APPENDIX 2: BERGVILLE ANNUAL REPORT

Conservation Agriculture Farmer Innovation Programme (CA FIP) for smallholders, Grain SA July 2015 to September 2016

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

Compiled by:

Erna Kruger

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Project implemented by:

Mahlathini Development Foundation

Promoting collaborative, pro-poor agricultural innovation.

mahlathini development foundation
Cell: (+27)82 873 2289
www.mahlathini.org
Email: info@mahlathini.org
erna@mahlathiniorganics.co.za
Reg No: 930051028

Contact: Erna Kruger (Founder and Coordinator)

Address: 72 Tatham Road, Prestbury, Pietermaritzburg, 3201, KZN

Email: erna@mahlathiniorganics.co.za, info@mahlathini.org

Cell: 0828732289

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SUMMARY

The 3rd cropping season of the Grain SA SFIP in Bergville saw the continuation of the horizontal scaling process for the awareness raising and implementation of CA in smallholder communities. Three new villages were brought on board and along with expansion in the existing villages a total of 56 new farmer experimentation participants were included.

This brings the total number of smallholder farmers who have undertaken CA experiments and implementation to 143. A CA awareness raising process was also initiated in Nkandla, working with members of a KZNDAE maize cooperative in Mpotholo, with 6 participants and in collaboration with the Siyazisiza Trust in Vulamhlamvu, with a group of 22 women.

Strategies to accommodate for the pervasive drought included planting of drought tolerant summer cover crops such as millet, sunhemp, cowpeas, sunflower and Dolichos and planting of late season beans. Participants waited for rain to start planting their maize and as a consequence some did not plant at all (around 31% of participants). Cattle invasions into the fields that were planted were extremely common this year as they were not sent to mountain pastures due to a lack of grazing. Of those who planted around 74% managed to harvest.

This season a subsidy was introduced for the 2nd and 3rd year participants. They were expected to pay around 30% of the total costs of their trial inputs package costs. This amounted to R127 per participant for the 400m^2 trial plots and R320 for the 1000m^2 trial plots. 68% of the participants who were eligible for payment paid their subsidies (48 participants). Some participants felt they could not afford to pay and withdrew their participation and others did not want to take a chance due to the drought. Of those who paid, 88% planted their trials (41 participants). In the review focus group discussions held for each village, participants voiced their appreciation for this subsidy and their commitment to pay these subsidies in future seasons.

Yields for maize and beans have been about 56% of that obtained in the previous seasons. Although cowpeas grew better than beans, yields have been even lower (35%) than before. Generally, (for around 85% of the participants) yields for the CA plots have been consistently higher than the control plots, where the participants have practised their 'normal' methods of farming. For the 2015-2016 season, despite the drought, average maize yields for the CA plots have again been higher than the average yields for the control plots. This is considered an indication of the increase in soil health for the participants over time as well as the increased soil organic matter and water holding capacity under the CA cropping methods.

Soil health tests have indicated a higher availability of nutrients and microbial activity in the soil as compared with veld benchmark samples. The veld sample indicates the natural 'baseline' of microbial activity and soil fertility in uncultivated veld and generally would be expected to be higher than a sample from a cropping field. These tests have also provided a clear indication for the need for both intercropping or mixed cropping (with a grain and legume mixture) as well as planting of cover crop mixes. Intercropping, (with beans or cowpeas) provides for much higher N availability for the crops, but does not provide for substantial build-up of the organic matter and humus in the soil in the short term. This only starts to happen once multiple species cover crops, a minimum of 3-5 (such as vetch, fodder oats and fodder radish) are included in the rotation as well.

For the purposes of deriving fertilizer recommendations, soil samples have been taken for 119 participants from 10 villages across the Bergville area between 2013-2015. An analysis was done to check the accuracy of a generic fertilizer recommendation for the area that has been calculated and used. It was found that the generic recommendation of 40kg/ha P and 0kg/ha K holds true across the villages and the years. However, a higher generic lime recommendation of 5t/ha as opposed to 1t/ha would need to be made. Overall it would make more sense to make a generic recommendation on village level, that is benchmarked on a yearly basis.

The building of innovation platforms on strong and active local farmer groups has continued. Locally managed savings and credit groups have been used for this purpose, saving specifically for their agricultural inputs, now exist in Emmaus, Stulwane and Ezibomvini and are to be set up for this season in Ngoba, Vimbukhalo and

Emangweni. Bulk buying groups have not yet taken off, given the tendency to work within specific and different projects. Participants are getting used to the idea of paying a subsidised amount for their trial inputs. During this first season only 62% of those eligible paid their subsidies. This was partly due to the drought, partly due to paying also for other maize production projects where they had already contributed R1000 each and partly due to lack of finances. During the yearly review processes participants indicated their appreciation for this subsidy and also their willingness to continue with these in the future.

Individual interviews have shown a marked contribution to livelihood improvement and food security contributed from the harvests of the CA trial plots. The contribution of both maize and beans in the diet as well as fodder for livestock has made a marked difference in participants' ability for food provisioning for their families. Support has also been provided to neighbours in need due to the drought.

Groups are ready to engage in micro enterprise activities around milling and supplying of input packs and tools. In each village the group made a decision as to whether this would be a group or individual process.

The open days and farmers' days attended and hosted, provided substantial sharing and learning for the learning group members and further promoted awareness in the broader community. In each village more participants have been brought on board and another 5 new areas are to be included in the CA trial process in the coming season. Stakeholders from the Government and NGO sectors have been engaged and further collaboration with LandCare, KZNDAE, specific LM's, and the NGOs – Siyazisiza Trust, ACAT, The Institute of Natural Resources (INR), Lima Rural Development Foundation and the Farmer Support Group is envisaged in the coming seasons.

Monitoring processes have again included the in-depth monitoring of each CA trial using the CA indicators and scores and the VSA (Visual Soil Assessment) monitoring process. A decision has been taken to base the subsidies/incentive scheme on a different framework as these indicators are sensitive to weather conditions. This skews the scores and outcomes and does not fully take into account the individual effort and social organisation that is also crucial to this process. A new framework will be designed going into the future. These indicators are however still very useful for monitoring purposes and will continue to be used for individual trial monitoring purposes.

KEY ACTIVITIES

The table in Appendix 1 outlines the key activities and deliverables planned for and implemented, with associated budgets, during the period of July 2015-September 2016.

Progress

The provincial wide drought has seriously hampered planting and production in trial plots. Many farmers have not planted maize (in their control plots) as a consequence, but the trials have continued. To accommodate for the dry conditions a summer cover crop mix of drought tolerant crops has been introduced (millet, sunnhemp, sunflower, Dolichos, cowpeas) into a crop rotation experiment to test the survival of these compared to the maize and beans planted by most smallholders.

