APPENDIX 3: BERGVILLE ANNUAL PROGRESS REPORT

CA Farmer Innovation Programme for smallholders in Bergville

Period: October 2016 - September 2017

Farmer Centred Innovation in Conservation Agriculture in upper catchment areas of the Drakensberg in the Bergville region of KwaZulu-Natal

Compiled by:

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Project implemented by:

Mahlathini Development Foundation

Promoting collaborative, pro-poor agricultural innovation.

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In collaboration with:

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Contents

Identification of the project

Description and selection of study areas

Work in the Bergville (KwaZulu-Natal) site continued with the scaling out (horizontal expansion) process that has been implemented, to include more villages around central nodes and more farmers within each village. In this way villages included expanded from 11 to 17 and the numbers of farmer participants in farmer level trials have increased from 163 in the 2014-2015 season to 263 this season. The overall area for trials has increased from 5,9ha to 13ha.

Approach and Methodology

The farmer centred innovation systems research process underpinning the programme, which is based on working intensively with farmer learning groups and local facilitators in each of the villages, has been continued and strengthened.

Within the learning groups farmer innovators volunteer to set up and manage farmer-managed adaptive trials as the 'learning venues' for the whole learning group. Farmer Field School (FFS) methodologies are used within the group to focus the learning on the actual growth and development of the crops throughout the season. New ideas are tested against the 'normal' practise in the area as the controls. Farmers observe, analyse and assess what is happening in the trials and discuss appropriate decisions and management practices. Small information provision and discovery-learning (training) sessions are included in these workshops/ processes. These are based also on the seasonality of the crop and the specific requests and questions from farmer learning group participants.

Local facilitators are chosen from within and by members of the learning group to be a person who has the required experience, knowledge and a willingness to support the other farmer innovators in their implementation. Facilitators are only chosen and appointed where people with the appropriate skill and personality exists. Local facilitators receive a stipend for a maximum of 10 working days per month, for their support to the farmer innovators. They fill in detailed timesheets outlining their activities against which they claim a monthly stipend.

Learning group members agree to a season long learning process and put forward the farmer innovators to run the trials. Each prospective innovator is interviewed and visited and signs an agreement with the Grain SA team regarding their contribution to the process. They undertake to plant and manage the CA trials according to the processes and protocols introduced as well as a control plot of the same size. For the latter, farmers provide their own inputs.

The adaptive trials are also used as a focus point for the broader community to engage through local learning events and farmers' days. Stakeholders and the broader economic, agricultural and environmental communities are drawn into these processes and events. Through these events, *Innovation Platforms (IPs)* are developed for cooperation, synergy between programmes and development of appropriate and farmer-led processes for economic inclusion. These IPs also provide a good opportunity to focus scientific and academic research on the 'needs' of the process.

As learning groups mature they engage in a number of additional processes within the value chain that build social capital and cohesion. VSLAs (Village savings and loan associations) are set up to

provide a mechanism for payment for inputs and for setting up bulk buying groups for production inputs. Farmer centres are set up and managed locally (at village and nodal level) to provide for local access to inputs through negotiated agreements with local suppliers and agribusiness, management of shared tools and advice and mentoring in CA. Learning group members also negotiate joint decisions around their crop production planning and marketing and engage with stakeholders and support organisations. To support this process a social compact agreement has been designed to outline roles and responsibilities of the various role players in these forums.

In this season (2016-2017) we have continued to focus on the following elements of the model, namely:

a) Support farmers who are in their 1st, 2nd , 3rd and 4th seasons,
b) Conscious inclusion of crop rotation to compare with intercropping trials
c) Inclusion of summer cover crops in the crop rotation trials
d) Continuation with experimentation with winter cover crops, but planted in separate plots rather than in-between maize
e) Planting of late season beans
f) More focussed introduction of lab-lab beans and
g) Initiation of nodes for farmer centres that can offer tools, input packs and advice.

Key activities: October 2016-August 2017

This report builds on, but does not repeat information presented in the 6-monthly interim report in February 2017.

For the 1st year of the 2nd phase of this CA Smallholder Farmer Innovation Programme (SFIP) we have given attention to broadening the organisational scope and areas of operation of the programme. A proposal was submitted to the LandCare programme of DARD in KZN and a collaborative process was agreed to. Expansion into further villages in the Bergville areas was initiated.

Researcher-managed trial plots were set up in Ezibomvini and Eqeleni to work on quantitative benchmarking of some of the visual CA indicators being used in this process. This process is designed to augment the new monitoring system being put in place.

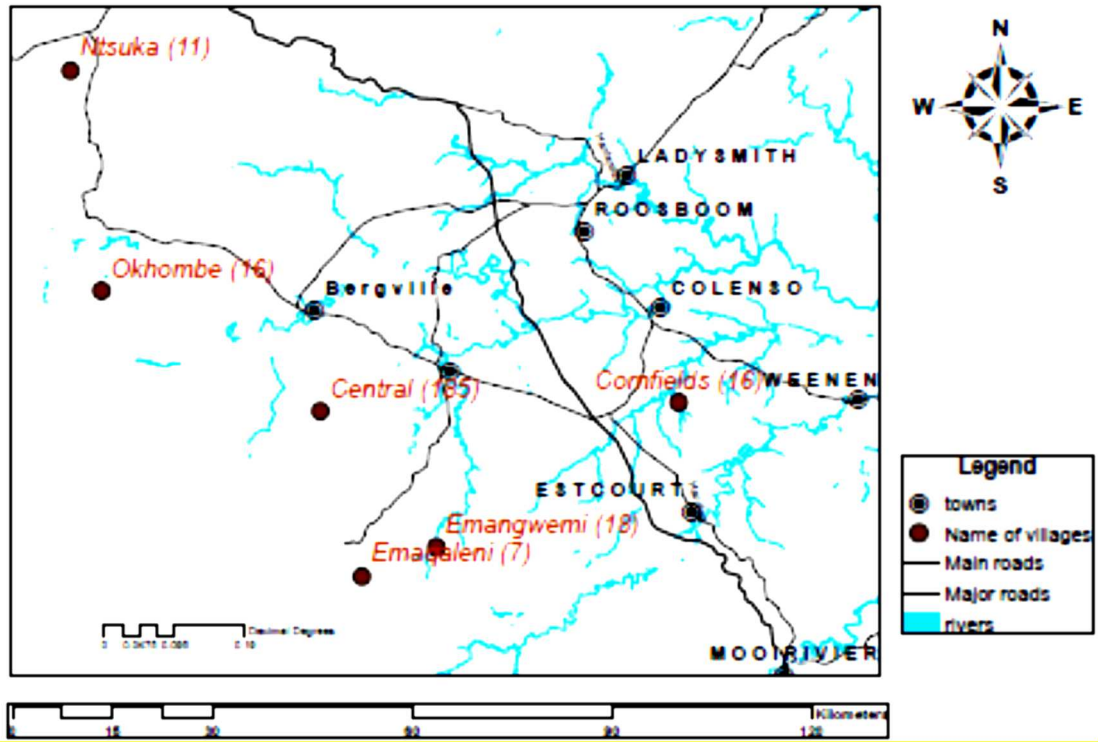
The table below outlines the key activities and deliverables planned for the period. Expenditure has been in line with the work plan. An initial over expenditure on inputs has been accommodated for in the subsequent months. Partial recovery of over-expenditure on inputs (R98 196) was received from smallholder participants paying input subsidies (R18 900). Subsequent savings were made in running expenditures. Presently an amount of R83 475 remains for implementation in the last three months of this project, which is sufficient for outstanding activities

TABLE 1: KEY ACTIVITIES, OUTPUTS AND DELIVERABLE OCTOBER 2016- SEPTEMBER 2017; PLANNED AND ACTUAL.

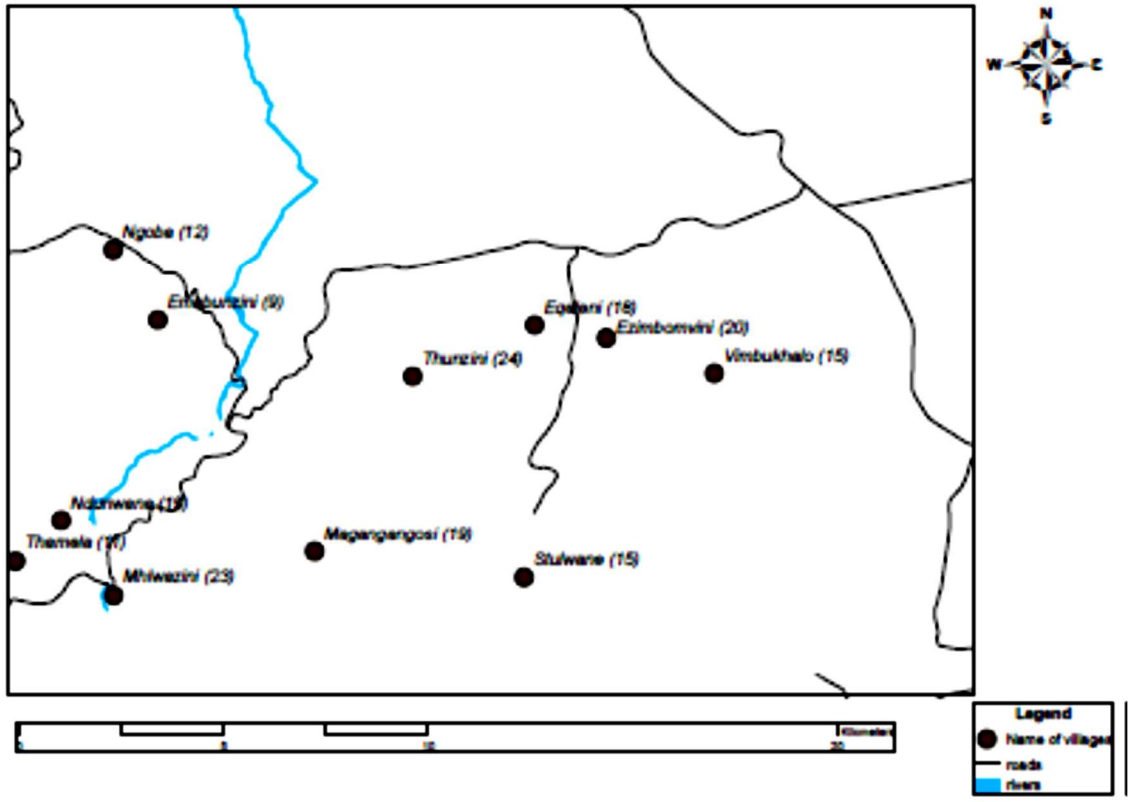
Bergville, KZN Milestones: Farmer Centred Innovation in CA. October 2016- September 2017				
Milestones/ Outputs	**Key activities**	**Outcomes/ Deliverables**	**Actual expenditure Aug 2017**	**Budgets**
	Capital Equipment		R10 410	R18 650
	Documentation and M&E	Meeting and monthly reports	R89 786	R90 000
	Experimentation	List of participants, interviews and contracts, awareness and training	R 404 454	R 481 400
	Innovation Platforms	Stakeholder meetings, platform building and events	R16 926	R15 000
	Budget expenditure end June 2017		***R 521 576***	***R605 050***
	Remainder		***R83 475***	
Sub - TOTAL: Oct2016-Sept2017				**R 605 050**

Progress

This year has seen a great upsurge in new participants and the project expanded into 6 new villages. The project is now operational across 17 villages in the Bergville area, with a total of 263 learning group participants and 212 farmer based trials. The map below shows the spread and distribution of the villages involved.



A further map indicates the spread of villages in the Central Bergville region indicated above. This gives some indication of the three clusters or nodes of villages that are presently involved; 5 villages around Ezibomvini (Stulwane, Magangangozi, Thunzini, Eqeleni and Vimbukhalo), 2 villages around Ndunwana (Thamela and Mhlwazini) and one village close to Ngoba (Emabunzini). These three nodes are being explored for the farmer centres.



The basic experimental design was followed for all 1st year participants and most of the 2nd year participants as well. Variations have included crop rotation instead of intercropping, summer and winter cover crop mixes, planting of lab-lab beans and late season planting of beans.

The table below outlines activities related to objectives and key indicators for the period of October 2016 -September 2017.

TABLE 2: SUMMARY OF PROGRESS (OCTOBER 2016 – SEPTEBMER 2017) RELATED TO OBJECTIVES AND KEY ACTIVITIES

Objectives	Key activities	Summary of progress	% completion and comment
1. Document lessons learned	Documentation for learning and awareness raising	- Finalisation of CA manual (Eng and Zulu) - Soil health symposium – presentation and participation (Nov 2016) - Finalised PID report and progress reports for CA SFIP- on MDF website - Sharing of information through innovation platforms processes;- Participation in Ezibomvini and Mhlwazini farmers' days - Stakeholder engagements with DRDLR, DARD, Okahlamba LM, NGOs - Articles and promotional material	- 100 copies of E and Z manuals printed. A further print run expected. (50% complete) - 100 copies of group and individual savings books printed and in use. A further print run of 300 copies done in January 2017 (100% complete) -Innovation platforms (100% completion) - ongoing - Grain SA DVD promotional DVD produced and viewed at farmers days (100% completion)
	Final report	- 6 monthly interim reports and final progress report	- Interim report finalised. Final report at finalised (100% completion)
2. Increase the sustainability and efficiency of CA systems	1st level experimentation: farmers see their own practice as a control – size 400m^2 ha exp, 400m^2 control, Control.9 villages, 45 farmers	- 9 villages, 115 farmers	- 100%. Basic CA design- intercropping with maize beans and cowpeas on a 100m^2- 400m^2 plot, with a control plot managed entirely by the participant. Adaptation trials included late season planting of beans with a mixture of winter and summer cover crops.
	2nd level experimentation: 24 existing farmers use their own practice as a control – size: size 400m^2 ha exp, 400m^2 8 villages, 59 farmers	- 10 villages, 55 farmers	- 100%. Adaptation trials included late season planting of beans with a mixture of winter and summer cover crops. Most participants opted to continue with intercropping practice from their 1st year.

	3rd level and 4th level experimentation; own contribution, larger plots, own ideas (2 villages, 7 farmers in total)	- 6 villages, 27 farmers	- 100%. Larger level plantings using oxen drawn planters and including cover crops. Intercropping still practised. Awa crop rotation and summer and winter cover crops.
	Develop and manage PM&E framework; – weekly and monthly M&E visits	- M&E forms redesigned and used - Digital monitoring system piloted	-100%. Monitoring completed for 138 participants across all 17 villages, including yield measurements for maize, beans and cc's
	Facilitation of innovation platforms	- Co- facilitation of information sharing and action planning with stakeholders and role players	- 100%. Farmers days
	CA working group, and reference group	- Attended and presented in Feb and Sept 2017	- 100%
	Sharing of information using a range of innovation platforms	- Presentation at LandCare conference end 2016	- 100% -Stakeholder interaction- DRDLR, DARD, Okahlamba LM, NGOs

A performance dashboard is indicated below. This provides a snapshot of performance according to suggested numbers and outputs in the proposal.

TABLE 3: PERFORMANCE DASHBOARD; SEPTEMBER 2017

Outputs	Proposed (March 2016)	Actual (September 2017)
Number of areas of operation	3	2
Number of villages active	16	17
No of 1st level farmer experiments	45	115
No of 2nd level farmer experiments	59	55
No of 3rd level experiments	39	27
No of 4th level experiments	-	12
No of local facilitators	6	6
No of direct beneficiaries	149	212
Participatory monitoring and evaluation process (farmer level)	Yes	Yes
CA manual (English and Zulu)	Yes	CA manual English – yes CA manual Zulu-yes

Results achieved to date

The framework for scaling out implementation included: Continuation with existing farmer experimentation options for 1st, 2nd and 3rd level participants. This includes intercropping, crop rotation, late season planting of beans and combinations of summer and winter cover crop mixes.

4th Year participants design their own implementation processes and provide a mentoring role for newer entrants into the CA process

Cover crops, both a mix of SCC's (sunflower, millet and sun hemp) as well as a late season relay cropping of a mix of SCC and WCC (saia oats, fodder peas and fodder radish) were planted by 38 and 55 participants respectively across 5 villages. For the SCC's a number of participants have managed to collect some seed, mostly for the sunflowers that participants want to use as poultry feed.

Six (6) new villages were included, based on their interest in CA. Thus around 212 farmer experiments were set up across 17 villages around Bergville. Two (2) Farmer centres were initiated in Ezibmovini and Ndunwane respectively. The farmer centre in Ezibomvini is functioning very well and will continue. The centre in Ndunwane did not do very well.

A total of 8 VSLAs have been initiated and supported specifically for the purposes of saving for inputs for field crop production (Ezibomvini, Eqeleni, Nudnwane and Emabunzini). See the table below. An improved record keeping process has been designed and record keepers in each of the VSLAs have received training and mentoring. This has allowed for accurate recording of group savings and loans and an indication of use of these funds by the individuals in the groups

TABLE 4: SCGS OPERATIONAL IN THE BERGVILLE AREAS, WITH NUMBER OF PARTICIPANTS AND YEARS OF OPERATION

SCG NAME	NUMBER	AREA	VILAGE	YEAR
Masithuthuke	25	Bergville	Qeleni	4th year
Masibambane	25	Bergville	Qeleni	4th year
Mtwana	26	Bergville	Stulwane	3rd year
Ezibomvini	23	Bergville	Ezibomvini	2nd year
Ukuzama	17	Bergville	Ezibomvini	2nd year
Mphelandaba	19	Bergville	Ndunwane	1ST year
Sceluthando	17	Bergville	Mhlathuza	1st year
Siyaphambili	20	Bergville	Ndunwane	1st year
Sakhokuhle	23	Bergville	Emabunzini	1st year

Two very successful farmers days were held in Ezibomvini and Mhlwazini respectively. Interest in this process is growing and many external role-players and stakeholders participated actively in these processes. Further involvement with stakeholders has been pursued with the DRDLR DARD, the Okahlamba LM – LED section and LandCare to ensure coherence and work on collaborative implementation processes. Discussions with DEA are in progress around a payment for ecosystem services model appropriate for smallholders.

TABLE 5: ACTIVITIES AND NUMBERS OF FARMERS INVOLVED, PER VILLAGE FOR OCTOBER 2016-SEPTEMBER 2017.

BERGVILLE	Year started with CA					COMMENTS
Villages	2013	2014	2015	2016	Total	
Emabunzini				10 (8)	10 (8)	Intercropping with hand hoes and MBLI planters; Maize, beans, cowpeas
Emangweni-Engodini			12 (14)	7(2)	19 (16)	1st and 2nd level experimentation; intercropping
Emangweni-Emaqeleni				(5)	(5)	1st level experimentation; intercropping
Eqeleni	9 (5)	13(3)	7(4)	(1)	29 (13)	1st, 2nd and 3rd level experimentation; MBLI's hand hoes and animal drawn planters; intercropping crop rotation summer and winter cover crops, late season beans
Ezimbovini		1 (6)	8 (4)	(10)	19 (20)	1st, 2nd and 3rd level experimentation; MBLI's hand hoes and animal drawn planters; intercropping crop rotation summer and winter cover crops, late season beans
Magangangozi		10(7)	1		11(7)	1st and 2nd level experimentation; intercropping
Mhlwazini			17(5)	12(13)	29(18)	1st, 2nd and 3rd level experimentation; MBLI's hand hoes, intercropping crop rotation summer and winter cover crops, late season beans
Ngoba			6(6)	4(5)	10(11)	1st, 2nd and 3rd level experimentation; MBLI's hand hoes and animal drawn planters; intercropping crop rotation summer and winter cover crops, late season beans
Nsuka-Zwelisha				11(12)	11(12)	Intercropping with hand hoes and MBLI planters; Maize, beans, cowpeas
Okhombe		11	6(3)		17(3)	1st and 2nd level experimentation; intercropping
Potshini					1(1)	3rd level experimentation
Stulwane	7(7)	14(4)	3(2)	(2)	24(15)	1st, 2nd and 3rd level experimentation; MBLI's hand hoes and animal

						drawn planters; intercropping crop rotation summer and winter cover crops, late season beans
Thamela				11(12)	11(12)	Intercropping with hand hoes and MBLI planters; Maize, beans, cowpeas
Thunzini				20(24)	20(24)	Intercropping with hand hoes and MBLI planters; Maize, beans, cowpeas
Vimbukhalo		(7)	7(5)	12(12)	19(23)	1st and 2nd level experimentation; intercropping
Ndunwana			14(15)	9(0)	23(15)	1st and 2nd level experimentation; intercropping
Emazimbeni				10(10)	10(10)	Intercropping with hand hoes and MBLI planters; Maize, beans, cowpeas
Grand Total	**19(12)**	**59(27)**	**81(55)**	**106(115)**	**263(212)**	**~13-14 ha**

Of these 263 participants, across 17 villages that registered for participation in the beginning of the season, 212 (80%) farmers planted their trials. The beginning of the season was still quite dry and a few farmers opted not to plant or left planting too late. In some of the villages, cattle were not sent into the mountains for summer grazing, as is the general procedure, due to a lack of grazing caused by the severe drought of the previous season. Cattle invasion of fields was thus a big issue and some participants opted not to plant because of that. Others did not come forward with the required subsidy payments and then opted not to plant.

Although the payment of subsidies is a comparatively small amount (R150 for 400m^2 and R320 for 1000m^2), the issue for some participants was that they were also paying the subsidy amounts for the Grain SA Farmer Development Programme (FDP) and for the DARD, both of which amount to around R1,100 each for inputs for 1ha. 60% of participants who started between 2013-2015 have continued with the CA experimentation process. The arrangement is that the 1st season participants, those from 2016 on this list, do not pay the subsidy.

The two Grain SA programmes and the DARD are in communication with each other to ensure as much coherence as possible across programmes. CA is being introduced in all three processes to a greater or lesser extent. Participants are encouraged to participate across these programmes to be able to glean the benefit from them. The Grain SA SFIP focusses on farmer centred IS research, emphasising learning and experimentation with different aspects of CA within the maize value chain, while the Grain SA FDP and DARD focus on commercialisation options. Some support for inputs is provided in all three processes.

VSLAs (Village saving and loans associations) are being promoted to enable cash flow and affordability of inputs. These are present in 9 of the 17 participant villages, with 3 new villages having been brought on board in this past year.

CA practice

Going into the 4th year, the farmer experimentation protocols for each level of farmer participants have been more clearly defined, given that those farmers with more experience can now incorporate some of their own learnings and preferences in the trials, but the 1st level trial participants still need to get used to the overall CA planting process and thus the close spacing intercropping trial plots are 'prescribed' for them.

