture
CCA	Climate change adaptation
CRA	Climate Resilient Agriculture
CSA	Climate Smart Agriculture
CSAG	Climate Systems Action Group
DAE	Department of Environmental Affairs
DSS	Decision Support System
MDF	Mahlathini Development Foundation
QCTO	Quality Council for Trade and Occupations
RIEng	Rural Integrated Engineering
SWC	Soil and water conservation
UJ	University of Johannesburg
UKZN	University of KwaZulu Natal

Interim Report: Results of pilots, season 2

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 9

This report focuses on piloting the decision support process in new contexts, consolidation of the practises database and inclusion of more practices and reviews of implementation to date; piloting the new participatory resilience assessment framework. Farmer level experimentation with practices and development of the internet-based platform and the manuals and handouts are ongoing and progress is reported on.

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. This 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 five-month period have included:

- **Practices activities**: Inclusion of learning processes, experimentation and learning materials towards compiling practice summaries for small dam construction and livestock fodder production and supplementation and design of a web-based survey/platform for the decision support system.
- **Process activities**: Continuation of farmer level experimentation in the EC (3 villages), KZN (3 villages) and in Limpopo (2 villages). CoP engagement has consisted of presentation of a model for vulnerability assessments at the NRVF workshop hosted by DARDLEA, co-hosting a farmers day in Sedawa (Limpopo) with Agroecology network members on processing and value addition in smallholder farming, a National workshop hosted by AWARD on sharing climate change adaptation experiences, collaboration with the INR in an Umgeni Water pilot project; the uMkhomzai Restoration Project, collaboration with a GEF5 funded programme at Rhodes University, assisting with development of a framework for vulnerability assessments and a joint presentation with KZNDARD on climate change adaptation success stories for the Okahlamba land and agriculture summit.
- **Monitoring and evaluation:** Further testing of the participatory impact assessment framework in Limpopo.

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

Date	Activity	Description	Team
2019/08/02	Agroecology network	Farmers day and workshop on value adding and processing for participant learning groups	Erna, Betty
2019/08/06	National Risk and Vulnerability Framework (NRVF) workshop DARDLEA	Presentation of MDF's model for vulnerability assessments at the workshop in JHB.	Erna
2019/08/12	AWARD; Sharing CCA experiences	National workshop in JHB including members of the Adaptation Network in intensive sharing of experiences	Erna
2019/08/12,22	1. Fourth Ukulinga Howard Davis Memorial Symposium	Developing resilience through partnerships and collaboration. Hosted by UKZN. Presentation on climate smart agriculture	Erna, Mazwi, Phumzile, Tema

2019/09/10,12	Participatory impact assessments	For KZN (Gobizembe) and Limpopo (Turkey)	Erna, Tema Nontokozo, Betty
2019/09/29,30	Learning sessions	Natural pest and disease control workshops for KZN learning groups – Bergville, Gobizembe	Erna, Tema, Nontokozo, Phumzile
2019/10/07-11	Rhodes -GEF workshop; EC pilots	Vulnerability assessment workshop at Rhodes University. Learning and monitoring for 3 learning groups in Eastern Cape; including CA – ripping and planting, Natural pest and Disease Control and shade net tunnel construction	Erna, Tema, Mazwi, Lawrence
2019/10/14,15 and 28,29	uMkomazi Restoration Project	Climate change impacts and adaptation scenario development workshops in 2 villages in Impendle	Erna, Tema.
2019 -Oct-Nov	Ezibomvini (Bergville) Spring Protection	Water committee process for implementation of spring protection and reticulation to learning group members' households	Erna, Phumzile, Chris
2019/11/25	Okahlamba land and Agric summit	Presentation of a position paper for CCA in KZN and success stories	Erna, Tema
2019/11/28, and 2019/12/11	Fodder supplementation and production learning workshop	In collaboration with CEDARA Argic College- Review of supplementation experimentation and introduction of strip cropping in Stulwane (Bergville,KZN), Madzikane (Madzikane Forum Open day in association with KZNDARD and LandCAre) and Ozwathini	Erna, Phumzile, Tema, Mazwi, Alan Manson and Charmaine Mchunu
2019 Nov-Dec	Limpopo water committees - boreholes	Water committee activities in drilling boreholes and reticulating water to learning group members	Erna ,Betty
2020/01/09,10,16		Strip cropping field demonstrations in Bergville (stulwane), Madzikane (SKZN)and Ozwathini (Midlands)	Erna, Phumzile, Tema, Mazwi, Alan Manson and Charmaine Mchunu
2020/01/03		Uploading of DSS and e-survey onto MDF website	Erna, Matthew Evans

Capacity building and publications:

- Research presentations and chapters:
    - Mazwi Dlamini – M Phil (PLAAS UWC-yr 2); Continuation with fieldwork
    - Palesa Motaung – M Soil Science (UP); Finalisation of research results and write up of thesis in progress
- Publications:

- Cross visits: Agroecology Network farmers open day on process and value adding in Sedawa (Limpopo)
- Stakeholder engagement:
    - Collaboration in uMkhomazi restoration Project – Umngeni Water and the INR
    - Collaboration with GEF5 team at Rhodes University – vulnerability assessments
- Conference papers and presentations: -
    - Adaptation Network: National workshop on Climate change adaptation experiences. Presentation on smallholder DSS
    - NRVF workshop DEAT: Presentation on vulnerability assessment methodology
    - Ukulinga Howard Davis Symposium; UKZN: Presentation on climate resilient agriculture.
    - Okahlamba Land and Agriculture summit; presentation on Climate change and CCA success story

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 (September 2019-October 2020)

*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 **-** Monitoring and review of CA experimentation **-CA experimentation introduction (2nd round)**	-Farmers w NGO support (Lima RDF)	- Tunnels and drip kits - Individual experimentation with basket of options -Conservation Agriculture
	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 **-**Monitoring and review of CA experimentation - Fodder and supplementation learning process - Natural P&D control learning **-Water issues continuation (Spring protection)** -**Strip cropping and CA experimentation continuation**	-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/ Gobizembe	- CCA workshop 1 **-**CCA workshops 2 and 3 **-**CCA workshop 4 **-** Monitoring, review and re planning **-** Monitoring of garden, tunnel and CA experimentation **-PIA and Nat Pest& disease control learning session** **-CA experimentation continuation**	-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 -Set up of gardening and tunnel experimentation - **Madzikane Forum open day – strip cropping and CA mechanisation**. - **Strip cropping and CA experimentation continuation**	-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 -CA learning and mentoring - Monitoring, review and re-planning -S&WC and small dams learning and experimentation -Monitoring of CA experimentation -**Open day; Value adding and processing** **-PIA's (Mametja, Sedawa, Turkey)** **-Water Committees – boreholes and reticulation** **- CC impact and adaptation strategies workshop- new villages** **- CA experimentation continuation**	- 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
	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/Middled rift area	- CCA workshop 1 - CCA workshop 2 - CCA workshop 3 -CCA workshop 4 and 5 - Monitoring, review and re-planning - Set up tunnel experimentation process **-Learning sessions in CA, NP&D control and tunnel construction**	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 Tunnel experimentation progress

This farmer level experiment has been continued with the three participants in Bergville (Phumelele Hlongwane, Nombono Dladla and Ntombakhe Zikode), one participant in Swayimane and one participant in Madzikane as well as 12 participants in Limpopo (Sedawa, Turkey, Mametja)

The experiment is to plant a range of vegetables in trench beds (with or without mulching), inside and outside the tunnels and to compare productivity. Water productivity has not been calculated for this round of experimentation; mainly due to difficulties in getting farmers to focus on accurate record keeping. Qualitative assessments have however been conducted with the farmers to ascertain progress and learning by farmers and their learning groups.

Although the research team was intent upon repeating the WP results to gain a second season's worth of information, the farmers felt as though they had already learnt how it worked and fine-tuned their practice and consequently could not be persuaded to focus on the record keeping aspects in enough detail.

In Madzikane (the 2nd Southern KZN site), the farmer chosen for this process by the learning group, was not up to the task. She presented many excuses and reasons, the main one being lack of water – even though upon choosing her site, she had insisted she had access to water. The tunnel will be moved in January 2020.

In Limpopo, 12 participants were taking part in the process alongside three participants who were meant to be keeping records and for whom chameleon readings were taken. Again, an almost blanket lack of recording, despite numerous attempts to ensure that this was happening, took place.

Thus, a more qualitative analysis of this practice was undertaken through monitoring and interviews.

2.1.1 **Bergville**

(a) Ezibomvini (Phumelele Hlongwane and Nombono Dladla) and Ntombakhe Zikode (Eqeleni)

Bergville has been in the grip of a quite severe drought, with uncharacteristically high temperatures, even during winter. The summer rains only finally set in during the first week of December 2019. Consequently, participants have been hard pressed to find water for their crops, carrying water from springs and boreholes substantial distances from their homesteads.

Cropping Cycle and practices

Participants have now included *a mixed cropping regime* as their standard practice. This consists of planting between 2-5 different crops per bed for each planting cycle of around 4 months and rotating these with different crops in the following season; e.g. rotating root crops with leaf crops, or cabbage with spinach. They explain that the actual planting mixes are chosen depending on whether they are heavy feeders or not and on crops belonging to different crop families. It is clear that they are now using some of the principles of mixed cropping and crop rotation that were introduced, in their cropping cycles.

Spinach is cut / harvested 3-4 times before being replaced.

Crops grown between April and August 2019 included: Mustard spinach, kale, rape, leeks, cabbage, Spinach, Chinese cabbage, beetroot and onions, green paper and herbs (parsley, rosemary, spring onions, fennel ….). A new round of cropping commenced towards the end of September.

Crops grown between October 2019 and March 2020 include: Cabbage, spinach, beetroot, onions, green pepper, Chinese cabbage and herbs such as thyme, coriander and parsley.

Figure 1: Seedlings of vegetables and herbs being sold to participants in the learning group from the farmer centre in Ezibomvini; spinach, beetroot, cabbage, Chinese cabbage, onions, and herbs.

In addition, *seed saving* is being practised and seed of a number of the crops has been shared among participants; including coriander, parsley, rape, kale, mustard spinach and leeks.

Both the procurement of seedlings and saving of seed are new practices among these gardeners and bodes well for future sustainability of their gardening implementation.

Figure 2: Seeds that have been saved by group members and that are shared among the learning group members; including coriander, parsley, rape, mustard spinach and kale

*Mulching i*s also now being used by all three participants on an ongoing basis.

Drip irrigation is being consistently used by all three participants. They feel that this practice assists in reducing evaporation and saves them water. They have also undertaken to change the sand and gravel water filters in these buckets from time to time, as they have noticed that the application rate of water through the system slows down substantially when these "filters" become blocked.

Observations

Below is a summary of some of the observations made by the participants:

- Use of animal manure when planting successive crops in the trench beds helps to keep the fertility levels high and has also resulted in the presence of a larger number of earthworms in the beds.
- The cool season crops such as Chinese cabbage, spinach and beetroot do a lot better inside the tunnels than outside, as they are not stressed by the high variability in temperatures and excessive wind inside the tunnels
- Evaporation of water outside the tunnels has remained substantially higher outside the tunnels than inside, even during the winter months. This is the biggest advantage of the tunnels – reducing water and wind stress for the crops.

- Pest incidence was not much of a problem in the winter season.
- Although the mulching assists in weed control, some weeding is still required- especially in summer and the main advantage of the mulch is to keep the soil moist and cool.
- All three participants have increased the size of their vegetable gardens (outside tunnel beds) and are growing for household consumption and sale. Sales from these small gardens have averaged around R400-R800/ month.

Figure 3: Left; Phumelele Hlongwane's tunnel beds showing chinese cabbage, spinach, onions, parsley and cabbage and Right; Ntombakhe Zikode's tunnel with Chinese cabbage beetroot and cabbage visible.

Figure 4: Left: Nombono Dladla's garden beds outside her tunnel, featuring a bucket drip kit, spinach, onions Chinese cabbage and parsley and Right; Phumelele's much extended vegetable garden newly planted in November 2019

(b) Chameleon sensors and irrigation

These sensors have been installed in the three tunnels, mainly as a way to assist the participants to learn about different irrigation practices; working with drip irrigation, shallow watering and deep watering.

Given the extreme lack of water in the area, the temptation to add small amounts of water more often, rather than deep watering was very high for participants- evidenced in the high levels of red readings in the chameleon sensors for the driest period of the year; April- October 2019. They were constrained by access and thus elected to reduce their irrigation. In addition, the humic acids released by beds with high organic matter content (i.e. all the trench beds), slowly (or more quickly in some cases) dissolve the gypsum covering of the underground sensors over time, leading to the sensors no longer being accurate or active. It was very difficult to discern whether the lack of readings was due to the soil being dry or sensors being inactive. Sensors were replaced in September 2019

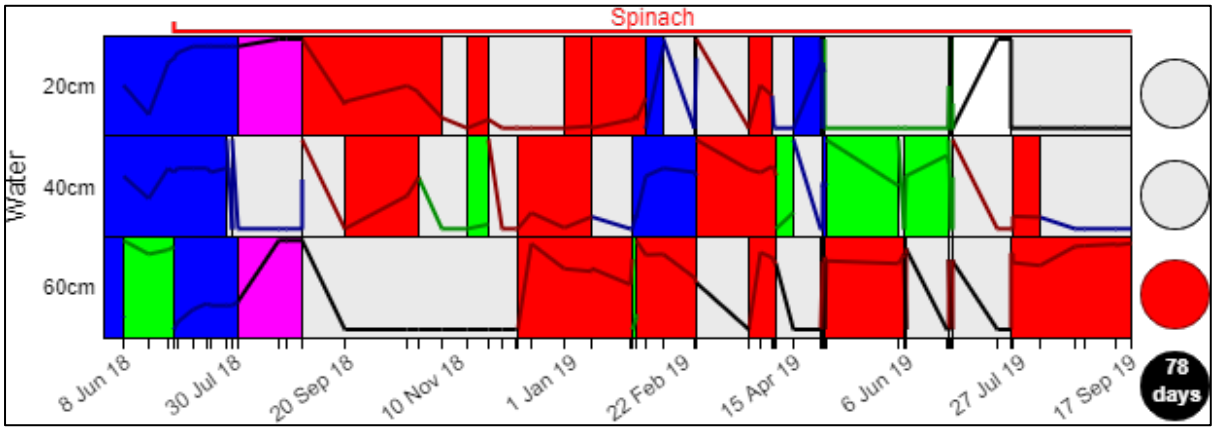


Figure 5: The chameleon sensor data for Phumelele Hlongwane's trench bed outside her tunnel for June 2018- September 2019. The grey colouring indicates either a lack of water in the soil - so little water that a reading is not possible, or the sensor not working well due to the decay of the gypsum covering. Because the sensors were grey at times and then went back to red, it was assumed for some time that the soil was just very dry.

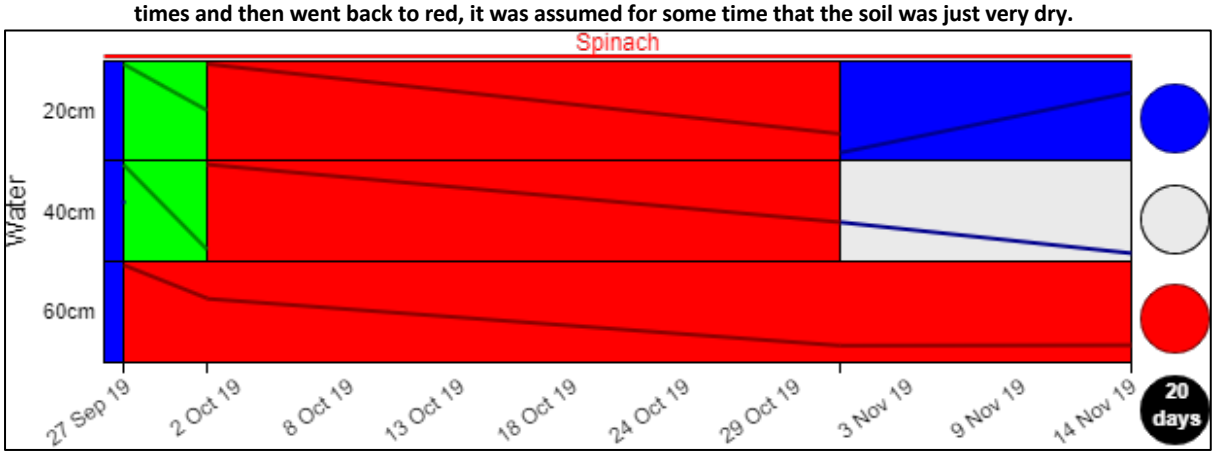


Figure 6: The chameleon sensor data for Phumelele Hlongwane's trench bed outside her tunnel after the sensor array was replaced towards the end of September. After the new sensors were installed, readings appeared to be more firmly in the red – meaning that the soil at all three depths remained very dry for the whole of October. Watering in November improved the soil water down to around 20cm depth, but not the deeper layers- indicating the shallow water both from the drip irrigation kits and hand watering, due to limited water supply.

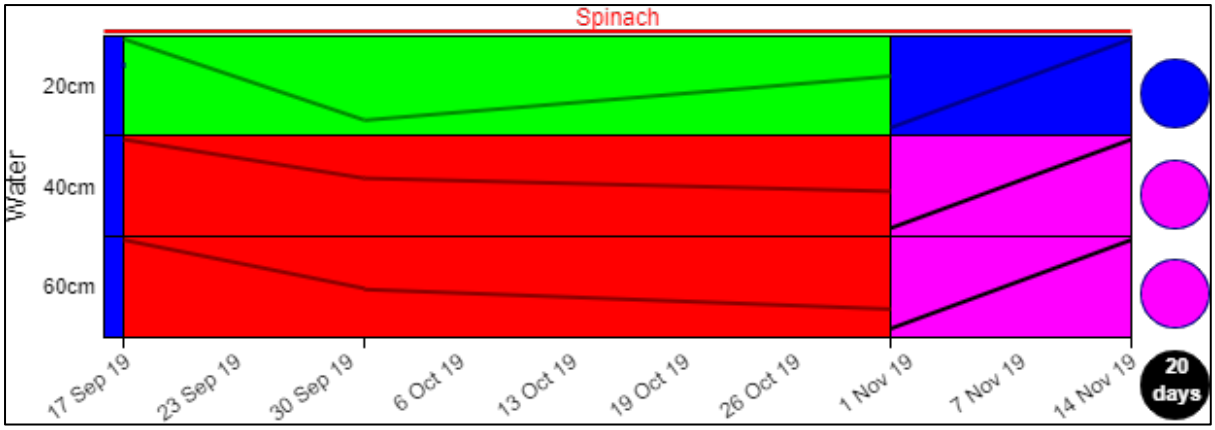


Figure 7: The chameleon sensor data for Phumelele Hlongwane's trench bed inside her tunnel after the sensor array was replaced in the middle of September. In this case, she has manged to keep her top layer (around 20cm depth of soil) well wetted between September and November and also provided enough water to allow for an increase in moisture in the deeper layers of the soil from the beginning of November. The pink readings indicate interference by humic acids in the soil, due to application of manure and compost for her new planting cycle in early November

Because Phumelele no longer kept records of actual irrigation amounts, it is very difficult to draw any significant conclusions from the chameleon sensor results. It is however clear that the watering in the tunnel was more effective in keeping the soil moist for extended periods of time, than outside the tunnel. Phumelele did indicate that she needs to supply more water outside the tunnel to keep her crops alive than inside the tunnel. A coherent cycle of record keeping will be attempted one more time for this participant. She will need more consistent support from field staff to manage this process.

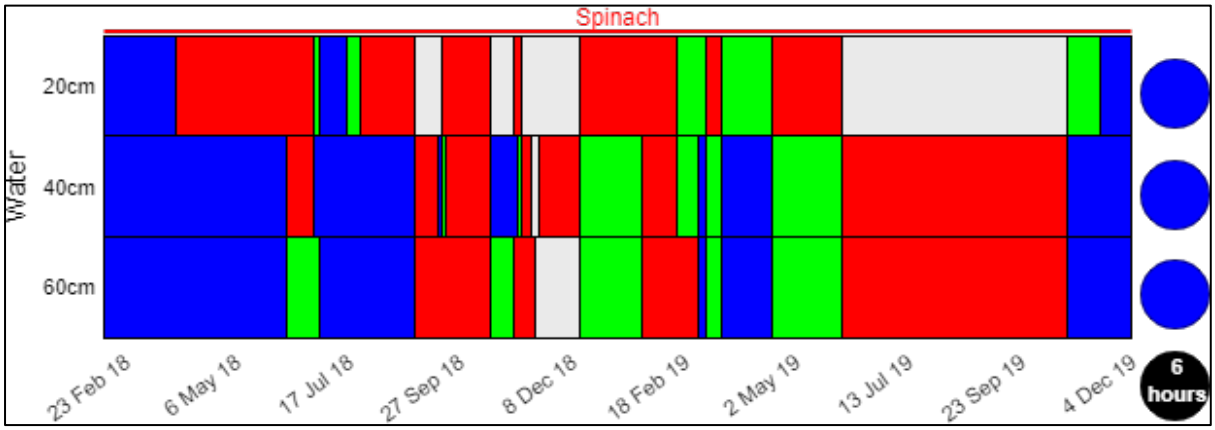


Figure 8: The chameleon sensor data for Ntombakhe Zikode's trench bed inside her tunnel between February 2019 and December 2019. It can be seen that she irrigated little between September 2018 and February 2019, starting irrigation again in the drier winter months of March- June 2019. She ran out of water almost completely between July-October 2019 and the latest good soil moisture readings (November-December 2019) are more likely due to rain than an improved ability to irrigate.

Ntombakhe Zikode's chameleon readings provide an indication of the lack of access to water for irrigation, that has become more severe as the local drought dragged out after the winter season. It is thus not really possible to use the readings from these sensors as a measure of irrigation efficiency, as in reality they provide an indication more of periods of extreme water stress.

(c) Other gardening practices; tower gardens and eco-circles

These practices have been introduced and tried out by 10-12 participants across the three learning groups involved in Bergville. For this 2nd season of implementation only a few participants have continued with implementation – notably Phumelele Hlongwane. For her ,the ability to use greywater and manage her irrigation using the bottle drip system in the eco-circles has become part of her overall gardening management practice.