The table below outlines activities related to objectives and key indicators for the period of July 2015 - September 2016).

Table 1: Summary of progress July 2015 to September 2016 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, English version. 2 small print runs (100) - Translation of all 4 chapters into isiZulu. – 1 print run (200) - Soil Symposium presentation in Stellenbosch - CA chapter in CABI book - Presentation at No till open day in Hilton Presentation at kwaNalu and KZNDAE farmers days -Paper for LandCare conference	-100%. Further printing and distribution -90%. Finalise translation and print -90%. Further information sharing options through collaboration with PID process (Kit- Netherlands), Lima RDF- CA demonstrations at farmers' days, articles and conferences
	Exploration of PES mode	- PES chapter for CA manual – draft1 - Exploration of funding options - Farmer level monitoring forms produced, translated and facilitated at farmer level	-95%. Continuation of framework design -100%. Ongoing- proposals to USAID and WRC -50%. Ongoing- still needs more fine tuning
	Final report	*Consolidation of experimental outcomes and planning* for 1st, 2nd and 3rd level experiments for future interventions, including the design of a PES model for implementation	-100%, support from interns, including soil fertility results, soil biological indicators, and socio economic indicators.
2. Increase the sustainability and efficiency of CA systems and 3: To Use the CA systems in Bgvl to produce and scale out sustainable farming system	*Farmer-centred Innovation Systems Research : 1st level experimentation:* Trying out the basic CA system	47 farmers across 7 areas – use their own practise as a control – size: 400m^2 experiment, 400m^2 control	100%. 56 farmers across 8 villages. Basic CA design- intercropping with maize beans and cowpeas on a 400m^2 plot, with a control plot managed entirely by the participant. Adaptation trials included introducing crop rotation that includes winter and summer cover crops.

scenarios that include livelihood and environmental criteria of assessment	*Farmer-centred Innovation Systems Research: 2nd level experimentation:* existing CA farmers focus on experiments that include advanced CA options	- 50 farmers across 6 villages use their own practise as a control – size 400m^2 exp, 1000m^2 control). Payment of 33% towards inputs by farmers themselves	100%.71 farmers across 5 villages Basic CA design- intercropping with maize beans and cowpeas on a 400m^2 plot, with a control plot managed entirely by the participant. Adaptation trials included introducing crop rotation that includes winter and summer cover crops.
	Farmer-centred Innovation Systems Research: 3nd level experimentation: existing/ experienced CA farmers focus on experiments that will cement their practice into the future and using the CA process at scale in their fields.	25 farmers across 2 villages use their own practise as a control – size 1000m^2 exp, 1000m^2 control). - 3 villages, 5 farmers. Payment of 33% towards inputs by farmers themselves	100% 16 Farmers across 2 villages Adaptation trials included introducing crop rotation that includes winter and summer cover crops.
	Incentive and market based mechanisms	Economic scenario development and analysis that includes food security and Ecosystem services criteria- augmented by scientific research to ascertain ecosystem service components linked to CA.	60%; Ecosystems criteria being developed, baseline livelihoods research done. Still to continue with food security research to include more economic criteria and garner academic support for PES systems research
	Further development of M&E system	- VSA used actively for all farmers - M&E forms redesigned and used	100%. CA and VSA monitoring scores for all participants
4: Strengthen and use different innovation platforms	Facilitation of innovation platforms	- Learning group meetings and training workshops - Farmers days - Conferences and symposiums	-100%. Hosting 2 farmers' days including external stakeholders, attendance of 3 farmer's days - 2 symposiums, 1 conference
	CA working group, and reference group	-Attended and presented in Feb and Sept 2016	100%

RESULTS ACHIEVED TO DATE

This report builds on information provided in the 6 monthly report, which is not repeated here.

Summary of farmer participation and trials planted

The table below gives the final summaries for the number of farmer innovators who were active throughout the season.

Table 2: Summary of farmer innovation numbers and areas planted per village in this CA process; Bergville 2013-2016 (3 years)

Exp level	Village	Farmer (2013-2015)	Local facilitators	Comments; including planters used
1st, 2nd, 3rd	Stulwane	7, 12, 3	Mrs Makethi Dladla, Mr Kulekani Dladla	Group has worked well together. Savings and bulk buying set up Animal drawn planter used extensively, as were MBLI planters and hand hoes Cover crops and beans planted in 2015. Group less coherent due to internal community conflict. 14 Farmers paid the subsidies
1st, 2nd, 3rd	Emmaus - Eqeleni	9,8,7	Mrs Simephi Hlatshwayo, Ms Busisiwe Mvelase,	Group worked well together. Savings groups and bulk buying set up. Animal drawn planter used extensively, as were MBLI planters and hand hoes. 7 Farmers only paid the subsidies
1st	Okhombe	10(2014)		Oxen drawn planter, hand hoes and MBLI planters were used. Here, members of two youth groups were included as participants. Planting was at a homestead as well as field cropping level. No activity in 2015. Erosion, infertile soils and theft were constraints
1st, 2nd	Ezibomvini	10,11	Sindy Zikode, Phumelele Hlongwane	Group has worked well and expanded considerably. Hand planters and hand hoes only. People there have not used animal drawn planters before. Local facilitators both very motivated and supportive of farmers. Cover crops planted. 8 Farmers paid the subsidies
1st	Magangangozi	10 (2014)	Mrs Mbhele	2 people used the oxen drawn planter. Also plots done with hand hoes and MBLI planters. Local facilitator attended Farming for the Future training course in CA. Group inactive in 2015. Constraints included drought and absence of a facilitator
1st	Mhlwazini	6,13	Mantombi Zimba	Oxen drawn planter was brought from Eqeleni to be used (2014))- Most of the 9 participants used this planter. Participants bought their own seed. In 2015 participants started the process more formally and more joined. All plots were hand tilled with hoes. All paid subsidies
1st	Vimbukhalo	9,4		Planted with hand hoes – seed and fertilizer bought by individuals in 2014. In 2015 only 3 farmers planted due to drought. Subsidies were not paid.
1st	Emoyeni	5 (2014)		Planted using hand hoes. Follow up on weeding was not done on time. DISCONTINUED
2nd,3rd	Potshini	1, 1		One farmer working with Madondo in planting beans and cover crops in 2015.