The protocols are outlined below:

Year 1 (1st level) trial outlines

Experimental design is pre-defined by the research team (based on previous implementation in the area in an action research process with smallholders). It includes a number of different aspects:

- Intercropping of maize, beans and cowpeas
- Introduction of OPV and hybrid varieties for comparison (1 variety of maize and beans respectively)
- Close spacing (based on Argentinean model)
- Mixture of basin and row planting models
- Use of no till planters (hand held and animal drawn)
- Use of micro-dosing of fertilizers based on a generic recommendation from local soil samples
- Herbicides sprayed before and/or at planting
- Decis Forte used at planting and top dressing stage for cutworm and stalk borer
- Planting of cover crops; winter mix in Autumn
- Experimental design includes 2 treatments; planter type (2) and intercrop (2)
-

Year 2 (2nd level) trial outlines

Based on evaluation of experiment progress for year 1, this includes the addition of options that farmers choose from. Farmers also take on spraying and plot layout themselves:

- A number of different OPV and hybrid varieties for maize
- A number of different options for legumes (including summer cover crops)
- Planting method of choice
- Comparison of single crop and inter cropping planting methods
- Use of specific soil sample results for fertilizer recommendations
- Early planting and Own choices.

Year 3-7 (3rd level) trial outlines

Based on evaluation of the experimentation process to date this protocol includes issues of cost benefit analysis, bulk buying for input supply, joint actions around storage, processing and marketing. Farmers design their experiments for themselves to include some of the following potential focus areas:

- Early planting; with options to deal with more weeds and increased stalk borer pressure.
- Herbicide mix to be used pre and at planting (Roundup, Dual Gold ,Gramoxone)

- A pest control programme to include dealing with CMR beetles
- Intercropping vs crop rotation options
- Spacing in single block plantings
- Use of composted manure for mulching and soil improvement in combination with fertilizer, or singly.
- Soil sample results and specific fertilizer recommendations
- Planting of dolichos and other climbing beans
- Summer and winter cover crops; crop mixes, planting dates, management systems, planting methods (furrows vs scatter)
- Seed varieties; conscious decisions around OPVs, hybrids and GM seeds
- Cost benefit analysis of chosen options and
- Farmer level monitoring of trials for selected individuals.

Possible agrochemical spraying regime options

1 Roundup 2 weeks before planting, if there has been some rain. Dual Gold at planting (just after with Decis Forte/Kemprin)

2. Gramoxone at planting (just before or after planting) with or without Dual Gold and Decis Forte/Kemprin– Inactivated on contact with soil. Dual Gold does not work on dry soil (Followed by heavy rain)

From the outcomes of 2014-2105 season it has been decided to revert back to the use of a pre-emergence herbicide as many participants had trouble with nut-grass and couch grass. The spraying of Gramaxone at planting did not provide the same level of weed control as Roundup, but has still been included as an option given the dry conditions and the limited efficacy of Roundup and Dual Gold under these circumstances.

Rainfall Data

Rainfall data this year was collected by community based volunteers from 5 different villages. In previous years we have relied on data from nearby weather stations, but this season we wanted to engage the farmers more directly in this process and also see whether there are large differences in rainfall between the villages as the farmers have always suggested.

TABLE 5: SUMMARIES OF RAINFALL DATA COLLECTED BY FARMER PARTICIPANTS IN DIFFERENT VILLAGES AROUND BERGVILLE.

	Ezibomvini	Eqeleni	Ndunwana	Okhombe	Emangweni	Average
Cumulative rainfall (mm)	562.5	301.4	429.3	814	32.7	526,8
Mean (mm) per rainfall event	2.29	1.40	2.71	3.43	1.17	
Max (mm) per rainfall event	60	36	50	49	20.1	

Note: The data from the Emangweni participant is unreliable, given too few readings taken by her and was not included in the averages provided

In general, the average annual rainfall for the Drakensberg region ranges between 750mm-1350mm. The actual amount of rainfall has not been seen to vary over time that much (besides a potential 20 year periodicity), even for long term studies over 50 years, but the monthly variability has been increasing reasonably dramatically[1]

The rainfall data collected by farmer participants reflect the difference in rainfall in the Drakensberg region, mostly related to altitude, with those villages at a higher altitude closer to the mountains receiving more rain. The differences in the above table between the mean precipitation per rainfall event and the maximum also points strongly towards this kind of variability, with Okhombe being the highest altitude village in this series and Eqeleni being the lowest. It also points towards the high variability of rainfall between villages which participants experience. Eqeleni and Ezibomvini for example are neighbouring villages and should receive comparable amounts of rainfall.

From the participants' recordings, it can be seen that this year also was a below average rainfall year.

The graphs below are based on information from Ezibomvini. The first graph depicts daily rainfall and gives an indication of the rainfall distribution throughout the season. Together with the monthly averages in the second graph, this gives a clear indication of how rainfall spread across the season.

[1] Nel, W. 2009 Rainfall trends in the KwaZulu-Natal Drakensberg region of South Africa during the twentieth century. INTERNATIONAL JOURNAL OF CLIMATOLOGY Int. J. Climatol. 29: 1634–1641 (2009) Published online 12 December 2008 in Wiley InterScience (www.interscience.wiley.com) DOI: 10.1002/joc.1814

It can be seen that the season started quite late with very little rain before November. It then continued to rain reasonably regularly right through until the end of February and then rain stopped abruptly in the middle of March for about 3 weeks. The upshot of this trend is that the beginning of the season was very dry which affected germination of crops. The usual 'dry spell' between January and February did not materialise, which led to a substantial reduction in beans yields and the abrupt nature of the end of season rainfall led to difficulty in the cover crops' growth – It also meant that cattle were allowed back into the villages two weeks earlier than normal due to lack of grazing in the mountains.

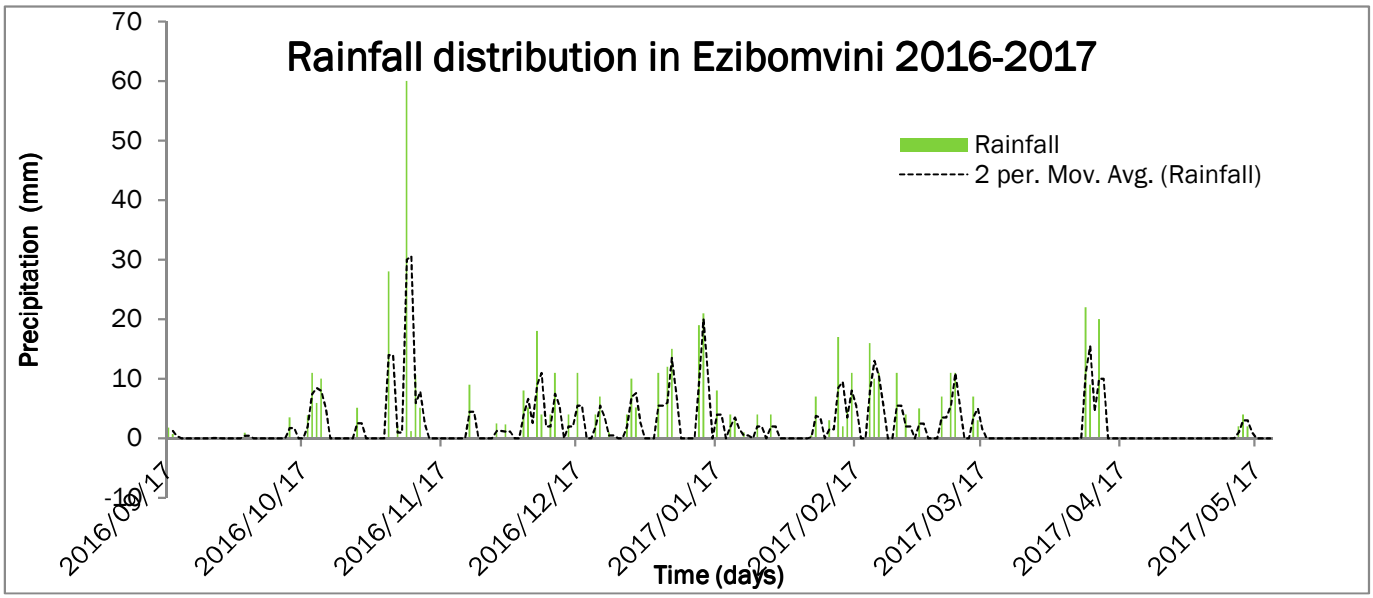


Figure 1: Rainfall data recorded by farmer participants in Ezibomvini

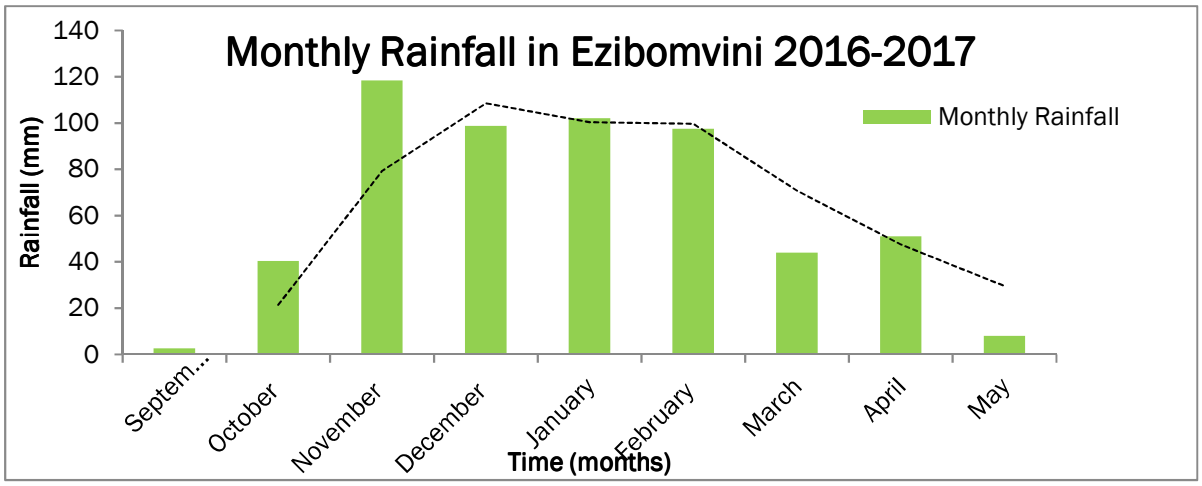
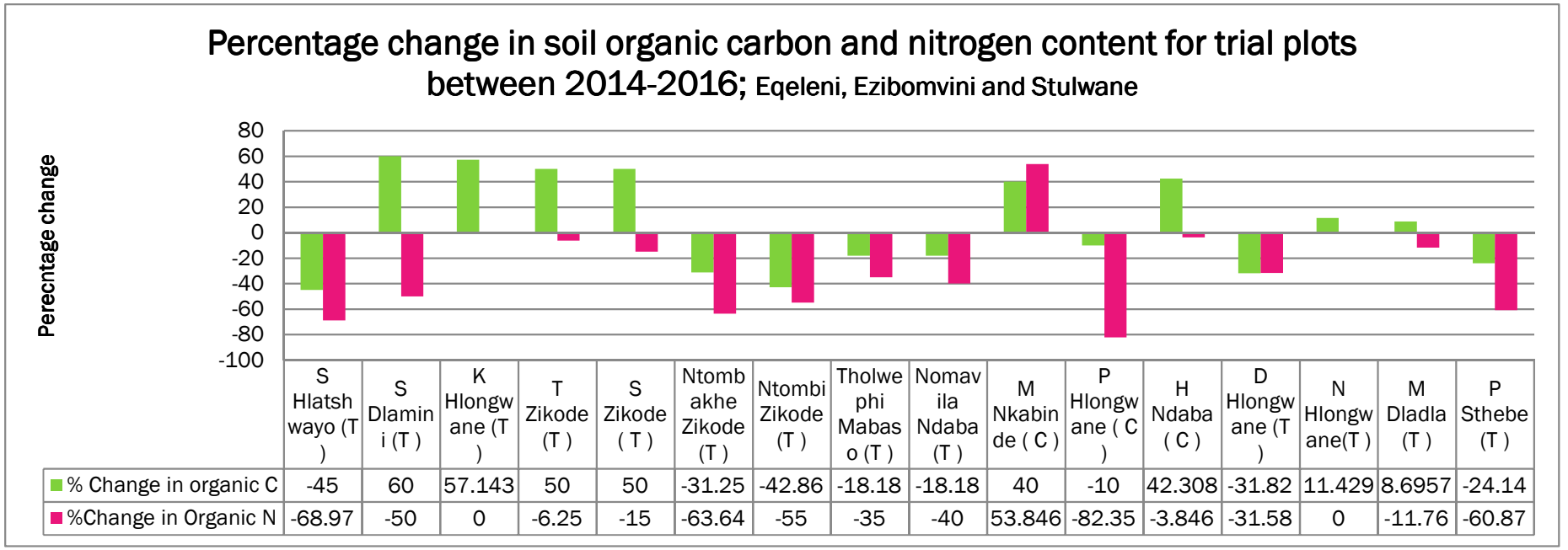


Figure 2: Monthly rainfall as recorded by farmer participants in Ezibomvini

Soil fertility and soil health test results and analysis

Soil samples were taken for a number of new participants to continue building on the information in the database. This information is important, both to ensure an appropriate soil fertility amendment recommendation for the trials (both generic and specific for individuals upon request) and also to be able to compare over time whether and how the soil fertility changes for the CA trials.

Repeat soil samples were taken for 16 participants across Eqeleni, Ezibomvini and Stulwane who have been active in CA trials for 3 years (see Figure 3 below). These were analysed at Cedara for the normal soil fertility parameters. Percentage organic carbon and nitrogen are determined by Cedara using Mid-infrared spectroscopy and are recorded as percentages. Generally, the percentage change organic carbon and nitrogen in the soil followed the same trend for each of the participants, although the values varies. For example, if the trial showed a positive trend in organic carbon, so did the control.



	S Hlatshwayo (T)	S Dlamini (T)	K Hlongwane (T)	T Zikode (T)	S Zikode (T)	Ntombakhe Zikode (T)	Ntombi Zikode (T)	Tholwephi Mabaso (T)	Nomavila Ndaba (T)	M Nkabinde (C)	P Hlongwane (C)	H Ndaba (C)	D Hlongwane (T)	N Hlongwane(T)	M Dladla (T)	P Sthebe (T)
% Change in organic C	-45	60	57.143	50	50	-31.25	-42.86	-18.18	-18.18	40	-10	42.308	-31.82	11.429	8.6957	-24.14
%Change in Organic N	-68.97	-50	0	-6.25	-15	-63.64	-55	-35	-40	53.846	-82.35	-3.846	-31.58	0	-11.76	-60.87

Figure 3: Percentage change in some of the soil fertility parameters, over time, for a selection of participants; 2014-2016

Comments:

- The average percentage organic carbon available in soils for these 16 participants increased from 1,93% to 2% over the three year period. There is no difference in the increase in percentage organic carbon for the trial and control plots.
- Nitrogen availability, similarly has been the same for both control and trial plots at an average percentage of 0,13% – 130kg/ha. The average percentage N decreased from 0,19% to 0,13% over the three year period.
- Average percentage increase in percentage organic carbon for the trial plots has been 6,3% over the three year period. This is an average increase of around 6,3 tons/ha of carbon (assuming a bulk density of around 1g/cm^3 for the samples)
- The average percentage increase over the same period for control plots has been 9,4%.
- Overall, on average, the organic carbon accumulation for the CA plots has been lower than that of the control plots.
- But for 56% of these participants the organic carbon has increased- and this at an average of 34,6% or 34,6 tons/ha. For 7 of these participants (thus 78%) the organic carbon on their trial plots has increased more than that of their control plots.
- Thus, in summary, the practice of CA is increasing the percentage organic carbon in the participants' soils. It is possible that participants provide more nitrogen in their CA plots, as topdressing is not a common practice in the control plots (even in those control plots where some of the CA principles are being incorporated). This could lead to a difference in the C:N ratios in the CA and control plots, which could lead to greater rates of mineralisation of the organic carbon in CA plots, with bacterial activity stimulated through the presence of more N. This assumption is, however, not supported by the soil health test results, where the C:N ratios are generally higher for the CA plots.
- An aspect that has been noted is that control plots for participants are adapted to more closely resemble the CA plots given that they have noticed increases in growth and yield in the CA plots. This makes comparisons of control and CA plots a rather tricky process. It means that data then needs to be compared over time within the same system.
- In addition, in the smallholder system of grazing of residues by cattle, no dramatic increases in soil carbon can be expected.

As for most of the analyses related to smallholder farmers the variability in results due to differences in farmer practices and also weather related variability in dryland conditions, provides for highly variable results that can be quite confusing. It can therefore be considered a positive step that the CA system, on average, provides for an increase in organic carbon in the soil and also that this increase is at a rate of around 34tons/ha over three years.

The small decrease in percentage nitrogen available can be interpreted in a number ways. One aspect of this process can be that the Nitrogen applied and available in the system is being more fully utilized for plant growth, or it can point towards the increased volatilization of nitrogen in the drier and hotter conditions that have prevailed in the last three years.

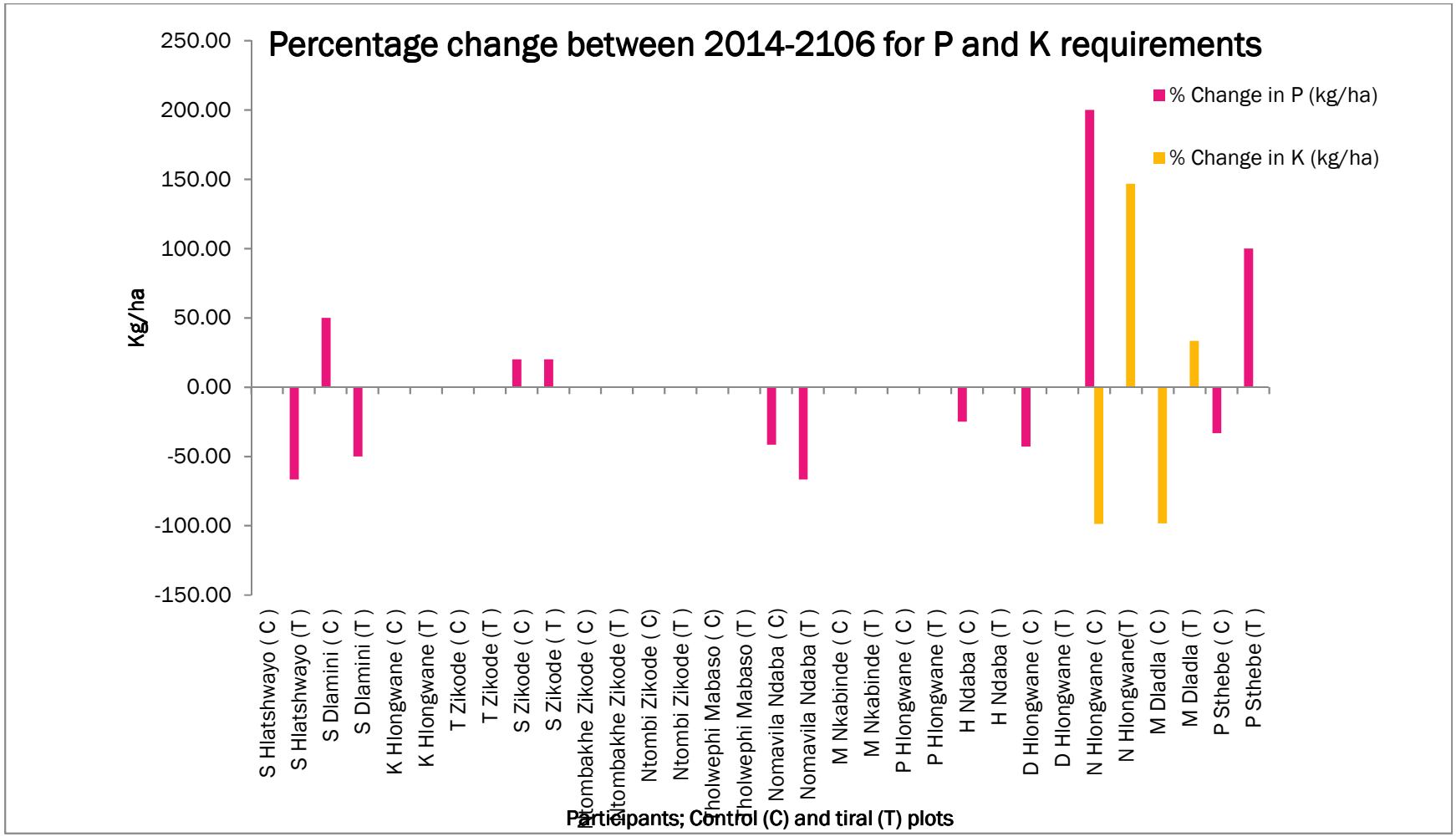


Figure 4: Percentage change in nutrient requirements; 2014-2016

Comparisons were made for soil sample results taken in 2014 and then again for the same participants in 2016. The intention was to see whether any changes in soil fertility could be attributed to the CA experimentation undertaken by these 16 participants. As the N recommendations in soil sample results are generic and based on crop nutrient use, these were not included here. What can be seen is that:

- For a number of participants (7/16- 44%), for both their trial and control plots, fertility recommendations have remained the same.
- For three participants (19%), the P recommendations have decreased for the CA trial plots, and for a further 3 participants (19%) the recommendation has decreased for their control plots- but not their trials.
- P recommendations have increased for one participant only (6%) in her trial plot and for 2 participants (12%) in their control plots.
- For the most part participants do not have to add K, as their soils contain adequate to high levels of K. However 2 participants (12%) , needed K in their plots, which increased for the CA trials and decreased for their controls. This is because no K has been added in the trial plots in the last three years and participants generally use compound fertilizers (with K) in their control plots.
- From the above trends the changes in soil fertility are more likely due to the addition of fertilizer than changes effected by the cropping system. The need for P in the soil also needs to be considered in combination with the soil acidity and liming requirements for those soils.

An analysis was also done for changes in Liming requirements for these participants. A yearly surface application of lime 1t/ha has been used throughout. The results are shown in figure 5 below.