Below are a few indicative pictures.

Figure 9: Above Left; One of Phumelele's tower garden sin the winter season (May 2019), showing kale, rape and mustard spinach growing well. Centre; Her tower gardens in September 2019, now planted to onions and spinach and Right: An eco-circle in her garden, with the central bottle drip system, a practise that she has extended into a number of her trench beds as well.

2.1.2 **Southern KZN tunnels and garden experimentation**

In this area lack of watering has been a major detracting factor in the productivity of the gardens. Farmers struggled with access to water. Again, records were not kept well by farmers, further reducing the ability to quantify any trends or water productivity in these experimental plots. In addition, pest issues featured quite strongly in this area as an issue inside the tunnels. Farmers were visited and interviewed periodically to ascertain their observations and learning from the process.

(a) Gobizembe

MaZondi has experimented with normal beds, shallow trenches and deep trenches in her garden. She noted that crops grew better in the normal raised beds and shallow trenches and indicated that she thought it was because the organic matter in the trench beds has as yet not decayed; almost 9 months later. It is likely that the breakdown of organic matter has been severely hampered by the lack of water. MaZondi did not change her irrigation management practices; still resorting to the small and

shallow watering technique common for smallholders. She did not use mulching.

Figure 10:Above left; thyme and parsley growing well in an eco-circle and Right: MaZondi's normal raised beds in the foreground, and shallow trench beds with spinach in the background. Growth in the mixed crop shallow trenches is substantially improved over that in the raised beds.

MaZondi also undertook an experiment of her own, of a practise that she heard of form other group members; planting potatoes in sacks/bags.

This practice worked very well for her and her potatoes grew well. She did however not have a control, or normal practise to compare against, which limits the conclusions that can be drawn from this exercise

Figure 11:Right; MaZondi's sacks being prepared for planting potatoes and Far-right: potatoes growing well in these sacks.

Mrs Mcnanyana has continued with her tunnel experiment; planting in normal raised beds, shallow and deep trenches both inside and outside her tunnel. She did use mulching, mostly to avoid run-off and erosion in her beds. She planted purple cabbage, beetroot, lettuce, turnips and parsley in these beds.

Figure 12 Above: Mrs Mcnayana's beds in her tunnel. Left- raised bed, Middle- shallow trench beds and Right-deep trench beds. The raised bed was unaffected by snails and aphids, but the shallow and deep trenched beds were heavily predated. Note: It is the impression of the facilitator that the damage caused was not by snails, but by grasshoppers and/or beetles. Snails do not eat large holes in the leaves, which were in evidence and generally require a much moisture environment than was present in Mrs Mcnayana's garden.

Figure 13: Right; Mrs Mcnayana's shallow and deep trenched beds outside the tunnel. Here she used some mulching and stones on the edges of her beds to avoid soil erosion during watering and rain.

Pest attacks were evident both inside and outside the tunnel, but were worse inside. The higher predation on the trench beds is not considered to be an effect of the bed design system, but is likely more an outcome of the environmental conditions as well as water stress and general levels of low fertility in Mrs Mcnayana's soils. Again, the extended dry conditions can be considered to have slowed the decay of the organic matter in the trench beds considerably.

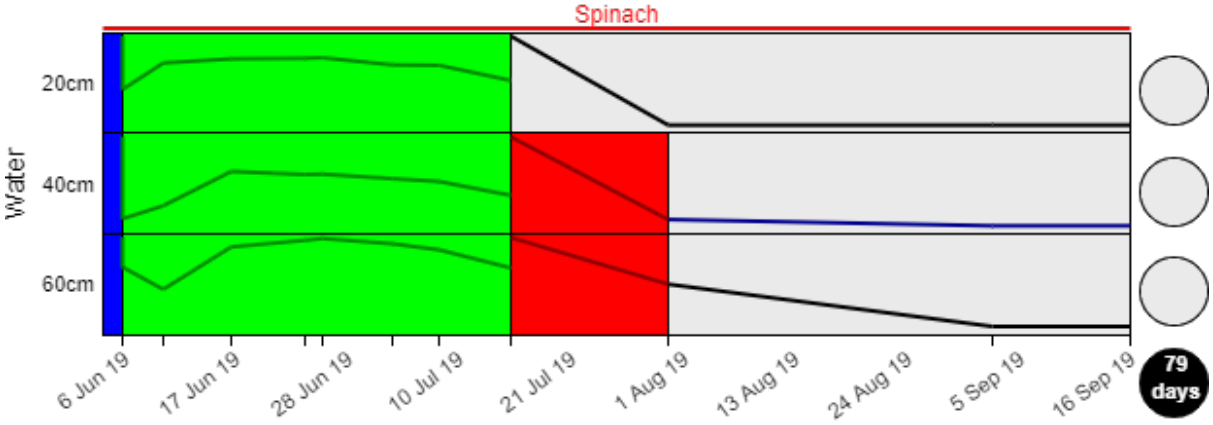


Figure 14: Chameleon sensor readings between June and September 2019 for Mrs Mcnayana's trench bed inside the tunnel. The soil dried out during July and remained extremely dry until September.

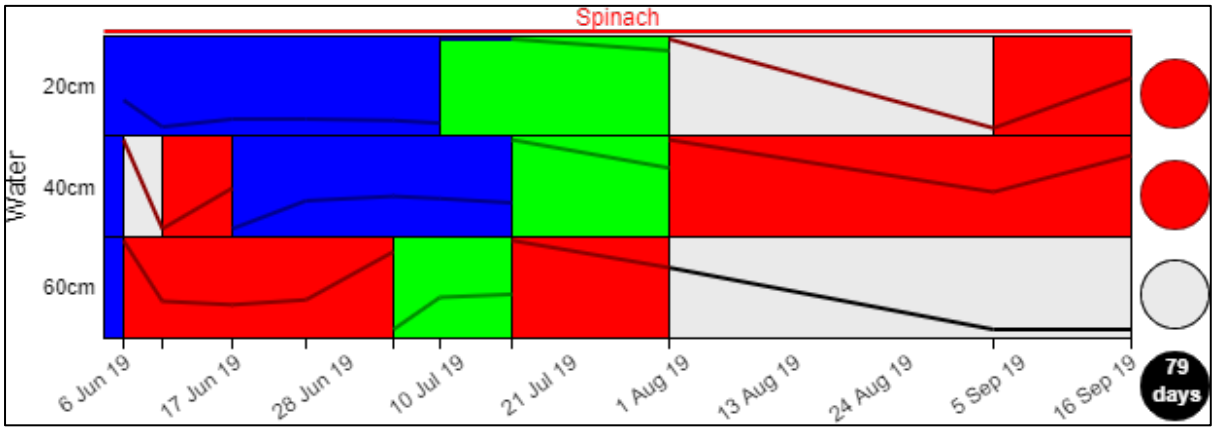


Figure 15: Chameleon sensor readings between June and September 2019 for Mrs Mcnayana's trench bed outside the tunnel. Here the soil was only marginally less dry after July, when compared to the tunnel. Mrs Mcnayana's difficulties in productivity and high levels of predation by grasshoppers and aphids is considered to be mostly an outcome of extremely water stressed plants.

(b) Madzikane

Mrs Shozi who was undertaking the tunnel experimentation in Madzikane really struggled with understanding and internalising the concepts of this experiment. She had extremely little access to water and somehow had an expectation of good growth despite the dry conditions and lack of fertility in her garden. She removed most of the plants in the tunnel due to extremely poor performance and then concentrated a little on the beds outside the tunnel – which fared somewhat better. She did not get the hang of taking the chameleon readings and also did not keep records.



Figure 16: Above Left to Right: Mrs Zondi's trench bed outside her tunnel, Phumzile assisting her with taking the chameleon reading and water stressed turnips, beetroot and spinach inside her tunnel

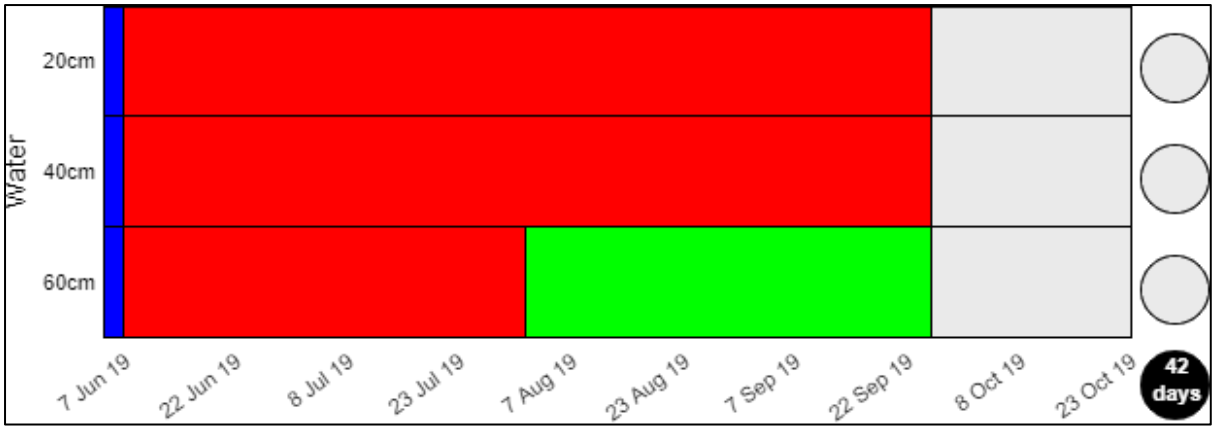


Figure 17: Chameleon soil moisture readings for Mrs Zondi's trench bed outside her tunnel. It is clear that the soil remained dry throughout after the initial watering when the chameleons were installed in June 2019. Mrs Zondi indicated that she has to get up at 5am in the mornings to walk the long distance to the closest river where she can get water.

In conclusion, crops have been severely water stressed throughout the growing period, which has also led to increased pest attacks on her crops. She has managed to harvest some beetroot, turnips and spinach. She is still planning to plant again for the summer season, but the learning group has opted to move the tunnel to a different participant's homestead to try the experiment again, as very little could be concluded from this attempt.

2.1.3 **Eastern Cape**

The tunnel experimentation process in Berlin has not progressed well, despite introducing a new intern at the ZIngisa Centre's training garden to the process and working on a management and monitoring process with her. The Imvotho Bubomi learning network discussed this and decided to move the tunnel to a community garden in Xhukwane. This was done in early October 2019.

(a) Xhukwane CCA workshop and tunnel experimentation

Written by Nontokozo Mdeltshe and Temakholo Mathebula

This learning group (18 participants) was taken through the discussion process of climate change impacts and adaptive strategies prior to introduction of the shade cloth tunnel experimentation process.

Below is a brief summary of the community

Table 3: Summary of background information for Xhukwane

List of organizations or cooperatives in the area	Type of livestock kept	Summary of activities
Sabela Service Center for the aged	Sheep	Gardening
CWP country program	Cattle	livestock
Msenge wasefama coop	Goats	Field crops (maize, beans)
Nonyushwana coop	Chickens	
	Pigs	

(b) Climate change impacts

- Rainfall variability has increased to a point where crops are dying,
- Struggling to keep up with the changing weather patterns,
- Things have changed, we have different rain patterns, extended high temperature durations. We were confused yet happy to receive October rains, they no longer occur at this time of the year,
- Used to have crops in the field year-round including peas and wheat in winter,
- In the last 5-6 years, things have changed for the worst,
- The natural environment is taking strain, wild fruits such as prickly pear have died and the peach trees have decreased in numbers. In the past they would just come up and grow on their own,
- Increased vaccinations are required for livestock due to poor grazing areas and degrading rangelands,
- Water sources, dams and rivers are drying out and
- Water is very scarce, we struggle for drinking water, and gardening becomes a huge task(issue)

Figure 18: Tema facilitating the CC impacts and adaptive measures discussion in Xhukwane

(c) Adaptive practices/strategies

- Use of compost
- Organic farming
- Windmills
- Pasture rehabilitation
- Reforestation

The participants came up with a list of practices they have tried and new ideas during the 5 fingers discussion, as outlined in the table below.

Table 4: Adaptative practices within the 5 fingers (soil ,water, crops, livestock and natural resources)

Water	Soil	Crops	livestock	Natural environment
Efficient use; including water saving and drip irrigation	Organic compost	Green manure for soil fertility and livestock fodder	Feed production	Wind breaks
Grey water	Reduced erosion; mulching	Biomass; grow crops with high biomass	Manure harvesting	Restoration of degraded soils
Storage	Fertility; use manure and fertilizer as well as legumes	Weed suppression, using different crop combinations	Grazing land rehabilitation	Grazing management

Access: windmills, dams, boreholes	Soil types; plant in deep and more fertile soils		Meat production	Reforestation
	Topography; take care not to plant on steep slopes			Organic farming

(d) Water management

Erna presented practices that farmers can try and emphasised the importance of combining different practices. Combining practices such as mulching, mixed cropping and use of grey water will have a greater impact than just doing one practice, such as mulching alone for example. The following practices were briefly presented (using the power point presentation of CSA practices)

- Bucket drip kits
- Shade cloth tunnels
- Furrows and ridges
- Mulching
- Diversion ditches
- Infiltration pits
- Rain water harvesting storage
- Small dams
- Liquid manure
- Trenches and shallow trenches and
- Eco circle

Thereafter, the tunnel was installed in the garden. There are a few indicative pictures below.

Figure 19: Above Left; learning group members constructing the tunnel, Centre; the final product and Right; construction of the deep trench beds with installation of the drip irrigation kit at Xhukwane

2.1.4 **Limpopo (Sedawa, Mametja and Turkey)**

Written by betty Maimela and Erna kruger

Participants with chameleons undertook to record irrigation and harvests for a 2nd season, (June-September 2019), but most stopped their record keeping around June-July 2019 due to severe water

shortages in the villages. They stopped watering their beds outside the tunnels and focused on keeping small quantities of crops inside their tunnels alive. It was thus not possible to do a second round of water productivity calculations. One participant however made a brave attempt and her calculations are presented below

This season participants planted their own crop combinations and used crops for selling through the organic marketing system set up in the area and for household consumption.

(a) Makibeng Moradiye (Mametja)

In this village the gardeners have been using municipal water for irrigation, as all other surface sources of water dried out some time ago. The pump for the village's water system broke in early July and was not fixed. Mrs Moradyie has been buying water for household use and irrigation.

Table 5: Makbeng Moradiye's irrigation and harvesting record keeping sheet (June-September 2019)

Date	Water applied(l)		Crop type	Yield	
	Inside tunnel (4,5m trench bed)	Outside tunnel (4,5 m trench bed)		Inside tunnel	Outside tunnel
04/06/2019	25l	25l	Spinach, chilli and leek	4,89kg spinach 0,1kg leeks	3,26kg spinach
09/06/2019	25l	25l		0,1kg leeks	
16/06/2019		25l			4,89kg spinach
20/06/2019	25l	25l		1,63kg spinach	
23/06/2019	25l	25l		0,25kg leeks	
27/06/2019	25l	25l		0,1kg chilli	0,1kg leek
04/07/2019	25l	25l		4,89kg spinach	3,26 kg spinach
09/07/2019	25l	25l	Leek, spinach and beetroot		0,05 kg chilli
18/07/2019	25l	25l			
20/07/2019	25l	25l		0,25kg leek	1,63kg spinach
09/08/2019	25l	25l			
20/08/2019	25l	25l		0,25kg leek	1,63kg spinach
28/08/2019	25l	25l			
01/09/2019	25l	25l		3,26kg spinach 1,63kg beetroot	0,05kg chilli
04/09/2019	25l	25l			0,05kg chilli
11/09/2019	25l	25l			

Using the simplified method of water productivity calculation; using irrigation and yield only, provides an estimate of the WP for the two practices (trench beds inside and outside the tunnel). During this time, there was no rain at all. Given that Makibeng planted and harvested a mixture of crops (Spinach,

leeks, chillies and beetroot) and that the crop coefficients were not used in this calculation the results are largely qualitative in nature.

Table 6: Water productivity calculation (simple method) for Makibeng Moradiye (June-September 2019)

Bed	Water applied (m)	size of bed (m^2)	water use (m^3)	Total weight (kg)	WP (kg/m3)
Trench inside tunnel	0,375	4,5	1,6875	17,35	10,28
Trench outside tunnel	0,4	4,5	1,8	14,92	8,28

From the above table it can be seen that Makibeng's water productivity inside her tunnel was around 24% higher than outside the tunnel. The effect on WP, of planting inside her tunnel, is much lower than in the previous season where WP in the tunnel was close to double the WP in outside beds. This is due, in a large part, to Makibeng's observation that the shading has a very beneficial effect on crop growth and that she has now moved her outside beds to be either in the shade or surrounded by shade-cloth to reduce the effect of heat and wind. She has thus already internalised the principles inherent in the advantages tunnels can provide and have applied these to the rest of her garden.

Figure 20: Above left; spinach and leeks inside the tunnel, in the bed Makibeng used for her record keeping. In the foreground are peas and parsley. Above Right; A trench bed outside the tunnel with beetroot and spinach – planted slightly later in the season, planted in an area with shade and surrounded by shade cloth, to emulate the effects of the tunnel.

2.2 Conservation Agriculture

2.2.1 Eastern Cape

Due to the failure of the CA experimentation process last season in Mxhumbu, caused by low rainfall and extremely compacted soil, it was decided to include deep ripping as part of the experimentation process this season. In addition, large quantities of manure have been added to the soil to increase fertility and soil health and counteract the compaction.

This process was conducted in association with the Fort Cox Agricultural Training Institute, who donated the use of their tractor and deep ripper for the demonstration and also brought a group of third year students to participate.

An area of close to 2500m^2 was ripped prior to addition of manure and lime and planting, using a Haraka wheel planter. Double rows of maize were intercropped with sugar beans and a summer cover crop mix (sunflowers, Sunn hemp and Babala/ millet).

In addition, a 10x10m plot was hand planted using hand hoes and MBLI planters to a tramline intercrop of maize and beans and maize and cowpeas.

Figure 21: Right and Far right; preparing planting basins and furrows for the planting of maize and legumes, with the Fort Cox students.

Figure 22: Above Left; Deep ripping of the field, Centre; preparation of the Haraka planter with different sized seed plates and Right; addition of manure mixed with lime and planting of maize, beans and summer cover crops.

2.2.2 **Southern KZN- Ozwathini CA open day: Focusing on mechanisation and cover crops**

An open day was hosted by the Ozwathini learning group on the 24th of September, focussing on demonstration of the two-row tractor drawn planter and on cover crops. This day was held in association with the KZNDARD, LandCare and AGT Foods, who donated a range of CC seeds and did a

presentation on cover crops for the group. Around 120 farmers participated, including farmers from Swayimane and Bergville

Below are pictures of the CC poster and handouts provided to all participants.

Figure 23: Cover crop poster and handouts provided at the Ozwathini farmers' day (in isiZulu)

The mechanisation demonstration had the intention of showcasing the newly acquired two-row planter for the group, but also to demonstrate contour planting for the steeper slopes typical of the area, as well as using the planter to inter crop maize and beans. The two separate seed hoppers, means that they can be set for different seed types and different planting depths making intercropping an easy and realistic option.

Figure 24: Right; The two-row planter with different seed types (maize, sugar beans) in the seed hopers and Far right: a view of the planter being demonstrated in the field

Mr Simon Hodges from AGT Foods, head of their cover crops division, was an important guest and speaker at the event. Cover crops are important in CA systems for improvement of soil fertility and soil health and also for provision of fodder for livestock

Figure 25: Right: Mr Hodges doing his power point presentation at the open day and Far right; examples of cover crops – millet and mung beans.

2.2.3 **Southern KZN – Madzikane Stakeholder Forum CA open day.**

Written by Mazwi Dlamini

This is an annual event held in the local hall where stakeholders meet and get to share information on different projects as well as experiences. The farmer to farmer sharing of information is key to the improvement and sustainability of livelihoods. This also serves as a platform for coming up with pro-poor collaborations geared at improving and sustaining livelihoods and dealing with issues such as poor grazing quality and quantity in the winter commonages in the area. The 2019/2020 season saw attempts where fodder production options were introduced on both household and field scales where fields are now being fenced off; activities achieved only through collaboration.

At the forum presentations were given by the following stakeholders:

- Temakholo Mathebula (MDF); Areview of CA learning and importance of stakeholder forums for learning, sharing and social agency
- Siyanda Memela (KZN Department of Agriculture); Programmes for smallholder farmers supported by KZNDARD
- Charmaine Mchunu (Soils and analytical services, Cedara); Strip-cropping with fodder species and maize
- Nqe Dlamini (StratAct); the importance of cash flow management and savings for successful farming enterprises
- Sibusiso Madiba (Farming Systems Research Unit Cedara); the spacing and maize variety trial layout and purpose and
- Ntokozo Zulu (LandCare); introduced the LandCare programme and partnership with MDF

Visiting farmers from Ofafa, Ngongonini and Plainhill also attended the event.

(a) Field visits

In the fields, participants visited a number of field level demosntrtion trials;

- One, was an experiment by Farming Systems Research (FSR) in Cedara, trying out different maize spacing regimes under CA (30cm, 50cm and 75cm) using different maize varieties. Here they wanted to see crop performance and weeds under the different spacing.
- Alongside the FSR experiment was MDF's CA rotational farmer level trial. The trial has ten plots; MB-M-MC-L-MB-SCC-B-MC-SCC-M that were rotated from the original plot of M-SCC-MC-B-SCC-MB-L-MC-M-MB from the previous season. Soil samples were taken from this trial to assess the effect of multi cropping and crop rotation on soil fertility and soil health parameters. The inclusion of cover crops was explained as very beneficial for the soil as they provide nitrogen; reducing need for chemical fertilizers; as well as providing the much needed organic content and soil cover. These cover crops may be cut and stored for livestock feed in the harsh winters, especially given our degrading rangelands.

Figure 26: Sibusiso Madiba from FSR, explaining his trial with the farmers

- A few metres from there was Mr Xaba's plot that he planted using the two-row no till planter from Edenequip. Mr Xaba spoke authoritatively on the use and calibration of this planter, indicating his experience with the planter.