1st	Emangweni	6 (2015)		An expansion area in Loskop, started in 2015, Women work on fields close to the river. Planted using hand hoes, Intercropping trials. Issues with drought and weeds.
1st	Ndunwane	15(92015)		Expansion area from Mhlwazini, started in 2015. All used hand hoes and did 1st year intercropping trials.
1st	Ngoba	6 (2015)		Expansion area with DoA. 6 Women planted intercropping trials but switched to cover crops due to drought and lack of germination.
	12 (2013=3, 2014 =7, 2015 =3)	**143 (2013 =16, 2014 =71, 2015 =56)**		
1st	Nkandla	12		One group of 6 larger scale smallholder in Mpotolo who use the animal drawn planter as a tractor drawn implement to plant in partnership with PID and a community garden group in Vulmahlamvu linked to the Siyazisiza Trust.

Due to the drought a number of farmers opted not to plant or did not continue after their first attempt at planting was thwarted. In addition, a number of farmers withdrew due to not being able to or willing to pay the newly introduced subsidy costs for the trial inputs.

The table below summarises the figures for this season.

Table 3: Summary of participant number for Bergville for 2015-2016

Category	No of farmers	Percentage of total
Participant farmers registered for trials in 2015	156	
Farmers with intention to plant for 2015 (for whom inputs were ordered)	143	91% of those who registered
Participants who actually planted	99	69% of those for whom inputs were ordered
Participants eligible for subsidies (years 2,3)	77	
Participants who paid subsidies	48	62% of those eligible
Participants who paid subsidies and planted	41	85% of those who paid
New participants for 2015	56	58% of those who planted.
Participants who managed to harvest	73	74% of those who planted managed to harvest

From the table it can be seen that a large number of participants were to be part of this CA process for this season. Some did not engage in the process due to drought and subsidy payments, some bought the inputs, but then did not plant due to the drought and some planted but did not have any yields. In the end, around 74% of the participants who planted managed to harvest something, which is around 52% of the total group.

Table 5: Performance dashboard; August 2016

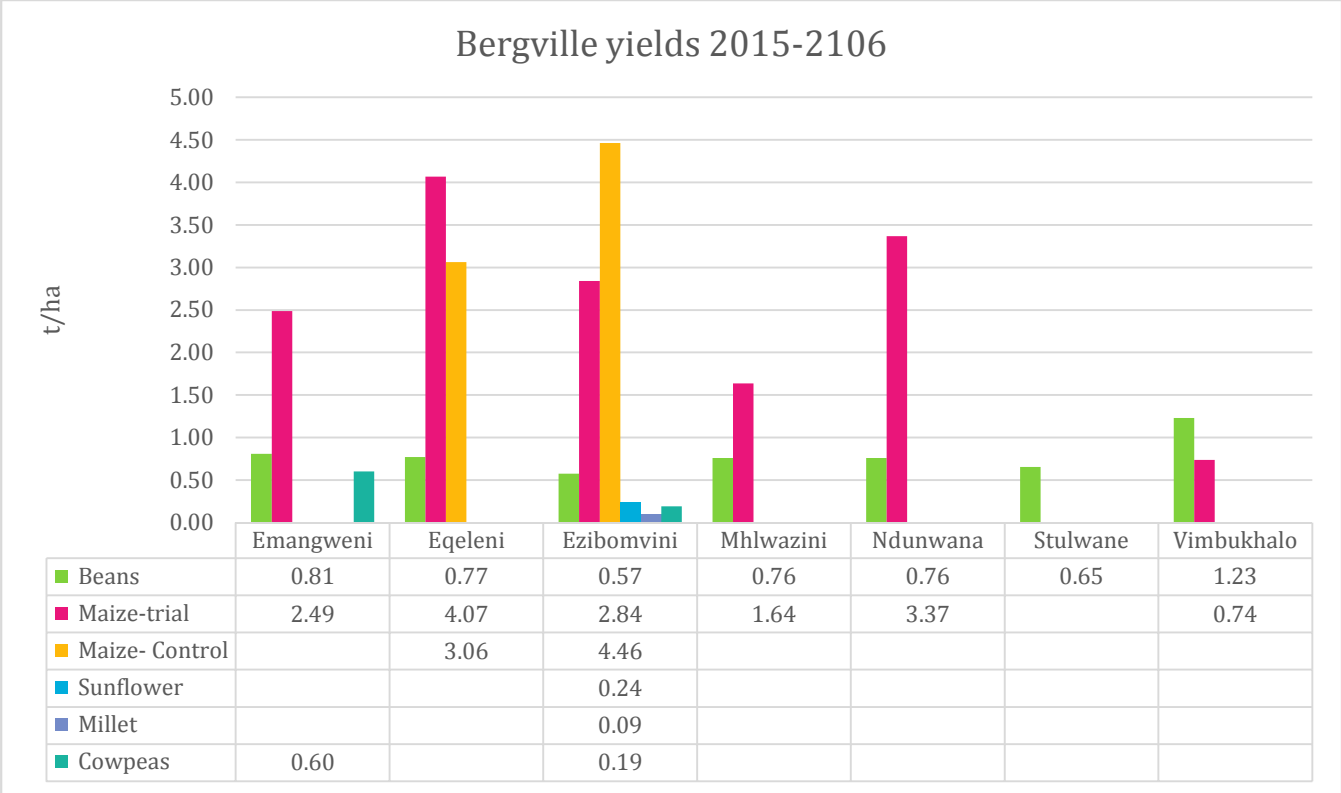
Outputs	Proposed (March 2015)	Actual (August 2016)
Number of villages active	13	11
No of 1st level farmer experiments	97	56
No of 2nd level farmer experiments	37	71
No of 3rd level experiments	28	16
No of local facilitators	5	4
No of direct beneficiaries	166	99

Participatory monitoring and evaluation process (farmer level)	Yes	Yes
CA manual (English and Zulu)	Yes	CA manual English – yes CA manual Zulu- yes

Nkandla was introduced as a new area and those participants have not been included in these tables.

Results for the 2015-2016 season

The province wide drought hampered planting and production in trial plots, but not as much as expected. Farmers who took a chance and planted maize late in the season did receive reasonable harvests. Quite a number of farmers however also had zero yields. The variability in growth and yields has been extremely high. The introduction of more drought tolerant summer cover crop and winter cover crop mixes were well received. These cover crops generally grew better than the maize and beans. Harvesting of seed has been hampered by extreme grazing pressures from livestock let into the fields.