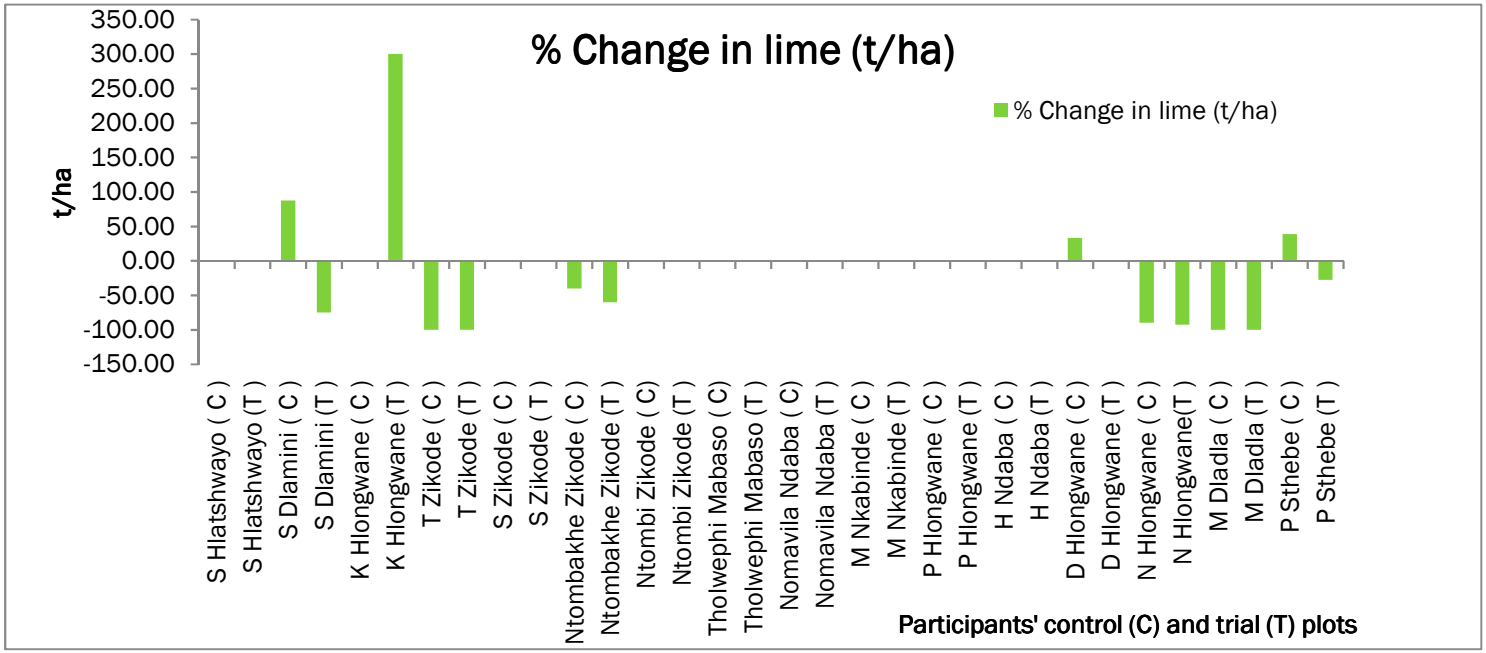


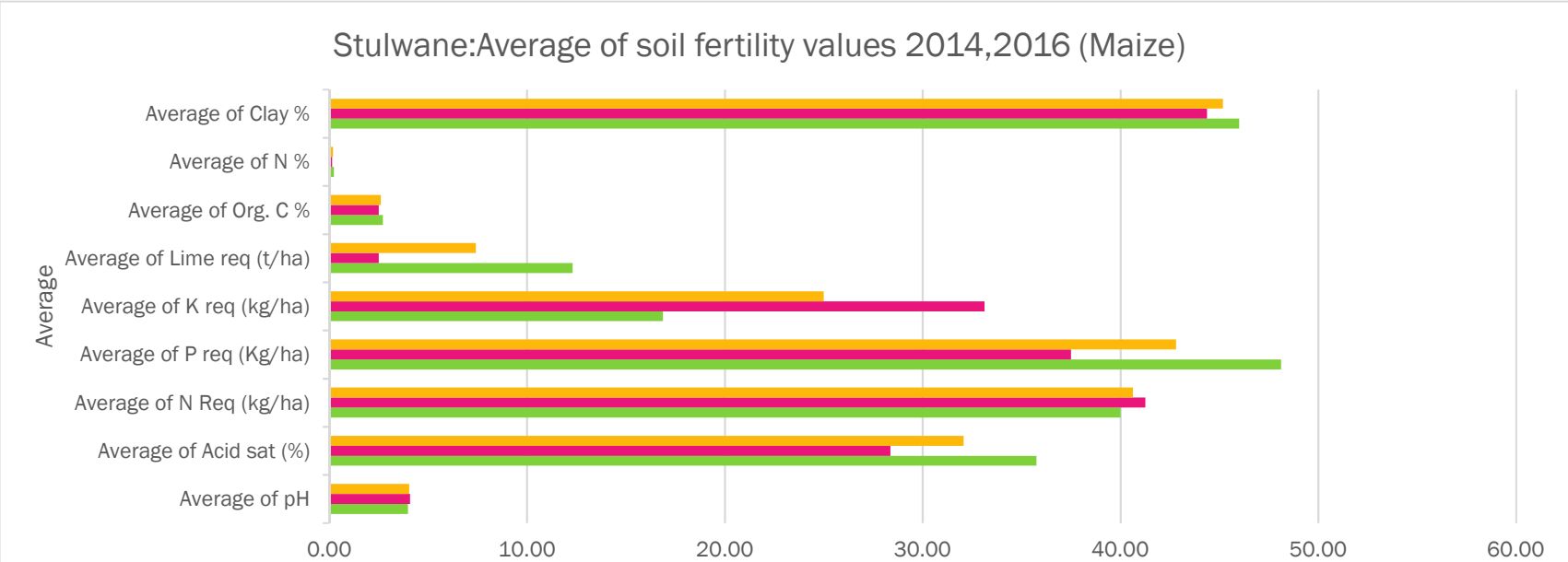
Figure 5: Percentage change in lime requirements; 2014-2016

Increased requirement for P is mirrored in increased requirement for Lime and thus is related to unavailability of P through acidity in 2 participants' (12%) of the control plots. 6 Participants (38%) have shown a reduced need for lime, and for a further 6 participants (38%) the lime requirement has remained unchanged. This indicates that the 'top-up' liming practice of using 1t/ha every year is having the required effect of stabilizing or reducing acidification in the soil. However, given that the average pH for these participants is 4,17 and the average % acid saturation is 19,2% one would have to comment that the situation is stable but not ideal. These soils need much more lime than is presently being used.

The four participants who have an increased need for lime all have pH values below 4 and acid saturation values of >40% in their plots and would need the application of much higher quantities of lime in their fields to make a significant difference.

Stulwane: Soil fertility status

In Stulwane, repeat samples were taken for 8 participants who have been active for three or more seasons (2014-2016). The intention is to see how the soil fertility parameters have changed for these participants in their CA plots. The assumption is that the combination of good soil management practices, soil building strategies using crop diversification and soil residues, and judicious use of fertilizers would improve the soil statues and reduce the need for fertilizers. The figure below provides summaries for acidity, nutrient requirements and carbon and nitrogen stocks in the soil.



	Average of pH	Average of Acid sat (%)	Average of N Req (kg/ha)	Average of P req (Kg/ha)	Average of K req (kg/ha)	Average of Lime req (t/ha)	Average of Org. C %	Average of N %	Average of Clay %
OVERALL AVERAGE	4.04	32.06	40.63	42.81	25.00	7.41	2.61	0.19	45.19
2016 AVERAGE	4.09	28.38	41.25	37.50	33.13	2.50	2.50	0.15	44.38
2014 AVERAGE	3.99	35.75	40.00	48.13	16.88	12.31	2.71	0.23	46.00

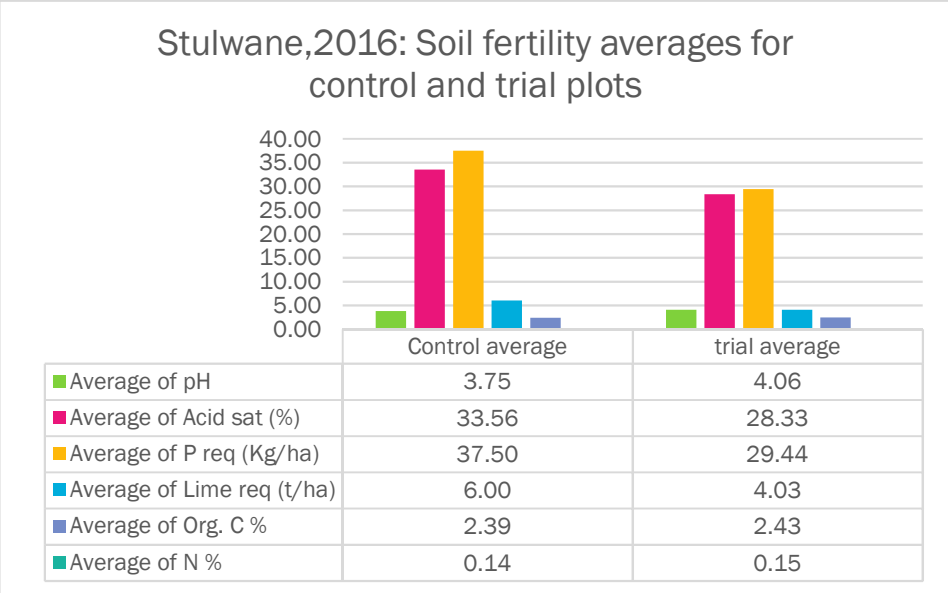
Figure 6:Summary of soil fertility status parameters for 8 participants in Stulwane; 2014-2016

From Figure 6 the following trends can be seen:

- Average pH has increased slightly and the percentage acid saturation has decreased. From the 8 participants pH in their plots have decreased for 3 participants and increased for 5. Average lime requirements or 2016 were much lower at 2,5t/ha than in 2014 when it was 12-13t/ha. This indicates that the small quantities of lime (1t/ha), added yearly as a top up have had a significant effect on the acidity status of the soils in the participants' CA plots.
- The average pH at 4,04 with acid saturation at 32% is still a matter for concern, as this will affect bean growth and yields, maize being a bit more tolerant to acidic conditions
- Along with acidity status, the amount of P required/ ha has reduced for 7 of the 8 participants.
- N required has increased for 1 participant, thus increasing the average and K requirements have increased for 2 participants
- Nutrient requirements have reduced for 6 of the 8 (75%) participants over the three years. This is a very positive trend
- The average percentage organic carbon in the soil has decreased, overall % organic carbon increased for 3 of the 8 participants only by and average of 0,4% (~400kg/ha).
- Mineralizable Nitrogen in the soil has decreased over the three year period by around 0,08%.

Generally, soil fertility status has increased in the CA plots over the last three years. Specifically acidity and the need for Phosphate has reduced. This is considered to be a combination of addition of lime to the soil and an increase in soil health for these participants. The % organic carbon in the soil has shown a small decline, which is unexpected, but is not likely to be statistically significant.

We also compared the soil fertility results for the control plot and CA plots of the 9 participants in 2016. Given the 3-4 years of CA being practiced it was expected that differences could now be seen in the soil fertility status between control and CA plots. Figure 7 provides the averages for a number of soil fertility measurements



	Control average	trial average
Average of pH	3.75	4.06
Average of Acid sat (%)	33.56	28.33
Average of P req (Kg/ha)	37.50	29.44
Average of Lime req (t/ha)	6.00	4.03
Average of Org. C %	2.39	2.43
Average of N %	0.14	0.15

Figure 7: Average soil fertility results for control and CA plots for 9 participants in Stulwane (2016)

Control plots were left for participants to practice their 'normal' way of planting. For most of these participants this entails ploughing, addition of some fertilizer (but not lime) and planting of mono cropped blocks of maize (traditional or bought seed) and beans (bought seed)

From the figure above the following comments can be made:

- The average pH for the trial plots is substantially higher at 4,06 than the control plots at 3,75
- Percentage acid saturation for the trial plots is significantly lower (28,33%) than for the control plots (33,56%). Thus the average lime requirement per hectare for trial plots is also lower.
- Average P requirement for trial plots is also substantially lower than for the control plots.
- The average percentage of organic carbon for trial plots is higher than for the control plots. 7 of the 9 Participants (78%) have a higher % organic carbon in their trial plots and the average increase is 0,24% (240kg/ha)
- The average percentage nitrogen is higher for the trial plots when compared with control plots for 6 of the 9 participants (67%), and the average increase is 0,09%. This is equivalent to around 90 kg/ha of mineral nitrogen more that is available for the CA plots.

These results indicate that soil fertility and soil health is better on the CA plots than on the control plots. This would be a combined effect of more accurate use of fertilizers and lime and the positive effect of the conservation agriculture on soil. The differences are not as marked as one might expect (most likely due to the removal of crop residues by livestock), but the reduction in percentage acid saturation, the lowered P requirements and the increased percentage of organic carbon are all indicative of a more productive, better balanced soil and are important observations.

Mtholeni Dlamini (Stulwane)

Mr Dlamini has been involved since 2013.

Right: Mr Dlamini standing in his CA maize and bean intercrop plot

Far right: MR Dlamini's bean yield for this season

The table below indicates some general information regarding his trials

TABLE 6: YIELD COMPARISON FOR THREE SEASONS FOR MR MTHOLENI DLAMINI (STULWANE)

Season	Trials (1000m²)	Yields Maize (t/ha)	Yields maize t/ha (Control)	Yields Beans t/ha	Comments
2014-2015	M+B intercrop, maize and beans single blocks	1,9	-	-	Also planted winter cover crops and control
2015-2016	Beans, cowpeas	n/a	n/a	-	Summer cover crops and control
2016-2017	3(M+B), 2 (B), 1 (B+SCC), 2 (M), 1 (M+C), 1 (SCC)	3,85	2,63	1,81	Summer cover crops and control

Mr Dlamini's soil health results show a pattern that is similar to a number of participants who are considered to be good farmers and already put in the work and get reasonable yields. He is also one of the participants that mixes kraal manure and fertilizer in his control plots. For these participants, the soil health test results for the control plots so far have been on a par with the CA plots.

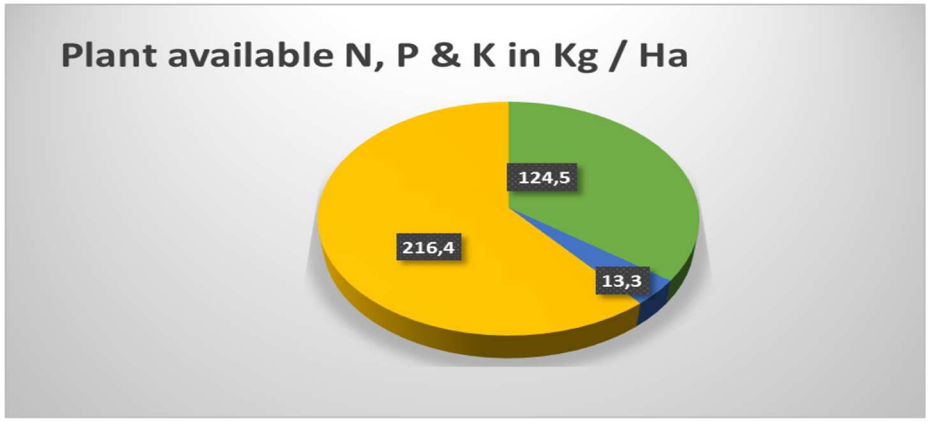
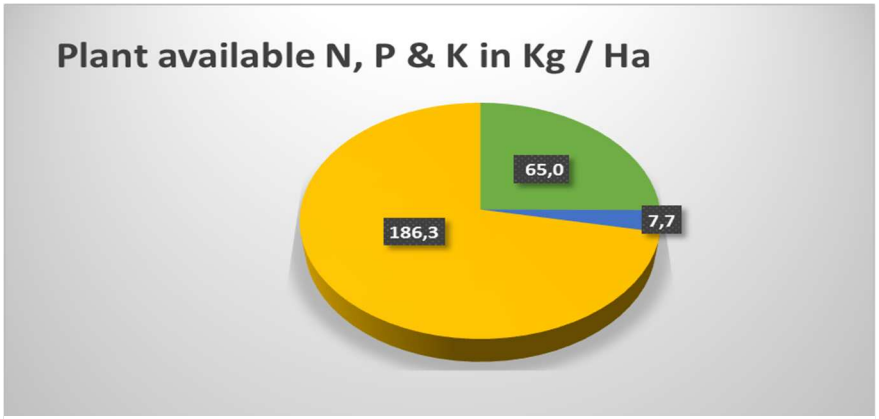
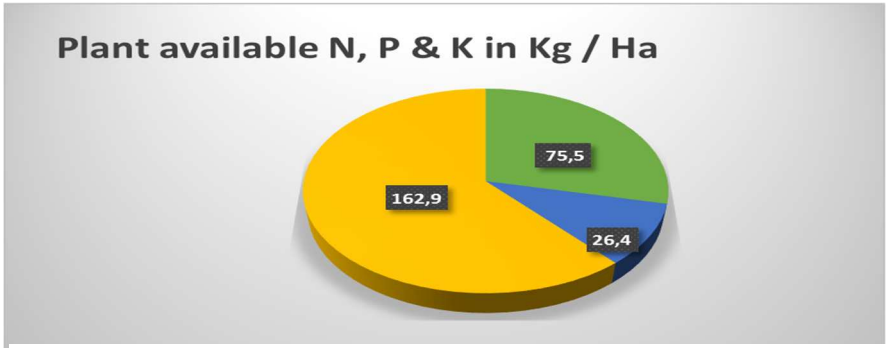


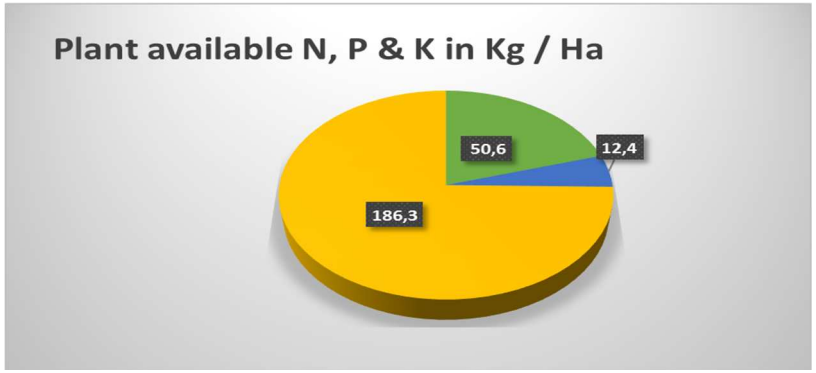
Figure 8: Veld baseline sample plant available N,P and K. This is a 'high' benchmark against which the cropping experiments can be compared. N=124,5kg/ha, P=13,3kg/ha , K=216,4kg/ha



CA trial plot; bean and cowpea intercrop, 2015-2016, following on a maize and bean intercrop (2014-2015 and 2013-2014). N=65kg/ha, P=7,7kg/ha, K=186,4kg/ha



Control plot: Planted to beans 2015-2016. following on a maize control plot in 2014-2015. N=75,5kg/ha, P=26,4kg/ha, K=162,9kg/ha



CA trial plot: summer cover crops (sunflower, miller and sunn hemp), 2015-2016. following on a maize and bean inter crop (2014-2015 and 2013-2014) N=50,6kg/ha, P= 12,4kg/ha , K=186,3kg/ha)

From the above results, it can be seen that the bean and cowpea mixture predictably provide for more N to the following crop and the scc mix provides for more P. The control plot values are higher than the CA trial plot values in this case. Mr Dlamini, is another of the participants who has been practicing CA in his control plots. Fertilization practices, spacing of crops and seed types are however different to the CA trial plots. All values are below the high veld benchmark.

Phumelele Hlongwane

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

- Intercropping of maize with beans
- Intercropping of maize with cowpea
- Planting cover crop in between rows of maize
- Intercropping maize with lablab
- Planting a single crop of maize (control)

- Planting a single crop of Lab-lab (Dolichos) beans and
- Intercropping of maize with Lab-lab beans

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

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

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

TABLE 7: MAIZE YIELDS FROM DIFFERENT EXPERIMENTAL PLOTS IN PHUMLELE HLONGWANE'S (EZIBOMVINI) FIELD

2015/2016 season		**2016/2017 Season**		
Crops Planted	**Maize Yields (t/ha)**	**Crops planted**	**Maize Yields (t/ha)**	**Change in yield (t/ha)**
Maize +Beans	8,3	Maize + Beans	8,8	0,5
Maize +Cowpea	8,7	Maize + Beans	8,9	0,2
Maize + Beans	10,4	Maize + Cowpea	7,7	-2,7
Maize +Cowpea	6,9	Maize	6,5	-0,5
M +SCC+WCC	8,7	Maize + Beans	10,1	1,4
Maize +Beans	6,9	Maize	6,2	-0,7

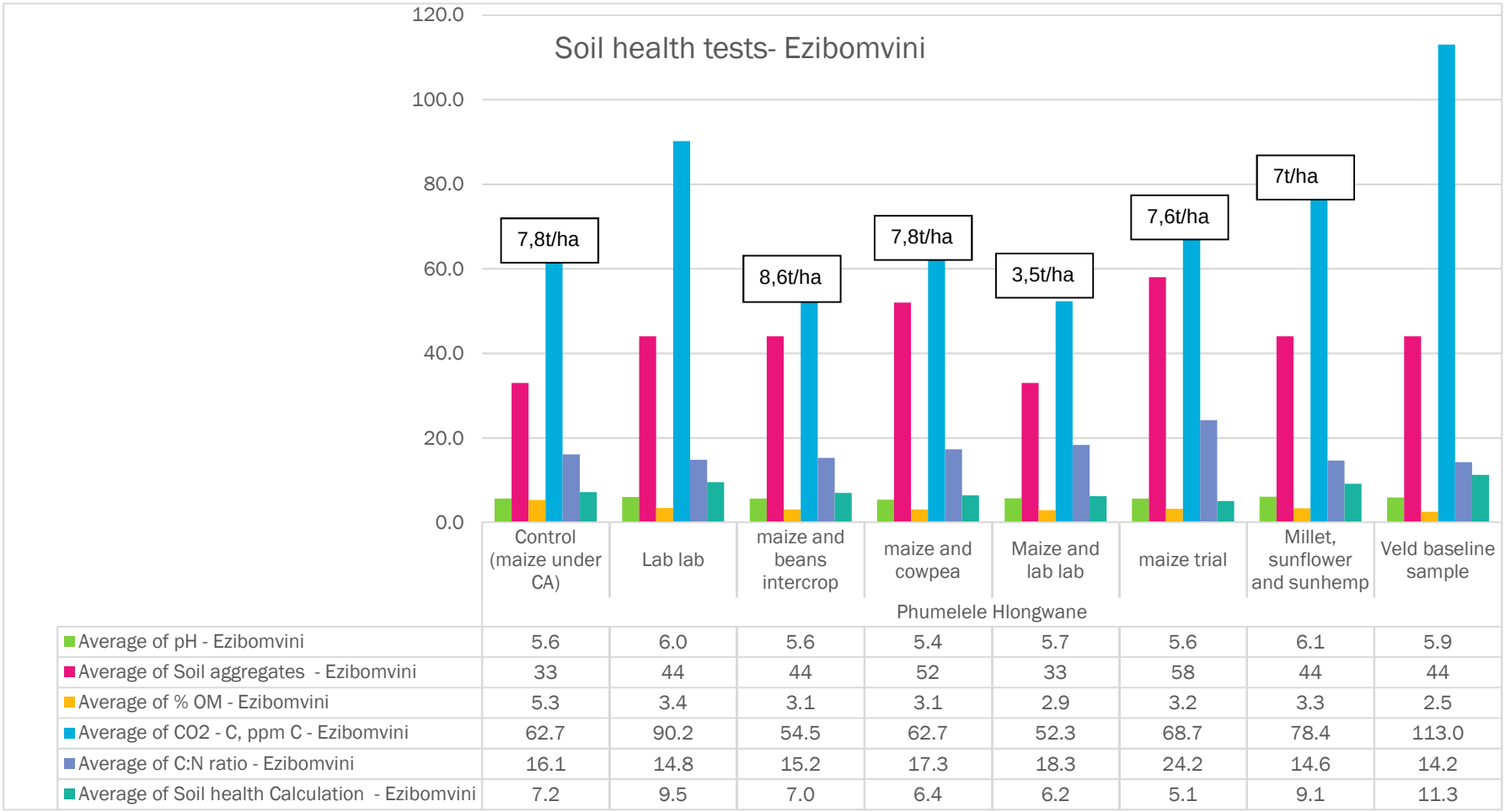
The small table below indicates yield averages over the last two seasons.