During these demonstrations there was a lively discussion regarding CA and its reality in rural systems. The importance of retaining crop residue on the ground was discussed, as well as the importance of retaining living roots in the soil. These play an important role in giving back some of the nutrients used when maize crops were growing. Maize stalks also serve as a source of organic matter in the soil, improving fertility and soil structure for better water holding capacity. There was then a question of trade-offs between cover retention and livestock feed; typical of rural areas, maize stover is grazed by cattle in the fields but this causes traffic and soil compaction which is precisely what were are working

Figure 27: Mr Xaba addressing farmers on his trials and the importance of spacing and intercropping

against. One of the visiting farmers from Ngongonini then suggested stover be carried and grazed in the kraals, this than gave MDF a chance to talk about the production of fodder as its quite clear that crop production and livestock cannot be separated. Options for production of feed through; relay cropping, dedicated fodder production blocks and strip cropping with fodder species were then discussed as potential options. Some of the farmers were reluctant to consider grasses for strip cropping that they generally consider as weeds in their fields, despite the advantages of having fodder available for grazing in winter. It was decided to try out the strip cropping in a fenced field dedicated to this option to understand how this could work.

The participants also visited Mr Xaba's homestead, to view the CA equipment in use by this learning group; including MBLI, Haraka and tractor drawn two- row planters, as well as the boom sprayer and a local thresher and mill. Regarding the latter, the importance of local savings groups was emphasised as a mechanism to finance such equipment.

2.2.4 **Limpopo**

Written by Betty Maimela

The Conservation Agriculture process was re-introduced in Sedawa and Turkey villages in Lmpopo. Due to the difficult planting conditions, participants still did not have a strong grasp of the theoretical aspects, given that the practical demonstrations and farmer level trails have failed in the past seasons. Below is an outline of a workshop and demonstration process conducted in early December in Sedawa as an example.

(a) Introdution

Of the 24 participants who attended the workshop 7 were male and 17 were female. This learning group was established towards the end of 2016 under the AgriSI project (in association with AWARD) and most if not all members practice homestead gardening and field cropping. CA has been introduced for three consecutive seasons. For the 1st 2 seasons, complete crop failure was experienced, due to the drought in the area. In the 2018-2019 season, summer rainfalls started very late, but there was enough rain to have some growth and yields. Group participants felt that they knew how to work with the CA principles, but it has become clear that for most of these participants, their understanding of the process has been very superficial and that a more concerted and in- depth effort is required.

(b) Current status of field cropping in the area

We started the workshop by finding out what participants know about CA (or rather still remembered) and what their observations have been from their CA trails in 2018-2019. Participants said the following:

- Lack of rainfall has been a major challenge with regard to both field cropping and homestead gardening,
- Pest outbreaks which are associated with extreme heat has been worse, especially on maize,
- Those with supplementary irrigation were able to get some harvest from field cropping systems. For example, Mr Maphori got 160kg of sugar beans (grain) from a 0,75 ha field,

planted to a monocrop (~0,2t/ha – which is around 10% of the yield potential of beans) while Mpelesi Sekgobela also realised a good harvest of maize and cowpeas (not quantified),

- Magdeline Malepe who has struggled with poor soil and soil erosion, has installed stone bunds in her field and planted in between them and has planted millet which has helped her to increase her soil cover. She believes this is already contributing to improving her soil,
- Farmers have observed that soil in the CA plots hold moisture longer than their traditionally planted plots and
- Farmers have also observed less competition between the crops in their CA plots compared to their traditional planting method, despite the close spacing used.

Options for dealing with some of the problems:

- Famers would like to try bird resistant sorghum and
- Would like more detailed and site -specific planting calendars, although in this regard it was explained that planting calendars cannot accommodate for rainfall variability – as there is no predictable pattern.

From this discussion, it became apparent that the 3 pillars of CA which are (Minimum soil disturbance, Soil cover and mixed copping) were not fully understood amongst the participants.

(c) Methodology used in conducting the workshop

We ran the workshop over 2 – 3 days: One day for theory and the 2nd and 3rd days for practical demonstrations and planting workshops.

For the theoretical part, we used a power point presentation on CA and cover crops, which was printed out and pasted on a wall, for participants to peruse, as each slide was discussed. Topics covered in the presentation include: Principles of CA, different planting options and planters, farmer level experimentation and layout of CA trials, intercropping examples, reduction in runoff, cover crop options (summer and winter combinations and a Bergville case study (Phumelele Hlongwane)

Figure 28: Introduction of concepts in CA and cover crops using printed slides

Comments from the group included:

- "*One thing that is clear is that we have not left as much soil cover as we see in the pictures (this could be because in winter we clear and turn the field cropping fields into a garden). This*

also means that we till the soil, so we haven't minimised the tilling. This has led to a lot of run-off in the plots and in summer the rain washes away the seed and causes erosion"

- "*Seeing examples of places where CA has worked, gives us courage to keep trying, one day we might realise the same benefits. Even will high level of uncertainty it is worth trying."*
- "*Though it seems in the examples shown on the slides, the people have access to water or it rains a lot in their area "*

(d) Practical component (CA demonstration)

We first asked what participants would like to try in their fields. The majority wanted to try out sunflowers and also asked for options related to value addition of this crop.

The learning group was divided into 3 sub-groups:

1. Those who had already planted their fields at the time of the workshop
2. Those who have planted only portions of their fields at the time of the workshop
3. Those who had not yet planted and

For sub-group 1, the idea was to incorporate cover crops into what they have already planted. Most of them had planted maize only. We chose Magdalene Malepe's homestead to do the demonstration. For sub-group 2, the demonstration was done at Meisy Mokwena's homestead. with group 2 we aimed at trying different combinations (maize plus beans, cover crops and lab lab) depending on how much space was available.. For sub-group 3, Nomsa from Santeng (just before Willows) requested that we do a demonstration in her village and she organised a group of participants (about 23 members)

Table 7:Sub-groups for planting demonstrations

Sub-Group 1	Sub- Group 2	Sub-Group 3
Christina Thobejane	Meisy Mokwena	Nomsa
Ema Malepe	Lourance	+ 22 participants from Santeng
Magdeline Malepe	Joyce Mahlako	
Lina Malepe	Makgale Malepe	
Mapekere	Eric Malepe	
	France Malatji	
	Thamara Malepe	
	Ngobe Manana	
	Nora Malepe	
	Elizabath Matsete	
	Koko Maphori	
	Esina Malepe	
	Mr Maphori	
	Joyce Seotlo	
	Alex Mogopa	
	Prisc Sekgobela	
	Makobila Malepe	

(e) Sub- Group 1 (CA demonstration)

For Magdeline's field; some parts of the field the maize was about 20 cm high while in other parts the maize was only starting to germinate. The inter and intra row spacing between the maize varied (from 25 cm to 40 cm) and the rows were not straight. We planted Sunnhemp in between the maize in areas where the spacing between the maize was around 40cm. A few maize plants were removed to accommodate for intercropping using beans and cowpeas as well.

Figure 29: Magdalene Malepe's planted field

Magdalene has made stone lines across her field to slow down and spread the water flow. This gave as an opportunity to talk about different ways to control water movement in the yard, field or garden. We also experimented with mulch. A bale of grass was used as mulch in a small portion of the field, to test whether this conserves soil moisture and improves the growth of the maize.

Figure 30:Above left – one of the stone lines in Magdalene's field. Chillies have been planted along the stone line and maize has been planted above and below this line. Above right: Mulching a small portion of Magdalene's maize to test soil moisture conservation.

(f) Sub Group 2 (CA demonstration)

Having learned from Magdalene's plot that the spacing between the maize varied, we introduced a rope with knots made 50 cm apart to help participates keep the spacing constant. The rope is stretched between two droppers and is 10m long.

For maize the rope needed to be offset by 25cm in the 2nd line to accommodate for the zig-zig pattern of making the planting basins. Another rope with the knots at 25cm was made for the legumes.

Figure 31: Right: Knotted rope for spacing of maize planting basins.

Due to low and unpredictable rainfall in the area, we recommended that participants should incorporate the cover crops into their maize field once the maize has reached knee height, to avoid competition.

With sub-group 2, we demonstrated planting (maize with summer cover crops mix), (maize with sugar beans/ cowpea) as well as (sunflower and maize). The maize and beans/ cowpea intercrop is something participants are familiar with.

Participants wanted to plant the Dolichos (Lab-Lab) in the way they are familiar with, namely along the fence line, so that it can climb. It was suggested that they plant a few rows inside their fields as an experiment- so that the soil improvement effect on neighbouring crops can be tested.
There was a good positive energy amongst participants and everyone took part during planting,

Figure 32:Above left; Mpelesi Sekgobela planting maize during the demonstration, Centre; Group busy planting, and Right; Mulching a section of the plot after planting,

WEEDING: This is an issue in organic CA systems, hence the use of mulch to suppress weeds. One plot was mulched, and one was left without mulch as a comparison. Participants were worried that the

mulch would blow away and pegs were used to keep the mulch in place. Meisy Mokwena was also asked to weed these CA plots, without disturbing the soil too much and ensuring that she leaves the weeds on the soil surface to act as a mulch.

Review of the learning demonstration:

- *"We appreciated that you are patient with us, it helps us when our memories are being refreshed (even though we should be knowing this very well by now)*
- *You always try new methods to help us understand the subject matter*
- *Please provide use with some sort of a template on how to plant different combinations under CA, (something that will look like a calendar that I can paste on a wall)*
- *We are going to plant, let's hope and pray that it rains (we really want to see the full potential of CA*
- *We don't collect wood anymore as such and ropes are not really available in the households, but we will share the existing rope templates and try our best".*

(g) Sub-Group 3 (Santeng village/ Sedawa extension)

With this group, we went straight into the CA planting demonstration, without the day workshop on the theoretical aspects. These aspects were however explained and discussed during the planting process. Luckily some of the participants have worked for commercial maize farmers in the past and were already familiar with some of the CA principles. We demonstrated how to plant maize and beans / cowpeas and talked about cover crops and their importance with the group. The group asked for a full workshop where we would cover a wide range of topics, from soil fertility, to pest control to seed saving.

(h) Conclusion

For participants who have been introduced to CA before, had a reasonable grasp of the land preparation and planting process, but were lacking somewhat in the theoretical aspects. Ways need to be explored to introduce the CA concepts in an even more simplified format, to ensure that participants remember and use the principles. With regard to cover crops, as is the case the most smallholders, their reason for planting these crops is for food either for themselves or their livestock and the soil improvement aspects are considered and added bonus. Lab-Lab for example is popular as people can eat both the leaves as greens and cook the beans.

Under the present difficult climatic conditions, it is likely that the field crops will only do well if supplementary irrigation can be provided.

(i) Actions for MDF

- To make templates for planting CA plots (something that one can put on a wall). We are already playing with options
- Find bird resistant sorghum seed
- Design a workshop on pest control specifically for field crops (maize in particular)

- Think through weeding options; there was a hand "weeder" that was used in Bergville at some point that could be useful to try out.

2.3 Bergville Fodder supplementation progress and strip cropping introduction

Bergville CA livestock integration workshop: Fodder supplementation and strip cropping 28 November 2019

DATE: 28 November 10 am
Venue: Nothile Zondi in Stulwane (Bergville)
Attendance: 29 Participants (Emabunzini, Stulwane, Ezibomvini and Vimbukhalo)

2.3.1 Agenda

Time	Activity	Person
10:00-11:00am	Review of winter fodder supplementation experimentation process	Erna Kruger, Thabani Madondo, Phumzile Ngcobo- MDF
11:00am-12:00pm	Input on CA strip cropping options with perennial grazing options (grasses and legumes	Alan Manson - KZNDARD
12:00-1:00pm	Discussion of options for experimentation among learning group members and finalisation of experimentation protocols and participants	MDF and KZNDARD
1:30pm onwards	Field level layout and demonstration of planting grasses and legumes in strips	Postponed due to drought and heat, for 1st or 2nd week of January 2020

2.3.2 Review of winter fodder supplementation experimentation

A process was undertaken to cut and bale grass and also some of the cover crop residues participants had planted – namely cowpea, lab-lab, Teff and maize. In addition, supplements were introduced that could be included in these "rations" for winter feeding. These included LS 33 and Premix 450. Seven participants undertook this experimentation process and recorded their feeding as well as the results using the livestock condition scoring sheet. The experiments are outlined in the two slides below.

Table 1: Bergville Participants who undertook experimentation

Village	Name of Participant

Ezibomvini	Phumelele Hlongwane
	Ntombenhle Hlongwane
Stulwane	Mtholeni Dlamini
	Dlezakhe Hlongwane
	Khulekani Dladla
Eqeleni	Ntombakhe Zikode

For participants who did not want to undertake such a focussed experiment, the idea of licks was introduced to supplement the grazing from the veld during winter.

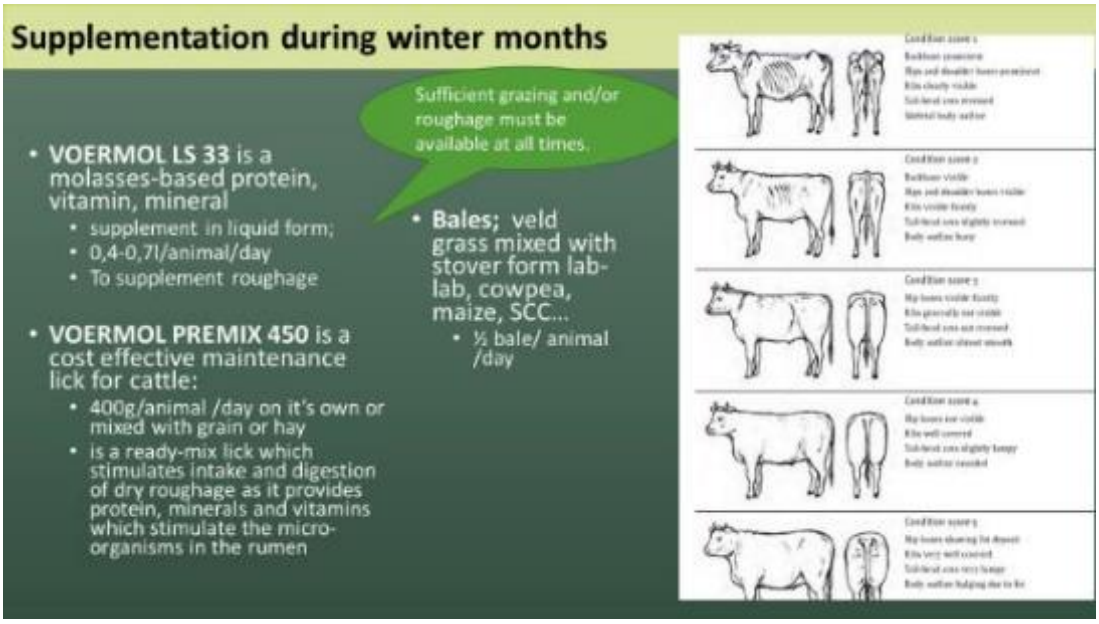


Figure 33: The fodder supplementation experiment outlines

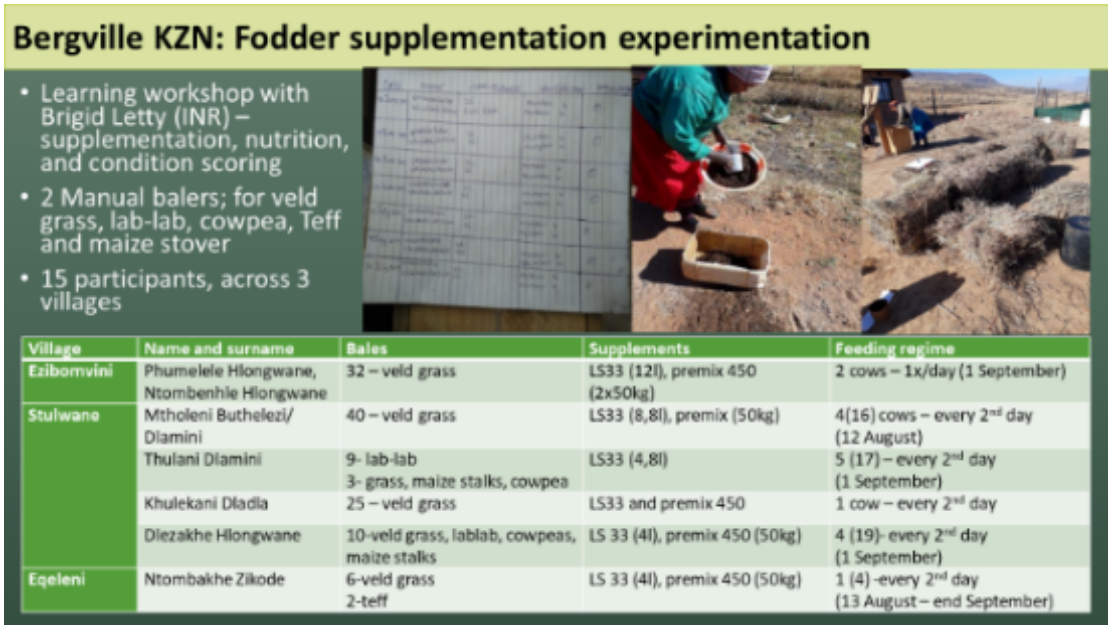
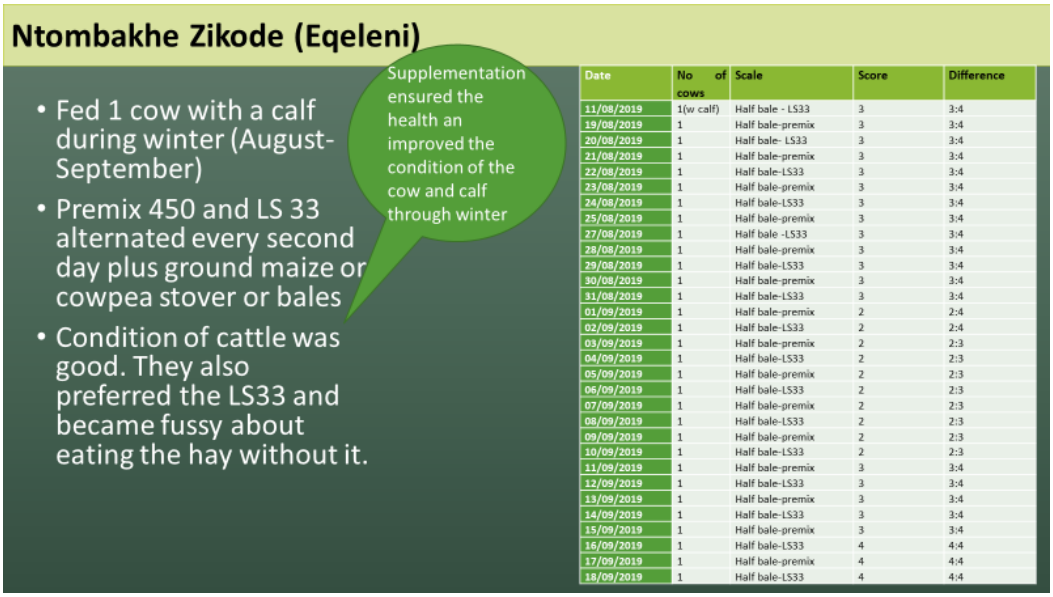


Figure 34: Experimental outlines for 7 of the 15 participants who recorded their process and results between August and October 2019

2.3.3 **Results**

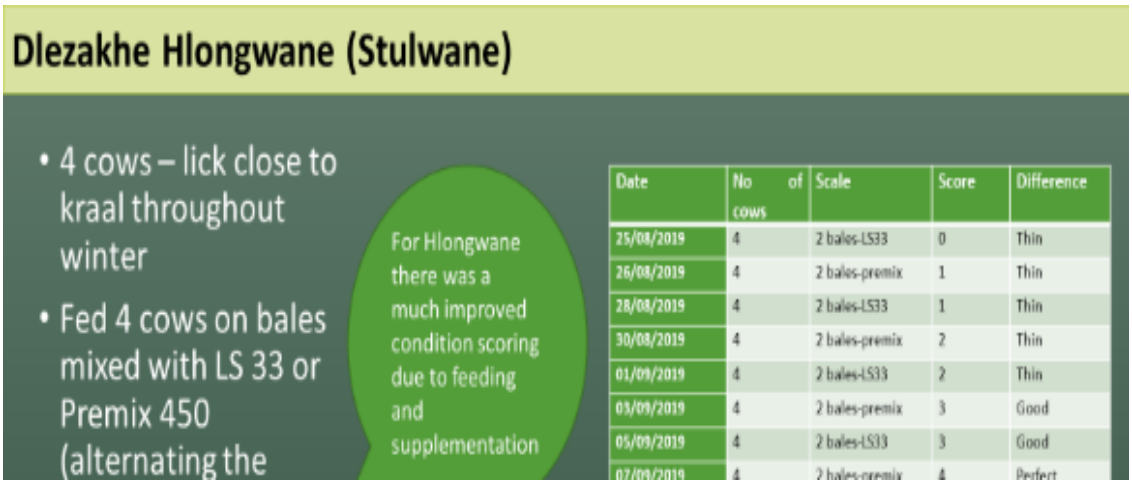
Participants undertook the fodder and supplementation for between 2-4 cattle from their herd; either cows with calves who struggle in winter or cows in poor condition. They were fed with a mixture of the supplements and baled grass or crushed maize, either every 2nd day or twice a week between mid-August and mid-October.

In general, this process managed to either maintain or improve the livestock's' condition for all 7 participants. At the end of the experimental process livestock were all scored at ratings 3 (ribs well covered and body outline smooth) or 4 (ribs not visible and body outline rounded), according to the condition scoring sheet shown above. Below, are a few examples.