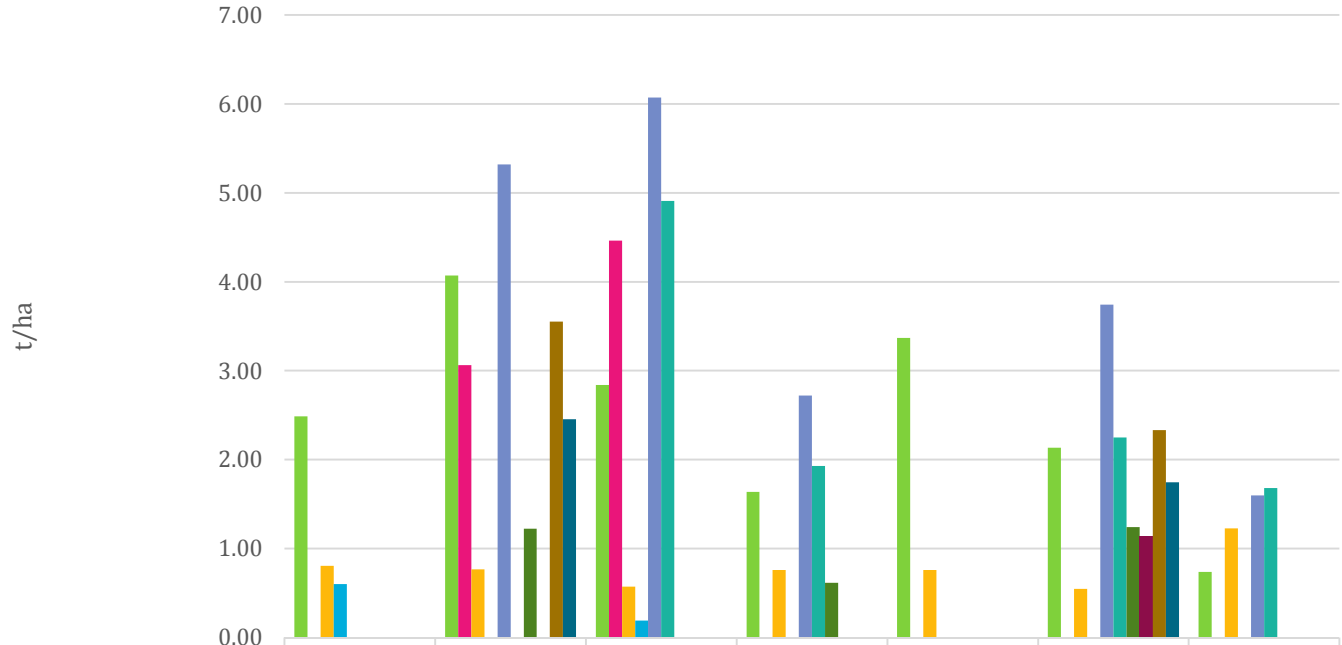
	Emangweni	Eqeleni	Ezibomvini	Mhlwazini	Ndunwana	Stulwane	Vimbukhalo
Beans	0.81	0.77	0.57	0.76	0.76	0.65	1.23
Maize-trial	2.49	4.07	2.84	1.64	3.37		0.74
Maize- Control		3.06	4.46				
Sunflower			0.24				
Millet			0.09				
Cowpeas	0.60		0.19				

Figure 1: Average yields for the CA trials in Bergville villages 2015-2106 season

The average yields obtained for the CA trials in a number of villages in Bergville are shown in the figure below. Yields for the CA trial plots are corrected for the area planted to maize in the intercropped plots (60% of the area of the plot). The same is done for beans (40% of the area of the plot). LER's (Land equivalent ratios) have generally not been calculated, as very few participants have both intercropped and single block plantings of their maize and beans.

The table indicates the increased yields of maize in the trials as compared to the control plots in the three areas (Eqeleni, Ezibomvini and Emangweni) where control plots were planted. Beans were planted in all 7 villages and some yields were obtained, albeit on the low side ranging from 0,57-1,23t/ha.

A summary table of all yields in Bergville for the seasons 2013-2015 is shown below



	Emangweni	Eqeleni	Ezibomvini	Mhlwazini	Ndunwana	Stulwane	Vimbukhalo
Maize-trial (2015)	2.49	4.07	2.84	1.64	3.37	2.13	0.74
Maize- Control (2015)		3.06	4.46				
Beans (2015	0.81	0.77	0.57	0.76	0.76	0.55	1.23
Cowpeas (2015)	0.60		0.19				
Maize-trial (2014)		5.32	6.07	2.72		3.74	1.60
Maize- Control (2014)			4.91	1.93		2.25	1.68
Beans (2014)		1.22		0.62		1.24	
Cowpeas (2014)						1.14	
Maize trial(2013)		3.55				2.33	
Maize-Control (2013)		2.46				1.75	

Figure 2: Average yields of trial and control plots in Bergville: 2013-2015

Yield data is available for 95 participants across 7 villages. Generally yields between villages are quite variable, but there are trends within the villages in terms of yields.

The following points can be made

1. Three years of yield data are available for Eqeleni and Stulwane:
    a. Maize control plot yields are lower than trial yields in both areas for all three seasons
    b. Maize trial yields increased from 2013-2104 in both areas, and then decreased a little again in 2015 – due to drought conditions.
    c. Bean yields in Eqeleni and Stulwane decreased by roughly 50% between 2014 and 2015 seasons.
2. Two years of yield data are available for Ezibomvini, Vimbukhalo and Mhlwazini
    a. Maize control plot yields are lower than the trial yields for both seasons.
    b. Maize trial yields for 2015 are lower than those for 2014 due to the drought conditions.
3. One year of yield data is available for Emangweni and Ndunwana, as these villages only came on board in this last season. The maize yields for these villages have been surprisingly good, given the difficult season and their first year of operation. Bean yields however have been low – similar to other villages. No control plots were planted in these villages.

A closer look at yields for one area, taking Stulwane as an example, shows the following

Crop yield (t/ha)	Stulwane 2013-2015	Bergville average 2015 (all participant villages)
Maize	3,4	2,5
Beans	1,1	0,79
Cowpeas	1,1	0,38

This summary indicates the lower average yields obtained in the 2015-2016 season when compared to a 3 year average (which includes this dry season) for maize, beans and cowpeas.

A further example of maize yields for seasons 2013-2015 in Eqeleni is shown in the small table below.

Maize yields (t/ha) Eqeleni	2013/14	2014/15	2015/16
CA plots	3,26	5,32	4,12
Control plots	3,39	5,4	3,05
Overall average	3,28	4,86	4
Max yields CA plots	10,3	8,4	7,37
Max yields control plots	5,65	9,59	3,05

Overall, of the 20 participants for whom yield data have been obtained in Eqeleni for the last three seasons the control yields for only 5 of these participants have been higher than their trials, meaning that 80 % of participants have enjoyed higher yields in their CA plots when compared to their conventional tillage plots.