TABLE 8: SUMMARY OF DIFFERENT CROP YIELDS IN PHUMELELE HLONGWANE'S EXPERIMENTAL PLOTS.

t/ha	2015-2016	2016-2017
Maize (Control)-CA	7,8	9,7
Maize Trial CA - combined	6,93	8,3
Beans	0,25	1,81
Sunflower	0,3	0,8

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

The soil health test results from 2015-2016, with some yield data obtained for the different plots are shown in the figure below.



	Control (maize under CA)	Lab lab	maize and beans intercrop	maize and cowpea	Maize and lab lab	maize trial	Millet, sunflower and sunhemp	Veld baseline sample
	Phumelele Hlongwane							
Average of pH - Ezibomvini	5.6	6.0	5.6	5.4	5.7	5.6	6.1	5.9
Average of Soil aggregates - Ezibomvini	33	44	44	52	33	58	44	44
Average of % OM - Ezibomvini	5.3	3.4	3.1	3.1	2.9	3.2	3.3	2.5
Average of CO2 - C, ppm C - Ezibomvini	62.7	90.2	54.5	62.7	52.3	68.7	78.4	113.0
Average of C:N ratio - Ezibomvini	16.1	14.8	15.2	17.3	18.3	24.2	14.6	14.2
Average of Soil health Calculation - Ezibomvini	7.2	9.5	7.0	6.4	6.2	5.1	9.1	11.3

Figure 9: Phumelele Hlongwane's soil health test results for different cropping practices within her CA system for the 2015-2016 cropping season. Yields re indicated in the square text boxes for each practice.

From the figure above the following points can be made:

- After the veld baseline the highest Soil Health Test (SHT) scores (in descending order) were : Lab-Lab beans, Summer cover crops, Control maize (CA), maize and bean intercrop, maize and cowpea intercrop, with the lowest score for the maize CA plot.
- The Solvita, microbial respiration tests followed the same trend with the veld baseline being the highest followed by Lab-lab beans, summer cover crops, maize CA trial, maize and cowpea and maize CA control with the maize and lab-lab plot showing the lowest Solvita results.
- The C:N ratio for the maize CA trial plot is particularly high, due to no legumes (low N input) and maize residues having a high C content (or C:N ratio) . Yields were not affected, as the inorganic N content in this plot was higher than the others; the maize requires higher N-fert input due to N immobilisation in the soil.. It also vindicates Phumelele's decision not to supply basal fertilizer in the following season.
- The lowest C:N ratios were achieved for the cover crop plots (lab-lab and summer cover crop mix) – which correlates with the Solvitas and indicates highest microbial activity and conversion (mineralisation) of nutrients in these plots.
- The maize yield for these plots do not entirely coincide with the soil health scores. The highest yield for maize was achieved in the maize and bean intercropped plot at 8,6t/ha, followed by the maize and cowpea intercrop plot and the control CA maize plot at 7,8t/ha respectively.

If one goes into a bit more detail regarding the soil Nitrogen availability; the following small table represents the SOLVITA Labile Ammonium Nitrogen Analyses (SLAN). This provides the amount of "upstream nitrogen" bound in the Soil Organic component and represents total releasable N over time.

TABLE 9: COMPARISON OF DIFFERENT FORMS OF NITROGEN AVAILABILITY FOR PHUMELELE HLONGWANE'S CONTROL AND CA TRIAL PLOTS; 2015-2016

Plots: Phumelele Hlongwane 2015-2016	SLAN Total releasable N	Long term release N	Short term release N	Immediate release N	Rand value of N saved
	Kg/ha				
Maize CA trial	397,6	383,0	8,3	6,3	R107,00
Maize CA Control	341,6	313,6	9,6	18,4	R312,00
Lab-Lab	341,6	310,9	0,0	30,7	R522,00
Maize and scc	319,2	285,2	3,4	30,7	R522,00

Maize and beans	308,0	278,0	11,6	18,4	R312,00
Maize and Lab-Lab	268,8	242,4	17,2	9,2	R156,00
Maize and cowpeas	240,8	218,2	9,2	13,4	R228,00

What can be seen from this table is that:

- The cover crop plots (Lab-Lab and scc) are the best at providing immediate release N for the next crop and can save a Rand value of R522 of nitrogen fertilizer. This helps to explain why the soil health scores are highest for these two plots. They also provide a substantial amount of long term release N and are thus a very important practice in building soil health.
- The CA maize trial plot provides for the highest long term release N but the lowest immediate release N, This point towards this practice building soil organic Carbon over time.
- The CA control plot provided more immediate release N, but lower quantities of stable nitrogen, indicated by the larger overall soil disturbance in the control plot vs trial plots.
- The Maize and legume intercrop plots combine a high value of long term release N with larger quantities of short term and immediate release N than the Maize only CA plot and provide an average of a rand value of R228 of Nitrogen to the following crop.
- In addition the maize and bean intercrop plot also provided for the highest yield of maize in the experimental plots at 8,6t/ha (previous figure).

Overall, for soil health and for benefit of the following crops in terms of available nutrients the cover crop plots and the maize-legume (specifically maize and beans) intercrop plots are the most beneficial. The latter also provides for the highest yield of maize.

A further study on Soil health was done through a team from the ARC[2]. They took a number of samples from different CA sites in the Free State North West and KZN. Of interest is that 4 samples from Phumelele Hlongwane were also included (Soybean following maize; maize following maize, maize and bean intercrop and soybean(1st season), They used the Shannon-Weaver (microbial richness) and Evenness (microbial abundance) indices to look at microbial populations for these samples. "The Shannon-Weaver diversity index is used to quantify the functional diversity of soil microbial communities based on the amount of different carbon sources utilised by soil microbial

[2] **Innovative soil health assessments to advance the understanding, improvement and sustainability of grain crop cultivation systems in South Africa.** *Johan Habig.ARC-PPRI, Soil Microbiology Laboratory, Private Bag X134, Queenswood, 012*

communities. The Evenness index, on the other hand, is used as an indicator of how abundant species are within a soil microbial community, i.e., how close in "numbers" each microbial species are in a soil microbial community."

The report attests to the following :

"The overall highest microbial diversity was present in samples obtained from the smallholder farmers, while the lowest microbial diversity was found to be in the Vrede district. These results could be attributed to the fact that soils from smallholder farmers are not as intensively cultivated as is the case with commercial farmers. The low microbial diversity in the Vrede district might be attributed to soil physicochemical properties or weather conditions. Although insignificant, the microbial diversity was slightly higher under CT than CA practices in Bergville and Winterton, whereas the contrary was true for the Vrede district".

He continues to summarise the results as:

"The highest overall microbial activity was present in the "old no-till" soils cultivated with maize in Bergville, the smallholder farm cultivated with maize monoculture intercropped with beans under CA in Winterton, and where maize followed a multispecies mix under CA in Vrede".

The significant points are that Phumelele's CA plots contain a high microbial diversity, with a high evenness of distribution of different microbial species, which had the highest potential of all samples tested to convert N for plant uptake. This study also corroborates the finding that the maize and bean intercrop plots are the most beneficial for soil health.

An aspect that could be interfering with seedling germination and growth and overall yields is the presence of pathogenic soil fungi. A study was conducted using soil samples from Phumelele Hlongwane's CA trial plots by the ARC[3]. Specifically, for Phumelele's plots Fusarium and Phoma species were detected. These are damping off species that would affect germination and early growth of seedlings.

The data indicates that the severity of root rots is higher in the CA plots than the conventionally tilled plots.

This could then provide the beginnings of an explanation as to why the yields in conventionally tilled plots tend to be a bit higher than the CA plots.

Right: Figure indicating the severity of root and crown rots from soil samples taken from Phumelele Hlongwane's plots. The potential for higher severity of soil borne diseases in the two CA plots is shown clearly.

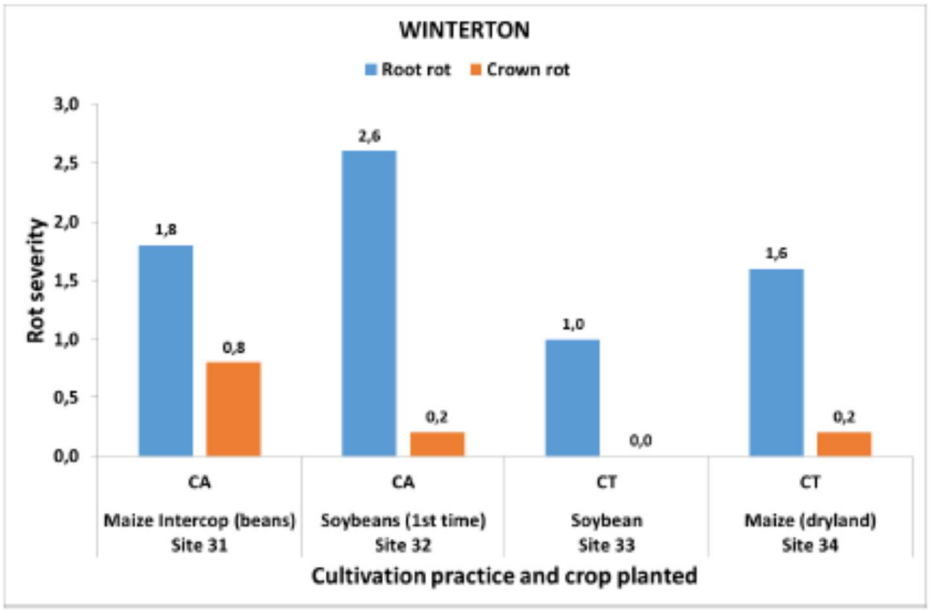


Fig. 2F. Root and crown rot severity of maize and soybean collected from the conservation (CA) and conventional (CT) tilled fields in Winterton.

[3] Agricultural Research Council. Plant Protection Research Institute. P/Bag X134, Queenswood, Pretoria 0121. Preliminary Consultation Report-Analyses Of Soil borne Diseases Of Maize, Soybean And Sunflower – Soil Health Project. Prepared by: Dr Sandra Lamprecht and Thabo Phasoana. Tel: (021) 887 4690 Fax: (021) 887 5096. Email: lamprechts@arc.agric.za

Pasteurisation of the soil samples prior to germination and growth of seedlings was done to test the difference. The two pictures below are indicative

Figure 10: Maize grown in pasteurised (2 pots on the left) and non pasteurised (2 pots on the right) soil from Phumelele's CA maize trial plot. The difference in growth and germination is clearly visible.

Maize grown in pasteurised(2 pots on the left) and non pasteurised (two pots on the right) soil from Phumelele's CA maize and bean intercrop CA plot. The difference in growth and germination is clearly visible

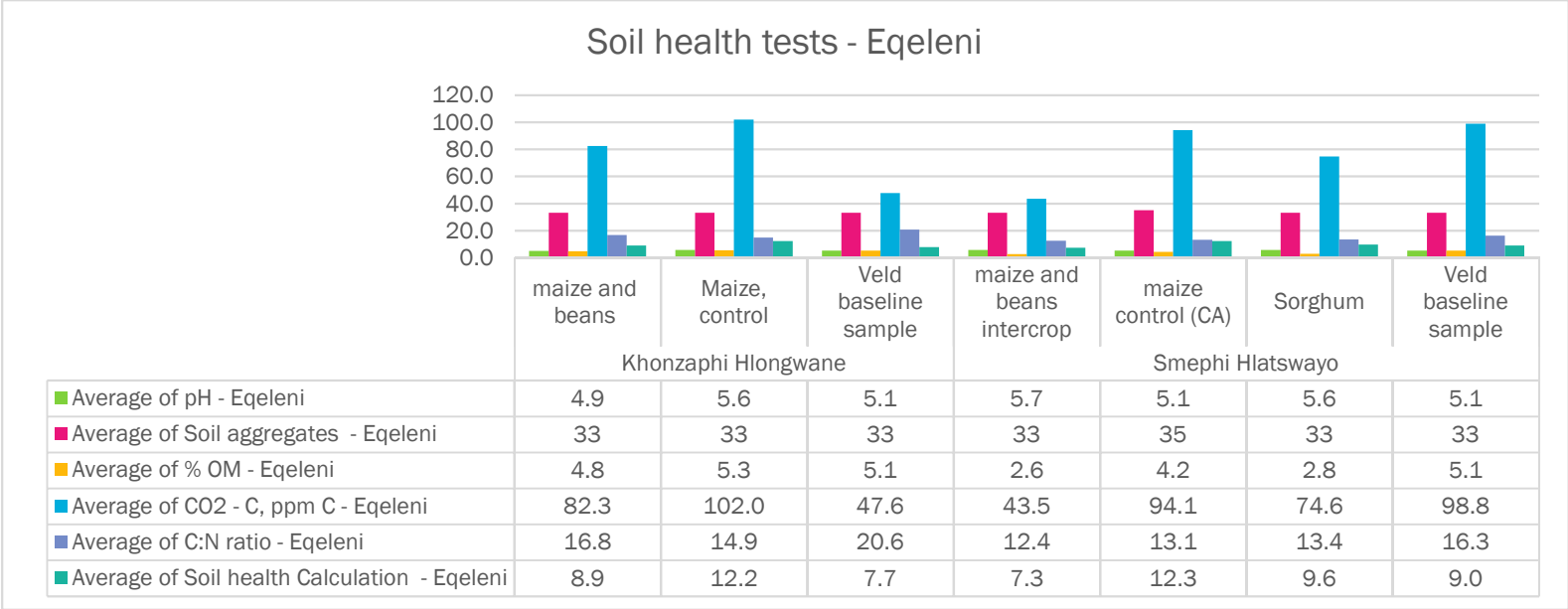
Eqeleni

In Eqeleni soil health samples were taken for control and trial plots for Khonzaphi Hlongwane and Smephi Hlatshwayo. Both are good farmers who have been part of the CA farmer innovation process for 4 years.

Khonzaphi Hlongwane is another of the participants for whom the soil health results are presently higher for her control plot than her maize and bean intercropped plot. As shown for Phumelele Hlongwane in the section above this does not mean that gains in soil health in terms of longer term build up of nutrients and microbial populations in the soil is not occurring.

Right: Smpehi Nkosi's conventionally tilled maize control showing drought stress on 25 February 2016 Far right: Her sorghum cover crop, following on 2 years of CA maize and bean intercrop growing very well at the same time.

For Smephi Hlatshwayo her CA maize plot fared better than the cover crop (sorghum) plot. Both plots however have very high soil health scores. The maize CA plot in particular has a much higher percentage of OM in the soil and also a high rate of microbial respiration, indicating a soil with high microbial diversity and evenness of microbial population types. The results are shown in the figure below



	Khonzaphi Hlongwane			Smephi Hlatswayo			
	maize and beans	Maize, control	Veld baseline sample	maize and beans intercrop	maize control (CA)	Sorghum	Veld baseline sample
Average of pH - Eqeleni	4.9	5.6	5.1	5.7	5.1	5.6	5.1
Average of Soil aggregates - Eqeleni	33	33	33	33	35	33	33
Average of % OM - Eqeleni	4.8	5.3	5.1	2.6	4.2	2.8	5.1
Average of CO2 - C, ppm C - Eqeleni	82.3	102.0	47.6	43.5	94.1	74.6	98.8
Average of C:N ratio - Eqeleni	16.8	14.9	20.6	12.4	13.1	13.4	16.3
Average of Soil health Calculation - Eqeleni	8.9	12.2	7.7	7.3	12.3	9.6	9.0

Figure 11: Soil health test results for veld baselines, control plots and CA plots for Khonzaphi Hlongwane and Smephi Hlatshwayo from Eqeleni (2015-2016)

General recommendations regarding soil health tests:

- Veld baselines need to be done specifically for each farmer and every season. They also need to be taken in the same place every year to make them comparable.
- Some attention needs to be given to sampling- the need for a larger no of sub samples is becoming evident in high variability in results from the same plots
- As the control plots no longer represent standard conventional tillage – these samples need to be taken in plots that do represent that – and need their own veld baseline samples.
- It may not be possible to compare soil health test results across years meaningfully, especially in the early CA implementation stages and also due to high climatic variation between seasons.
- Comparison of soil health test results from different CA practices within a trial seem to be interesting and provide for meaningful comparisons.

Liming trials

After 2-3 years of involvement in the GRAINSA-SFIP project, some famers are still getting low yields from their trial and control plots. Soil acidity appears to be one of the major contributing factors to this problem. The soil sample analysis results have shown lime requirements ranging between 0 t/ha and 11 t/ha. Generally, maintenance lime of 1 t/ha has been recommended as a standard for farmers in the programme. For those with the highest lime requirements, yields remain very low and the maintenance lime does not work well for them.

In order to test if soil acidity is a cause of low yields, three farmers with the highest lime requirements in 3 villages (Eqeleni, Mhlwazini and Stulwane) were selected. The farmers in Eqeleni, Mhlwazini and Stulwane had lime requirements of 10.25 t/ha, 7.25 t/ha and 11.5 t/ha, respectively. A farmer led experimentation was undertake with these 3 farmers (see the small table below) to test the following; (a) if applying the required lime would have an impact on the yields and (b) which of the two lime application methods (applying lime and leaving it on the surface under CA plots and applying lime and ploughing it in the soil under conventional tillage) is more effective. The overall aim of these experiments was to test two methods of lime application and to evaluate how those contribute to yield improvement.

TABLE 10: LIMING REQUIREMENTS AND APPLICATION FOR THE 3 PARTICIPANTS IN THE LIMING TRIALS; 2016-2017

Name and village	Ntombakhe Zikode (Eqeleni)	Phumzile Zimba (Mhlwazini)	Phasazile Sithebe (Stulwane)
Amount of lime required(t/ha)	10.25	7.25	11.5
Amount of lime applied (50 kg bags)	20	10	23
Maintenance lime (t/ha)	1	1	1

Figure: Top left: Phasazile Sithebe applying lime in her field, Top right: tilling the lime under conventional tillage, Bottom Left and right: method use in applying maintenance lime for beans and or cowpea and maize, respectively

The results from all three experiments indicated that the yields are higher in plots were lime was applied and left on the surface compared to plots where lime was applied and ploughed in. See the table below. This shows that lime application under CA/ No Till is more effective compared to lime application under conventional tillage. Other factors (e.g. fertilizer application) were kept constant and therefore lime was the only variable in the experiments. Other factors, such as planting dates, rainfall and frequency of weeding, were also kept constant and their effect is considered negligible.

TABLE 11: YIELDS FOR THE 3 LIMING TRIALS:2016-2017

Names	Ntombakhe Zikode (Eqeleni)	Phumzile Zimba (Mhlwazini)	Phasazile Sithebe (Stulwane)
Surface liming plot (maize yield (t/ha))	3	6.2	3.4
Lime and plough plot (maize yield (t/ha))	2.6	4.6	1.6
Difference	0.4	1.6	1.8

An attempt was made to compare the results from this year's trial and conventional tillage control plots, to those of previous seasons. Yields from 2013 and 2014 were compared, as the first year of involvement for the three participants. Yields for both the CA and control plots have increased substantially. See the small table below.

TABLE 12: YIELD COMPARISONS FOR 2 SEASONS FOR THE THREE LIMING TRIAL PARTICIPANTS.