Date	No of cows	Scale	Score	Difference
11/08/2019	1(w calf)	Half bale - LS33	3	3:4
19/08/2019	1	Half bale-premix	3	3:4
20/08/2019	1	Half bale- LS33	3	3:4
21/08/2019	1	Half bale-premix	3	3:4
22/08/2019	1	Half bale-LS33	3	3:4
23/08/2019	1	Half bale-premix	3	3:4
24/08/2019	1	Half bale-LS33	3	3:4
25/08/2019	1	Half bale-premix	3	3:4
27/08/2019	1	Half bale -LS33	3	3:4
28/08/2019	1	Half bale-premix	3	3:4
29/08/2019	1	Half bale-LS33	3	3:4
30/08/2019	1	Half bale-premix	3	3:4
31/08/2019	1	Half bale-LS33	3	3:4
01/09/2019	1	Half bale-premix	2	2:4
02/09/2019	1	Half bale-LS33	2	2:4
03/09/2019	1	Half bale-premix	2	2:3
04/09/2019	1	Half bale-LS33	2	2:3
05/09/2019	1	Half bale-premix	2	2:3
06/09/2019	1	Half bale-LS33	2	2:3
07/09/2019	1	Half bale-premix	2	2:3
08/09/2019	1	Half bale-LS33	2	2:3
09/09/2019	1	Half bale-premix	2	2:3
10/09/2019	1	Half bale-LS33	2	2:3
11/09/2019	1	Half bale-premix	3	3:4
12/09/2019	1	Half bale-LS33	3	3:4
13/09/2019	1	Half bale-premix	3	3:4
14/09/2019	1	Half bale-LS33	3	3:4
15/09/2019	1	Half bale-premix	3	3:4
16/09/2019	1	Half bale-LS33	4	4:4
17/09/2019	1	Half bale-premix	4	4:4
18/09/2019	1	Half bale-LS33	4	4:4

Figure 35: Results for supplementation experiment for Ntombakhe Zikode, who fed one cow and calf.



Date	No of cows	Scale	Score	Difference
25/08/2019	4	2 bales-LS33	0	Thin
26/08/2019	4	2 bales-premix	1	Thin
28/08/2019	4	2 bales-LS33	1	Thin
30/08/2019	4	2 bales-premix	2	Thin
01/09/2019	4	2 bales-LS33	2	Thin
03/09/2019	4	2 bales-premix	3	Good
05/09/2019	4	2 bales-LS33	3	Good
07/09/2019	4	2 bales-premix	4	Perfect

Figure 36: Fodder supplementation results for Dlezakhe Hlongwane from Stulwane, who fed 4 cows, which were in a very poor condition at the start of the feeding process.

Participants are very satisfied with the outcomes of these experiments and feel that they can continue with supplementation in future. The supplements are not that expensive and now that they have some experience with cutting and baling grass, they also feel this is manageable and a good idea.

Participants mentioned that once they started feeding their cows the supplement, the animals were reluctant to eat the "dry grass" after that. This is common and thus most farmers (commercial) only introduce the supplements once the cows are obviously quite hungry.

Participants also commented that they did not need to herd the animals that were being fed as they all now come home to the kraal in the evenings for their "meals". This is in fact a major advantage. Participants also agreed that the cattle prefer the LS33 over the premix 450. The LS 33 however, is a bit more expensive (R180/20l vs R230/50kg).

16 Participants volunteered to try out the supplementation experimentation process in the coming season, of whom around 50% are women.

Comments from the farmers

Dlezakhe Hlongwane- Stulwane
"*Cattle did not like grass, used yellow maize mixed with lab-lab bales and premix. One of the two cattle that were part of the experiment was with calf and the other not. At the start of the experiment the cattle's condition was poor and after the inclusion of the yellow maize the condition improved.*

Khulekani Dladla- Stulwane
"*Bales help, I started experimentation late and the condition score 2 for my cattle now the condition score has improved to condition score 4"*

Mtholeni Dlamini- Stulwane
"*Experiment included bales + LS 33. Condition score of herd at the beginning of experiment was condition score 3 at the Mid of August. The 4 cattle that were part of the experiment have kept their condition throughout the winter months"*

Phumelele Hlongwane- Ezibomvini
"*Experimentation is going well, condition score of my cattle is 4.5 going onto condition score 5. I supplement the feeding with waste from my vegetable garden, spinach leaves & umbido. Premix 450 mixed with grain and bales mixed with LS 33.*

Recommendations by farmers who undertook experimentation:
Dlezakhe Hlongwane- Stulwane

"*Yellow maize is very important to have especially when the cattle do not like grass. Use of grain, cowpea bales, drybean residue mixed with LS 33 are good and addition of Premix 450"*

Khulekani Dladla- Stulwane
"*My cattle did not like Voermoel Premix 450 and preferred Molatek LS 33 supplementation*

2.3.4 **Strip cropping with fodder crops**

Mr Manson presented slides to cover the concepts of strip cropping on steep slopes for soil and water conservation. He showed how this practice promotes the slow formation of bench terraces for the maize strips between the grass and also indicated that the grass can be cut and used for fodder.

He introduced a few strip cropping options:

1. Strip cropping with annual fodder crops such as velvet bean, oats, vetch and ryegrass, as well as kale and Japanese radish. Some of the benefits of kale include drought tolerance and dual-purpose use (animal and human consumption). Japanese radish is highly drought tolerant although it requires a lot of water at planting and is also a good crop for animal feeding.

2. Strip cropping with perennial grass species
    a. Selected by using a broad leaf herbicide and repeated mowing – which selects for perennial grasses such as Digiteria /Catstail grass- dubbed "msila wekathi" in the workshop
    b. Planting specific species such as Paspalum/ Bahia grass- dubbed "Mbili grass" in the workshop
    c. Lespediza / poor man's Lucerne, which is a hardier legume than Lucerne without the high liming requirement, that can also be interplanted with grass. There are low tannin varieties now available, which removes the need for carefully managed intake by livestock and

d. Tall fescue; which is a grass planted in either spring/autumn , that remains green throughout winter.
e. Napier grass- grows considerably slower than the other perennials but lasts longer, grown extensively in other African countries such as Kenya where it is cut and fed and to cattle.

Perennial grasses are planted once and require no repurchasing of seed and acts as a good cover for the soil all year round.

Careful consideration needs to be taken to make sure that grasses growing in field are not left to grow vigorously. At planting, the grasses and perennials are mowed to decrease competition with the established crop. During the first season of establishment mowing takes place at least 4 times and decreases to about twice per season during the third and fourth seasons of establishment.

A comment arose from the farmers considering the extent of stray livestock invasion into fields. It was discussed that perennial grasses are highly adaptive to grazing and regrows after grazing. However, it is important to protect the grasses from damage at establishment. Options discussed were cut and carry and leave of grass as foggage for cattle to graze.

3. Strip cropping with the summer cover crop mix (Sunnhemp, babala and sunflower) and cutting this during the season to dry and bale – rather than growing out these cover crops to seed.

Below are some indicative images

Figure 37: Above left; strip cropping maize and Paspalum (Mbili grass) and Above right: Strip cropping with Digiteria/ Catstail grass

Figure 38: Above left; Vetch and black oats strip crops with maize and Above right; A plot showing Maize following a winter planting of vetch (left) without fertilizer, compared with maize planted without fertilizer and without the cover crop (right)

Figure 39: An example of Lespediza (Poor man's Lucerne), brought as a sample to the workshop.

A discussion followed. Some participants were worried about the grass attracting livestock during the growing season. It was pointed out that the grass could and potentially should be cut at least cone during the season, to dry as hay and that in winter it would be grazable along with the maize stover. The grass is now treated as a "cropping field" and livestock are excluded, as they would be for maize only fields.

An experimental layout plan was considered as follows:
Strip: 2,5m x 10 m. Seeding rate 20kg/ha – thus 50g per strip for perennials
Trial size thus 20mx10m

Paspalum
Maize
Lespediza
Maize
Digiteria
Maize
Lespediza +Paspalum/Digiteria
Maize
Tall fescue (optional to be planted later in the season)

Thereafter a list of participants who wanted to undertake the experiments was compiled.

Village	Name and surname	Strip cropping with SCC (and cutting for hay)	Strip cropping with perennial grasses and legumes
Ezibomvini	Phumelele Hlongwane	Y	Y
	Ntombenhle Hlongwane	Y	Y
Vimbukhalo	Sibongile Mpulo	Y	
Emabunzini	Valindaba Khumalo	Y	Y
Stulwane	Nelisiwe Msele		Y
	Khethabahle Miya	Y	Y
	Cuphile Buthelezi	Y	Y
	Nothile Zondi	Y	
	Fikile Hlatshwayo	Y	Y
	Phasazile Sithebe	Y	Y
	Khulekani Dladla	Y	Y
	Dlezakhe Hlongwane		Y
	Thulani Dlamini	Y	Y
	Mtholeni Dlamini	Y	Y
	Matolozana Gumbi		Y
	Dombi Dlamini	Y	Y
	Dombolo Dlamini	Y	Y

2.4 Water committees

In this period progress was made with the matching grant funding and implementation processes planned by the water committees in Ezibomvini (Bergville) and Sedawa and Turkey (Limpopo).

This has meant in both cases that the participants have had to learn to plan and budget together as well as clearly define their rules of operation. This has been an invaluable experience. The most important learning in terms of process and social agency has been that participants only really start thinking properly about particular aspects when they start to do them. It was not really possible to put the budgeting and implementation plans in place prior to the activities taking place. It means that a step by step facilitation process is required.

2.4.1 Ezibomvini Spring Protection process

(a) Background

This process was initiated in August 2018 and was suggested by the Ezibomvini learning group as a way to provide household and agricultural water for the homestead gardens.
A survey of the local springs and potential options was conducted with assistance from Chris Stimie (RIEng) and a process was initiated for the group to come together and collect monies, which would be matched by MDF, to provide for a small fund to protect and reticulate one of the springs, with a simple gravity fed system to participants' homesteads.
The participants undertook to provide R1000 per household. This process took some time and by September 2019 an amount of R8000 had been put together. MDF then decided to continue with the process. Phumelele Hlongwane, the local facilitator for the area and the main driver for this process, promoted this initiative tirelessly throughout this period. She initially put down R7000 and also offered her 2200l JoJo tank as the header tank for the group. She has subsequently been paid back most of this money.

Participants who have paid and are now part of the water committee: Lungile Sithole, Cabangani Hlongwane, Phumelele Hlongwane, Phumelele Gumede, Goodman Dlamini, Landiwe Dlamini, Hlengiwe Nkabinde, Mantombi Mabizela and Devu Dlmaini/Velephi Zimba – 9 in total.

(b) Progress in July 2019

Even though very little had happened by then, there was already some conflict within the group that needed to be smoothed out. In one homestead there were two participants and an agreement was reached that both needed to pay. Those who had paid and wanted to withdraw had their monies returned to them. Another participant, Landiwe Dlamini, requested that water be provided at her new homestead site (across the road and much further downhill than the rest of the group). It was re-iterated that there is not a lot of water and that it is for homesteads and gardens only. For a time, people believed that after elections, the Municipality would in fact deliver the promised water provision to the area. This did not materialise. There were also some petty jealousies and fears related to how people who are not part of this group would respond, to some participants refusing to have pipes laid across their land and others feeling that people could not be trusted not to steal water, even within the group.

(c) Phase 1: Protection of the spring and laying of the main pipe to the header tank

(i) Design considerations

The spring is typical of the area, in that the eye is situated in a bank quite close to the streambed.

Local participants have dug out a small catchment dam for the spring, from which people collect water and cattle also drink.

Figure 40: Right; the spring's catchment pond with evidence of use by cattle and people and Far right: The catchment pond dug out to make a bigger pond and small dam wall

It is thus important that this part of the spring can still be shared in the community, as there is no direct 'ownership' of this spring by the group.

Consequently, the design includes an offtake from the spring consisting of a slotted pipe buried in a trench filled with gravel and stones, below the main catchment dam for the spring. This trench can be completely closed up and covered with soil to avoid any damage and tampering.

Figure 41: Left; The capped end of the 1m length (50mm dimeter) slotted pipe that provides for the below ground offtake of water from the spring and Right; the fittings linking this slotted pipe to the main pipe (5omm HDPE) (from Chris Stimie- RIEng)

The spring is situated in the veld above the village and thus allows for a gravity fed system. Because this is a low-pressure system and the main pipe to the header tanks is around 350m long, it is important that the ditch for this pipe be place on an even slope. Following the contours of the land, with the pipe going up and down accordingly could lead to air bubbles that stop the flow of the water. These airlocks are extremely difficult to remove without having release valves at the correct points in the pipe. An even gradient for the pipe removes this problem

.

Figure 42:From Left to right; Starting on the trench for the slotted pipe, below the spring and pond, deepening and widening this trench to 50cm x50cm x 1,2m), the trench with slotted pipe installed in a bed of gravel, covered by shade cloth and rocks with a small furrow leading water from the spring to this trench and the trench damaged by livestock before it could be properly covered and closed.

Figure 43: Left; Measuring the gradient for the main pipeline using a dumpy level. And Right; adjusting the line for the pipe to avoid some of the larger dongas and rough terrain, while keeping it on an even gradient.

The ditches are dug to be around 30cm wide and 40cm deep – evenly throughout the length of the pipe. These ditches are dug by the learning group participants as their contribution in kind to the process.

A header tank with a ball vale (in this case a 2200l tank with a drinking trough ball valve) is placed, ideally at the highest homestead in the group. In this case it was placed at Phumelele Hlongwane's homestead as she is the leader of the group and also prepared to do the daily opening and closing of taps to provide water to the rest of the learning group members.

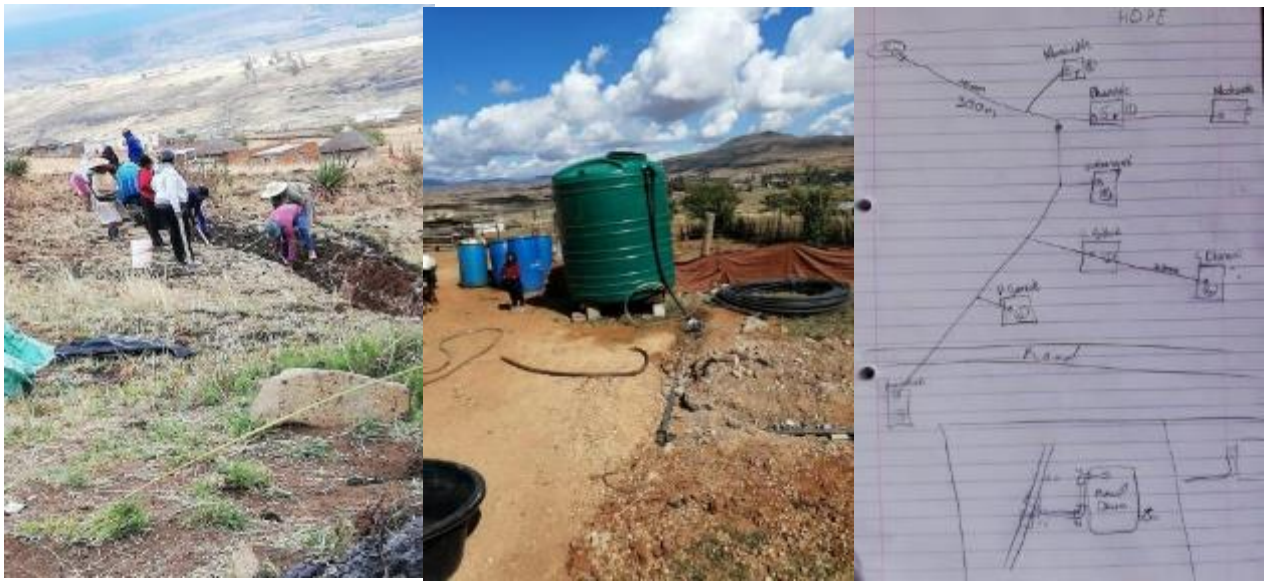


Figure 44: Left to Right; Digging the ditch from the spring to the header tank, the header tank at Phumelele Hlongwane's homestead – which was not installed on a level platform and has subsequently been corrected and an initial rough layout drawing of the flow of the water to participants' homesteads.

Once it was ascertained that the water actually flows into the header tank, the time taken to fill up this tank was carefully recorded over a few days. In this way the water flow and capacity of this process was determined. This is then used to work out the water allocation for each of the 9 participants on a daily basis. Presently, due to the dry conditions in the area and low flow of the spring 2200l in 7 hours, thus ~300l/hr), participants have been allocated 200l drums with ball valves. These can be filled up twice a day- once in the morning and once in the late afternoon.

(d) Progress meeting 5 November 2019

Attendance: 12 Participants

Summary of observations thus far:

- Water is being decanted from the 2200l header tank straight into 200l drums of the participants, without waiting for the tank to fill up
- The water is a little muddy due to the damage caused in the offtake trench by cattle
- The water is running very slowly, this is disappointing for the participants who were hoping for more water.
- Participants suggested making the small pond/dam bigger – it was explained that this would not increase the flowrate of the spring
- One participant also suggested closing up the whole spring to be able to get more water; it was stressed that this spring is communal and that removing access entirely is likely to cause conflict in the community. The participants also mentioned that there is an old belief in the

community that when you completely close up a spring, then the "water owner/ spirit" will move it to another place and it will dry up.

(e) Social process

Erna stressed that this is an experiment in working together and taking responsibility for management of a local resource. There is no precedent. It means that we will need very clear agreements between participants and that we will need to trust each other to stick to the rules we make. If only one person reneges, or tries to take more water than their allocation, or leaves their tap open, it means that none of the other participants will get water. This can quickly escalate into major conflict among the participants. Thus it is important to commit entirely to the process at the beginning.

(i) How this will work

1. The header tank needs to be left to fill up. Then the tap will be opened and the 200l drums for each household will fill up
2. Once the top household's 200l drum is full the tap for the header tank is again closed- so that it can fill up again.
3. No-one can use water while their drum or tank is filling up. You need to wait until it is full and the main tap is closed.
4. Each person can receive 2 x 200l in one day- so for example at 8am in the morning and again 8 hrs later at 4pm.
5. The header tank will then be left to fill up and remain full overnight, so as not to draw too much water from the spring.
6. Phumelele Hlongwane will have access to 3x200l drums, meaning that she will get more water than the other participants; an agreement made because she will be responsible for checking the header tank and opening and closing the main tap twice on each day. She has also provided a greater initial financial contribution.

These rules need to be strictly adhered to.

Thereafter a discussion was held about where the ditches would go for the pipes to peoples' households. It was agreed that the main feeder pipe would be dug along the small road that comes up to Phumelele's house from the main road at the bottom and that people would take their pipes off this line. It was also agreed that the pipes would go through a few of the participants' fields to get to the homesteads.

It was agreed that Landiwe's 2nd homestead site across the road could not be included in this process, but her main homestead above the road would. It was also agreed that no more participants be included and those that have not yet paid are now removed from the list (Ntombenhle Hlongwane, Malusi Zondi and Zodwa Zikode). Participants requested lids for the 200l drums. It was suggested that they arrange for this themselves.

Figure 45: An initial correction has been made to the google earth map created for the group from GPS coordinates taken using cell phones – this as not very accurate. The blue line indicates the main feeder pipe to participants' homestead running along the small road going up to Phumelele Hlongwane's homestead

.

(f) The header tank and reticulation to the households

A level plinth was constructed by the learning group for the header tank, after it collapsed in a storm, due to the initial, less secure arrangement of cement bricks and a pallet. This was an important lesson for the group where an attempt to save money and effort led to this unfortunate event. The group shouldered this set back well and worked together to construct the more secure plinth.

Figure 46: The plinth constructed for the 2200l header tank

They then dug the ditches for the pipes leading to their households, according to the discussion and map provided for them and also with assistance from MDF field staff. Each household procured the 200l drum required. This was done within a week, after which RIEng assisted in laying the procured piping and installing the necessary connections and float valves in the drums.

Below are a series of indicative pictures

Figure 47: Above Left to Right: Laying the piping along the edges of the fields, with branches towards the different homestead; fitting the inlet pipes to the 200l drums and installation of a float valve in each drum.

It was also agreed by the group, not to have taps installed in the drums, but to take water from the top of the drums. The system is now operation, after a few false starts where participants tried to take water before the drums were full and the tap at the header tank shut off.

It took a few attempts before participants fully understood that none of their drums would fill up unless everyone waits until they are full and the main tap is closed. This is a requirement due to the low flow of the spring and also due to the gravity fed nature of this system.

Figure 48: The main valve in the pipe-line shutting of water from the header tank

(g) In conclusion

This has been an extremely valuable process for building of social agency in the learning group and also for systemic and systematic learning by all the group members. They had to grapple with both the understanding of the technical aspects of this process, as well as a social process that they could put in place and adhere to.

The whole group was involved throughout and learning took place through discussions, provision of information, working with the mapping and layout aspects and practical work. A lot of the learning happened through trial and error, as participants started changing their perceptions and understanding.

Some of the technical aspects that participants needed to experience before fully appreciating them were;

- That increasing the size of the small dam for the spring, does not increase the amount of available water – which has to do primarily with the strength of the spring
- That the underground water flow into the slotted pipe is just as strong or stronger than water flowing in a ditch above the ground
- That the main pipe taking water from the spring to the header tank needs to be at an even gradient, regardless of the fact that the header tank is situated well below the level of the spring. The initial ditch that was dug by participants did not adhere to this and water did not reach the header tank. This has to do with the broken nature of the terrain, the forming of air bubbles in the pipes and the low flow of the spring itself
- That households above the header tank are unable to receive water from this gravity fed system and that estimating the level of the household compared to the tank doesn't work well – this is something that needs to be measured and was done working with GPS coordinates and Google Earth maps in a participatory fashion
- That the header tank has to be on a secure and level plinth due to the weight of the water in the tank
- That a gravity fed system fills up the drums from the bottom of the slope first and moving upwards from there and
- That filling up of the household drums is reliant on all adhering to the need to not use water until all the drums re full and the main tap at the header tank is closed.

In terms of the social aspects, participants initially believed it would be easy for them to manage the water use, but very quickly realised that it is very important to have up front and strict rules to ensure that everyone receives the same allocation of water. This has been a deeply empowering process for these learning group participants.

2.4.2 **Limpopo Water Committees**

For Sedawa and Turkey a small grant was secured from the US Embassy Community Development Fund. This has enabled the implementation of the plans to drill 4 boreholes and reticulate water to 50 participants' homesteads.

Equitable access to the water from the boreholes still has to be re-negotiated, as the borehole strength could only be determined after drilling. In addition, a few of the participants live too far away from the boreholes to be accommodated through this process. A few more live across tarred and paved roads, which will complicate implementation considerably as permission has to be obtained from the Road Service Authority to lay these pipes. Alternative solutions will be discussed in the interim.