In summary, yields for CA trial plots have been on average slightly lower than for the control plots, in this village. This last season, despite the drought conditions has been the first season where average yields for the CA trial plots have been higher than the average yield of control plots. This is seen as an indication of the increased soil health and water holding capacity built up through CA over time, improving the water use efficiency of the system. This result is peculiar to Eqeleni and perhaps also to Ezibomvini. For most of the other villages where farmers have participated, their control plot yields have been consistently lower than their trial plots.

Control plots are plots where farmers use their 'normal' farming practices - in terms of tillage and fertility amendments. For most of the participants this means ploughing their fields and addition of very low amounts of fertilizer. There are the few who have taken on CA as their 'normal' method and use this also in their control plots. Eqeleni, Stulwane and Ezibomvini are the three villages where this has been the case: As the fertility amendments and weeding practices here are different, these are still considered control plots. Yields in these "CA control" plots have been higher than those under conventional tillage. In future a better differentiation between control and trial plots will need to be made to avoid a potential misrepresentation of the results.

The maximum yields for the CA trial plots have remained substantially higher than the maximum yield of the control plots. This is borne out in the figure below which outlines control and trial plot yields for Eqeleni over three seasons

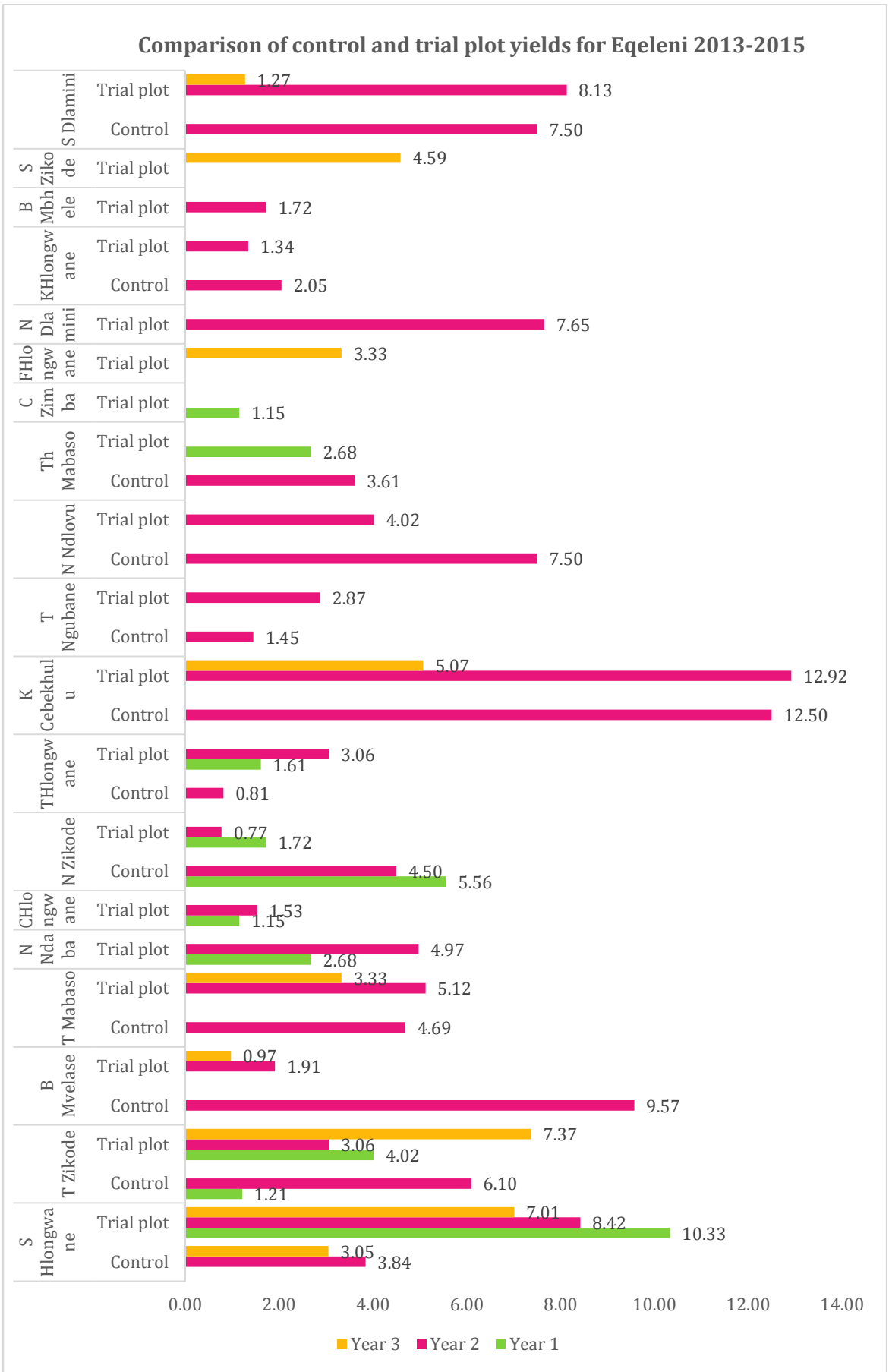


Figure 3: Maize yields for trial and control plots in Eqeleni for 2013-2015

Soil fertility results; fertilizer recommendations

Fertilizers are expensive and difficult to access for most smallholder farmers. Knowledge about different types of fertilizers and even the standard nutrients provided through fertilization (N, P, K) is limited. As a consequence, smallholders tend to use fertilizers that they have seen others use or what is recommended in the shop, rather than what is required on their fields. In addition, they buy what they feel they can afford in terms of quantity, rather than what may be required. This has meant that fertilizer application, has often not been as effective as desired and potentially very inefficient.

In an attempt to deal with this, the practice of micro-dosing of fertilizer has been introduced, which implies placement of small quantities of fertilizer close to the seed, rather than spreading or banding. This reduces the overall amount of fertilizer required.

In addition, a yearly generic recommendation has been put together for each area (e.g. Bergville), meaning that participants all use the same recommendation and fertilizers. This has helped farmers to be able to remember which fertilizers they are using, which quantities are required and what the specific fertilizers are for.

An analysis was done to check whether these recommendations are in fact justifiable or not. In the Bergville area 119 soil samples have been taken across 10 villages over the last three years. See the summary of samples in the table below.

Table 7: Summary of soil samples taken in Bergville from 2013-2015.