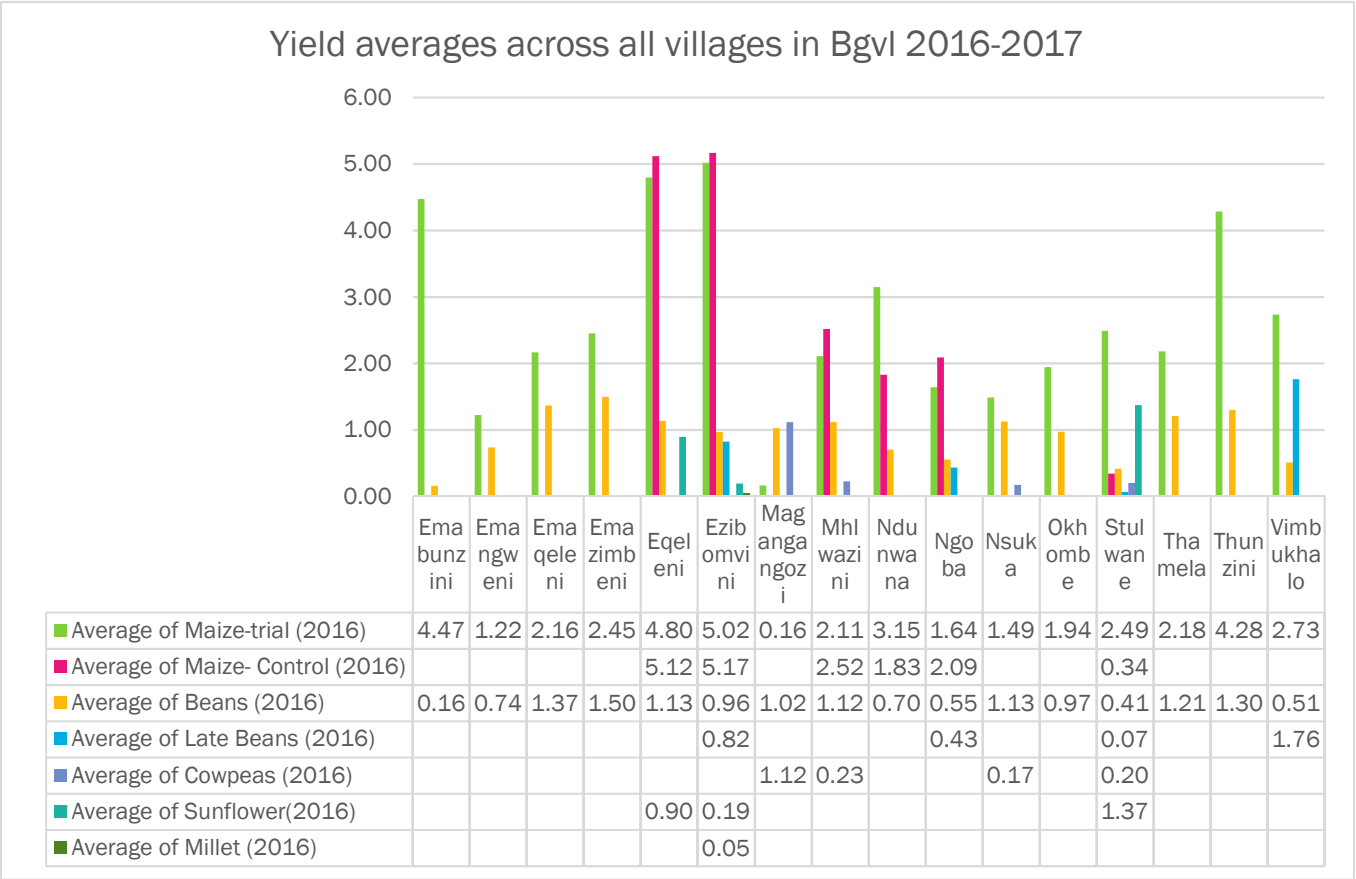
Names	Ntombakhe Zikode (Eqeleni)		Phumzile Zimba Mhlwazini		Phasazile Sithebe (Stulwane)	
	2013	2016	2014	2016	2013	2016
Surface liming plot (maize yield (t/ha))	1.72	3	0.93	6.2	2.67	3.4
Lime and plough plot (maize yield (t/ha))	2.5	2.6	0.75	4.6	-	1.6

This indicates that liming can have a significant effect on yields. For this small sample of participants there is no indication however, that ploughing in of lime works better than surface application. The experiment will be continued into the next season.

Yields for CA trial and control plots

Yields were measured and recorded for 164 of the overall 212 participants. This accounts for 78% of the participants who planted. 22% of participants experienced crop failure. 85% of participants collected their harvests for weighing. This, under these smallholder circumstances, is truly an impressive feat of organisation and motivation of smallholder farmers, by the Mahlathini field work team.

The figure below summarises the average yields across all the villages in Bergville.



	Emabunzini	Emangweni	Emaqeleni	Emazimbeni	Eqeleni	Ezibomvini	Magangangozi	Mhlwazini	Ndunwana	Ngoba	Nsuka	Okhombe	Stulwane	Thamela	Thunzini	Vimbukhalo
Average of Maize-trial (2016)	4.47	1.22	2.16	2.45	4.80	5.02	0.16	2.11	3.15	1.64	1.49	1.94	2.49	2.18	4.28	2.73
Average of Maize- Control (2016)					5.12	5.17		2.52	1.83	2.09			0.34			
Average of Beans (2016)	0.16	0.74	1.37	1.50	1.13	0.96	1.02	1.12	0.70	0.55	1.13	0.97	0.41	1.21	1.30	0.51
Average of Late Beans (2016)						0.82				0.43			0.07			1.76
Average of Cowpeas (2016)							1.12	0.23			0.17		0.20			
Average of Sunflower(2016)					0.90	0.19							1.37			
Average of Millet (2016)						0.05										

Figure 12: Yield averages across all villages in Bergville:2016-2017

TABLE 13: AVERAGE, MINIMUM AND MAXIMUM CROP YIELDS FOR BERGVILLE; 2016-2017

YIELDS (t/ha) 2016-2017	Maize - Trial n=141	Maize Control n=29	Beans Trial n=137	Beans late n=13	Cowpeas n=14	Sunflower n=10	Millet n=1	Sunn hemp n=1
Average	2,80	2,82	0,91	0,76	0,52	0,97	0,05	0,20
max	11,74	9,69	2,44	2,10	2,80	2,95	0,05	0,20
min	0,28	0,34	0,02	0,07	0,05	0,05		

From the above figure and the small table outlining the yields for this season the following points can be made:

- The highest average maize yields were obtained in Ezibomvini (5,02t/ha), Eqeleni (4,8t/ha) and Emabunzini (4,47t/ha). The latter is a new expansion area next to Ezibomvini.
- The lowest average maize yields were in Magangangozi (0,16t/ha). This area struggled a lot with cattle invasions and yields were decimated. The other two villages with the lowest trial maize yields were Emangweni (1,22t/ha) and Nsuka (1,49t/ha). In these two villages yields suffered because of lack of trial maintenance and weeding.

- The average maize yield for all villages in the trials(2,8t/ha) was marginally lower than for the maize control plots (2,82t/ha)
- The highest yield for the maize trials was 11,74t/ha - for Nombono Dladla in Ezibomvini and the highest control maize yield was 9,69t/ha for Phumelele Hlongwane in Ezibomvini - this was a CA control plot.
- For beans, the average yield for early season beans was 0,91t/ha and for late season beans was slightly lower at 0,76t/ha.
- For cowpeas the average yield was 0,52t/ha and the range of yields fell between 0,05t/h to 2,8t/ha.
- For sunflowers, the average yield was 0,97t/ha (0,05-2,95t/ha)

Maize yields in intercropped plots tend to be slightly higher than in single block plantings, with an LER of 1,1-1,5 depending on the farmer. This is not generally factored in as most farmers tend to combine their maize harvests, so it is not possible to differentiate yields from the different plots of maize and beans and maize and cowpeas for example.

This season, as with previous seasons, the range of yields was incredibly variable - on average from about 0,28t/ha to 11,74 t/ha for the maize trials as an example. More participants fell within the lower range of yields which brought the average down to 2,8t/ha.

If one compares the yields across the 4 seasons where the Grain SA SFIP has been active a clearer trend becomes apparent.

For maize for example (see figure 13 below), there was a systematic increase in yields from 2013-2014 – both good rainy seasons. For 2015 there is a dip in yields due to the drought and then the yields increased again this year. For the first two years there was a definite increase in production of the CA maize over the control maize. In the drought year, the control maize grew better and in this last season the yields are comparable.

For this year the comparable yields are probably due to the fact that quite a number of the longer term participants are now planting their control plots under CA as well.

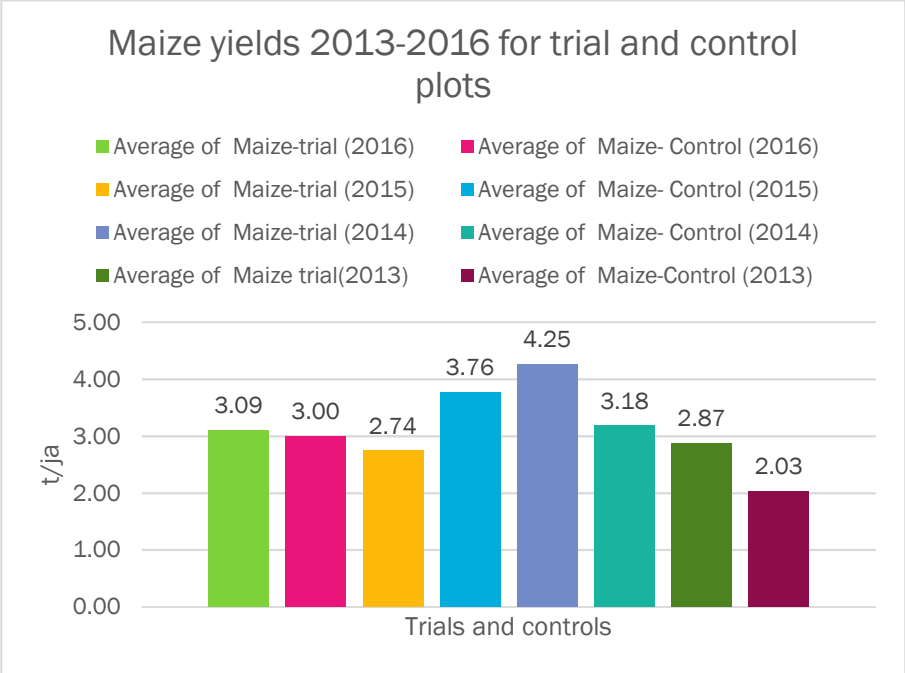
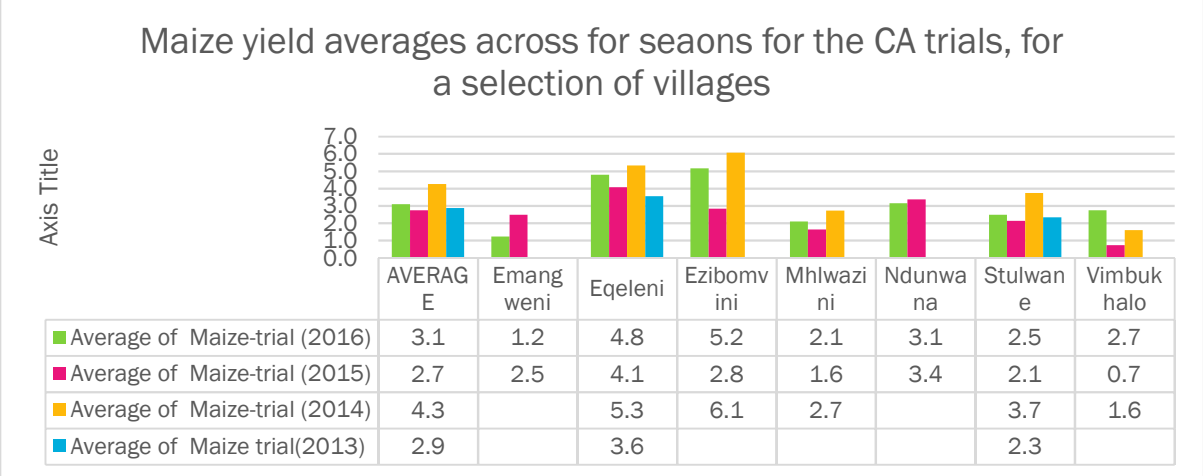


Figure 13: Maize yields for control and CA trial plots; 2013-2016

If one disaggregates the average maize yields somewhat and look at the average maize yields across these seasons for different villages, then another trend becomes apparent. See figure 14 below. But, perhaps it does indicate yield differences between villages



	AVERAGE	Emangweni	Eqeleni	Ezibomvini	Mhlwazini	Ndunwana	Stulwane	Vimbukhalo
Average of Maize-trial (2016)	3.1	1.2	4.8	5.2	2.1	3.1	2.5	2.7
Average of Maize-trial (2015)	2.7	2.5	4.1	2.8	1.6	3.4	2.1	0.7
Average of Maize-trial (2014)	4.3		5.3	6.1	2.7		3.7	1.6
Average of Maize trial(2013)	2.9		3.6				2.3	

Figure 14: Average maize yields per village across 4 seasons

From this figure it is clear that the average yields in some villages are higher than in others. So in addition to the yearly variations in yields due to weather conditions, there are now variations that appear to be village based. Why this would be the case is a bit of a mystery.

The trend of a general increase in yields over time for the CA plots, is only clear for Eqeleni, Ezibomvini and Stulwane – it appears from this that the local variability in weather conditions between different villages can affect the yields considerably.

Bean production

As in previous years, most participants have planted beans (Gadra or Pan 148) either as an intercrop in the maize plots or in mono cropped plots. A number of participants also opted for late season planting of beans (Jan-Feb 2017), as they have found that beans planted later tend to yield better. This is an adaptation that is being made to accommodate the changing climate in the area.

The "normal" bean plantings (November 2016), have again had problems in pod production. Generally, the beans grow well during the season, but shading of plants, infestation of CMR beetles and late season rains, along with initial germination problems tend to depress the overall yields considerably.

In addition, this year has seen problems of theft of seed from the fields. In a few of the villages, the inefficacy of the initial herbicide spraying meant a heavy weeding load and consequent negative impact on bean growth and yields. Vimbukhalo participants specifically mentioned this issue

Below is an analysis of yields obtained in the different Bergville villages where bean yields were obtained, as at end May 2017

TABLE 14: TOTAL YIELD OF DRY BEANS HARVESTED PER VILLAGE BERGVILLE '17

Village	Number of pp weighed	Total beans (kg)	Ave per participant (kg)	Yield (t/ha)*
Stulwane	14	160.4	11,5	0,46
Ezibomvini	17	196.74	11,6	0,46
Thunzini	09	127.19	14,1	0,56
Thamela	11	60	5,5	1,4
Emazimbeni	07	17.77	2,53	0,54
Emangweni-Emaqeleni	02	7.94	4	0,4
Nsuka- Zwelitsha	06	3	0,5	0,05
Ndunwana	15	127.31	8,5	0,85
Emabunzini	05	7.2	1,4	0,14
Eqeleni	13	320.35	24,6	1,1
Mhlwazini	11	119.95	10,9	1,1
Vimbukhalo	14	88.15	6,3	0,63
Ngoba	08	161.23	20,1	0,81
Okhombe	01	10	10	1,0
Emangweni-Engodini	05	19.79	4	0,4
Total	**138 participants**	**1427.02 kg**	**10,3kg**	**Ave~0,63t/ha**

*Yields have been calculated, estimating the area of the plots for each participant under beans to be 25% of the total trial planted.

From the above table, it can be seen that the average yield for dry beans (normal/early season planting) was around 0,63tons/hectare. The highest yield was obtained in a new area -Thamela at 1,4t/ha. Reasonable yields were also obtained in Eqeleni, Mhlwazini and Okhombe. Overall the most beans were produced in Eqeleni, followed by Ezibomvini , Ngoba and Stulwane.

The actual yields can be seen to be extremely variable ranging from 0,05-1,4tons/hectare. This is not unusual in a smallholder system and indicates that different management practices are the main source of variability in yield.

The above table also shows that a total 1.43 tons dry beans were harvested in the Bergville area in the 2016/2017 planting season. The Figure below provides a representation of the amount of beans harvested in each village.

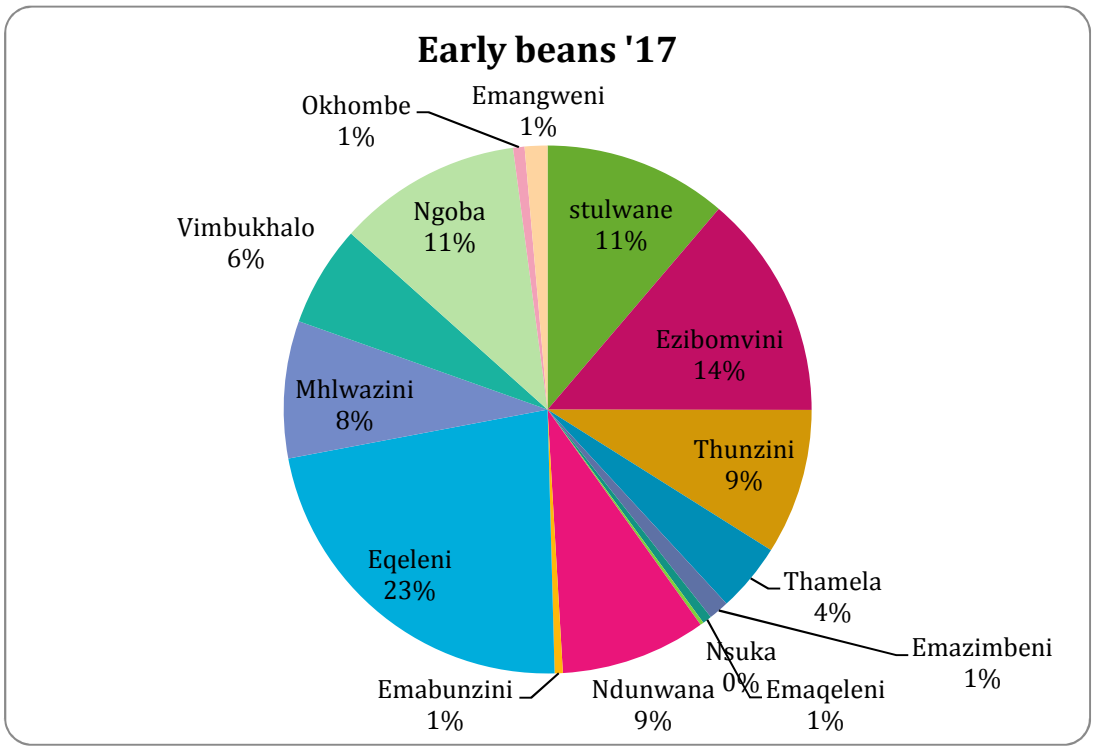


Figure 15: Percentage bean yields per village

As with the maize yields, there is no clear explanation why yields in certain villages are much lower or higher than in others. The same overall trend of higher production in Ezibomvini, Eqeleni and Stulwane is apparent.

Following are some photographs indicative of the season.

Mrs Thembelani Hlongwane from Ngoba busy with de-podding her late bean harvest.

Mr Mtoleni Dlamini from Stulwane with his bean harvest. He also planted the traditional runner bean (yellowish seed) and obtained a reasonable harvest.

Tozi Zikode from Eqeleni with her late bean planting yields. She considers this a much better option for bean production than panting earlier in the season

Zodwa Zikode from Ezibomvinii planted beans in single crop blocks 9Left) as well as in the recommended intercropping design. Growth for both plots looked similar and good midseason when these photographs were taken

Sibongile Mpulo from Vimbukhalo shows her stored beans with bruchid damage. No control mechanisms are known to participants

Maize production

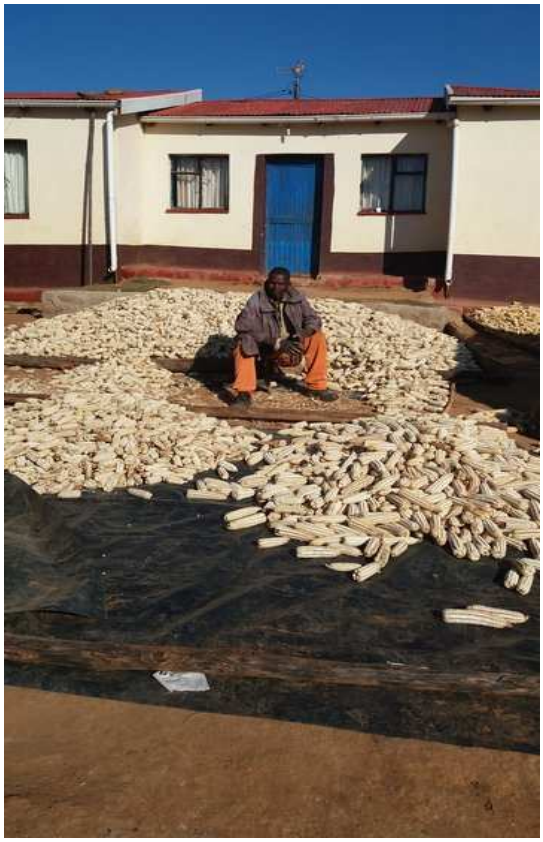
This year, despite the dry start, has been a good year for maize in the Bergville area. Two hybrids were used in the trials, i.e. PAN6479 and PAN53. Harvesting and weighing of maize has been a huge task for both the field staff and the farmers. Many participants were involved also in the Grain SA Farmer Development Programme and planted 1ha of maize, alongside their CA trials. For the most part, participants do not have the labour and logistical and infrastructural requirements to handle these volumes.

Smephi Hlatshwayo from Eqeleni surveys her mountain of harvested maize. She has no dedicated structures for maize storage and does shelling by hand.

Some participants have constructed new and slightly larger structures for maize storage. These traditional structures are however not vermin or damp proof.

Neliwise Msele from Stuwlane constructed a new maize storage structure for her harvest.

A number of participant farmers planted a variety of maize cultivars alongside each other, such as traditional landrace maize (e.g. red and yellow varieties),other OPVs, white and yellow hybrids, as well as genetically modified varieties. This is not an ideal practice, since the protection of local biodiversity, through the avoidance of cross-pollination and contamination of local landrace seed, is an important co-benefit to strife for in these smallholder situations..



Mr Mthileni Buthelezi from Eqeleni has harvester 4-5 different kinds of maize including yellow maize and a traditional red variety. On the right, he is busy sorting his maize for shelling and storage.

Cover crops

Cover crops are offered as an experimentation option for participants in their 2nd to 4th years of involvement. Two to three variations are presently being tested:

- Planting a mix of 3 summer cover crops (SCC's) – millet, sunflower and sun hemp, in a plot as part of a four block rotations trial (Here a number of participants opted to plant the sunflower separately in part of the 10x10m plot and the millet and sun hemp together – to ensure a better seeding rate for the sunflower. This is done in one 10mx10 block as a rotation for maize.
- Planting lab-lab (Dolichos) beans in one of a four block crop rotation plot and
- Relay cropping a mix of 5 covers crops; 2 SCC's (sunflowers, sun hemp) and 3 winter cover crops (WCC's)- fodder rye, saia oats and fodder radish, into a stand of maize in towards the end of the growing season (February-March).

For the most part, participants are not too keen to plant a crop that they cannot eat themselves, no matter the benefit to the soil and potentially to livestock. A concerted effort was made by the facilitation team to promote the planting of cover crops and thus a reasonable number of participants participate: 30 for SCC and 59 for WCC. See the tables below for more detail.