Community members have been suffering under the yoke of an extreme drought for almost 5 years and combined with a lack of action on the side of government to provide adequate water supply in these villages, people felt the need to act and come up with solutions for and by themselves. It is within this context that the learning groups came together to explore options for agricultural water provision.

There are springs and small streams still flowing in the higher reaches of the villages (along the mountainous ridges). Here it has worked mostly on a first come first serve basis and there are individuals and small groups who have protected and reticulated springs for household and farming

use. Further access to such sources is thus now very limited. In addition, there are many boreholes in these communities, some managed by the Municipality, some by institutions such as schools and cooperatives and some by individual households.

The map below indicates the boreholes in the region and the area in the circle is the Mametja area.

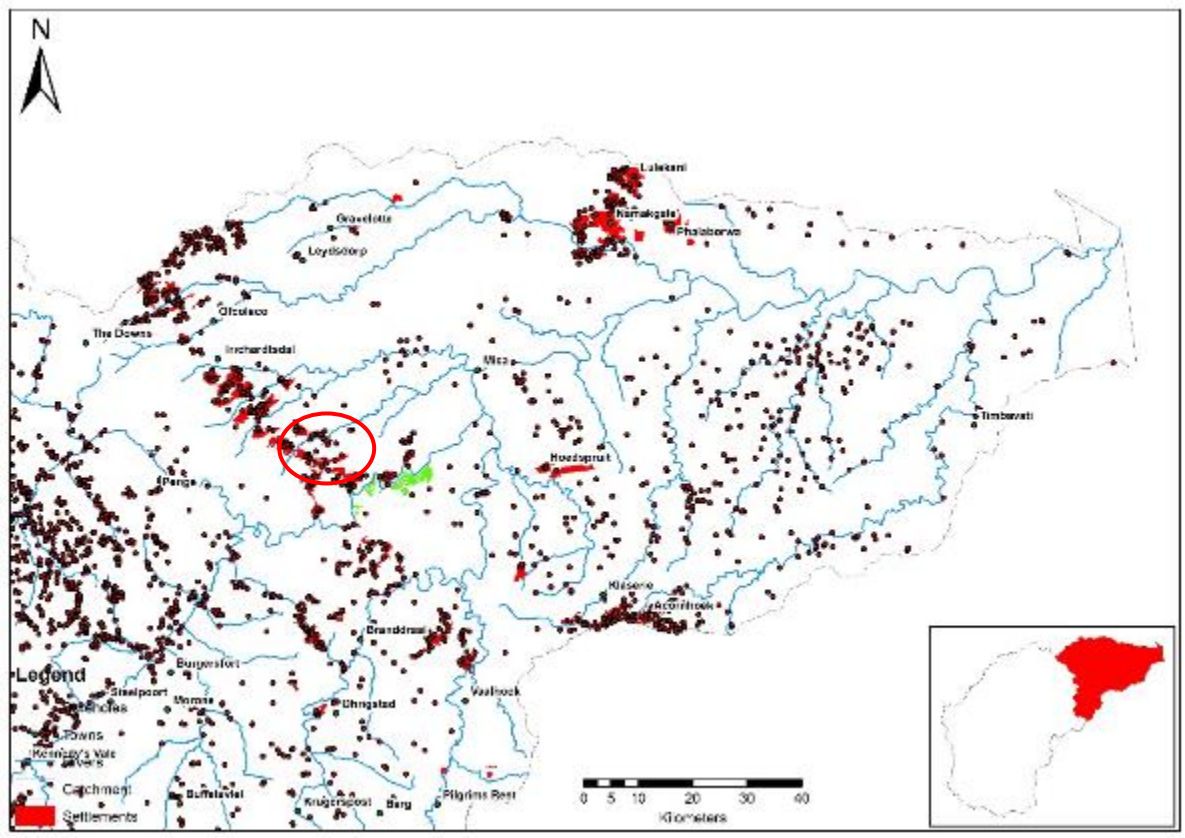


Figure 49: Map of boreholes in the Lower Olifants region (supplied by Derick du Toit – AWARD)

Although drilling of further boreholes is questionable in terms of overall water management for the catchment, it is also the only option presently available. That is also why working with groups of people to share this limited resource and to put viable and sustainable water management plans and practices in place is so important.

(a) Sedawa

The learning group has divided itself into two – for two different areas to have access to borehole water. There is a final list of 19 participants for borehole 1 and 5 participants for borehole 2. They have collected a total of R17 500 as their initial contribution (around R600/participant); a few households have more than one participant residing there and for one household (Mr Mtshana) payment was doubled for access to water both at his household and at his field.

There are still contributions from a few participants who are now no longer on the list – as they are further away and will not be able to join given the chosen borehole sites. These contributions will be returned to them and some has already been returned.

From the hydrological survey that was conducted by Mr Raymond Vonk, three potential sites were identified. Mr Vonk surveyed the areas around potential borehole sites suggested by the learning group participants, to find the most suitable locations close to where participants wanted the boreholes.
The learning group prioritised 2 of these; firstly, using the criterion of participants who have little to no access to other water for household and farming use and secondly on being able to provide water to the largest number of participants. Thus borehole 1 was prioritised and borehole 2 was prioritized for the people on the other side of river in Sedawa. The third borehole site was too far away to be practical.

Summary of discussions from earlier meetings:

1. Participants need to be clustered around potential borehole sites in a way that makes sense. Those that are too far away will need to be reimbursed – A limited amount of funding has been secured and this will not be able to accommodate complicated works or very long distances. The idea is to keep it simple and work with a gravity fed system to reduce the need for pumping.
2. Pumping would be limited to pumping from the borehole to a heard tank that can feed the household tanks through a gravity fed process.
3. From an exploration of the participants' water requirements, each household needs around 600l of water per day for household needs and another 715l for gardening; THUS **1500l-2200l/ day per household**.
4. It was thus agreed that each household would need a 2200l JoJo tank and that a float valve would be installed to ensure that each household receives one tank of water per day – or per cycle. It was discussed that participants may need to be allocated days on which they would receive water to ensure that everyone receives their allocation – as the borehole may not be strong enough to provide that amount of water to all the participants, every day.
5. Medium to strong boreholes in the area, supply around 60 000l/day with 24hours of pumping. Considering pumping for 10 hrs per day (to accommodate for a solar pump), would mean provision of around 20 000-25 000/day. This means that only 9-11 participants can receive an allocation of 2200l on any one day.
6. The issue of pumping continuously was discussed and participants conceded that boreholes could be pumped dry quite easily and that when this happens the boreholes often do not function properly thereafter. Thus, a period of recharge is important and pumping for only 8-10hours per day is preferable.
7. Community members got 2 quotes from drilling companies that operate in their area and who they consider cheap and reliable; Alexander drilling and Savuki drilling.
8. Alan Malepe, the Maruleng Ward 5 chairperson of SANCO has attended these meetings. The agreement is that they will liaise with the councillor and the LM to get support from the Municipality.

9. It was agreed that participants needed to add another R200, to the R400 they initially collected, as a more suitable contribution. There is a group account that has been opened at the Post Office and Magdalena Malepe has the account statements.

(i) Borehole sites

Upon inspection, both sites are close to small streams/ riverbeds and both are in areas with a lot of public traffic/access. Borehole 1 is right next to a school and is in the middle of a track/small road for vehicle access. Potential for damage/vandalization is reasonably high, especially for borehole 1. For this borehole around 12 of the participants are situated comfortably below the borehole for a gravity fed system. It is possible to pump to a header tank (at Joyce Seotlo's homestead), which would provide access for 18 of the 19 participants. A late entrant, Joyce Mahlaku is situated much higher up the ridge and quite far away (1600m), with added challenges of needing to traverse a large donga and streambed.

Borehole 2 is close to a municipal pump-station which is not in use. The difficulty here is that the borehole is situated on the opposite side of a deep streambed and much lower down than the 5 households that need to be serviced. In addition, these households are all far away – between 1100 and 1900m. It was considered worth exploring an alternative borehole site – as the engineering and pumping for the present option would be prohibitive in terms of cost.

Figure 50: The municipal pump station, not in use, but which participants thought provided an example of the kind of "protection" they would like for their borehole. It was explained by the facilitation team that such a structure is costly and was not budgeted for.

The Sedawa 1 borehole was drilled and provides around 14000l of water per hour. Permission has been obtained form the school adjacent to the borehole site to situate the solar panels and pump within the school grounds
The Sedawa borehole 2 site- produced no water. An alternative arrangement for these 5 participants of 2200l Jo-Jo tanks has been negotiated with the group

(ii) Sedawa borehole 1

A meeting was held with the water committee and the Sedawa learning group to finalise contributions and participants and also to start discussion on some of details of the proposed implementation.

Participants and permissions

The group reiterated that they have permission from the Traditional Authority and that members of the council are also on the water committee. As such they do not foresee problems in the community.

They volunteered to take their proposal also to the Local Municipality, both to inform them of this activity and also to provide a letter to request a donation from the Municipality.

One participant, brought on board a lot more recently, Joyce Mahlaku – lives quite a distance away from the proposed borehole site (~1,6km). Her homestead is also at a higher elevation than the site chosen for the header tank and the pipe to her homestead would need to cover rugged terrain (dongas, and eroded streambeds), necessitating metal pipes and construction of a pipe line. This can not be covered within the confines of the present funding. **Joyce Mahlaku will be asked to withdraw and or the surveyor will be asked to site a second borehole from which water can be gravity fed, as a possible solution**

An issue that emerged upon visiting participants, is that the pipes will need to cross both local roads and also properties of participants who are not involved in this process, to get to participants' homesteads. These issues will need to be very carefully considered on a case by case basis and local arrangements will need to be put in place. In addition, the pipes that will be buried alongside the road, will need to be done in such a way as to not interfere with the road reserves, as specific permissions will need to be obtained, which could hamper and delay implementation of this process.

Figure 51: Christina and Magdalena form the water committee, study the google earth map with proposed participants and pipe layouts to clarify potential options.

Other permissions that will be required will be from the local Roads Agency, to be able to lay some of the pipes underneath and across the roads. Wayleave applications will need to be submitted and approved, before work can begin and will be inspected by the Agency upon completion.

In addition, the plans for these boreholes will be lodged with the local Water Service Authority (with assistance from AWARD -the Association for Water and Rural Development), who works closely with this authority (Maruleng Local Municipality). This is mostly a formality, but also the avenue to discuss whether water users' licences will be required for these boreholes. It is presently assumed that the water use will fall under Schedule 1, for which no permissions are required.

"As part of the new allocation system incorporated into the National Water Act, a land owner, or legal occupier of the land, has a right to reasonable use of water taken from an aquifer on that property. This 'reasonable use' is defined in Schedule 1 to NWA as:

- *'reasonable domestic use in that person's household';*

- *'small gardening not for commercial purposes';*
- *'the watering of animals (excluding feedlots) which graze on that land within the grazing capacity of that land'.*

Schedule 1 water uses do not require any permission or registration.
Although an upper limit for Schedule 1-uses has not been set in the NWA, a catchment management agency may in terms of item 2(e) of Schedule 3 limit the taking of water under Schedule 1. For the purpose of applying these provisions, it is assumed that if a person uses more than 10 kilolitres of groundwater per day (10 000 litres/day) for a 'non-commercial small garden', then they are exceeding the limits of Schedule 1, and the water use should be registered" from https://bwa.co.za/the-borehole-water-journal/2016/7/3/to-register-or-not-to-register-permitted-water-use-explained-in-terms-of-the-national-water-act (accessed on 20191107)

Protection of borehole

PARTICIPANTS: Suggested building of a sturdy blockhouse (see Figure 2) to protect the borehole and also suggested collecting rocks to build such a structure.
FACILITATION TEAM: Proposed an alternative solution of creating a small subterranean chamber for the pump and wiring, but to locate the electricity supply at one of the participants' homesteads. **This was agreed to. The electrical supply would be situated at Magdalina Malepe's homestead (around 400m away)**

Pump

PARTICIPNTS: Suggested an electrical pump and that participants would pay monthly for pumping
FACILITATION TEAM: Proposed that a solar pump be used and that the panels be paced on a house roof, welded into a permanent frame to reduce the risk of theft. **This was agreed to.**

The limitation of a solar pump, is that pumping can only happen during the day and is also limited in overcast conditions. Participants were initially not very keen on this option. They mostly feared that the solar panels would be stolen., but agreed it is a better option, given that there are no ongoing costs for pumping. The group also suggested that if savings could be made, then perhaps 2 deep cycle batteries could be procured to ensure some pumping in overcast and rainy conditions. **This option will be budgeted in.**

Figure 52: The Sedawa learning group discusses options with support from the MDF field team and an agricultural engineer, Mr Chris Stimie

Fields

In the October meeting, participants started talking about taking the borehole water to their fields. This was not initially discussed- as we agreed on households and gardens. Tour participants; Norah Malepe, Esinah Malepe, Paul Maphori and Frans Malatji were insistent, even though not all participants in the meeting agreed with this. Some participants felt that they should receive the JO-Jo tank like everyone else and pump to their fields themselves if that is what they want to do. The participants who want water at their fields volunteered to shoulder the cost of extra piping that would be required and that they would manage the water according to the group requirements. **It was agreed to include these fields in the initial survey of distances, but that a final decision would still need to be made.**

Upon inspection the following was found:

- For Norah and Esinah their fields are a considerable distance from the homesteads (`2km), crossing rugged terrain, that includes dongas and streambeds. In addition, neither has cultivated there for some time. In addition, neither of these ladies is presently fully utilising their homestead lots and thus the facilitation team will not recommend taking water to their fields
- Paul and Koko Maphori's fields already has a borehole, which is presently running dry. It is the opinion of the facilitation team that this is because the borehole has been over- used. Again, the team will not recommend taking the group water to these fields, as the allocation is very small compared to the size of the fields under irrigation and as the boreholes present in these fields are not being well managed.
- Fields for Taola Maphuri and Refilwe Mogofe are > 500m away and across rugged ground. This will require metal piping and engineering processes that were not part of the initial understanding of the process.

Digging of trenches/ ditches for laying pipes.

The group agreed to work together on all ditches as a group. Some of the older ladies felt that they would need some assistance with digging (Koko Maphori, Joyce Seotlo, Tamara Malepe, Mpelesi Sekgobelo and Tryphina Malepe) and requested that funding be provided for this. Upon further discussion within the group **it was agreed that those who need help will need to find someone to help them and that this cannot be paid through the funding provided.**

JoJo tanks

The group members felt that they could not afford to buy JoJo tanks on top of the contributions they have given, even though in previous meetings it was agreed that the payment towards water, would need to be seen as an initial payment and that people would probably need to contribute more.

It was agreed that the facilitation team would price a bulk order of JoJo tanks and that the R17 500 already collected by the group would be used towards this cost.

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2.4.3 **Individual boreholes**

During the discussions, it became much clearer that a number of the participants in this learning group already have their own, individual boreholes, either in their fields or at their homesteads. A number of these participants have withdrawn from this process, as they in fact already have water. A few however are determined that they should also benefit from this process and voiced that this water would be a back-up for them if their own water runs out and also, that given that they have paid their contributions, they have a right to be part of this process. The facilitation team was not in agreement with this and feel quite strongly that this water should favour those who do not have and those who are too poor to provide water for themselves. In addition, those individuals who do have boreholes are presently "selling" water to their neighbours and the community, providing a further reason why they should not need to be included. This point needs to be discussed further as there was no agreement in the group during the meeting.

Those with individual boreholes include: Christina Thobejane, Mpelesi Sekgobela, Paul Maphori and Mpelesi Sekghobela,will be asked to withdraw from this process by the facilitation team.

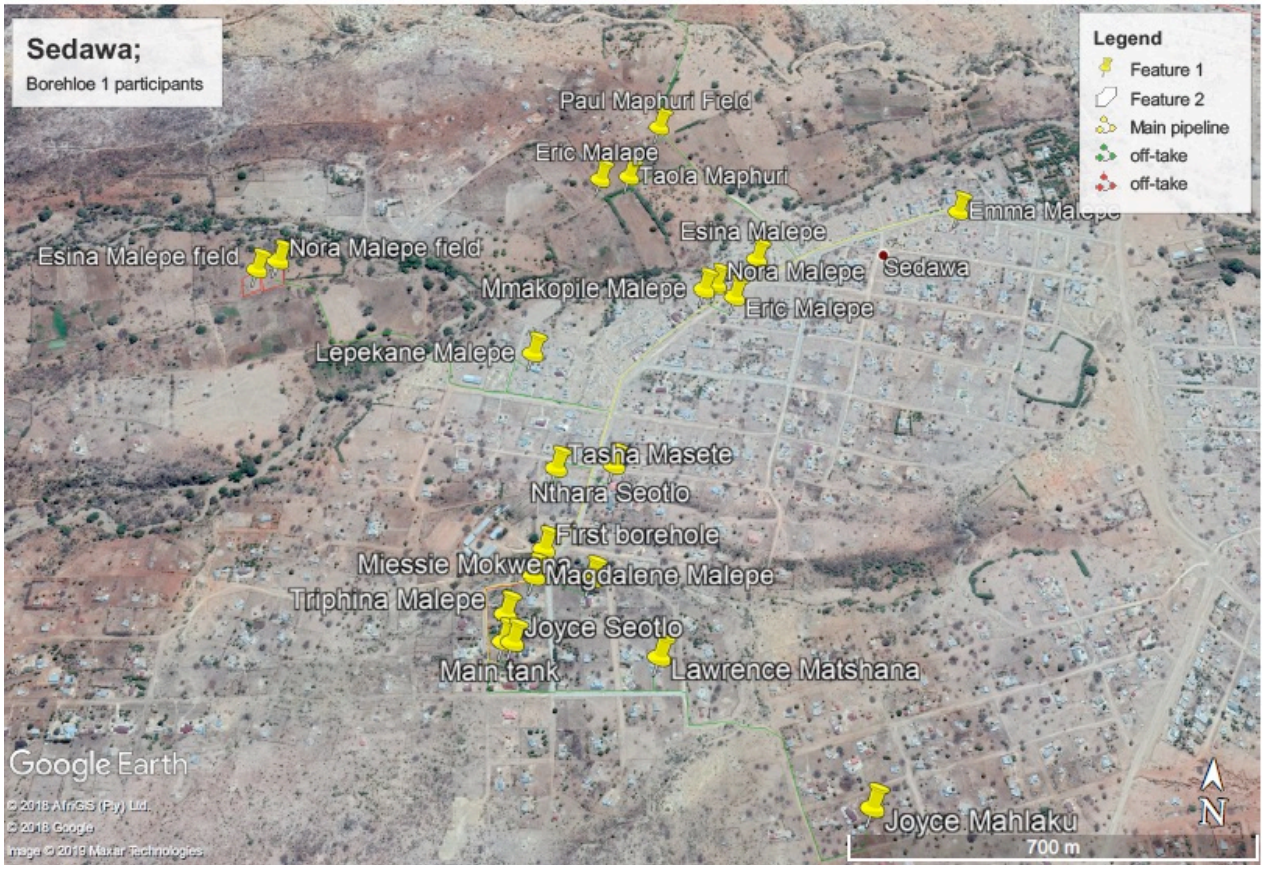


Figure 53: Google earth mapping of participants (with distances indicated.

(i) Sedawa Borehole 2

For this borehole there are presently only five participants, scattered over a wide area, of whom at least two already have their own household boreholes. The surveyor has been requested to resurvey the area to ascertain whether a more appropriate and more easily accessible borehole site could be found as a first step. In addition, those with boreholes need to withdraw and the question as to whether the funding should rather be spent on the bigger group only needs to be considered.

This was done (7 November) and the borehole site was moved across the stream bed. This makes it easier for 4 of the 5 participants as they are all on that side of the river bed. The distances to their houses are however are all close to 1km and at a higher elevation than the borehole. In addition, the landscape is rugged and eroded, making this process unlikely within the present budget constraints. Given also, that 2 of the 5 participants already have their own household boreholes, alternative options need to be sought here

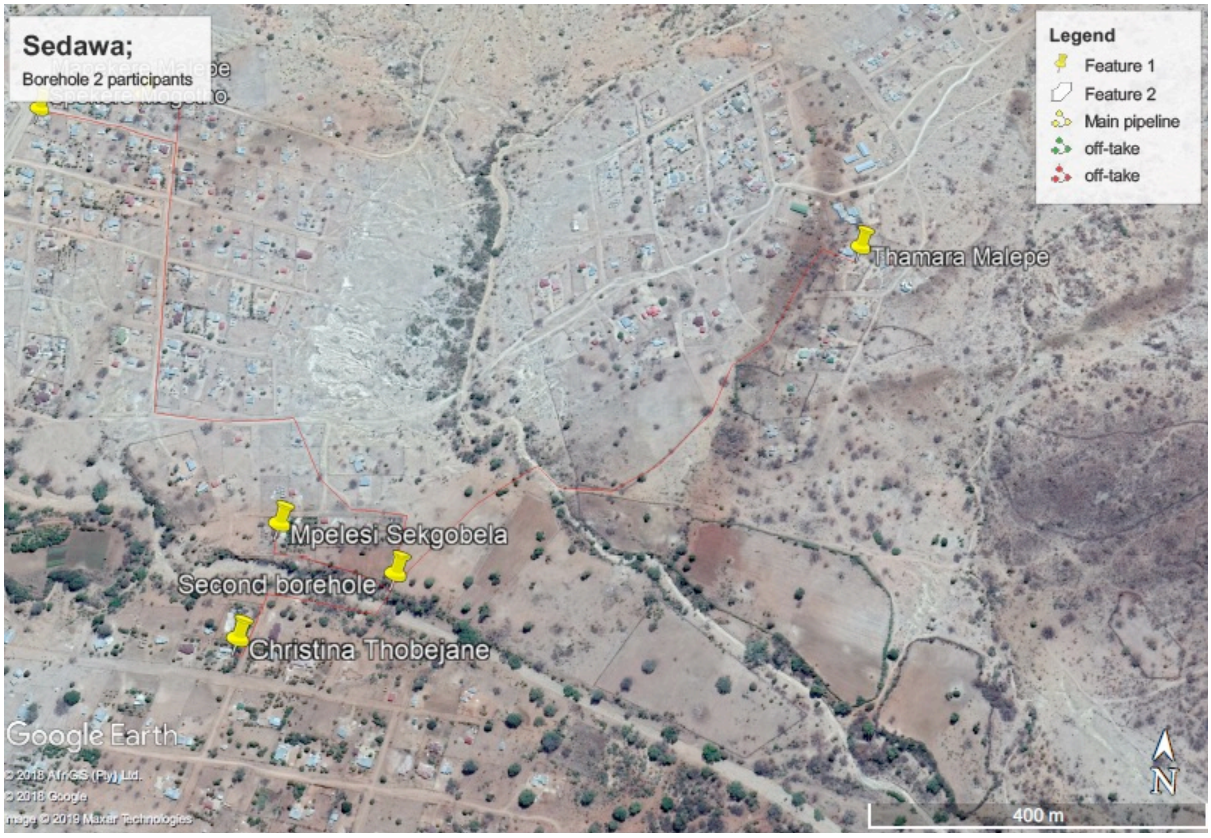


Figure 54: Google earth map of participants for borehole 2 in Sedawa

(b) Turkey

The follow-up meeting was held on 24 October at the Phediseng Centre in Turkey 2

Attendance: 19 participants (Turkey 1 and Turkey 2)

This group started slightly later than the group in Sedawa, but have been somewhat more coherent in their thinking.