Area	Village	Year	Total no. of samples	No. of samples which required:		
				P(kg/ha)	K (kg/ha)	Lime(t/ha)
	Emangweni	2015	11	11	1	7
	Emmaus	2013	3	3	-	-
		2014	13	13	-	8
	Ezibombini	2014	9	9	-	3
	Magangangosi	2014	10	10	2	8
Bergville	Mhlwazini	2015	14	13	-	9
	Ndanwana	2015	14	14	1	12
	Okhombe	2014	11	11	3	10
		2015	6	6	1	5
	Potshini	2013	3	3	1	2
	Stulwane	2013	5	5	1	4
		2014	14	14	4	12
	Vimbukhalo	2015	7	7	1	5

From the above table it can be seen that P is the most deficient element in the soils as all samples have a P requirement. Only 15 of the 119 samples require K and 85 of 119 samples require lime.

On the strength of a general analysis of average requirements form the samples the following generic fertilizer recommendation has been used:

> 250kg/ha MAP (equivalent to 40kg/ha P), 150kg/ha LAN (equivalent to 60kg/ha N) and 1t/ha of lime. K was not included in the generic recommendation.

A more detailed statistical analysis was done to see if these generic recommendations hold true. A category was also developed for outliers- samples that fall far below or above the generic recommendation and where fertilizer applications based on actual soil samples would be required.

From this analysis the following points can be made:

For Phosphorous (P): The generic recommendation of 40kg/ha would mean that 89% of the samples would receive the correct amount of P or an amount of P that could guarantee 80% of the potential harvest for maize and dry bean production. The outlier samples have also been identified to ensure individual recommendations for these participants.

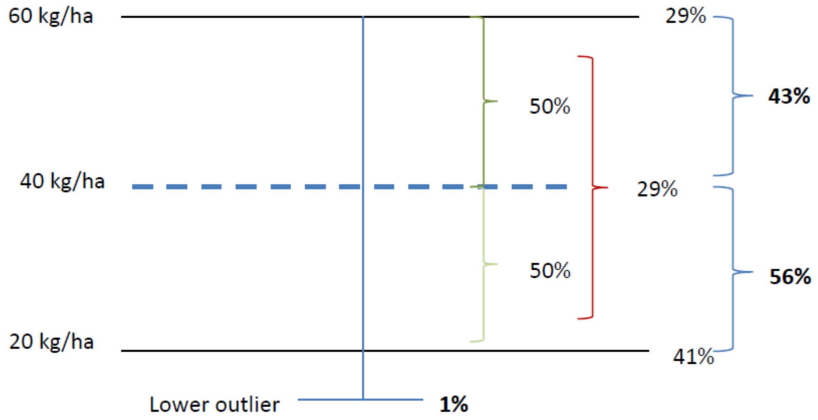


Figure 4: Derivation of a generic fertilizer recommendation for P application for dry beans and maize in the Bergville area

For Potassium (K); In the Bergville area, 88% of the samples have a K requirement of 0kg/ha, while the remaining 12% of the samples have a K requirement of between 10kg/ha and 140kg/ha. See the figure below. Following a generic recommendation of 0kg/ha, even for the samples with a K requirement between 10kg/ha to 140kg/ha, provides for a relative yield of 94%, as long as N and P are provided in the required amounts.

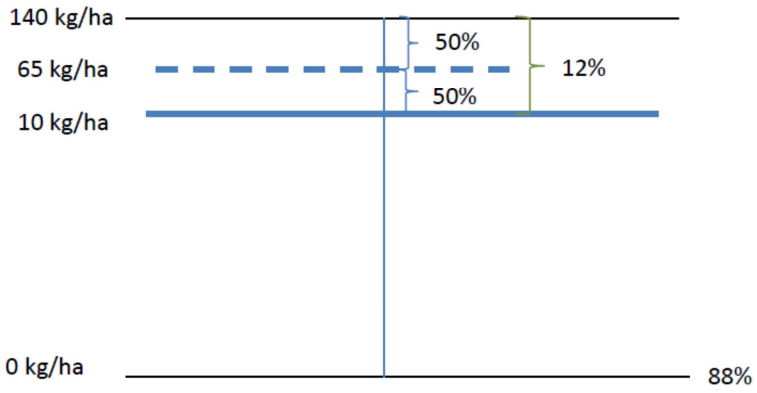


Figure 5: Derivation of a generic fertilizer recommendation for K application for dry beans and maize in the Bergville area

For lime; In the Bergville area, 29% of the samples have a lime requirement of 0t/ha, while 71% of the samples have a lime requirement which lies between 1t/ha to 75 t/ha. When excluding the soil samples with a lime requirement of 0t/ha, the mean lime requirement is 7 t/ha and the maximum lime requirement is 75 t/ha. Since, over 60% of the samples have a lime requirement of between 0 t/ha and 7 t/ha, the generic fertilizer recommendation for lime has been be set at 5 t/ha. According to the soil sample recommendation report from Cedara, not applying lime when P and K recommendations are followed does not significantly affect the relative yield for soils with a pH above 4.5. Specific lime recommendations need to be followed for those participants with a soil pH lower than 4.5

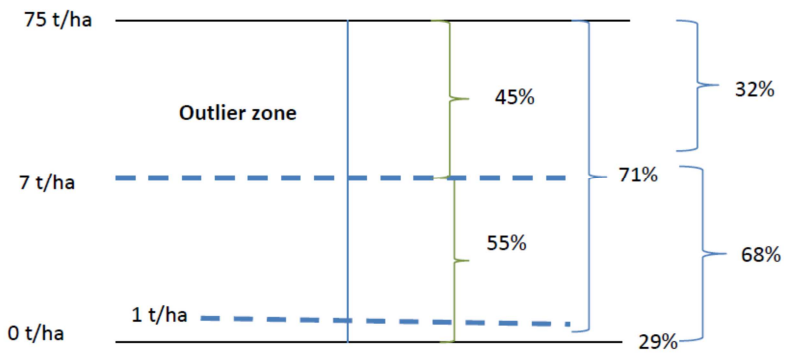


Figure 6: Derivation of a generic fertilizer recommendation for lime application for dry beans and maize in the Bergville area

We then considered the question of whether there was variability in this generic recommendation across villages in the same area. It is possible that soils vary between villages and that the general practices for soil fertility enhancement also vary.