For the late season cover crop planting, which was either scattered into maize plots or planted in rows after harvesting of beans in intercropped plots, the germination was again not very good. A lot of the seed, was eaten by free range poultry. Villages where WCC were planted include Ezibomvini, Ngoba, Eqeleni, Stulwane and Ndunwana. For those where the seed did germinate, growth was reasonably good until the cattle were let back into the fields. Presently all has been consumed.

There also appears to be a fine balance in terms of timing of planting of the WCC. It needs to be done early enough to take advantage of remaining soil moisture- thus somewhere in February, but late enough that actively growing maize does not compete for soil moisture. Of those who planted, only 52% (20/38) of participants' cover crops germinated and grew.

1PHumelel Hlongwane's. maize plot that had a relay planting of wcc. Livestock are browsing (July 2017)

TABLE15: SUMMARY OF PARTICIPANTS INVOLVED IN SCC TRIAL PLANTINGS

NO	Village	Name and surname	Cover Crops	Description
1	Eqeleni	Ntombakhe Zikode	2 plot SCC intercropped with maize	
2		Simephi Hlatshwayo	2 intercropped plots:	1 maize and sunflower, 1 millet and sun hemp
3	Ezibomvini	Phumelele Hlongwane	1plot SCC in rotation 1 plot lab-lab	Sunflower planted in separate rows intercropped with millet and sun hemp
4		Cabangani Hlongwane	1 plot SCC	Sunflower planted in separate rows intercropped with millet and sun hemp
5		Mtuleni Nkabinde	1plot SCC in rotation 1 plot lab-lab	Sunflower planted in separate rows intercropped with millet and sun hemp
6		Velephi Zimba	1 plot SCC	Sunflower planted in separate rows intercropped with millet and sun hemp
16		Balungile Mkhwanazi, Zodwa Zikode, Kcinegile Zikode, Mantombi	1 plot SCC	Sunflower planted in separate rows

		Mabizela, Landiwe Dlamini, Nonhlanhla Zikode, Tozi Zikode, Alfred Gumede, Ntombono Dladla, Khanyisile Zikode		intercropped with millet and sun hemp
17	Goba	Fikile Benghu	2 plots SCC 1 plot WCC	In rotation trial In relay cropping with maize
18		Sebenzile Hlongwane	1 plot SCC	Crop rotation plot of millet, sun hemp and sunflower.
19		Thobile Mthembu	1 plot SCC	Crop rotation plot of millet, sun hemp and sunflower.
20	Stulwane	Mtholeni Dlamini	1 plot SCC	Crop rotation plot of sunflowers
21		Dlezakhe Hlongwane	1 plot SCC	Crop rotation plot of sunflowers
22		Khulekani Dladla	2 plots SCC	1 plot Sunflowers, 1 plot maize intercropped with millet and sun hemp
23		Cupile Buthelezi	2 plots SCC	Sun hemp, sunflower and millet
24		Makethi Dladla	2 plots SCC	Sun hemp, sunflower and millet
25		Bangeni Dlamini	2 plots SCC	Sun hemp, sunflower and millet
26		Thulani Dlamini	2 plots SCC	Sun hemp, sunflower and millet
27		Nokwaliwa Hlongwane	2 plots SCC	Sun hemp, sunflower and millet
28		Xabanisile Mabaso	2 plots SCC	Sun hemp, sunflower and millet
29		Phasazile Sithebe	2 plots SCC	Sun hemp, sunflower and millet
30		Kethabahle Miya	1 plot SCC	Intercrop plot with maize

Below is a summary of yields measured for sunflower. Very few yields were recorded for sunn hemp and millet and these were very low.

TABLE 16: SUMMARY OF YIELDS OF SCC – SUNFLOWER.

Area	Name and Surname	Weight	Yield (t/ha
Stulwane	Nelisiwe Msele	14,6kg/100m^2	1,1
	Nokwaliwa Hlongwane	7,4kg/100m^2	0,55
	Chupile Buthelezi	5,7kg/100m^2	0,43
	Dlezakhe Hlongwane	2,4kg/100m^2	0,24
	Khulekani Dladla	2,7kg/100m^2	0,27
	Thulani Dlamini	8,2kg/100m^2	0,82
Eqeleni	Ntombakhe Zikode	6,7 kg/100m^2	0,67
	Simpehi Hlatshwayo	6,74kg/144m^2	0,46
		14,9kg/625m^2	0,23

Ezibomvini	Zodwa Zikode		0,18
	Phumelele Hlongwane		1,7

Simpehi Hlathwayo from Eqeleni shows her sunlfower harvest.

Mrs Simpehi Hlatshwayo a 4th year participant from Eqeleni designed her own trials; she planted sunflower on a control plot (24mx12m) intercropped with maize and another trial plot where it was intercropped with beans (50mx25m) and millet. Her sunflower that was intercropped with beans developed very big heads, even though there was poor germination because seeds were burnt due to fertilizer mixed with seeds during planting.

Neliswe Msele'S (Stulwane) sunflower harvest.

TABLE 17: SUMMARY OF PARTICIPANTS INVOLVED IN WCC TRIAL PLANTINGS

Name & Surname Ezibomvini	Status	Planting method
Phumelele Hlongwane	Planted and germinated very well but eaten by cows	Broadcasted as a mix between maize rows
Cabangani Hlongwane	Planted and germinated very well but eaten by cows	Planting method
Ntombenhle Hlongwane	Planted and germinated very well but eaten by cows	Broadcasted as a mix between maize rows
Mantombi Mabizela	Planted and germinated very well but eaten by cows	Broadcasted as a mix between maize rows
Mthumeni Nkabinde	Planted but seeds planted eaten by chickens	Broadcasted as a mix between maize rows
Balungile Mkhwanazi		Broadcasted as a mix between maize rows
Gcinekile Zikode	Planted and germination very well but eaten by cows	Broadcasted as a mix between maize rows
Nombono Dladla	Planted and germinated very well but eat	Broadcasted as a mix between maize rows

Fikile Zikode	Planted but seeds planted eaten by chickens	Broadcasted as a mix between maize rows
Tozi Zikode	Planted but seeds planted eaten by chickens	Broadcasted as a mix between maize rows
Alfred Gumede	Planted and germinated very well and eaten by cows	Broadcasted as a mix between maize rows
Velephi Zimba	Planted but eaten by chickens	Broadcasted as a mix between maize rows
Zodwa Zikode	Planted and germinated very well but eaten by cows	Broadcasted as a mix between maize rows
Name & Surname Goba	**Status**	**Planting method**
Fikile Bhengu	Planted and germinated very well but eaten by cows	Broadcasted as a mix between maize rows
Thembelani Hlongwane	Planted and germinated very well but eaten by cows	Broadcasted as a mix between maize rows
Ntombenhle Hlongwane	Planted but poor germination due to chicken's damages ate seeds.	Broadcasted as a mix between maize rows
Sebenzile Hlongwane	Planted but poor germination due to chicken's damages ate seeds.	Broadcasted as a mix between maize rows
Mantombi Shabalala	Planted but poor germination due to chicken's damages ate seeds.	Broadcasted as a mix between maize rows
Thenjiwe Hlongwane	Planted and germinated very well but eaten by cows	Broadcasted as a mix between maize row
Vimbeni Ndaba	Planted and germinated very well but eaten by cows	Broadcasted as a mix between maize rows
Khangwayini Hlongwane	Planted and germinated very well but eaten by cows	Broadcasted as a mix between maize rows.
Name & Surname Ndunwana	**Status**	**Planting method**
Elizabeth Hlatshwayo	Planted and germinated	Planted between maize as a mix
Noyi Mazibuko	Collected seeds but not planted	
Matozo Zondo	Planted and germinated	Planted between maize as a mix
Shiyiwe Zondo	Planted and germinated very well	Planted between maize as a mix
Tholiwe Nkala	Planted and germinated	Planted between maize as rows(2 rows of a mix between maize)
Boniwe Hlatshwayo	Planted but seed eaten by chickens	Planted between maize as a mix
Makhu Mdluli	Planted	Planted between maize as a mix
Zandile Khumalo	Collected seeds but not planted	
Name & Surname Stulwane	**Status**	**Planting method**
1-14.	All participants received seed and planted	Planted between maize as a mix. Germination was not very good.
Name & Surname Eqeleni	**Status**	**Planting method**
1-16.	All participants received seed and planted	Planted between maize as a mix. Germination was not very good.


Above left; Khulekani Dladla in front of his sunflower plot and Above right: His maize and millet & sun hemp intercropped plot.

2

Zodwa Zikode from Eizbomvini standing in front of her SCC plot. Sunflowers have been intercropped (double rows) with millet and sun hemp mixtures.

A participant in the Ngoba learning group standing in her lab-lab and maize intercrop plot. Thi swas in May 2017, and the lab-lab has started to pod.

A participant form Eqeleni who planted her SCC mix in a separate plot, She planted in rows and mixed the three varieties provided. Millet seeded well in this case and sunflowers did not.

Farmer Centres

The concept of farmer centres was introduced to all participating groups with the main focus being the villages in the 2nd to 4th year of programme participation. The general response from the participating groups was that the procurement of production inputs has been widely limited to the neighbouring towns of Bergville and Winterton and with this the challenge has always been around transportation. Although the thinking behind the introduction of such centres is positive, the greatest threat is that of security in the villages. With most of the programme's participants being women and heading households their greatest fear was that should this be known to the local community they would be subject to robberies. Although this was the case the villages of Ezibomvini and Mhlwazini were very much willing to give this a try. Mam Phumelele Hlongwane and Mam Zodwa Zikode opted to run the Ezibomvini Farmer centre as a pair with Mam Mathula Mdladla solely running the Mhlwazini Farmer Centre.

Ezibomvini Farmer Centre

This farmer centre has exceeded the expectations of the owners as initially they as pair ventured into something completely new and were uncertain about how successful this new business would be. However, they were amazed by the response the people in the village had and the way in which they supported the initiative. Production inputs such as seed, fertilizer and herbicides are the main products available at the farmer centre. Villagers were particularly drawn by the availability of these in quantities that are small enough and affordable. Seed and fertilizer available at the farmers centre ranges from 1kg to an entire bag (25-50Kg). Where members required a whole bag of fertilizer, they were encouraged to put in their orders and payment beforehand. Villagers buying inputs from the farmers centre are also equipped with knowledge and skill of how to optimally use these inputs using CA principles, with Mam Phumelele Hlongwane, the community facilitator in the programme being at the forefront of this. The customers of the centre range from programme participants who want to use the inputs in control plots and own fields to general community members that are not part of the programme who practice CA on their own.

Off-season farmer centre operation

During the growing season the farmer centre is very active with sales taking place as often as possible, but this trend has been seen to decline during the off-season months. This has led the pair to start assessing other options because they now feel that it is important for the farmer centre to be operational throughout the year. The local department of Agriculture in Bergville also works very closely with the farmers of the area and have steered a number of initiatives of which the programme participants are a part of.

These include the Department's no-till programme which makes use of GMO seed as well as sweet potato production in the area. The department has been responsible for the sourcing of sweet potato vines and the provision of trainings regarding the planting and further processing of the produce. With this the farmer centre owners found an opportunity to broaden the list of inputs that are now available at the farmer centre now providing different culinary spices. This was a of good example of creating opportunities from various ideas that are presented to them. Apart from

this the farmers have also identified that there is a need to include inputs required in the winter season such as seed potatoes and seedlings, venturing slightly away from maize production during the winter season, however still speaking to maize production the duo are looking to source the preservative pill, Quickphos and Blue Death to protect stored grain from grain moth and weevils.

Right: A view of the available products at the Ezibomvini farmer Centre in July 2017

Farmer centre model

The initial capital outlay that was provided by Mahlathini was R 2900; this has been used to purchase the initial set of inputs, the loan amount was paid back on the 14th of March 2017. Cash on hand available is currently R 2 700.00. The sharing of profits made from the farmer centre has not been tabled as the team still wants to focus their energies on the growing of the farmer centre and injecting any profits made into the further growing of the centre.

Markets

Products are sold to local farmers and other farmers not in the programme but from the area. Clients are happy about the service they receive from the farmer's centre. Positive feedback received based on the quality of seed farmers centre offers. Beans seeds are in high demand. It goes out of stock faster than anything else.

Management

The farmers centre is managed by two farmers (Zodwa Zikode and Phumelele Hlongwane) who formed a solid partnership to manage their business. Apart from business partnership, these farmers are neighbors and they are relatives. Zodwa is the treasurer, she takes care of finances and she plays a major role in collecting money from people who owe. Phumelele Hlongwane manages all other business operations such as selling inputs to farmers, weighing and pricing inputs. She also plays a major role in giving advice to farmers on how to apply or use inputs.

Challenges

Resources are insufficient; they need the following: a) a scale for weighing inputs to ensure an accurate and equal amount of inputs sold to individuals; b) a money box to keep the money safe; c) a receipt and record book to keep records of their business. The record keeping system of the farmers still needs an upgrade and a training on this is required.

Customers are not always expected to buy products with cash. The challenge is that people buy on credit and don't always pay back.

There are emerging competitors within the community who are selling the same products that are sold in a farmer centre.

In the absence of Mahlathini Development Foundation field workers, transport to deliver bags of inputs becomes a problem.

The two small tables below summarise the expenditure and income for the centre between December 2016 and April2017.

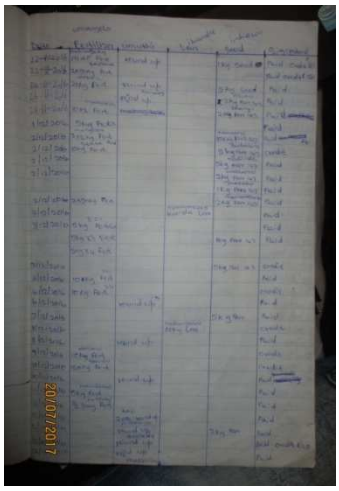
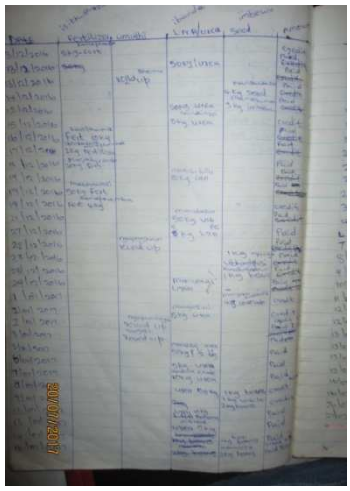
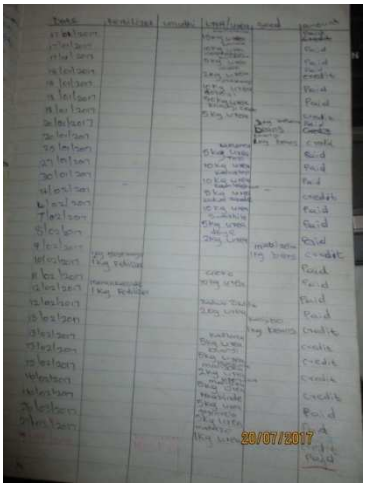
TABLE 18: SUMMARY OF EXPENDITURE FOR EZIBOMVINI FARMER CENTRE FROM 13/12/16 TO 16/03/17

Date	**Inputs bought**	**Payment by centre**	**Potential profit(@12.5% Mark up)**
13/12/16	2x50kg fert 2:3:2(22)zn 4x50kg UREA(46) GRAN 4x5kg seed drybean 148 3x1L Round up powermax 1x5kg seed PAN 66	R3000	
06/01/17	4X50kg UREA(46) GRAN	R1003.20	
17/01/17	2X50kg UREA(46) GRAN	R501.60	
04/02/17	1X50kg UREA(46) GRAN	R267.50	
16/03/17	1X50kg UREA(46) GRAN	R274.70	
20/07/17	Cash on hand(R2700)		
Total		**R5047.00**	**R630.87**

TABLE 19: EZIBOMVINI FARMER CENTRE RECORD (SALES) FROM DEC 2016 TO APRIL 2017

Date	Fertilizer	Herbicide	Top dresser	Seed	Total
December 2016	R2758	R1400	R480(LAN) R630(UREA)	R1161(maize) R80(beans)	R6509
January 2017	R0	R280	R1692(UREA)	R360(beans) R72(maize)	R2404
February 2017	R24	R0	R336(UREA)	R80(beans)	R440
March 2017	R0	R0	R36(UREA)	R0	R36
April 2017	R0	R0	R0	R0	R0
Total					**R9389.00**

Below are some images of the record keeping sheets for the farmer centre.

Mhlwazini Farmer Centre

The Mhlwazini Farmer centre ran by Mam Mathula Mdladla did not get off the ground; the issue was primarily around her commitment to other things and in a lack of awareness of how much time the running of the farmer centre requires. Another issue was around the fact that a number of people in the village are part of the Grain SA FDP where inputs are received in bulk. Marketing of the services provided was not on par, and the centre fell under. Those interested in the services also required products prior to payment and this was not possible with insufficient capital to stock up on larger orders beforehand. She received a start-up grant from MDF to the amount of 2x50kg Map and 1x50kg LAN. She has not paid back this amount.

Socio-economic situation of participant smallholder farmers

A yearly review is conducted with learning groups involved in the farmer experimentation process. There are a number of objectives in the process including assessing the impact of the CA implementation on the participants' livelihoods, their level of understanding, learning and implementation of CA practices and development of social and organisational capacity within the groups.

The review consists of focus group discussions and individual interviews. The latter have now been digitalised for ease of analysis of information.

Socio economic data

Of the 258 participants on the farmer experimentation listings, 35% are male and 65% are female. There has been an increase in the number of male participants over the last four years. The average household size in the area is 5 household members. Ages of participants range from 18 to >70 years. Around 60% of participants are between 36-55 years of age. Over time the average age of participants has been decreasing, meaning more economically active and younger people have become involved.

The main sources of income in the community are social grants (72%), employment (11%) and farming (10%). See the figure below

This is the first year (in four years of involvement) that participants have started mentioning farming as a source of income and supports participants' responses that they are now selling some of the surplus maize and beans they produce in the community.

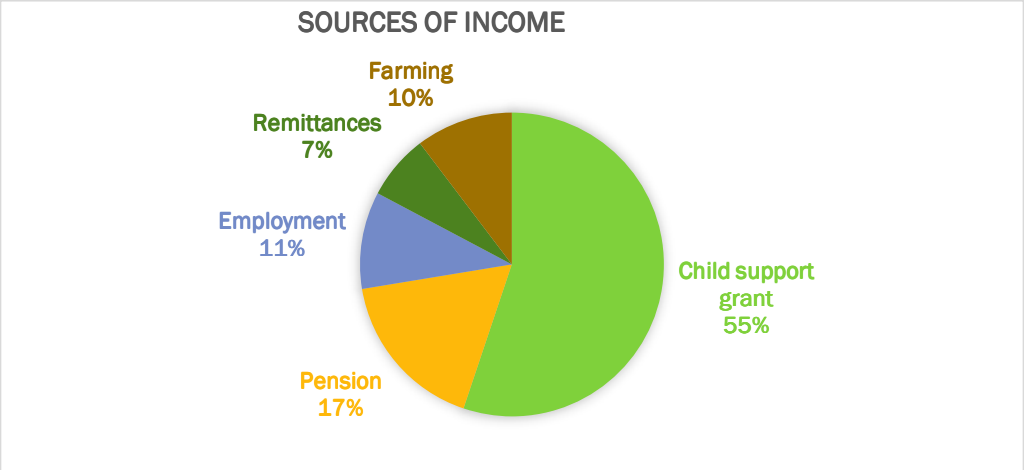


Figure 16: Sources of income for CA participants in Bergville, 2017

Overall incomes per household are extremely low, with 75% of households earning between R0-R2000/month. The remaining 25% earn >R3 000 /month. The average income is R1875/hh/month – a reduction from last year where the average was around R2450/hh/month

Maize and beans have been used primarily for household food supply; 53% of participants now have enough for 7-12months food provisioning. This proportion has increased from around 33% the last season. See the figure below

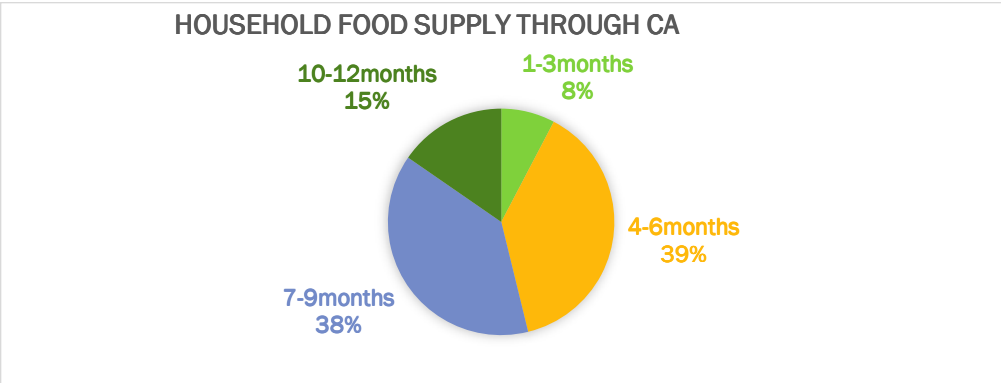


Figure 17: Months of food provisioning for CA participants, 2017

Around 10 VSLAs (village saving and loan associations) have been established across the 17 villages where CA is being implemented; so roughly 59%. Savings are for consumption smoothing,

household expenses and saving for inputs (28%). Overall savings is R100-R500 per person per month.

Notwithstanding the very low incomes, participants do save for inputs. Generally, these savings amount to around 10-15% of their income. The two small figures below indicate the percentage of savings group members who save for inputs and give an indication of the amount saved.

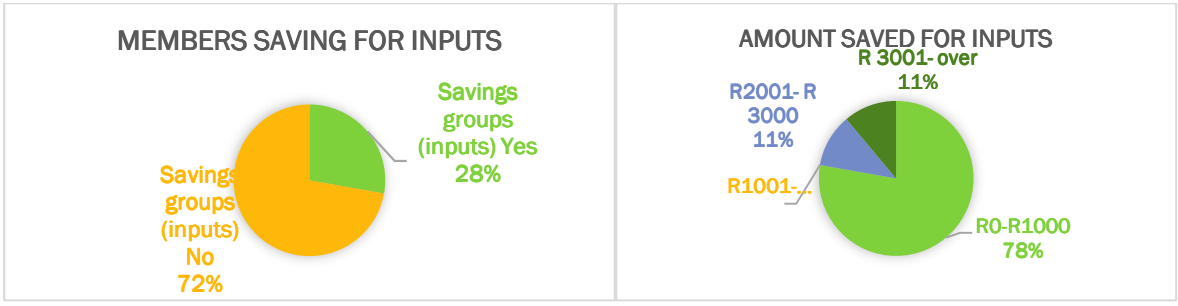


Figure 18: Money saved for buying inputs

Learning and implementation of CA practices

All participants in the farmer level trials start in their first season by comparing different hand- held planters- mostly use of hand hoes, compared to the MBLI (Afritrac) hand planters. The jab planters and wheel planters (Haraka planters) are not commonly used, but are introduced for planting of cover crops. Animal drawn planters are used by a small sub-group of participants who have access to oxen. The small figure alongside indicates the participants' continued use of the implements after their initial learning. The 69% of participants who use the MBLI planters said that it works better than hand hoes because it saves time and effort. Some participants felt that they needed to check all the time whether the seed and fertilizer had been deposited properly and thus did not feel they saved time. In very high percentage clay soils, or very hard soils, the MBLI planters also do not work too well, thus the combined use of hand hoes and planters.