Summary of thinking thus far

TURKEY 1: 14 participants. They have chosen a site in the mountains, as the municipality and others who have gone there have found water. Some participants in this group feel that this site is too far away and have selected a 2nd potential site close to the households and the river. They feel there are security issues with a borehole far away and also that digging the ditches and laying pipes for such a distance would be too expensive.

-TURKEY 2: 13 participants. They have chosen where they think they want the borehole. They considered existing boreholes, whether the site has a high enough elevation for gravity feeding water and whether there are electrical poles close by, in their choice

Figure 55: Two potential sites for the borehole in Turkey 1 and Turkey 2. In both cases participants have chosen options right next to existing boreholes.- which could be problematic. The issues will be decided once the surveyor has been to the area.

The facilitation team re-explained the thinking behind this process for those new participants who have not been involved to date. This came about from community members choosing a water committee to try and solve some of the water issues and collecting of monies, which MDF was going to match in terms of funding. The idea was to drill boreholes and reticulate these to peoples' homesteads for water for household use and gardening. The work would need to be done by the community themselves. Now we have secured a small self- help fund from the US Embassy; around R51 000 for each borehole This covers drilling, header tanks, pumps and mainlines (~1000m and branching lines also around 1000m)

Mr Malatji, the chair of the learning group, who proposed the potential site in the mountains, maintained that the surveyor would make the final decision about the borehole sites. He understands

also that if the borehole is in the mountain then using a solar pump would not be possible, as it is far from any of the participants' homesteads.

The participants have an agreement to come together once the boreholes have been dug, to buy JoJo tanks and then evaluate how much water can be obtained from this borehole in a day to be able to rotate the use between the participants, to ensure everyone gets equal amounts without over using the borehole.

The group has informed the traditional Authority and have lodged the lists of participants with them. They felt that getting permissions from the Municipality would not be a problem as the Traditional Authority would negotiate on their behalf. He also stressed that the group would close up and fix and ditches they have made and ensure that the roads are left in a good condition. AN advantage here is that there are no paved roads – all the roads in turkey are basically dirt tracks, where digging and re-surfacing will not pose a problem.

The Turkey 1 borehole only provides around 200l of water per hour. It is thus questionable that reticulation can be managed.
The Turkey 2 borehole provides around 500l/ hour of water. This is still quite low, but a reticulation process can still be considered here, as long as participants are aware that their daily allocation of water will be low ~200l/ day

Ditches
The group members will do the digging. All agreed to assist, without any exceptions.

Pump
People are expecting an electrical pump and all will contribute every month towards costs. The idea of a solar pump, at someone's household and secured against theft was introduced here as well. Participants agreed readily and also felt that it is a good idea to only pump for 8-9hrs per day, as they can fill their JoJo tanks and then use the water from there. They also understood that there would be little to no pumping when it is raining.Participants also felt that having two x 5000l header tanks would work a lot better than just having one .

Community contributions
The issue was raised that there are quite a few community members who have adopted a wait and see attitude and have not paid their contributions. It was decided that the two groups of paid up participants would remain as they are and any further participants who would want to be involved would need to form another group

Each participant was meant to pay R500. Some have paid towards their R500, but have not paid the full amount as yet. The treasurer (Mabiletse Mogofe) has been keeping the money. It should go into

the bank, but they have still not done that. Finalising contributions and opening of a bank account is now a priority.

The secretary has recorded R10 500 that has been paid. According to her record sheet alongside – she recorded around R7 900. She will also prioritize updating her contributions list, as some people paid on the morning of the meeting.

What will their contribution pay for?

It was suggested that participants procure their own JoJo tanks. However, those participants who already have JoJo tanks (9 of the 27 participants) felt that they would not pay for others to get JoJo tanks if they did not also benefit.

After some discussion and also incorporating that the group accepts that they want to help the poorer members in the group first, it was agreed that the contribution would go towards piping leading from the mina pipes to their homesteads and that the remainder would be used to buy JoJo tanks for everyone. If the monies are not enough for that, all participants would provide a further contribution. 2200l JoJo tanks will be bought in bulk to ensure the cheapest possible price.

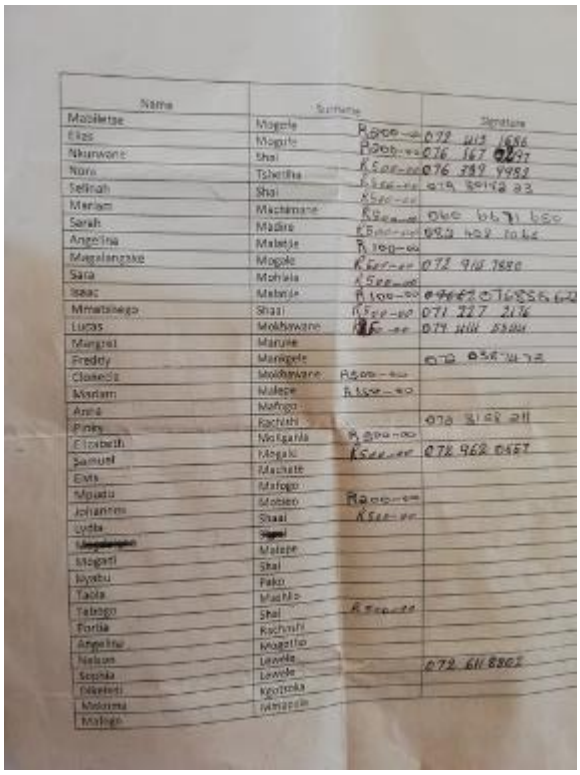


Figure 56: The record keeping sheet for participants'' payments in Turkey 1

2.5 Natural Pest and disease control learning sessions

These were conducted for learning groups in SKZN (Gobizembe), Bergville and EC (Xhukwane and Quzini). The learning workshop agendas for these groups consisted of initially summarising again the impacts of climate change and adaptive measures being implemented by group members, to provide a context for the learning process.

2.5.1 Natural Pest and Disease Control input

This was provided through a combination of a power point presentation visual aids, demonstrations and provision of plan material (including garlic chives, comfrey, lemon grass and rosemary). Three

main strategies for natural pest and disease control were presented; two of which revolve around organic garden management options.

(a) Use of plants and garden management

Pests can multiply and develop high populations (pest explosions) in situations where natural vegetation is cleared and monocrops are planted. This is exacerbated by use of pesticides that kill all insect life, such as the extensive usage of pesticides such as blue death and 'Bulala Zonke", which is common practice.

Gardens should be managed to have a much diversity as possible by leaving natural corridors, using mixed cropping and using multipurpose crops and plants; including those with pest repellent properties and those that attract insect predators.

Examples used and show in this workshop were: lemon grass, rosemary, thyme, coriander, parsley and bulbinella.

Figure 57: Coriander flowers attract wasps

(b) Promote natural predators

Here a visual aid was used where participants identified a number of pest predators, followed by a discussion and use of photographs to illustrate that many insects and life forms in gardens are not pests and that participants should more carefully monitor what insects are doing, before assuming they are pests. The role of bees as a pollinator of crops was discussed and it was emphasised that most pesticides also kill bees, thus creating a further imbalance in their gardens.

Figure 58: Right: A visual aid used to identify a number of pest predators including; lizards, chameleons, preying mantids, ladybirds, centipedes, frogs and lacewings. Far right: A bee pollinating onion flowers

(c) Make home- made pest control brews

Handouts were provided outlining a number of different remedies (in isiZulu and siPedi)

Two brews were demonstrated

- Chillies, garlic and green bar soap; This is for soft bodied insects such a aphids and worms and is an anti -feedant; discouraging the pests rather than killing them

- Onions in paraffin; this is for more persistent and hard bodies insects such as beetles and caterpillars and will kill the insects, mostly through interfering with their breathing.

Figure 59: The demonstration table; indicating the making of the chilli, garlic and soap brew and some of the multipurpose plants discussed

Home- made remedies are generally contact poisons (and are assisted to adhere to plants by the soap and or oil (paraffin) base. When it rains, these are washed off and will need to be re-applied.

2.5.2 Example of workshop discussions: Qhuzini (EC) Pest and Disease workshop: 10 October 2019

28 participants

(a) Climate change Impact

Listed below are the impacts of climate change that the participants have noticed over time.

- The sun is very hot, as a result plants get burnt and water resources such as dams and rivers dry out,
- This has been happening for the last 5-6 years,
- Late rains,
- Animal deaths,
- Snow falls in summer (it used to snow in winter),
- Summer used to be a long season and now winter is dominating,
- Cold days have extended (gets cold up to November),
- Crops (spinach) do not grow well; leaves are burnt and the surviving plants become stunted,
- Increase in stalk borer in maize,
- More pests and diseases in vegetable crops,
- Increase in aphids on cabbages,
- Cabbages are the most affected by pests and diseases and
- Fruit trees have pests like yellow locusts

(b) Adaptive strategies used by the group

One of the learning group members outlined her construction and use of tower gardens – which uses grey water and mixed cropping. Phindiwe explained that it only takes effort to build up the tower, which is very fertile. Planting is easy; with leafy crops being planted into the sides of the bag and root and fruit crops planted in the top. Shem mentioned that the crops in the tower garden have grown very well with few to no pest and disease problems.

Figure 60: A view of Phindiwe's tower garden with cabbage, beetroot and spinach growing well

To control the aphids some participants have used blue death and other commercial pesticides. A few have tried sunlight liquid mixed with water and some have used woodash. Mr Pambela uses liquid manure and grey water to chase away insects. The grey water is stored for 7 days before use.
Other practices include mixing salt, garlic, onion, chilies, aloe, and sunlight, add water and soak for 3 days, and they use this mix to chase snails. Use pig dung to chase the moles.
For cut worms they use coarse salt and blue death. The participants said that all of the above practices are based on indigenous knowledge. To chase locusts from the fruit trees they boil the cow skin and spray. Burn cow dung mixed with marigold to chase the insects (if they inhale the smoke they go away).
After the presentation and demonstrations a few further topics were discussed.

(c) Negative effects of pesticide use

Erna took farmers through the effects that chemicals have in the environment; the main problem being that the pesticides are non-selective and also kill bees and other pollinators. This reduces fruit and seed set in a number of important crops such as sunflowers, pumpkin, sour melon, chillies and green peppers, citrus fruit and many others. She also mentioned that using salt can have negative impacts on the soil and plants.

(d) Liquid manures

Liquid manures assist both in improving fertility and plant nutrition and in reducing pests and diseases on crops. A fertility brew was introduced to participants, consisting of the following ingredients:

- 20l (container) + 2kg manure
- Add lime + bone meal
- Sugar
- Milk
- Blackjack and other dark green leafy material

The mixture is covered and left to ferment for 7 days prior to use. It is diluted in a ratio of 1part liquid plus 4 parts water before spraying onto plants.

(e) Companion planting

The facilitators discussed with the participants the type of crops that can be planted together, the main principle being that plants in different families with different growth patterns and nutritional requirements are grouped together. As an example, crops such as chillies, green peppers, tomatoes, potatoes and brinjals all belong to the same family and should not be planted together. Some combinations such as carrot, onions and tomatoes also assist in reducing pest attacks from common pests such as carrot and onion fly.

In conclusions the farmers were very happy about the workshop and wished it lasted for a week, they said that they learnt a lot and would love to learn more. The group was given handouts that have information on pests and diseases, liquid manure, mixed cropping, diversified production and crop rotation. They were urged to try out some of these ideas and to share their experiences on their local Imvotho Bubomi whatsapp group.

3 PARTICIPATORY IMPACT ASSESSMENTS

The methodology designed for conducting the PIAs with the learning groups who have implemented climate resilient agriculture was fine-tuned and used to conduct assessments for three learning groups (Gobizembe – SKZN and Sedawa and Mametja – Limpopo)

Below is an outline for the PIA workshop agenda.

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)
- 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

3.1 The Gobizembe PIA

Written by Temakholo Mathebula and Nontokozo Mdletshe
Participants: 12
This learning group has been active in intensive gardening practices (tower gardens, trench beds, tunnels, mixed cropping, eco-circles, infiltration ditches and Conservation Agriculture). A review and re-planning session (for their 2nd season of implementation) was held on the 12th of September 2019.

3.1.1 Climate Change impacts; summary

- Hotter, drier weather
- It doesn't rain in June anymore (winter rains)
- This year it rained in August, accompanied with very cold conditions, which is unusual. There was even frost
- Dry soils lead to more erosion
- A lot of wind and wind erosion
- Heavy rains now cause more erosion than before
- Increase in pests
- Frogs (Amasele isinana – rain frogs), used to be found in moist soils when raining. They have now disappeared. The same for earthworms
- There used to be a lot of roots in the soil when cultivating. Now with less and less vegetation there are fewer roots
- Now when you put out buckets of catching rainwater this water is dirty, full of soil. Used to be clean – due to more dust and wind.
- Permanent springs are still working but temporal ones have been drying out
- Now seeing new insects along the streams; leeches, could be due to cattle sharing the water and increased bilharzia in the water
- Increased soil borne pests and diseases in field crops
- Meant to be planting amadumbe and beans now; but it is still too dry
- Effect on crop germination – e.g traditional maize, it now takes almost two weeks rather than 7 days. Stunted growth
- Imifino; imbuia, uxadolo now a lot less prevalent (traditional leafy greens)
- Higher yield losses over time (amadumbe and other crops)
- Difficult now to do winter crops of potatoes

- Peaches now more rotten, chillies as well and the guavas as well… the fruit is now small
- Drying out of bananas…reduction in avocado yield, a lot of the fruit drops early
- Livestock ownership now a lot less due to theft and decreased vegetation in the veld
- Not enough grass and water for livestock (goats- reduction in numbers)
- Now more problems with mole rats; although it's always there, especially when you plant sweet potatoes, amadumbe, amazambane.
- Not enough drinking water

Although this list is quite extensive, participants did note that the effect is not that drastic or severe and that their emphasis remains on trying to improve their yields and production.

3.1.2 **Adaptive strategies**

These were discussed by the group and are summarised below:

Soil	Water	Crops	livestock	Natural resources
Infiltration ditches (for leading grey water to crops)	Use of greywater on cabbages	Pre-germination of seed in containers before planting out	Participants do not own livestock, outside of a few goats and are not focussed on this	No ideas were mentioned related to natural resource management; given the focus of these women on productivity
Manure	mulching	CA- planting in basins		
Trench beds – very nice crops from that	Maize residues	Mixed cropping		
Eco-circle	Tower gardens- it is easy for older people, good crops	Herbs, marigolds, new crops (Chinese cabbage, mustard spinach, kale, spring onions		

3.1.3 **Adaptations and suggestions**

I have now planted three tower gardens, so that I have spinach all the time
Planted Chinese cabbage- but this attracted too many snails
We would like crops which we can harvest multiple times in our vegetable gardens.
Since the goats started eating the cover crops, they have now given birth to twins. Two previous birthings have always been single kids. So, the cover crops help a lot.

The learning group members want to try the same practices again; tower gardens, trench beds, mulching and CA.

Regarding CA the group suggested separating the maize and beans, as they believe the beans will produce a better harvest when not inter=cropped. They also suggested increasing the spacing, as an alternative, to reduce the competition between the crops. This was discussed and MDF suggested an alternative strategy, noting that going back to an earlier practise and ignoring the potential benefits of close spacing and inter-cropping did not make much sense. It was proposed that a lot of the water

competition was in fact an effect of tree roots at the top end of the fields in question. Thus, it was suggested that these participants dig a ditch (cut off drain) below the avocado trees, just above where they would start planting to cut some of the roots.

The group then discussed the potential benefits of close spacing and intercropping and came up with the following points:

- To improve fertility, some return nutrients
- To cover the soil, keep it wet and reduce erosion
- To protect the soil from direct sunlight

Participants' suggestions for alternatives:

- Plant beans a few weeks before the maize,
- Plant climbing beans so they can get to the sun
- Pumpkins can be planted as an intercrop, but they have battled with germination in field situations. It was suggested by MDF that seeds need to be treated with water to allow them to germinate and need a lot of organic matter to germinate and grow well.

3.1.4 **Indicators**

Here participants discussed nad decided on the most useful impact indicators for the practices they have implemented.

- Improved yields
- Income
- Harvest multiple times
- Pests and diseases
- Soil fertility
- Water availability, water use, saving water
-

Figure 61:Right; Tema Mathebula facilitating the matrix exercise; here discussing the scores to be used for each indicator.

3.1.5 **Impact matrix**

Soya beans were brought as counters, but the ladies did not want to use them on the matrix, choosing to take them home for plating. A rating of 1-3 was used where 1 is little/low, 2 is medium or average and 3 is good/a lot

Table 8: Impact matrix for the Gobizembe learning group; first round of CRA implmenetation

Practice	Soil fertility	Water saving/ availability	Yield/ food	Pests and diseases	Income	TOTALS
CA	15	27	16	0	4	62
Mulching	15	15	18	0	0	48
Trench beds (6)	27	27	27	0	18	119
Tower gardens	36	36	36	0	33	171

Use of grey water	33	33	30	0	33	129
Infiltration ditches	10	36	27	0	27	110
Eco-circle	36	36	36	0	36	144
Tunnel (Incl trench beds)	33	36	36	12	24	141

From this table the practices with the greatest impact for participants were tower gardens, eco-circles, tunnels. Participants however insisted that tower gardens were much better than eco-circles, followed by use of grey water and trench beds.

Some comments related to the matrix:

- Although Conservation Agriculture did not rate that high, the group had the following comments: CA helps a lot with water retention and also with reducing run-off. Ploughing is expensive, so money is saved by doing the CA. Ploughed crops do not necessarily do better and there is a lot of erosion. Reducing this erosion already increases yields a lot. Pest issues were a lot this year. They weren't sure that all the problems in the CA plots were due to weather issues and thus rated it lower.
- None of the practices helps much with pest and disease control although some have indirect advantages- but not much was observed in terms of differences. Participants did not find much difference in pest incidence inside the tunnel when compared to outside.
- Infiltration ditches do help over time to improve the condition of the soil; as organic matter collects in these ditches and use of greywater in these ditches improves yields substantially. Participants were adamant that greywater has significant fertility benefits.

3.1.6 **New ideas**

Of the twelve participants in this workshop, around 8 have not tried many or any of the practices mentioned.

They have now undertaken to start some of the practices

- Tower garden; 10
- Eco circles; 5
- Tunnel; 1
- CA; 65 (Zandile Zondi, Lamina Mbatha, Miriam Ngubane, Thokozile Mabaso, Nelisiwe Ngcobo and Delisile Ngobese)
-

Figure 62: Right; One of the small groups at the Gozembe review perusing the CSA practise one pagers and being assisted with explanations by Zoli Gwala from MDF.

Participants were given time to explore the CSA practice 1 pagers and selected a number of practices from there to try out in the next round of learning, demonstrations and experimentation. The intention was to go through the online DSS for the area, jointly with the group – but this was not possible due to a lack of cell phone reception at the venue.

Practices	Comments
Keyhole beds	
Furrows and ridges	For field crops such as potatoes and amadumbe
Herbs; garlic and onion for pest control	Participants requested seed form MDF (this will be linked to a seedling production process
Seedling production	The have damping off problems and have only done this in seed trays before- asked for advice and a better system
Seed saving	
Natural pest and disease control	A mini workshop was held after the review session;
Fruit Production	
Cover crops	6-9 participants to attend the Cover Crops open day in Ozwathini on 27th September
Poultry Production	Poultry production workshop to be run by Mazwi – October 2019

3.2 Sedawa and Mametja PIA (Limpopo

Written by Betty Maimela

Number of participants: 24

Figure 63: The Sedawa and Mametja PIA held under the trees at Christina's homestead.

3.2.1 Climate Change impacts

Here participants looked into the changes that they have observed caused by climate change under the following 5 livelihood categories (5 fingers) Natural (Environment and farming), Physical (infrastructure, environment), Economic, Human and social (skills, knowledge).

Table 9: CC impacts in Sedawa nad Mametja, summarised during the Seasonal PIA.

Natural (environment and farming)	Physical (infrastructure, environment)	Economic	Human and social (organisation)
Food Insecurity	Reduction in the number of tree through cutting for wood to cook	Poverty	Fight in the community due to hunger
Crops not growing well	Soil erosion, dongas and less growing grass	Indigenous seeds are lost	No sharing and working together in the community
Disease	Seasons have changed	Lost indigenous fruits and vegetables like Magaba that assisted with high blood, Dithokolo	We don't trust each other, as there are many fraud cases

Less rain	Butterflies are no longer been seen	More diseases that affect their health and crops through extreme heat	Life is too short
Dry environment		Less rain for their cover crops	Their farming activities have decreased
Loss of traditional medicine		Fighting with neighbours	
Hunger		Hunger	
Livestock		Lost their old ways of living	
Death due to different kinds of disease			
Water shortage			

3.2.2 **Adaptive strategies/practices to Climate Change impacts**

Table 2 below summarizes the practices and strategies participants have implemented. They stated that when the weather started to change, they didn't understand why things were changing, and the only answer they had was that, things were changing because they were not following the rules and laws that their fore-fathers have used to survive. They met AWARD and Mahlathini Development Foundation and they started learning about climate change and it was then that they understood why they were experiencing all the changes and that they only needed NGOs like AWARD and Mahlathini Development Foundation to educate them. Mahlathini worked with participants, facilitating learning workshops in the community around practices they can use to adapt to Climate Chang and provided practical and mentoring support during the implementation of these practices.