The table below shows the results of the generic fertilizer recommendation analysis for P across the 10 villages in Bergville

Table 8: Generic P requirements for different villages in Bergville

Area	Village Name	Sample distribution in terms of P requirement									
		Lower outlier (b)	X (20kg/ha)	i (%)	l (%)	u (%)	Y (%)	Upper outlier (a)	Lower boundary	Upper boundary	GR (kg/ha)
BERGVILLE	EMMAUS	3	56	28	56	44	13	0	72	25	20
	EZIMBOVINI	0	0	22	25	75	78	0	5	95	60
	MHLWAZINI	5	42	29	75	25	24	0	64	31	20
	MAGANGANGOSI	0	45	38	43	57	20	0	61	38	20
	NDANWANE	0	57	18	40	60	25	0	64	36	20
	OKHOMBE	0	21	21	29	71	58	0	27	73	60
	POTSHINI	0	0	67	25	75	33	0	17	83	60
	STULWANE	0	53	34	54	46	13	0	71	29	20
	VIMBUKHALO	0	38	38	75	25	24	0	66	33	20
	OTHERS	0	16	28	20	80	56	0	22	78	60

Variation in the P requirement between the villages does not seem to be associated with spatial arrangements or setting of the villages but is related more to the history of the land use within individual villages or households. What this shows is that there is some variability across the villages, although the overall generic recommendation would remain 40kg/ha.

A similar situation can be seen with the lime recommendations across villages in the Bergville area. See the table below

Table 9: Derivation of lime generic recommendation for Bergville villages

Area	Name of village	% of samples with lime of 0t/ha	Lime min (t/ha)	Lime mean (t/ha)	Lime max (t/ha)	% of samples with lime between min and mean	% of samples in the outlier zone	GR (t/ha)
			Excluding samples with lime requirement of 0t/ha					
Bergville	Emangweni	36	1	3	9	43	21	0
	Emmaus	41	1	6	17	34	25	6
	Ezibomvini	76	1	1	2	12	12	0
	Magangangozi	20	1	5	15	50	30	0
	Mhlwazini	25	1	5	12	61	14	5
	Ndunwana	33	1	8	17	52	15	8
	Okhombe	12	1	8	17	51	37	8
	Potshini	50	1	8	15	17	33	8
	Stulwane	18	2	11	75	53	29	11
	Vimbukhalo	50	2	4	10	29	21	4

Here however there is a more distinct difference between villages, which most likely has to do with whether there have been liming programmes in those areas in the past. It is suggested that a mean lime recommendation should be calculated and used for each village, rather than using a generic recommendation for the area.

We also considered the question of whether the same generic recommendation can be applied from year to year. This was to check whether the samples of new participants starting in 2013, 2014 and 2015 respectively could all fall within the same generic recommendation. This was checked as it is becoming evident more generally that soil fertility analysis is sensitive to the time of year samples are taken and the environmental conditions at that time. It means that a sample taken from the same field under the same cropping conditions in different years could have different results.

Again there was some variability across years, specifically for the P and lime recommendations and in fact this variability was higher than the variability across villages.

Overall it would still be possible to use the generic recommendations set for the area, although it may make more sense to set the recommendations on a village level and to benchmark these recommendations on a yearly basis.

Bergville - Soil health scores.

New laboratory based tools are available for assessing soil health. One of those tools derived in the USA, called the Haney test, has now been introduced through a few laboratories in South Africa. The soil health tool is an integrated approach to soil testing using chemical and biological soil test data, designed to mimic nature's approach to soil nutrient availability in the laboratory.

The soil analysis is performed using a soil microbial activity indicator (the Solvita Test), a soil water extract (for the organic C:Organic N ratio), and H3A extract. This provides information on the inorganic and organic fractions of nutrients available in the soil and their ratios and balances.

The **Solvita test** is presented in ppm and is the amount of CO2-C released in 24 hr from soil microbes after the soil sample has been dried and rewetted (as occurs naturally in the field). This is a measure of the microbial activity in the soil and is highly related to soil fertility - the higher the number, the more fertile the soil.

Since soil microbes are highly adaptive (different for each soil type and environment) and acquire C, N, and P in a ratio of 100: 10: 1 (C: N: P), it is safe to assume that soil microbes are a dependable indicator of soil health. This consistent need sets the stage for a standardized, universal measurement of soil microbial activity. Since soil microbes take in oxygen and release CO2, we can couple this mechanism to their activity.

WEOC: Water extractable organic carbon is the amount of C in ppm in the water extract and reflects the organic C fuelling the microbes. **% SOM** -Soil organic matter provides an indication of the overall amount of organic matter in the soil. Together with the **WEON** – water extractable organic nitrogen, also used in the microbial nutrient cycle these two fractions can provide the **organic C: organic N ratio**.

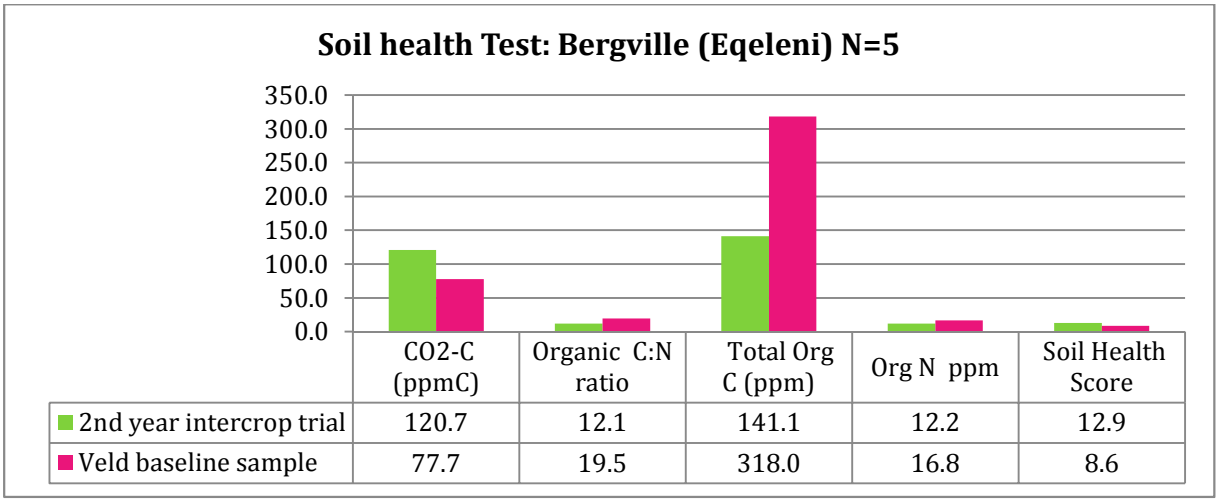
PMN is the potentially mineralizable N- fraction of the total N in the sample, which includes inorganic N.