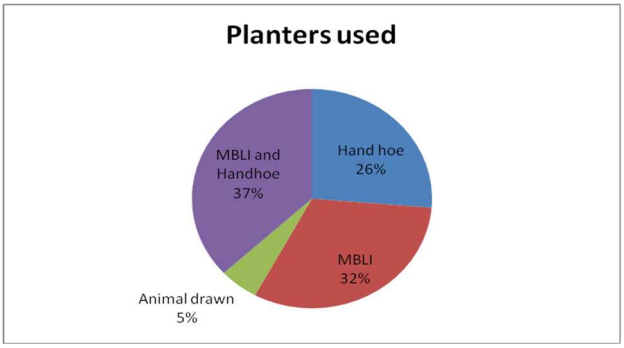


Figure 19: Use of planters by CA participants

Regarding soil fertility, 78% of the respondents shared that they are able to distinguish between fertile and infertile soils. Criteria for assessing fertile soil were the following: Increased yields (53%), weed infestation (17%), increased organic matter (12%), soil colour (12%) and improved crop growth (6%). This indicates that a small percentage of participants are starting to use characteristics introduced and discussed in learning sessions- such

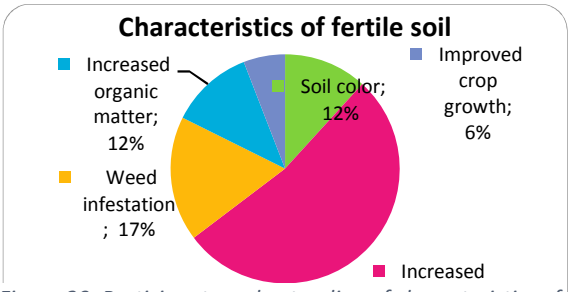


Figure 20: Participants understanding of characteristics of fertile soil

as organic matter alongside their traditional assessment criteria

Participants were asked what the most important factors were for them to improve crop growth. Their answers here indicated some of their learning around inputs. For the most part, respondents have not yet made the connection that CA practices in themselves can improve soil quality and soil fertility. See the figure alongside

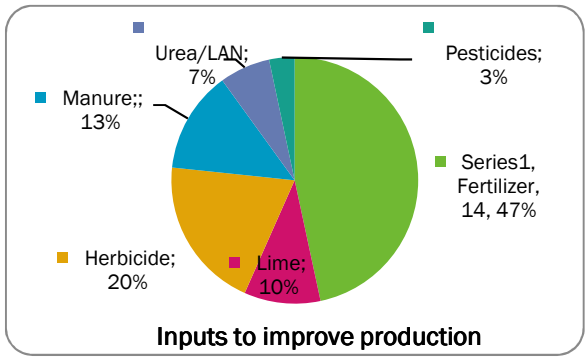


Figure 21: Participants' perception of inputs required to improve production

In terms of labour requirements, respondents felt that land preparation and planting are easier in CA then for conventional cropping. They were however divided in their responses regarding weeding. A significant number feel that labour for weeding is increased, but in fact one may have expected that more participants would feel that weeding pressure was increased. See the two small figures below.

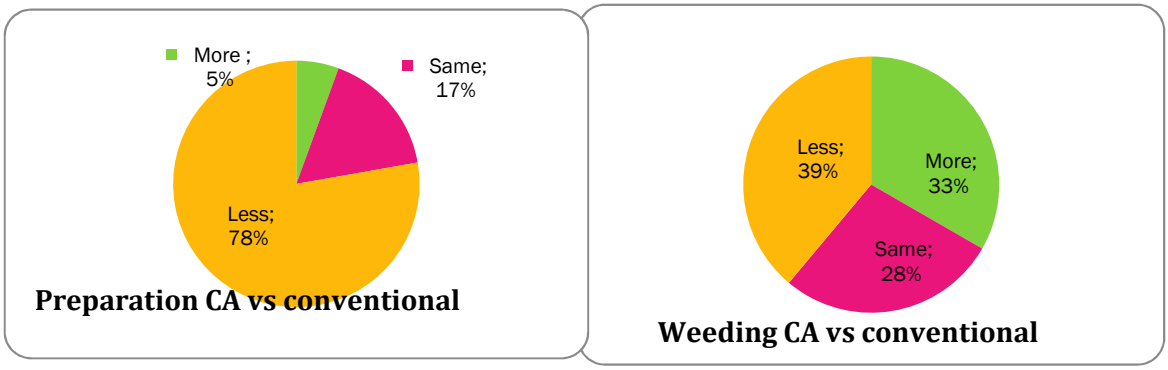


Figure 22: Labour requirements for land preparation and weeding in CA

Focus group review discussions have been held in the following villages

TABLE 20: VILLAGES WHERE FOCUS GROUP REVIEW SESSIONS WERE HELD; JULY-AUGUST 2017

Village	Tot. no. of pp in attendance	Tot. new members
Ezibomvini	17	03
Stulwane	09	01
Ndunwana	17	04
Ngoba	07	01
Thamela	13	03
Okhombe	09	0
Nsuka	08	0
Mhlwazini	13	0
Cornfields	13	0
Total	**106**	**12**

A very brief summary of some of the trends in these discussions is provided below:

- Participants are aware that input costs are very high but did not know the actual costs of inputs per hectare
- They are also still unsure of the actual size of their fields
- Most participants do some saving, but not many save specifically for inputs. Presently there are 2 savings groups (Ezibomvini and Ndunwana) set up specifically for saving for inputs. In the other groups a proportion of their savings would be used. Participants feel that they cannot belong to two savings groups as the extra burden in saving would be too much for them
- Participants are comfortable paying for the input subsidies and feel that the cheaper inputs help them a lot.
- Participants still buy inputs according to habit and what they can afford, rather than according to the actual inputs that may be required. So, they would buy 1 bag of fertilizer (or half a bag) and one bag of seed, irrespective of their field size – notwithstanding the fact that the facilitation team have been working with them on these calculations
- Participants also still buy whatever seed and fertilizer is suggested to them at the shops, rather than requesting the seed and fertilizer types promoted through the programme. This is mostly an issue of confidence, as most participants are now aware of differences
- Many participants still keep traditional seed for re planting, along with buying some seed from local shops such as Farmsave in Bergville
- Many participants shared that there is a considerable cost saving with CA practices because it negates the use of expensive tractors which charge R15-R20 per metre for ploughing and the same amount for discing.
- In Mhlwazini participants shared that with the practice if CA principles, they no longer make use of tractors and oxen and they have seen the general condition of their cattle improved ,because their cattle are now not subjected to intensive labour ploughing and planting fields.
- Participants felt that this season was good, and are satisfied with the yields they have obtained for maize and beans.
- The quality of bean seed harvested this year was not good in most cases, as late rains meant seed had water damage. The wetter seed has led to high levels of weevil infestation.
- The mixed brown cowpea planted grew well, but did not pod or seed well, or at all in most cases. It appears that podding happens too late in the season, when cattle are already allowed into the fields for grazing.
- Millet as a cover crop is not working too well as birds eat all the seed
- Sunflower seed has been harvested by most participants who planted these in their cover crop mixes. Some have even sold some of that seed in their local communities.
- Yields obtained are primarily for household consumption and for the feeding of cattle, goats and chickens but these normally feed on spoilt maize from the uhlaka storage structures which the participants reported is very prone to rat invasion and they have resorted to the keeping of cats for the control of this threat while other participants reported that the only way to save one's maize from being damaged is by decobbing,

storing the grain in drums and using the preservative pill to prevent weevils from affecting their stored grain

- Storage is an issue, especially for the older participants who are now producing a lot more grain than they can easily store in their small storage structures and their huts. Some of the older participants are now warming to the idea of joint storage structures, although they still have doubts about trusting others and feel that the transport to and from these structures would be problematic for the,, So overall, people would still want something at their own homesteads.
- Some participants reported the occasional sale of produce, mostly dry beans (R100/5l). Maize is seldom sold unless somebody comes requesting a "ithini"- (R50/20L). The participants indicated that this year few people in the village did not plant and there is a lot of maize to go around in the village.
- The local mill at Emmaus is responsible for the milling of maize from Emazimbeni, Vimbukhalo, Ezibomvini, Eqeleni, Thunzini and Stulwane villages among others. The pressure on this mill has meant the mill had been broken down quite a number of times already. Transportation is an issue for those who cannot walk to the mill, local vans charge anything between R 20-R25 for transportation to the mill.
- The experimentation with cover crops has been to date limited to the villages of Ezibomvini, Stulwane, Eqeleni, Ngoba and Ndunwana. Participants shared that their understanding of the purpose of the cover crops was to maintain soil moisture and the provision of nutrients to the soils. Some participants requested more information.
- For winter cover crop mix; black oats, radish and forage peas, participants shared that seed sown was affected negatively by scratching chicken. Of those that had germination in their plots radish and oats were seen to have grown well but they feel these were planted late because by the time they were growing well, the cattle were released into the fields.
- There is a large concern with cattle damaging crops and neither the owners, nor the traditional authority try very hard to keep cattle out of fields. This means that someone always needs to stay at home to chase cattle when they come. Participants feel that fencing their fields would be the best option, but feel that they cannot afford this expense. They also felt that perhaps the department of Agriculture could assist the community with secure grazing.

Learning workshops

This season learning workshops were conducted in some of the newer villages (Ndunwana, Emabunzini and Thamela). It became apparent to the facilitation team, during the course of the growing season when monitoring was conducted, that the introductory workshops and then the joint spraying and planting processes were not enough to help participants to fully understand and appreciate what CA is and how the process works.

The workshop agenda is shown in the text box alongside.

LEARNING WORKSHOP AGENDA

Healthy soils -Characteristics of a healthy soil

Soil texture- Characteristics of a soil texture types, methods of identifying soil texture- sausage method

Soil structure-Soil profile, different soil structure types, soil erosion and its effects

Soil sampling and significance- Essential plant nutrients and their functions (tell -tale signs of deficiency)

Principles of conservation agriculture- Planting systems (inter cropping, crop rotations), crop diversification, cover crops and their significance, disease and pest life cycles

Good practice -Integrated weed management

Chemical use- Precautionary measures, protective clothing

Different chemicals and how they work

Seed types -Traditional, open pollinated, hybrid seed, genetically modified seed. Important pointers to consider when using GMO

Workshops were well received, but due to time pressure in harvesting, these sessions could not be conducted in all the areas.

Workshop participants in Emabunzini in discussion with their facilitator Phumzile Ngcobo

Phumzile Ncgobo works with participants in Ndunwana on the soil texture test - making soil sausages

Implementation per area

Ezibomvini

This season 9 participants from the Ezibmovini learning group separated their yields per plot. This has allowed a comparison between different treatments for these participants.

Table 21 below gives an indication of yields for mono cropped and intercropped maize plots, as well as bean plantings and some summer cover crop yields

TABLE 21: PLOT YIELDS PER CROP FOR 9 PARTICIPANTS FROM EZIBOMVINI; 2016-2017 SEASON.

Note: C=Control, Sf=Sunflower, LL=Lab-Lab, S=sunnhemp, .E=Early, L=Late

Name Surname	year joined	trial size	trial description	Yields (tons/ha)								
				Maize				SCC			Beans	
				C	M+B	M+C	M	Sf	LL	S	E	L
N ZIkode	2016	400	2(m+b) 2(m+c)		6,10	6,02					0,98	
Zodwa Zikode	2014	1000	4 (m+b) , 4 (m), 1 (B), 1 scc plot	3,83	10,46	7,17	6,1	0,18			0,69	0,93
Landiwe Dlamini	2015	400	4(m+b)		8,75						0,29	0,46
Cabangani Hlongwane	2015	800	1(m+b)1(m+c)1(m)1(b)		10,4	4,33	5,94				2,66	0,15
Mantombi Mabizela	2016	400	3 (M+B), 1(M+C)		3,65	3,2					0,47	
Balungile Mkhwanazi	2016	400	4(M+B)		6,94						0,30	
Phumelele Hlongwane	2014	1000	3 m+b), 1 (m+c), 4(m), 1(Lab Lab), 1 Scc	9,69	11,99	9,79	9,0	1,72	0,02	0,01	2,27	0,92
Nombono Dladla	2016	400	3(m+b), 1(m+C)		15,34	12,7					0,75	0,39
Khanyisile Zikode	2016	400	2 (m+b), 2(m+c)		4,53	4,10					0,58	0,15

From the above table the following comments can be made:

MAIZE: Maize was planted either as an intercrop with beans or cowpeas or as a single crop.

- Overall, the maize yields have been extremely good this season; ranging from 3,6-15,3 tons/ha in the trial plots, and 3,8-9,7tons/ha in the control plots.
- CA trial yields have been significantly higher than the conventionally tilled control plots (Zodwa Zikode).
- Maize yields in the maize and bean intercropped plots have been higher than in the maize and cowpea intercropped plots as well as the maize single crop plots, for all participants where these were measured.

BEANS: Early beans were planted in November, along with the maize. Participants also requested to do a late season planting, expressing their feeling that late season beans produce better. This is due to late season rains that damage the early season harvest.

- Bean yields have generally been quite low – with the notable exceptions of Cabangani and Phumelele Hlongwane. This indicates that the yield potential for beans was good this season and that they have not been realised due to management practices and potentially soil acidity issues for most of the participants.
- Single block plantings of beans have not yielded better than intercropped plots- despite the strong 'belief' in the area that this is the case.
- Additionally, the late season plantings have not yielded better than the early season plantings as participants had hoped.

Seeds from summer cover crops (SCC) were only harvested by two of the participants. Yields have been low. The sunflower was planted in separate blocks with the intention of harvesting seed for use as poultry feed. Phumelele Hlongwane realised a reasonable yield of 1,7t/ha of sunflower seed. None of the participants managed to harvest millet this season due to bird damage. Yields for sun hemp have been similarly low due to bird damage.

Table22 summarises a selection of monitoring indicators for the participants mentioned above. From this monitoring data, it should be possible to discern whether the reduced bean yields for example are an outcome of specific management practices not being executed well.

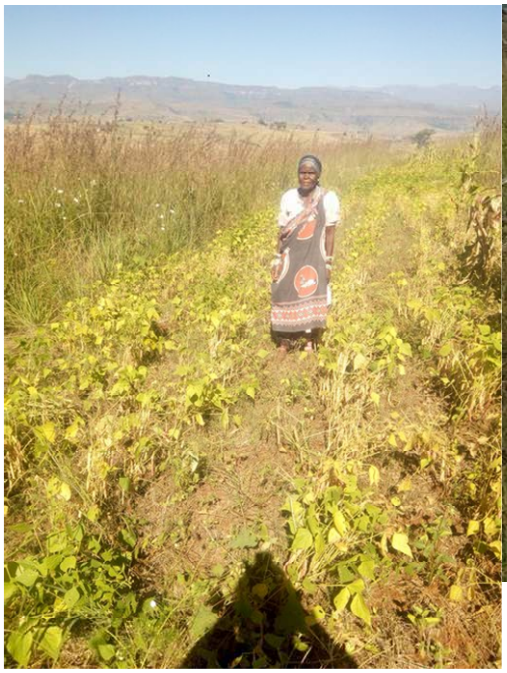
TABLE 22: MONITORING INFORMATION FOR A SELECTION OF PARTICIPANTS FROM EZIBOMVINI

	Ave yield (t/ha)				% Germination			At planting						
Name	**M**	**B**	**Age**	**Save for inputs**	**M**	**C**	**B**	**Method of weeding**	**% Residue**	**% Weeds**	**Fertilizer**	**Porosity**	**Run off**	**Pesticide**
Hlongwane Phumelele	10,3	2,3	38	yes	71	80	70	hand weeding	25	5	LAN	good	no	decis
Mabizela Mantombi	3,4	0,5	45	no	70	59	53	hand weeding	1	45	LAN	good	mild	decis
Zikode Zodwa	7,9	0,7	52	yes	61		60	herbicide	0	10	MAP, LAN	poor	yes	decis
Zikode Khanyisile	4,3	0,6	46	no	63	0	47	hand weeding, herbicide	2	15	MAP			decis
Dlamini Landiwe	8,8	0,3	60	yes	53	20,5	9	herbicide	1	13	MAP	fair	yes	none
Nombono Dladla	14	0,75	53	no	59	15	63	herbicide	0,2	2	MAP, LAN	good	no	decis
Zikode Nonhlanhla	6	1	56	no				herbicide	0	57				
			50	42%	63	35	60							

General comments on the information from the table:

- A few socio-economic indicators have been included here to give a sense of who the participants are. The average age of these participating women is 50 years. It is also evident that those participants who save for inputs all belong to VSLA (Village savings and loan associations). This corroborates the importance of introduction of the VSLA as part of the implementation process in is crucial for longer term sustainability.
- The brown blocks indicate participants who had planted PAN 6479. The rest of this sub-group planted PAN 53. It is understood in this area that PAN53 is better suited for drier, hotter conditions. The yields of the two hybrids however are comparable and there is no obvious indication of one out performing the other.
- This season, due to dry conditions early in the season, necessitated the use of Gramoxone, rather than Roundup as the herbicide of choice. Generally, the use of the herbicide was effective for this group.
- For most of the participants the percentage residue cover at planting is still extremely low. The only exception to this is Phumelele Hlongwane, who has a fenced plot and is in her 4th year of implementation.

- There is little correlation between percentage of weeds present at planting (after spraying) and bean yields, as may have been expected.
- Percentage germination for maize averaged 63%, for cowpeas -35% and for beans- 60%. These germination percentages are not very good, but are indicative of the extended dry conditions at the beginning of the season. The depressed bean germination percentages however cannot be directly correlated to the low bean yields, except perhaps in the case of Landiwe Dlamini who only saw 9% germination and a consequent yield of 0,3t/ha.
- There is no trend showing yields increasing proportional to length of participation. The four participants whose yields are blocked out in green, started implementation this year. On average their yields are comparable to the participants who have been involved for longer periods.
- Comments for individual participants:
- Phumelele Hlongwane realised exceptional yields for both maize and beans. She is in her fourth year of experimentation and opted this year for a reduced amount of external inputs. She did not spray herbicide (Gramoxone) but did hand weeding, citing that the use of herbicides to date has reduced her weed load enough to make hand weeding manageable. She also did not apply any basal fertilizer (MAP), but only did top dressing. This indicates that her soil fertility and soil health status is definitely a lot better than that of most of the other participants.
- Nombono Dladla is a new participant, who started this season. She has realised exceptional maize yields. This is mainly due to her use of a highly fertile plot just below her homestead, where there used to be a kraal.



Nombono Dladla, a new particpant in Ezibomvini standing in her plot of late planted beans.

Khanyisilei Zikode in Ezibomvinii standing in her late bean planting plot. She has not kept abreast of weeding and subsequently realised a low yield.

Phumelele Hlongwane indicates her sunflower yields

Phumelele also planted a 10sqm plot of soya beans and harvested 21,22kg -

Emabunzini

This is a new area, an expansion from the Ngoba group. The group consists of 9 participants who planted the 1st year trial design of 400m² maize and bean and maize and cowpea intercropped plots.

Some specific challenges in this area include:

- Threat of stray livestock
- Over commitment of participants
- General poor maintenance of the trials

Thenjiwe Hlowane's plot of maize and cowpeas intercropped. Here the poor maintenance and livestock damage have led to now yields being recorded.

Livestock were not sent to grazing areas this season, due to lack of grazing and thus participants who planted in unfenced plots spent much of the season trying to stop livestock from invading their fields. The initial herbicide spraying did not work particularly well and thus high weed pressure results. Some participants did not weed on time. They mentioned that they were unaware of the amount of effort required in maintenance of the CA plots and did not allocate the time.

Ndunwana

This area is in its 2nd year of CA trial implementation. The group consist of 19 members, 5 of whom joined this season. The group opted to plant the 1st year trial design layout of 400m² maize and bean and maize and cowpea intercropped plots. 13 of the14 2nd year participants paid their subsidy amounts for inputs.

They also planted the late season relay crop of cover crops into their drying maize plots – after harvesting beans. A mix of 5 cc's was used.

For this group, the following yields were obtained

Crop	Yield range (t/ha)	Average (t/ha
Beans trial	0,2-1,43	0,7
Maize trial	0,4-7,5	3,2
Maize control	0,3-4,8	1,9

Nomqibelo Hlathwayo's bean harvest being weighed.

Through the local facilitator, Mrs Boniwe Hlatshwayo, a number of participants collected the seed. However chickens feeding on the broadcasted seed were a major problem. Four participants had

signs of germination their fields (Nomgqibelo Hlatshwayo, Tholiwe Nkala, Shiyiwe Mazibuko and Matozo Zondo)

Oats, radish and sun hemp visible in the rows planted by Tholiwe Nkala in Ndunwana

Germination and growth of the wcc mix relay cropped into maize on Shiyiwe Mazibukko's plot in Ndunwana. radishes and oats are clearly visible.

Generally the group is happy about how the season has gone and feel pleased with the yields obtained for their maize crops. Beans however did not yield well because of late rains.

The group had a challenge with weeding, feeling that the herbicide was inefficient. As with most groups this year, Gramoxone was used instead of Roundup, given that there was not much weed growth yet at planting- as the area was still dry. This meant that weeds re-emerged quickly.

Tholiwe Nkala shows his wcc planting. he opted to make furrows adn plant in rows.

Solutions offered were decreasing the trial plot sizes and working with integrated weed management principles. These include early weeding as a very important strategy and the late weeding again to ensure that weeds do not set seed. Soil cover and canopy cover are critical components of the process.

Stakeholder engagement

In the Bergville area a lot more specific attention has been given to engagement of stakeholders in the past few months.