Table 10: Adaptive strategies/practices to Climate Change impacts

Natural	Physical	Economic	Human and social
Saving water by using grey water	Trench beds	We do back yard gardens	Sharing of seeds amongst farmers
Tunnels and shade netting	Legumes and sweet-potatoes	Our crops give us life	Sharing of experiences
Trench beds	Use of chicken/goat and cow manure	Income from selling crops	Teaching other communities and community members about the importance of farming and practices that they can use, to reduce hunger and poverty
Planting of trees and indigenous	Use liquid manure (banana stems, black jack)		
Rain water harvesting	Crop rotation	Less expenditure	
Mulching	Stone lines		
Tower gardens			
Cover soil - mulching			
Don't use tractors; minimum tillage			
No burning			
Stone lines			

Participants want other community members to understand the importance of the situation they are facing instead of relying on the Government. They also touched on the issues of water, that they want to be assisted with having access to water for irrigation so they can have consistency in their gardens to supply big markets.

3.2.3 Practices: Five finger principles and practices under each category

Under the practices implemented by farmers in their gardens and cropping, each farmer outlined the practices she/he used under each of the five finger principles. Through this exercise it was clear that participants generally implemented a range of 5 to 8 practices in their gardens. Reasons provided were that they have seen the difference in their own or other participants' gardens) and have listened to other participants' experiences during learning workshops and subsequently tried it out themselves. What was noticed was that farmers use criteria like yields, income, pest control and water usage to measure the impacts of each practice they implement.

Figure 64: The mind map of practices implemented as recorded during the workshop

Table 11: Practices implemented according to the 5 finger principles

Good water management	Decrease in soil erosion	Crop management	Soil health/fertility	Looking after indigenous crops
Line levels	Contours/ diversion ditches	Mulching using organic material	Mulching using organic materials	They stopped cutting trees in the environment for firewood
Furrows	Allowing grass to grow to hold water so it can infiltrate into the soil	Making and Adding compost	Trench beds	They plant more trees, including medicinal and indigenous trees
Mulching	Stone lines	Planting of Marigolds for pest control	Shallow trench beds	Prune their trees
Stone lines	Planting of sweet-potatoes in furrows	Using liquid manure made from black jack, aloe, banana stems and chilli	Not using tractors	Add compost and irrigate their trees using grey water
Banana basins		Minimum tillage	Minimum tillage/ CA	
Trench beds		Tunnel	Using chicken, cow and goat manure	
Underground rain water harvest tank		Intercropping and mixed cropping		
Tower garden		Crop rotation		
Using drip kits for irrigation				
Using grey water and bucket filters				
Tunnel				

Participants explained that they used to use blue death a lot in their gardens until they tried other practices they heard from other farmers during workshops and they started to use liquid manure especially using chicken and cow manure soaked in water as it was the easiest practice they understood and it also assists with soil fertility. They also shared this with other farmers in their communities who are using pesticides, such as Paul Maphori who used to use pesticides a lot. He is now in transition from conventional to organic production, even though he explained that it is a bit difficult as he is running a commercial farm and depends on the farm for an income and taking care of his household.

Practices	No. of participants who implemented the practice	No. of participants still to try implementing the practice
Tower garden	3	10
Mulching	24	
Tunnel	7	17
Stone lines	15	5
Trench beds	22	2
Drip kits	8	10
Liquid manure	20	4
Underground harvest tanks	2	22
CA	19	5
Compost	10	14
Line level	24	
Banana basin	2	
Furrows	24	
Contours/diversion ditches	8	11
Multipurpose (medicinal, windbreakers, flowers)	24	
Mixed cropping	24	
Crop rotation	24	

3.2.4 Comments regarding future implementation and uptake of practices

1. Participants explained their reasons for not implementing tower gardens. As simple as it looks to do a tower garden, for them it was too much. Although trench beds are even more work, they found the results a lot more impressive in terms of improved yields and water usage and thus prefer these beds.
2. Farmers are still interested in having tunnels. To them it will assist in protecting their crops from extreme heat, pests and wind.
3. Trench beds were implemented by almost all the participants, even though it requires hard labour. They paid people to help dig the beds for them as they love the results. In each house hold farmers have from 2 to 15 trench beds in their garden.

4. A learning workshop on how to make your own drip kits was held and farmers went home to implement the practice in their gardens. From this they worked out that one can use any old container and pipes and make up your own system.
5. Liquid manure using the following systems;
    - Soaking cow/chicken manure in water and diluting with water, this practice assists with soil fertility and pest control
    - Chopping aloe and soaking it in water
    - Soaking yarrow, a practice they have learnt during a farmer's exchange visit to Sekhukhune
    - Using black jack
    - Using chilli and sunlight liquid

Figure 65*:* Right; Magdalena made liquid manure using chicken manure in a meshsack/bag and soaked in water using a bath tab

6. Participants were introduced to CA and they observed results and now they use CA principle sin their fields.
7. Participants have learnt about how to make compost and they make their own compost to add to their crops and fruit trees, they also stated that they also saw that even commercial farmers are using compost and they make their own compost collecting all organic materials in the farm.
8. Participants explained that growing banana trees is difficult because they need water and they don't have water, other participants explained that their banana trees died, which is why so few participants tried out the banana basins as a practice.

3.2.5 Benefits and changes of CRA

In this exercise we started by discussing the changes and benefits, where each farmer takes a turn to state the changes in their garden and livelihood and the benefits of Climate Resilient Agriculture.
The following are the benefits and changes from participants;

- They knew nothing about Climate Change and they felt defeated. They stopped with their farming activities. They met Mahlathini and AWARD they were taught about CC and practices to adapt to CC, now they are no longer sitting doing nothing and saying that they don't have food. They have gardens in their households for consumption and they are making a small income.
- The project changed their lives in different ways, they now pick vegetables in their own gardens, which has decreased household expenditure.
- They are intelligent now and they can teach other farmers. They know and practice Agro-Ecology.
- They have learnt about integration of livestock and farming and they have seen the results, now they have their own livestock to avoid buying manure to use for soil fertility.

- They have learnt about crops they have not seen before and never thought they would grow such as herbs (coriander, parsley, rosemary, thyme lemon grass), brinjals, peas, kale and mustard spinach.
- They now use CA in their cropping instead of using their old system, and the results are good.
- They are learning new things every day.
- They know how to process their crops to add value and generate more income.
- They know the importance of saving water and protecting the soil and the environment.
- They don't burn organic material, instead they add organic material to their soil through mulching and making compost.
- They are making an income from their household gardens even though when they started it seemed impossible.
- They have learnt about poultry and how to treat chicken diseases and how to take care of livestock
- They know how to build a tunnel and how to construct a dam using bentonite
- Hunger has decreased
- They no longer sit around gossiping
- They work together, they also share seeds.

This exercise was followed by a matrix scoring exercise where participants chose the impact indicators to assess the practices against.

Table 12: Matrix ranking of CA practices

	Indigenous crops and trees	Soil health	Income	Productivity	Water use and management	Knowledge sharing with other farmers	Total
Conservation Agriculture	21	25	19	25	23	25	138
Livestock integration	10	19	20	15	15	23	102
Market	10	0	19	19	20	19	87
Tunnel	15	23	20	25	25	25	133
Trench beds	24	25	23	25	25	25	147
Drip kits	10	15	18	23	25	25	116
Mulching	23	25	22	23	23	25	141

3.2.6 **Expanding on CRA practices**

Participants have clearly pointed out the importance of CRA practices and how they will continue with these practices in their gardens and their fields. In their expansion they will work and invite other local farmers in their villages and share their experiences and practices with them. They will also continue to recommend practises to other community members and other neighbouring villages, with an understanding that there are small holder farmers and their work will change the livelihoods of their communities. Participants have also indicated that CRA practices have made their lives easier as they are able to feed their own families from their gardens. Sharing of experiences and knowledge has

helped some participants who only tired out a few practices to make the decision to include further activities and practices in their gardens.

Village	New practices	Comments
Sedawa	Tunnels Rain water harvesting tanks Bucket filters/drip kits Tower gardens Nurseries Fodder production Jo-Jo tanks	Participants have a lot of interest in having tunnels for shade to protect their crops from extreme heat. They also have interest in having either Jo-Jo tanks or underground rain water harvesting tanks. Participants who are interested in fodder production are participants with livestock and they are looking at making business es in their community. Most participants have never tried an eco-circle and would like to try the practice. As they have water shortages, small eco-circles would make a difference and they don't require a lot of labour like a trench bed.
Mametja	Tunnels Tower gardens Seedlings Compost Drip kits Jo-Jo tanks Eco-circles	

3.2.7 **Evaluation of the workshop**

Comments from participants;

- We have learnt a lot, you taught us and now we qualify to be teachers in agro-ecology, as we have experience of what we have learnt and we use those practices and principles you taught us.
- Through working with you we have learnt to work together as a community to better our livelihood through farming and small business.
- We have learnt about different kinds of seeds and the importance of seeds saving especially our indigenous seeds.
- Mahlathini has opened our eyes and our thought, for that we are very grateful and thankful for what you have done for us.

3.3 **Turkey PIA (Limpopo)**

Community impact indicators measure the changes that occur in people's lives and look at the end result of project activities. They measure the fundamental assets, resources and feelings of people affected by the project. Community impact indicators may be quantative, such as income earned from crops sales, or qualitative such as improved skills, knowledge or social status.

3.3.1 **Climate Change impacts**

Participants understand a lot about climate change because they have witnessed changes in the environment without understanding why are things changing. Much has changed in their community, for example, they are having less rain, it is extremely hot and soil erosion and dongas are continually

increasing, without any control. There are more livestock and crop diseases associated with new pests. Participants mentioned a decrease in ground water levels, which is proven by metres when drilling boreholes in their homesteads

Table 13: Climate change impatcs related to livelihood categories

Natural (environment and farming)	Physical (environment and farming)	Economic	Human (skills and knowledge)	Social (organisations)
Trees are dying	Soil erosion and more dongas	Less income from farming	Loss of old people's farming knowledge to share with youth	Decrease in stokvels
No grass for livestock to graze	Soil structure has changed	We buy water for both consumption and irrigation	Farming activities have decreased	Working with only one NGO to assist with farming activities
More diseases and pests associated with extreme heat	Livestock disease is increasing	We buy seedlings and seeds yet they die with no single harvest	Shortage of food	Fighting over water sources in the mountains
Less rain	No water for livestock		Shortage of water	
Very dry	Crops not surviving the heat			
Indigenous fruit trees are dying	No rain			
Growing seasons have changed	Ground water level dropping			
Too hot	Buying livestock food			
Rivers are all dry				
Springs and wells are drying up				

In summary farmers mentioned that farming has declined rapidly due to climate change; reduced and erratic rainfall and increased heat. Some people in the community are also of the impression that the little water there is, should be used for household consumption and not farming, which has caused some conflict. Another NGO, Wold Vision assisted the community in the past with water issues. Water was collected from a spring behind the mountain and small dams were built for storage. Small water harvesting dams were also constructed in the water drainage lines for collection of run-off water. All these structures are now dry and falling into disrepair. There are conflicts about the few remaining water sources in the mountains. It is very difficult to try and farm under these circumstances.

3.3.2 **Adaptive measures to CC**

- Participants also discussed their adaptive methods to climate change, example they use tunnels and they buy more nets to add to the tunnels they were awarded, because the results are good. The tunnel protects crops from extreme heat and from pests like chickens and birds that eat crops.
- The community relies on wood for cooking not electricity, 90% of households in Turkey the use wood for cooking, which means 90% of tree are cut down, which leads to more dongas and soil erosion in the community. What they do now is to teach others that are not part of the learning the importance of trees and why it is important to plant trees. They are planting more indigenous trees
- They are also implementing soil and water conservation practices in their homestead and gardens.
- They started using self-made drip irrigation system. They also learned about crops and how much water a crop needs per day.
- They no longer burn organic matter, but use the organic matter to fertilise the soil and reduce the rate of water evaporation by mulching.
- They use liquid manure for pest and disease control on their crop, using plants like; aloe, chilli, garlic and black jack.

All the CRA practices were then outlined using the 5 fingers principles

Figure 66: Adaptive practices used in turkey according to the 5 fingers principles

Participants started by mentioning all practices that they have implemented from those they were taught under each finger principle and adding them to the five fingers diagram. Below is a five fingers diagram with implemented practices by participants in Turkey.

Water management	Controlling of soil movement	Crop management	Soil fertility	Livestock	People	Natural resources
Mulching	Contours and line levels	Mixed cropping	Trench beds	Planting Lucerne	Market access for herbs and vegetables.	No cutting of trees
Making compost and adding to trees and soil	Stone lines	Liquid manure for pests and disease control	Legumes	Planting of Sunhemp	Learning group	Planting of trees
Using tunnels	CA	Adding composts	Adding compost			

Using drip kits for irrigation	Planting of trees	Eco-circles	Adding organic matter			
Grey water	furrows	Tunnels	Crop rotation			
Jo-Jo tanks and small dams for RWH	Minimum tillage	Trench beds and raised beds				
Rain water storage		Flowers and medicinal trees like aloe and moringa				
		Diversified crops				
		Crop rotation				

Participants mentioned that the livestock integration aspects are reasonably new, but that they are now having to start to plant fodder for their livestock- as there is no more grazing. They have found implementation of most of these practices easy, as they were first shown this implementation in other villages such as Sedawa and thus were readily convinced that they work under these hot and dry conditions. Participants are also interested in trying the following practices where they have seen good results from other participants in Turkey village:

- Eco-circles
- Tunnels
- Conservation Agriculture
- Compost
- Shallow trench beds
- Liquid manure using comfrey

3.3.3 **Changes and benefits from CRA practices**

Changes due to implementation of the CRA practices have been monitored throughout the project and participants are now comfortable with the concept of experimentation and having to quantify or explain the changes that they are noticing. Some observations include:

- From using a trench beds alone, they get good yields and beautiful fresh produce.
- The knowledge has changed everything; without this knowledge farming would have died and they would be buying vegetables for household consumption, but because of the knowledge gained they don't by vegetables, which means money for buying vegetables will be used for something else in the house.
- Soil fertility is improved through adding compost that they make using organic matter collected in their household.

- They know how to control pests and diseases in their gardens without having to buy pesticides that are expensive. And poisonous
- Good water management. They are very happy to have the knowledge that they can have a garden by only using grey-water for irrigation.
- The biggest change has been in their farming system and seasons. An example is the crop diversification that was introduced through learning workshops.

Practices were then ranked according to impact indicators chosen and outlined by the learning group members. For the matrix ranking below the following scores were used:

Participants used a scale from 10 – 50.
10< There is no change after implementation
20< There is change but not that convincing to implement the practice again
30<The practice is working as there are some signs of changes
40< The practice is working it can be recommended to other farmers
50<The practice is working well and gives good results

	Harvest/ Yield	Water management	Soil fertility	Pest control	Labour	Total
Tunnel	50	40	20	50	40	200
Drip kits	30	50	10	20	30	140
Mulching	30	30	40	40	50	190
Compost	40	20	50	30	40	180
Conservation Agriculture	30	40	30	20	50	170
Furrows	10	10	10	10	10	50
Liquid manure	40	10	40	50	50	190
Trench beds	50	50	50	30	50	230
Eco-circle	40	50	50	50	50	240
Planting of trees	30	30	20	20	20	120
Adding of organic matter	40	20	50	40	40	190
Grey water	30	50	10	10	50	150
Crop rotation	40	40	40	40	40	200

Comments

- Farmers are happy about all the CRA practices as they have made their farming activities easier; they now pick vegetables from their gardens and are selling in the community. It is also good to be farming all year round.
- They have learned how to fertilise their soil using organic matter that they used to burn before. They also reflected that some of the practices introduced, were in fact things that their grandparents used to do, but that they lost over time

3.3.4 Expanding on CRA practices

Participants have clearly pointed out the importance of CRA practices and how they will continue with the practices in their gardens and their fields. They also continue to recommend practise to other community members and other neighbouring villages. Participants have also pointed out that CRA practices have made their lives easier as they are able to feed their own families with what they make from their gardens and with crops from the gardens.

The table below outlines their planning for future activities.

Table 14: Future activities proposed by the Turkey learning group members

New practices	New workshops	New farming categories
Liquid manure using comfrey- participants have learnt how comfrey fertilizes the soil and also assists with pest control and with bone problems.	Crop processing workshop to add value and increase crop shelf life; e.g.how to make pesto and sauces with crops from their garden.	Poultry – Participants have seen the importance of integrating their crop farming with livestock farming after famers network, where farmers exchange experiences and success through integrating the two farming categories. Example having poultry makes it easier for them to use the saw-dust to fertilize the soil.
Eco-circle – eco-circles were introduced to participants and only 4 participants have implemented the practice in their gardens and they have observed the following results; the practice uses less water, assists with pest control and produces good yields and beautiful fresh produce.	Workshop on how they can use new introduced crops, to make it easier for them to explain to their customers in the village, which will make it easier for costumers not to fear buying a crop they don't know.	
Tower gardens- participants never implemented the practice simply because the practices demands of materials needed and they saw a trench bed as a practice that only demanded labour and yet with good results.	Seed saving workshop- as much as they had seed saving workshops through the project and they would love to have a review workshop on seed saving, because they are still experiencing problems regarding seed saving the seeds end up being powder and not usable.	
Tunnels- Participants still want tunnels in their gardens. Tunnels not only protect their crops from extreme heat, but combined with trench beds and mixed cropping there is good yield and water management, not forgetting beautiful fresh produce.	Workshop in business management. They believe as they are farmers having an idea of how to run the business will add value to their farming activity as they will have more understanding on how to run a business selling their crops from their gardens.	

3.3.5 Conclusion

Participants reflected on the project and the assessment and this are their thoughts;

- Participants appreciated the knowledge gained from working with Mahlathini Development Foundation through this project. They gave up on farming because of the loss they made through environmental and climate change with no knowledge of how to adapt to the changing environment and climate.
- The also appreciated the knowledge gained in crop diversity and new crops; for example, herbs were introduced in their community; they knew nothing about herbs nor how they are consumed or how herbs help in terms of pest control in their gardens.
- One other thing pointed out was that the project not only taught them. The project gave them an opportunity to meet with other farmers with either similar challenges or different challenges and share experiences and challenges and how to deal with challenges; networking gave them more courage to continue with their farming activities.

4 DECISION SUPPORT SYSTEM

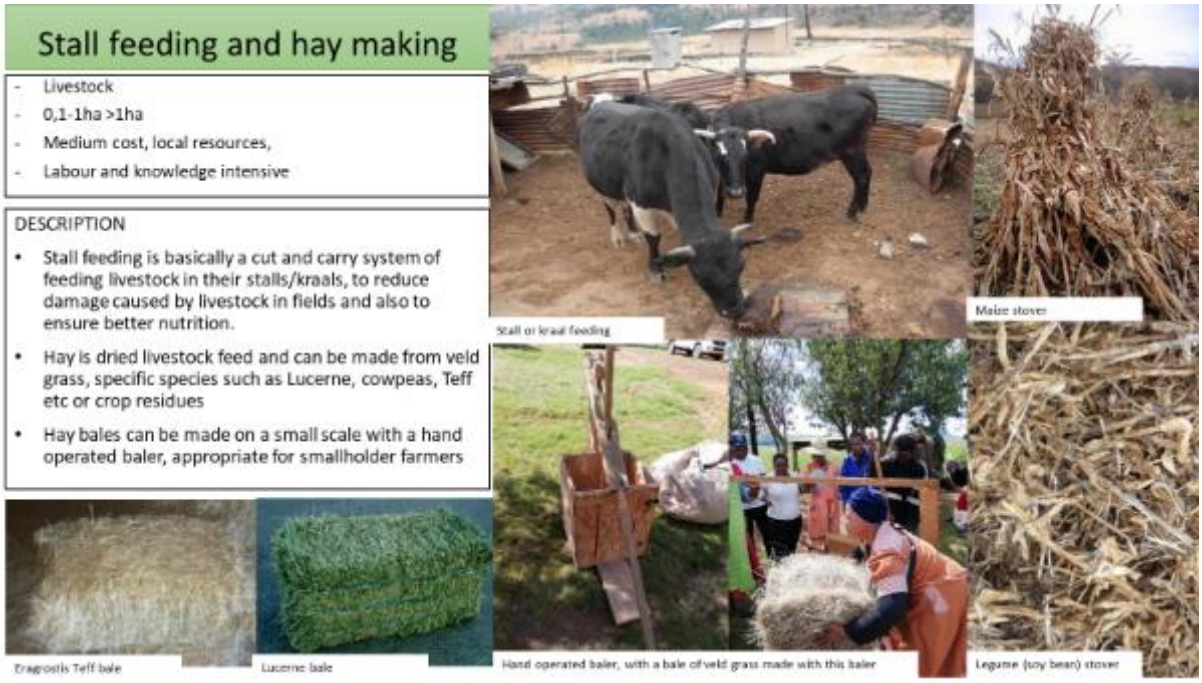
Written By Erna Kruger and Matthew Evans[1]
[1]Final year computer programming student at University of Pretoria.
With the completion of the refinement step of the DSS computer modelling process, Matthew Evans was brought on board to assist in designing an online survey process that could integrate the various components and steps of the modelling process.

This online survey has now been tested in a number of different workshops and refined and has been uploaded to the MDF website for easy public access.

4.1 Inclusion of 1- page descriptions

This has been undertaken for a further eight of the practices in the database, based at least in part on work undertaken and piloted through the CoPs in this programme. These include; strip cropping, Creep feeding and supplementation, stall feeding and hay making, improved organic matter, Planting legumes and green manures, crop rotation, grassed waterways and Zai pits.
In addition, the slide on small dam construction has been updated, following the experimentation process in Limpopo.