This has happened at a number of levels:

- Co-funding and implementation: Working with the KZN LandCare programme. Funding has been received through this programme for procurement of tools and limited inputs for the 2017-2018 season. Awareness raising events are to be conducted jointly in 2 areas of cooperation; Bergville and Ixopo.
- Links have been made with other NGOs operating in the area; namely Lima RDF and Pilakahle. In this context introductory team meetings were held to outline the organisations' respective programmes. Subsequent introductions were made with community level learning groups. In Ezibomvini for example the 19 learning group members have embarked on a training programme with Pilakahle in asset based community development and business management training – the group is also interested in the revolving loan fund operated by Lima, where much larger loans can be procured than in their VSLAs.

For the latter it has been agreed that close cooperation between MDF and Lima would be required to ensure that this revolving credit does not impact on the functionality of the VSLAs.

Explorations with government and Local Municipality officials to set up a stakeholder forum in the area around maize production which can pull together all role players. Potential stakeholders here include the DRDLR, DARD, Okahlamba LED section, DSD, COGTA, Dept of Health , local agribusiness, Grain SA FDP, NGOs and farmers. See attachment 1: Multi stakeholder Forum, for an outline of the proposed forum that has been sent around to prospective stakeholder participants.

Communication with the Okahlamba LED manager regarding collaboration. Here discussions revolved around Mahlathini's involvement in one of the LED strategic initiatives funded through the DRDLR – regarding the development of Agriparks and secondary cooperatives.

Farmers days have been held in Ezibomvini and Ndunwana. These have bene large public events showcasing the CA work in these communities and have included many different stakeholders and role players including DARD extension services, Cedara specialist from their Soil Sciences section and the Economics section, LandCare representatives and participants from universities (UKZN, Fort Hare) and NGOs (lima, Pilakahle and FSG). An outline of the programme for the Ezibomvini farmers day is presented in Attachment 3.

The farmer's day attracted a lot of attention from stakeholders this year, as in previous years. The general process was one of presentations being given by various stakeholders and then small group "walk abouts" to a number of stations including:

- CA trial fields;- Phumlele Hlongwane; showcasing intercropping cover crops, crop rotation, water runoff plots, and soyabeans
- A power point presentation on principles and progress
- A demonstration station run by DARD on LandCare and

- A beautiful 1st year trial- Nombono Dladla

Ezimbovini farmers' day. left: The FarmSave representative helping in distributing prizes for the CA quiz conducted and Right; Participants of the day listening to a presentation

Above left and middle: the Landcare demonstration site with posters for promotion of CA and a mulching demonstration. Above right, participants looking at a trial site

DVDs have been produced for implementation of CA in smallholder farming systems both as awareness raising materials for Grain SA and for a television programme.

The promotional DVD has been produced in both English and isiZulu and has been used extensively in further farmers days and awareness raising events. It has been very well received by farmers, given that they know some of the people being interviewed in the DVD and has done a lot to raise the profile of CA.

Exploratory meetings have been held with the Dept of Environmental Affairs to discuss their pilot programmes for Climate Smart Agriculture and the Grain SA CA SFIP involvement in this process as well as for consideration of incentive schemes based on payment for ecosystem services.

Busy setting up for a video interview in Stulwane

Building of Social platforms

This process is integral to the entire innovation development process and is built on voluntary association in learning groups as the first building block at community level. These groups then undertake a number of activities that build social capital and cohesion including:

- Joint working groups; where smaller groups of people undertake to do their farming activities together to save time and use their combined labour more efficiently
- Bulk buying groups; where groups of individuals club together to buy inputs from the farming activities
- Joint learning and review sessions; where groups come together to discuss progress and observations and plan next steps together
- VSLA's (village savings and loan associations); where individuals set up groups who save together and take out loans within the group to help them with consumption smoothing, productive activities and small enterprise development
- Selection of local facilitators; who assist the groups in monitoring and provision of advice as well as linkages with the programme and other stakeholders and
- Development of local farmer centres; designed and run by the learning groups to provide local input support, as well as management of group owned tools and provision of advice to learning group members and potential new participants.

In this way a local community of practice is built up around implementation of Conservation Agriculture that is community based and pays attention to the entire value chain for grain crop production.

This year has also seen the introduction of a Social Compact Agreement, wherein the learning group and Mahlathini undertake an agreement that outlines their roles and responsibilities in this process. This has become important as the groups mature and start to attract attention from other stakeholders and relationships need to be managed in a way that is collaborative and inclusive.

See Attachment 4 for an example of the social compact agreement. This agreement builds on the individual contracts that are signed with each farmer participant when they join the programme.

General comments and suggestions on the implementation of the smallholder CA innovation system

- The CA system being promoted with smallholders is already a low external input system where pre-planting spraying of herbicide is promoted, with the use of hand and mechanical weeding options during the growing season, that complement cultural practices. This strategy is causing some difficulties for participants, especially now that the onset of rains has been later and the spring and early summer seasons have mostly been drier than before. This trend has now been experienced for three consecutive years.
- The above situation implies that the fields are still 'bare' when spraying should happen (2 weeks prior to planting) as little to no rain has meant that weeds are still dormant.
- With the planting of SCC's (summer cover crops) growth has been good this season. Very few participants harvested seed, partly due to seeding being problematic for some of the cover crops, such as sun hemp and millet (bird damage). The hope that participants would be able to produce enough seed to continue planting their own cover crops is not being realised. Those that have harvested sunflower seed are intending to use the seed as poultry feed.
- In addition, the planting of winter cover crops is still a high-risk activity, given the potential for soil moisture competition in this relay cropping design, the difficulty of seeding the cover crops and the high likelihood of consumption of the seed by poultry and other birds.
- This means that in the foreseeable future the production of cover crops will need to be an externally supported and funded process. Farmers are not producing enough seed themselves and are unlikely to buy it, but are starting to appreciate the benefits of the cover crops. Further experimentation with the relay cropping of the winter cover crops is important. At the moment cover crops are not produced at a scale that is very useful for winter fodder production for livestock and experimentation with larger plantings of cover crops in certain situations could be a significant factor in bringing livestock owners on board. Only around 30% of the participants also own livestock and some of the larger livestock owners are not as yet a part of the CA experimentation process. It is generally the men that own the livestock and the women who grow the maize.
- Bean production is still encountering many challenges; low germination, good growth but poor podding, reduction of harvests due to late season pest (CMR beetles) and rain. An added issue is that this season a number of participants have storage pests (bruchids) and do not have specific processes to deal with this.

  This season a number of participants opted to try out late season bean plantings, believing that yields would be much higher for these plantings. As the climatic conditions have been shifting, participants have had some success with late season plantings. This season however these improved yields did not materialise, partly due to inadequate rain and soil moisture. Late season bean plantings will need to be timed quite accurately, potentially no later than the first week of February.

- Maize production this year provided bumper crops for a number of participants, as they had also expanded their production areas, partly by being involved in more than one maize production support process. They do not have the logistical or infrastructural requirements to handle these increased volumes. Suggestions for moving into the future include:
    - Setting up a process for harvesting support, contracting small teams of labour to assist, or working on a process for the joint activity groups in the villages to support each other.
    - A mobile shelling machine needs to be obtained, either bought or hired for the harvesting season to make this part of the process more efficient.
    - Storage options at homestead level need to be upgraded. This has been a need for a few seasons now. Participants do not easily consider buying storage containers and some kind of support process here is now urgently required.

- The lack of coherent grazing management systems in the villages is posing a direct threat to the implementation of CA and to dryland cropping. The traditional authorities are responsible for setting and enforcing rules around grazing management for each of the villages. Generally, there is a system for summer grazing in the mountains where livestock need to be taken to these grazing areas and are herded during this season. In winter, the cattle are allowed back into the villages. Fines can be levelled at people who do not follow these broad rules. However, in times of stress and drought the TA's will more often than not decide to keep the cattle in and around the villages as there is generally more water and grazing available. This then makes the planting and management of dryland crops almost untenable. Individual smallholders do not feel they have the power to intervene in such processes or ask for change. In some of the areas, the smallholders have suggested that outside facilitation of a planning and change management process for grazing management is the only option that they can see that will work. It may be an idea to embark on such a process in one or two of the villages to negotiate systems that are beneficial for both livestock owners and smallholders practicing dryland cropping

- Learning workshops are a central part of the facilitation and implementation process. Due to working with such a large number of participants across 17 villages, these workshops were not held in all areas. This is seen to have created a weakness in the programme, as newer participants are not well informed about the CA process.

  A process for ensuring that these learning sessions are done in each of the new villages is to be designed; interns can be brought in to assist with the planting and to free up some time for facilitators to run these sessions with the learning groups.

- Participants generally assess the success of their CA trials in terms of visible differences in their crops and in their yields. Generally, there are noticeable increases in yield in the CA plots, when compared to conventional plots in the short team (1st year). This is more likely an effect of better management practices ('basics') for maize production in general (nutrient and weed management) rather than being a primary effect of the reduction of

tillage or soil health. It will be important to work pro-actively with longer term participants to start to observe and analyse the more subtle changes wrought through CA.

Impacts of CA principles are presently quantified and analysed in the yearly reviews and participants are aware of a number of factors such as increased water infiltration and reduced run-off, increased moisture holding capacity of the soil, a reduction in weed pressure when CA is done properly, increased value being placed on secondary crops, such as beans and cover crops and the value of intercropping for increasing maize yields.

- A further important motivational factor for participants is a reduction in input costs. Given that they generally use a very low external input option for their control plots (buying minimal fertilizer and keeping their own seed for re-planting) the main saving is in ploughing costs. With the pending introduction of tractor drawn planters for the participants' planting larger fields, this particular benefit will be reduced. The other benefits of the CA system will then come into play more strongly

- Participants have been changing how they manage their control plots upon observations of benefits in their CA plots. Thus a number of participants have now opted to have CA control plots as well, or use the same fertilizer and weed management practices as for CA plots. This has meant that the obvious differences between CA and control plots are slowly disappearing as control plot yields catch up with the CA plots.

  A conscious strategy will need to be employed in terms of learning and observations for these participants to ensure that they can unravel the effects of CA on their crop management system and/or we will need to more consciously include conventionally tilled plots as control plots going into the future.

Budget statement by August 2017

Project	Total Actual YTD Aug 17	Total Budget YTD Sept17	Available to use
Bergville smallholders	604 967	605 050	83

Attachment 1: Multi-stakeholder Forum; Mahlathini Development Foundation.

Introduction

Smallholder farmers in South Africa and in KwaZulu-Natal face a wide array of challenges that constantly pose a threat to their livelihoods. These include limited resources, low economic returns, low yields, poor infrastructure, and lack of access to information. Many of these farmers are unemployed and rely on subsistence farming and government grants to sustain a living with women playing a vital role in agricultural production. These challenges have led to a decline in agricultural production in rural communities. However, smallholder farmers play an essential role in livelihoods creation and household food security, therefore efforts need to be strengthened by government, NGO's, the private sector and other key role players to ensure that agricultural production is revitalised in this sector (Ramaila *et al,* 2011).

In Bergville, KwaZulu Natal, there are a number of organisations working with smallholder farmers to improve their access to resources and information, sources of income and their social and economic levels. These organisations include government, NGOs' and civil society organisations. Although the challenges external organisations wish to address are similar, there is limited communication and collaboration between the stakeholders. This could be due to factors such as clashes in programs and timeframes and conflicting interests amongst others. The purpose of this document is to propose the formation of a multi-stakeholder forum in Bergville with the aim to improve stakeholder relations, coordinate programs and actions for more efficient implementation and gain deeper understanding of the various stakeholder roles. The establishment of a stakeholder forum entails initiating two-way dialogue seeking understanding and solutions to issues of mutual concern.

Objectives of the Stakeholder Forum

Create a platform for stakeholders to present their programs and encourage broader involvement.

Understand the expectations, roles and contributions of the different stakeholders in Bergville and identify areas for collaboration

Coordinate the implementation of projects by identifying common areas of interest, possible overlaps between projects and explore how stakeholders can support each other to avoid duplication and conflict of interest.

Share knowledge and experiences in addressing common challenges

Promote ways of accelerating the implementation of actions

The stakeholder forum will not only focus on coordination on projects but will also assess the roles of other key players such as input suppliers, commercial farmers and local businesses with the aim to strengthen relationships between them and other stakeholders such as government

and NGOs by sharing information and identifying areas of mutual benefit. The ultimate goal of the stakeholder farmer is to create partnerships that place the farmer at the centre and increase efficiency of project implementation.

Stakeholders

The stakeholders identified for the forum include the following:

- Local Government: Department of Agriculture and Rural Development (DARD), Department of Rural Development and Land Reform (DRLR), Department of Economic Development and Tourism (DEDT).
- Non-Governmental Organisations (Mahlathini Development Foundation (MDF), Philakahle, Lima, Farmer Support Group (FSG))
- Private businesses (retailers and local business people)
- Commercial farmers
- Input suppliers (TWK, Farm Save, etc.)
- Local Authorities (Chief/induna)

Forum Meetings

The stakeholder forum will be held quarterly, i.e. every three months in order to ensure continuous engagement and allow enough time action plans to be implemented.

Forum Deliverables

The primary deliverable of the forum is an action plan on discussions and agreed actions and updated reports on progress in implementation.

Attachment 2: farmers' day programme

Ezibomvini Farmer's Day

THEME: CONSERVATION AGRICULTURE: SOIL HEALTH AND USE OF REDUCED INPUTS

Date: 02 March 2017

Time: 10h00

Venue: Emmaus Ezibomvini

ITEM	**RESPONSIBILITY**
Opening prayer	Mr. L Dubazane
Welcoming of guests(isqongo)	Mr. Zimba
TALKS	
1. Asset based community driven development	Mrs Nkutha (Philakahle)
2. Cost benefit Analysis No-till vs conventional agriculture	Agriculture economist Dept. of agric
3. Soil health	Dr Charmaine Mchunu Dept of Agric
4. Soil health and soil fertility the Role of CA	Dr Hendrik Smith (Grain SA)
5. Progress in CA SFIP Programme	Ms Erna Kruger (Mahlathini Dev. Foundation)
6. Correct use and handling of chemicals	Mr Ngcobo (Nulandis)
7. Testimonies	Farmer (Ezibomvini) Farmer (Stulwane) Farmer (Eqeleni)
8. CA/ No till programme local Department of Agriculture	Mr Khuboni (Local Extension officer)
9. Local Municipal programmes involving small holder farmers	Mrs Ndaba (Senior LED officer)

9. Field visits to nearby sites	Zikode Zodwa, Dladla Nombono and Hlongwane Phumelele
10. Open session & Remarks from Visiting Farmers	
11. Closing Remarks	Mr Hadede (ward councillor)
12. Closing Prayer	Mr Dubazane
LUNCH	
END THANK YOU	

GUEST LIST EZIBOMVINI FARMERS DAY

GUEST	ORGANIZATION	EMAIL ADDRESS
Mr Ngcobo	Nulandis (chemical suppliers)	chemiseed@futurenet.co.za & neethling@megawifi.co.za
Mrs Ndaba	Okhahlamba Local Municipality	hlengiwe.ndaba@okhahlamba.gov.za
TWK representative	TWK agri boffins (Winterton)	wrmuller@twkagri.com & Winterton@twkagri.com
Farmsave representative	Farm save (Bergville)	Lydia@farmsave.co.za
Mrs Nkutha	Philakahle	Nnyadi.nkutha@gmail.com
Ms Zodwa Mazibuko	Department of Agriculture (Cedara)	Zodwa.mazibuko@kzndard.gov.za
Dr Charmaine Mchunu	Department of Agriculture (Cedara)	Charmaine.mchunu@kzndard.gov.za
Mr Rob	Grain SA (farmers support programme)	iron@futurenet.co.za
Ms Nonhlanhla Mthembu	Farmers Support Group (UKZN)	mthembuno@ukzn.ac.za
Mr Nkosi / Mr Khuboni	Local Department of Agriculture	Zamokwakhe.nkosi@kzndard.gov.za

Attachment 3: Social Compact Agreement.

GRAIN-SA SMALLHOLDER FARMER INNOVATION PROGRAMME

PROGRAMME IMPLEMENTATION AGREEMENT

Entered into and between:

MAHLATHINI DEVELOPMENT FOUNDATION

Represented by:

and

FARMER LEARNING GROUP

In the community of Nokweja

Represented by:

Name of the Programme

The name of this programme is: **Grain-SA Smallholder Farmer Innovation Programme**. This programme is funded by Grain-South Africa.

The Parties to this Programme Implementation Agreement (PIA)

The parties to this PIA are:

Mahlathini Development Foundation as the Programme Implementing Agent and herein referred to as MDF; and

Farmer Learning Group as a collective of participating smallholder farmers in the said community of Nokweja, and herein referred to as FLG.

PIA and Acceptance

MDF hereby confirms its commitment to support FLG as per terms and conditions contained in this PIA.

FLG hereby confirms its acceptance in participation in this programme as per terms and conditions contained in this PIA.

The duration of the programme shall be aligned to contractual dates of the Grain-SA as the programme funder.

In the event of any conflicts with regard to the interpretation and understanding of this PIA, the provisions contained in Section 7 of this document shall prevail.

Background

MDF has pioneered a model for value chain development and support at a local level for rural smallholder agricultural commodities with few partners in KwaZulu-Natal and the Eastern Cape provinces. The main commodities have been maize, and beans, poultry production (broilers and layers), vegetables and potatoes.

The model is based on a farmer innovation approach linked to Village Saving and Loan Associations (VSLAs) popular referred to as village level savings and credit groups, where smallholder farmers in previously disadvantaged communities organise themselves into commodity interest groups.

These interest groups work together within the whole value chain from input supply, through production to marketing to learn together and create local economic opportunities within the system.

These interest groups form bulk buying groups, set up local supply systems and local microenterprises, participate in farmer level learning and experimentation and forge local market linkages. They are supported to forge relationships with agribusiness and institutional partners and receive support and training in small business development.

Over the last 5 years, this model has proven extremely successful in stimulating local production and marketing and provides coherent support to smallholders to develop their farming enterprises. Linking the smallholder into the wider economy and ensuring ongoing profitability under their difficult conditions can be tackled as a challenge with appropriate industry and government support.

Purpose of the Programme

The main purpose of this programme is to optimise Conservation Agriculture (CA) system for non and semi-commercial smallholder farmers.

In other words, this programme aims to empower smallholder farmers to participate actively in local value chains, transform their production into profitable enterprises and consequently maximise their yields and their incomes.

Main Role of Mahlathini Development Foundation

MDF will facilitate the establishment of Farmer Learning Groups for the purpose of experimentation in conservation agriculture so that smallholder farmers can learn together and work as teams to increase their yields and income streams. MDF therefore commits to;

Promote the establishment of Farmer Learning Groups as the main community-based institution that will implement conservation agriculture in a community;

Promote crop diversification and introduction of fodder and other food crops for food security and income generation;

Promote innovation platforms open up options for local economic activities such as growing and milling yellow maize for animal feed;

Facilitate innovation platforms build relationships with agribusiness stakeholders including input suppliers, trainers, milling companies, marketing operations and buyers of produce;

Facilitate the establishment of Village Saving and Loan Associations (VSLAs) to support participating smallholder farmers to create a savings and credit facility that members will use it to procure inputs through bulk buying mechanisms; hire or buy no till implements and planters;

Train and supervise chairmen, secretaries and treasurers of VSLAs to operate and efficient VSLA that is able to provide most appropriate financial products and services its members, mainly savings and short-term credit;

Promote the establishment of a farmer-led support centre in a community;

Provide capacity building workshops, supervision session and operational guidelines to a well-functioning FLG to establish and operate a farmer-led support centre; and

Advise the FLG of potential programme supporters and potential programme donors. MDF shall do its best to invite relevant public and private sector stakeholders to participate in the programme.

Main Role of Farmer Learning Group

Farmer Learning Groups are established by local producers that are currently involved in food production whether for subsistence or commercial objectives. A FLG shall agree to participate in this programme if as a collective farmers are willing to;

Treat and maintain this programme as independent from all other development projects and programmes in the community,

Self-select members of a FLG from practising or active local small producers;

Work and learn together as a collective;

Establish, adopt and sign rules of engagement that are aligned to this PIA; which includes qualifications for participation, acceptance and termination of participants, and beneficiation rules;

Develop a database or list of participating smallholder farmers and provide it to MDF;

Elect an executive committee of Farmer Learning Group with a chairman, secretary and a treasurer;

Appoint a chairman as primary contact person and secretary as a secondary contact person of a FLG;

Operate a Village Saving and Loan Association (VSLA) which will be established to mobilise a loan fund that will be used to finance individual member farming operations;

Collect annual and/or joining fees from members of FLG to procure things like stationary and to pay for operating costs;

Encourage members of FLG to buy production inputs at the most appropriate time for a planting season;

Participate fully in regular programme meetings and programme activities such as training workshops, experimentation activities, harvesting, marketing and selling of produce, recording of lessons, etc.

Participate in all research activities and knowledge sharing activities as expected by the programme funder and MDF; and;

Take a lead in the establishment and operation of smallholder farmer-led support centre.

Dispute Resolution

In the event of a dispute arising between the parties in respect of any cause whatsoever, the following may happen;

A meeting will be called to identify and declare a dispute and to indentify the causes of a dispute;

A meeting will be called resolve a dispute; and

An independent arbitrator may be invited if the two parties fail to resolve the dispute on their own.

Confidentiality

The parties undertake, both during the existence of and after the end/and or termination of this PIA, not to disclose in any manner whatsoever any information gathered or obtained by virtue of the services performed in terms of this PIA, except in fulfilment of a party's obligations under this PIA.

All information gathered, obtained or known by virtue of involvement in services performed under this PIA shall be deemed to be of commercial value and the parties and persons under their control shall exercise due care and diligence in managing such information.

The parties accept that the information may be disclosed if a party is obliged to do so by operation of law.

Termination

This PIA shall remain valid and in full force and effect for the duration of the project, unless it has been terminated in terms of the provisions contained in this document.

General

This PIA constitutes the whole PIA between the parties and any amendment, addition or

alteration to the provisions hereof shall only be of force and effect if such amendment, addition or alteration has been reduced to writing and signed by the parties.

No contract of employment

Nothing in this PIA must be construed as constituting a contract of employment offered by MDF to participants in a FLG who by appending their signatures acknowledge that no such relationship exists.

Signature

The following persons, hereunder, sign this Programme Implementation Agreement on behalf of the members (participants) of the FLG.

Dated at _____ on this _____ day of _____ 20____

_____ _____
_____ _____
_____ _____

In the presence of the witnesses stated hereunder.

_____ _____
_____ _____