Below are a few examples


Stall feeding and hay making
- Livestock
- 0,1-1ha >1ha
- Medium cost, local resources,
- Labour and knowledge intensive
DESCRIPTION
• Stall feeding is basically a cut and carry system of feeding livestock in their stalls/kraals, to reduce damage caused by livestock in fields and also to ensure better nutrition.
• Hay is dried livestock feed and can be made from veld grass, specific species such as Lucerne, cowpeas, Teff etc or crop residues
• Hay bales can be made on a small scale with a hand operated baler, appropriate for smallholder farmers
Stall or kraal feeding
Maize stover
Eragrostis Teff bale
Lucerne bale
Hand operated baler, with a bale of veld grass made with this baler
Legume (soy bean) stover


Strip cropping
DESCRIPTION
- Cultivation in which different crops are sown in alternate strips to prevent soil erosion and optimise nutrient uptake
- Planting of strips have to be across the slope or on contour
- Crops need to be chosen to have a mixture of rooting depths and nutrient requirements.S trip cropping of multifunctional species is a good idea
- Agroforestry species such as Pigeon Pea, Moringa, Sesbania sesban, Leuceana etc work well
- Grasses such as vetiver, lemon grass and Napier fodder can also be used, as well as Rhodes-Smutsfinger (Digitaria)mix, Paspalum notatum and Tall Fescue
- Gardens, fields
- <0,1ha, 0,1-1ha, >2ha
- Low cost (Seed and plants), local resources,
- Easy to do
Strip cropping of maize with Paspalum and Digitaria
Strip cropping Pigeon pea/Leuceana and maize
Grass strips on contour in between maize
Moringa trees with grass in between strip cropping of other field crops
Maize and Lucerne or Lespedeza strip cropping

5 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 and have been reported upon in detail in the above sections.

5.1 Post graduate students

Progress with ongoing studies:

- Palesa Motaung: (M Soil Science- UP) has successfully conducted her fieldwork and is in the process of finalising her results and her write-up.
- Mazwi Dlamini: MPhil - UWC_PLAAS. He has conducted his first round of focus groups and interviews, has written these up and is in the process of conceptualising his second round of interviews. His progress has been slow, but he is also employed full-time as a fieldworker and has another year to complete this part-time study at UWC

5.2 Networking and presentations

5.2.1 Presentations

1. Fourth Ukulinga Howard Davis Memorial Symposium 20-21 August 2019. Developing resilience through partnerships and collaboration. Hosted by UKZN
Attended by around 200 participants from KZN including academics, government officials, students and development stakeholders. Presentation title:" A smallholder level decision support system improves resilience to Climate Change".

2. National workshop (DARDLEA, CSAG)6 August 2019. The development of a national risk and vulnerability framework: Learning from practice. Attended by a broad range on national stakeholders (around 60 participants) including Municipal and government officials, NGOs, Universities, consultants in the field. Presentation title: "Risk and vulnerability assessments for community level climate change adaptation".

3. National workshop (AWARD). Building adaptation capacity, literacy and justice on climate change in the communities of South Africa 22-23 August 2019. The workshop was to share lessons learnt and provide a space for implementing organisations to network. Around 40 participants from Civil society, government and Universities. Presentation title: "Climate change adaptation decision support system for smallholders"

4. Rhodes University, learning and sharing workshop 7 October 2019. GEF5 Sustainable Land Management Project: Securing multiple ecosystems benefits through SLM in the productive but degraded landscapes of South Africa. Facilitation of a process for project team

members to explore methodologies for vulnerability and impact assessments – using the WRC smallholder decision support process in CCA as a basis.

5. Okahlamba Land and Agriculture Summit 27 October 2019. MDF worked collaboratively with the KZNDARD (Mr Harland Wood) to present a paper called: "Climate change, adaptive strategies and a success story in the Okahlamba municipality – Climate Resilient Agriculture implementation by smallholder farmers".

5.2.2 **Collaboration**

A collaborative process was put in place with the Institute of Natural Resources to use the workshop methodology for exploration of climate change impacts and adaptive strategies as a way to discuss potential natural resources rehabilitation strategies to support the Umkomazi Restoration Project (Umngeni Water) pilot phase.

This process worked well to outline the community situation, issues and motivation for action and was used in two villages in the Impendle district of KZN.

(a) Preamble

There are considerable issues related to land and water management practices in the communal tenure areas around Impendle, with resultant high levels of soil erosion, over grazing and wattle infestation and encroachment, as the three main issues for siltation of streams and rivers in the area.

The Community Work Programme and the Working for Water process under the Extended Public Works Programme have both been active in this area. This has led to a high expectation for payment to do any work not specifically within the confines of peoples' homesteads and fields. This attitude is unfortunately confounded by the way communal tenure arrangements have developed over time.

The Traditional Authorities (TA) oversee land administration and land use regulations. The latter consists mainly of arrangements around summer and winter grazing of livestock (usually livestock are allowed into the built up areas and fields in winter and sent to the hills/ mountains for grazing in summer), allocation of fields and water access to individuals and groups in the community and use of wattle and natural resources for firewood and other purposes. The emphasis is on use, as opposed to management and conservation of resources.

This process is focused on finding opportunities for resource management options that community members are prepared to undertake and developing reciprocal arrangements for such activities. As such the facilitation approach has focussed on availability of resources, issues and changes within these and peoples' agricultural activities, to tease out some options for individual and joint activities that could lead to improved soil and water management and potential incentives to motivate such activities.

Two pilot sites, with different community -based management regimes have been identified:

1. ***Nxamalala in Impendle***; A typical communal tenure village, where the TA is respected and active and also where the village is in an upper catchment (to allow for the greatest potential impact in restoration work) and is contained (a limited and defined number of households in the village – to allow for community coherence) and
2. ***Ntwasahlobo in Stoffelton***; A historical 'black spot' with private landowners and tenants; where the land use and management are more directly dictated by the landowners, in conjunction with the TA in the area. Again, a contained village in the upper catchment of this area was selected.

(b) Methodology and process

Community level entry was negotiated through the traditional authorities. A two-day community level process was then undertaken, following the facilitation process outline below.

Table 15: Facilitation outline for Community level workshops

DAY 1	PURPOSE	PROCESS	REQUIREMENTS
INTRODUCTION			
Community and team introductions	- Outline of Umkhomazi restoration project -Introduction of team -Community introductions (incl farming activities)	- Use Info sheet produced by the INR and topographical maps awa -photographs and visual aids of typical erosion and climate change issues in this area	**Attendance register** - with columns for farming enterprises (so that each participant can tick what they do) - in English and Zulu **Name tags;** stickers, kokis
Purpose of the day	Introduction of the organisation/s and purpose of this workshop- link to already ongoing activities if possible and introduce visitors and other stakeholders involved	talk to CC necessitating adaptation from us - we may need to change how we do things and what we do to - This w/s is to help us explore options for such changes	Flip stand, newsprint, kokis, data projector, screen, extension cords, plugs - double adaptors, cameras
PRESENT SITUATION			
Present livelihoods and farming situation - discuss impacts related to CC	Use a series of impact pictures- from the local situation. Include the 5 categories (and describe them to the group) - water management (increased efficiency and access), soil management (erosion control, fertility, health), crops, livestock and natural resources	Impact pictures- either ppt or printed on A4 to facilitate dialogue (or both) Record community comments	**Power point presentation pictures**
PAST, PRESENT, FUTURE			

Discuss farming activities as they have changed, what they are now and what may happen in the future if the present trends continue	SMALL GROUPS (5-10people): facilitated discussion on farming activities (include the 5 categories) - prompt for all five and keep conversation focussed OR Facilitate a shorter plenary discussion on how things are changing (if time is pressing)	Important to note and record any discussions around changes and adaptations- so things people are already doing to accommodate for changes - also where they are not sure what to do	Small groups; each needs a facilitator and recorder
TEA	Fruit (apples, oranges, biscuits, juice and water, paper cups (lots) and plates…		
REALITY/IMPACT MAPS			
	Summarise impacts and local activities POSSIBLE SOLUTIONS: things that people know, have changed, have tried and or are trying to deal with the changes	Prompt for social, economic, environmental impacts as well if these don't come up in the group Also make a separate list on newsprint of names of people trying things (this is to facilitate h/h visits on day 2)	Small groups; each needs a **facilitator and recorder**
CLOSURE	REPORT BACKS - of possible solutions PLANNING FOR DAY 2 - choose 3-4 participants for household visits and ask for a small group of other interested individuals to join. Decide on venue and time (12 noon) for continuing with practices	Households to be within walking distance hopefully. Otherwise drive these 3-4 participants around and meet for focus group thereafter	Rapporteurs need to be chosen from the group to summarise the solutions in the report backs [5min/group]
LUNCH			
DAY 2: HOUSEHOLD VISITS AND FOCUS GROUP DISCUSSION			
Household visits	To look at local adaptations and innovations; To assess the household and general resource situations; To start to elucidate criteria people use to make choices and decisions	Use questionnaire and fill in through semi structured interview and observations	
Implementation options focus group discussion	To summarise and discuss ideas suggested in Day 1 and on household visit walks To introduce some ideas also from the facilitation team To agree on potential options and follow-up	List and summarise different actions – and potential interest groups for the different activities Finalise process and dates for follow-up activities	Presentation of a range of practices using a power point presentation or visual aids of beast practice options.
LUNCH AND CLOSURE			

(c) Nxamalala (Emapanekeni) process and outcomes

DATE: 15,16 October 2019

VENUE: Mr Duma: Member of TA, linked closely to induna Mr Khumalo, under Nkosi Zuma (Mapanekeng village – 14 households in total – Some people were removed

ATTENDANCE: 12 participants (4 men, 9 women)

FACILITATION TEAM: INR; Zanele, MDF; Erna, Tema, Nonto, Lima; Nosiphephelo

Figure 67: Mapanekeng workshop participants, Day 1.

Upon entry, it was evident that the resource management processes for this village different somewhat from other villages in the vicinity; there was a lot more grass in the grazing areas, little to no burning, evidence of green patches where wetlands were still functioning and containment of the wattle "forests" along the ridges. There was also evidence of managed cutting of wattle. There was some evidence of erosion (dongas and gulleys), although at first glance most of these appeared to be stable with some vegetation within and around the gulleys. This was discussed with the group as a way of introducing the process.

(i) Day 1: Community workshop on farming and resource management

(i).1 General discussion on resource management in the village

Figure 68: Left: Well grassed area, with green strip indicating a still functional wetland. Centre: Wattle" forest" on the slope with cut branches on the side and Right: Donga; reasonably stable with some vegetation in and around the gulley.

Comments from community members included the following:

- There is a highly functional dipping committee.

- There is an agreement not to burn in the area, to provide for more grazing for livestock. Fires that do happen are accidental or flow over from the commercial farm above.
- Some burning is done in the mountains in early spring for grazing for livestock. They are moved there in summer.
- Most of the men in the village own reasonably large numbers of livestock; including cattle, sheep, goats, horses, pigs and poultry.
- Water is obtained from the mountain through a protected spring, which is reticulated to a header tank and pipes with taps to each homestead. There is no lack of water here, but little municipal support

Many people would like to want to relocate to the area, but cannot due to local conditions. There is no real road access to the village – just a track that has to cross stream beds, which become flooder in summer, making getting in and out of the village difficult. It also means that at times children do not go to school, for this reason. The main requests for support from this community was support for building roads and bridges and also fencing of fields. On the walk it became clear that most of the households and homestead fields are well fenced 9around 4 were not), but that the request relates to wanting to expand cropping into the more communal unfenced areas surrounding the village.

People mentioned that they work together, that there is a local tractor for use in ploughing, but that people would still need more support in mechanisation and that the women need assistance with fencing of gardens and fields.
Most of the households have small vegetable gardens and dryland fields in the homesteads, but not all are actively using them, as cattle invasion and access to enough water can be an issue.

MAIN REQUESTs FROM THE COMMUNITY

- ***Assistance with roads and bridges***
- ***Assistance with fencing***
- ***Assistance with control of Wattle; not removal as people use them, but thinning in a controlled manner***
- ***Assistance in control of dongas encroaching on homesteads***
- ***Contours need to be rehabilitated to control run-off***
- ***Conservation Agriculture in fields; for soil fertility and soil health improvement and to reduce erosion***

(i).2 How have things changed over time?

- Dongas have increased over time (Mr Duma)
- When it rains there are big storms and erosion because of that… and also roads and paths are washed away and then cars cannot enter here (MamGwala)
- Crops get washed away due to heavy rains
- In the past people used to do field cropping with oxen a lot. Now there is not much… There is a need for fencing to control livestock
- Forests are now a lot less than before, but there is an increase of predators such as jackals in the wattle copses.
- The Wattle is taking over- issues with uncontrolled grazing there. Community wants them thinned out but not completely removed as trees for firewood are scarce.

(i).3 Present situation

- We have not really seen a difference in the amount of rain, just bigger storms and an issue with maintenance of soil and soil erosion control structures
- A TLB costs R600/hr. The municipality doesn't maintain the road here. The CWP also doesn't do anything here
- The Municipality doesn't assist here; Not much communication between community leaders and members here… Councillor doesn't help – no electricity here
- We grow small amounts in the gardens, maize, beans, potatoes, some cabbage and spinach.
- There is some erosion encroaching on the fields and homesteads….
- Sometimes livestock die in the dongas,
- We now keep them enclosed in kraals at night as they are vulnerable to predation otherwise…
- We also buy injections when they are sick, Lost 30 sheep to a disease – Scab on their skins…
- The problem is that the Wattle forests have become very thick. They are owned by Induna and Nkosi – but the community has permission to use it, for firewood and poles. There are no limitations placed on use … CWP were meant to clear – they just cut and leave the rubble and when it rains there are even bigger problems. No consultation with the community about how to do this and then this causes more problems.
- Some of the plantation belongs to MamZuma's family – but it belongs to the Nkosi originally.
- CWP brought muthi to kill the bigger trees, but now they have re-germinated. Chemicals did not work.
- When the women cut the trees, there are always new shoots growing
- Now no longer using the big fields further away because of cattle, only working in our homesteads. We use a tractor in our homestead plots. We pay for a tractor – for household food (maize, beans, potatoes, cabbages, tomatoes)
- The Extension officer from KZNDARD assists with sweet potatoes and cabbage…
- There is a group of women (isibonelo), registered as a cooperative. Not working together much. They are tired. Then there are problems with pests in the soil that eat potatoes (termites) and also pests for cabbages… Fencing was also stolen… The soils in the bigger fields are more damaged than the plots at peoples' homesteads… Some of the ladies are now old
- Some people still want to continue with planting…
- There are no markets for their products, (also led to collapse of their communal garden)
- Climate change has affected our yields
- There is no fertilizer to put in the fields.
- Lack of knowledge regarding recommended fertilizers
- Herbicides are used to control weeds

(i).4 Past situation

- They used to have oxen and planters- now do not have any
- The area that is covered by wattle now used to be houses. With the new government people were asked to move to be closer together to allow for service provision. Not everyone agreed to move.
- Children used to be available to do herding and help, now they are in school. Now struggling more to look after the environment.
- Fields were fenced by the Department of Agriculture, prior to 1994. This was stolen a long time ago. Now fields are allocated by the Nkosi, for which payment is required and if they

are not used, they revert back to the Nkosi. It is around 30 years since the large fields were last ploughed.

(i).5 Ideas for future

* Fencing for homestead plots
* Broilers and layers– for selling (they will be less work than cropping)
* Thinning of wattle copses
* Contours need to be rehabilitated, to control runoff…
* Correct use of fertilizers and herbicides

(ii) Day 2: Household visits and focus group discussion on options

Eight homesteads were visited; to check activities, donga encroachment and access to resources and a walk was taken to one of the wattle copses on the hillside. A summary of the bassline household information is provided in the attachment

Around 7 of the households are on one side of a large donga and stream and the rest are on the opposite side. On that side there is also access to taps with water from a spring in the mountain, but the water is not clean and not as reliable as on the near side. The municipality originally assisted with the spring protection and putting in the header tanks. There are also a few communal standpipes in the village- which are not really used, as people have water in their households

Figure 69: Mr Duma's tap in his homestead yard.

The mountain above the homestead provides grazing for livestock of the whole are in summer (October to March)), not just this village, which makes control of movement of livestock and management of the grazing there difficult. There is clear evidence of erosion due to cattle movement, over grazing and injudicious burning.

Figure 70: Left: The large donga separating the two sides of the village. Centre: Erosion due to cattle movement and overgrazing. Right: burning of the mountain for early spring grazing, also leading to erosion.

Most of the homesteads are well fenced, with a small garden and field, as well as kraals and housing for pigs and chickens.

Figure 71: Left: Mr Duma's vegetable garden with peach trees and Centre his fenced field. Right: Mr Khumalo's housing arrangement for his pigs.

Figure 72:Left- two households with decaying or absent fences and little farming activity and Right: 2 households with dongas encroaching on their fence lines. (Mvula Khumalo and Mkhulu Zuma.)

With regard to the wattle copses, the health of the stream flowing through the higher reaches of these copses was in a surprisingly good condition, with some native vegetation also evident and some grass between the trees. (Left picture)/ Further down the valley however these was evidence of soil erosion cause by the wattle thickets 9Rgiht picture). All major branches of the trees have been cut out, leaving them to become bushy, leading to a lack of grass cover and increased erosion.

(iii) Baseline information

Individuals from eight of the fourteen households were interviewed to get a snapshot of the general socio-economic and livelihoods conditions in the area. The two small tables below provide a summary of this information

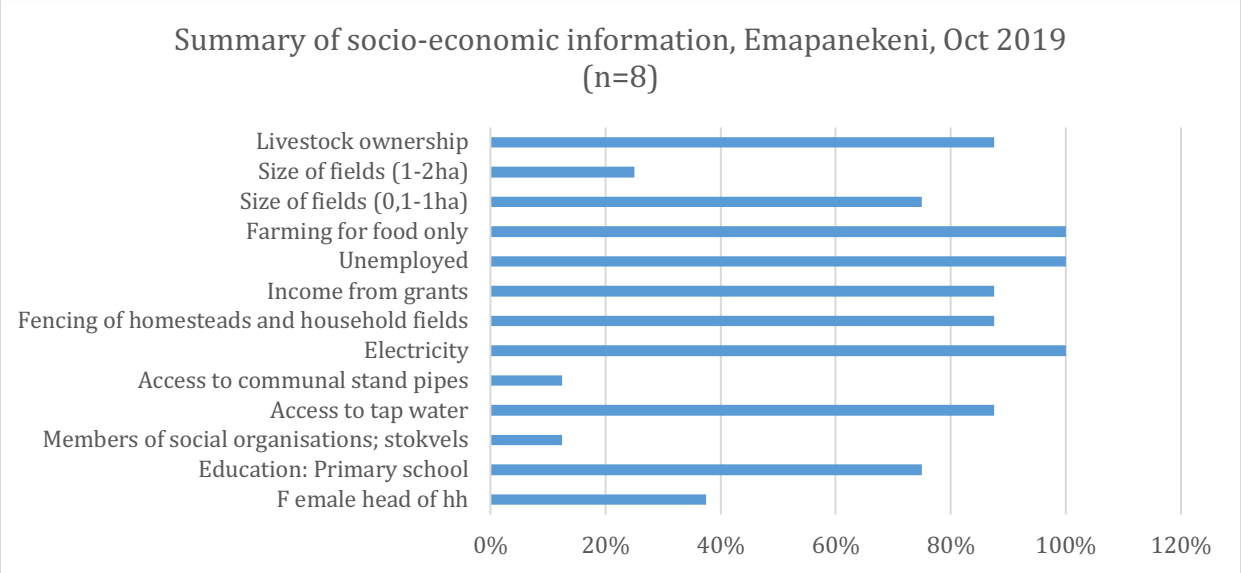


Table 16: Basic socio-economic and livelihoods information for Emapanekeni participants

From this summary it can be seen that none of the participants come from households where members are employed, all rely on social grants and around 38% of the household heads are female. The education levels are low, with around 68% of respondents only having a primary school level education. All households have access to electricity and water and around 86% have well fenced homesteads and household fields. Farming (cropping, gardening and livestock rearing) is for food production only and there is no access to markets. 86% of households own livestock (cattle, goats, horses and pigs). This is a substantial resource, made possible for this village by its relative seclusion and also access to a substantial area for grazing.

Ave age	51,5
Ave no of household members	4,6
Dependency ratio; average	1,17
Income (in Rands)- unemployed	R 1 457,14

The average household income for these participants is in the region of R1 500/month, shard by between 4-5 household members. The dependency ratio of 1.17 children to each adult is however quite low, when compared to other rural villages in the region. In summary, these households are all extremely poor and vulnerable economically, but are well resourced in terms of water and access to natural resources.

(iv) Focus group discussion

A discussion was held around the need for work in the wattle copses and on the dongas threatening homesteads and fields. Thus far the only efforts in this regard have bene through the Community Work Programme (CWP), although not much has been done. It is possible to speak to the councillor Mrs Shangase, to ask for the CWP teams to work in the dongas – although participants did not agree on

this approach, as some felt that the councillor wold not support them and others thought that then workers from other villages would be brought in and it would not benefit householders in this village. Also, workers brought in from elsewhere would not be committed to doing a good job.

A discussion around work for incentives rather than payment was held. Ideas included:

- Work in wattle copses and clearing of wattle form stream beds in exchange for poles and fencing materials
- Reducing the encroachment of wattle copses and removing wattle in streams (a more limited option) OR work in dongas threatening homesteads, in exchange for support on Conservation Agriculture (Inputs and training) OR fencing OR supplementation support for livestock

Regarding the Wattle copses and erosion on the mountain, it was noted that the broader community and the traditional Authority would need to be involved. In addition, some of the participants clearly favoured the need to be paid and felt they would want to decide for themselves how to use the monies earned, rather than being given specific materials

It was agreed that Mr Duma would discuss these options with the Induna (Mr Khumalo), to get a final answer. The answer from the TA, was that people should be paid. Sadly also, Mr Khumalo passed away a week later, removing a central person in the local decisions making process.

Regarding Conservation Agriculture, it was agreed that all 14 households want to be part of this process and that their contribution would be to plant an equivalent area to the CA trial plots by themselves as their contribution.

5.2.3 **Publications**

No articles or papers have been published during this period. An agreement is in place with CABI to produce a chapter entitled *"CA Innovation Systems build climate resilience for smallholder farmers in South Africa",* in a book entitled Conservation Agriculture in Africa: Climate Smart Agricultural Development, by mid -February 2020