A soil C: N ratio above 20:1 generally indicates that no net N and P mineralization will occur, meaning the N and P are "tied up" within the microbial cell until the ratio drops below 20:1. As the ratio decreases the more N and P are released to the soil solution which can be taken up by growing plants. A good organic C:N ratio is between 8:1 and 15:1. This C: N ratio is also used in calculating the soil health score.

The soil health score is calculated as 1-day CO2-C divided by the organic C: N ratio plus WEOC/100 + WEON/10 to include a weighted contribution of water extractable organic C and organic N. It represents the overall health of your soil system. It combines 5 independent measurements of the soil's biological properties. The calculation looks at the balance of soil C and N and their relationship to microbial activity. This soil health calculation number can vary from 0 to more than 50. This number should increase over time. It indicates the current soil health and what it needs to reach its highest sustainable state. Keeping track of this soil health score will allow one to gauge the effects of management practices over the years.

Soil samples were taken from 10 participants in the Bergville area (5 each from Eqeleni and Stulwane). Veld samples were also taken to act as the local soil health baselines or benchmarks. The table in Appendix 2 indicates the Soil health / Haney test results

The figure below indicates the results of the soil health test for Eqeleni.



	CO2-C (ppmC)	Organic C:N ratio	Total Org C (ppm)	Org N ppm	Soil Health Score
2nd year intercrop trial	120.7	12.1	141.1	12.2	12.9
Veld baseline sample	77.7	19.5	318.0	16.8	8.6

Figure 7: Soil health test results for 5 participants from Eqeleni, Bergville. The figure compares their 2nd year intercrop trial soils with a veld baseline sample.

From the summary of the soil health tests and the soil health scores provided above the following observations can be made:

1. SOLVITA: The ranges of values for this test are as follows:
    a. >100: High N - *sufficient for crops. Biomass 2500ppm.Well supplied with organic matter*
    b. 61-100: Mod-high N - *limited N required. Adequate organic matter*
    c. 31-60: Mod. *Supplement with N. Requires application of stable organic matter*

d. 6-30: Low-Mod. *Apply N. Biomass<500ppm. Supply organic matter*
e. 0-5: Significant fertilization needed. *Very inactive soil. Biomass<100ppm*

The SOLVITA tests here indicate that the CA intercropped plots provide for microbial activity and natural soil fertility that is higher than the veld baseline samples. This is a clear indication that this practice fast tracks increases in soil health and soil fertility. The veld samples are an indication of the natural soil fertility and microbial activity in the soils in an area, in undisturbed soils and is expected to be higher than that for disturbed soils and cropping fields.

2. The lower Organic C:N ratio for the CA trial plots means that the nutrients are mineralizable, thus available for use in the cropping period. This cropping system provides for higher availability of nutrients and microbial activity than the natural veld.

An analysis of the total N and the available organic and inorganic N fractions give an indication of build-up of soil organic matter (SOM) in the soil. The available and unavailable N needs to be balanced in the cropping system to ensure soil health and fertility improvement over time, rather than just replacing nutrients removed in the cropping cycle. The figure below shows this analysis for different scenarios of crop mixes with ratios of legumes to grasses ranging from 30/70 to 70/30., for 8 participants from Stulwane and Eqeleni, who practices intercropping and planting of cover crops in their CA trials.

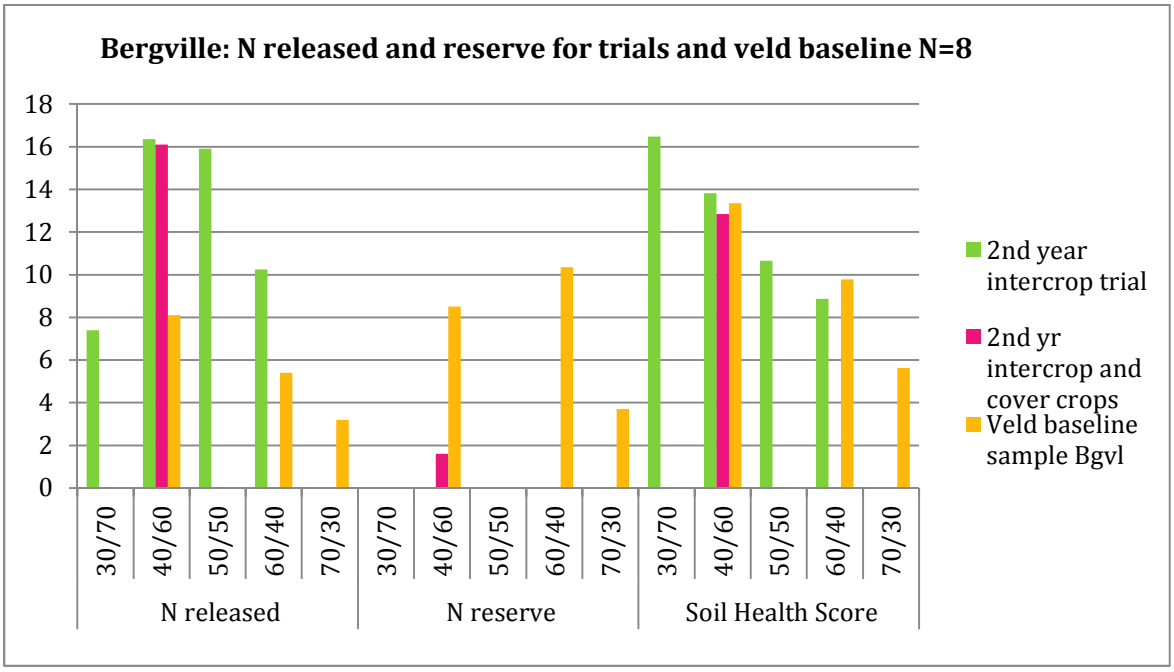


Figure 8: A comparison of N availability: released for use by plants and kept in the humus fractions reserve for CA intercropping and intercropping with cover crops as compared to veld baseline samples.

This graph indicates that intercropping with legumes builds up the N reserve in the soil over time, while also providing for greater microbial activity and soil fertility and clearly shows the importance of mixed cropping and inclusion of leguminous crops in the cover crop mixes. The graph also indicates the need for both mixed cropping and cover crops for providing for a high level of N availability for crops as well as building up the reserve. Intercropping or mixed cropping alone does not provide for build-up of humus and organic matter in the soil in the short term.

Soil health tests are to be included in the yearly analysis of results for a selected number of participants in the future to track changes and improvements in soil health status for these individuals.

OBSERVATIONS FOR THE FARMER LED TRIALS

Cover Crops

Mixes of summer and winter cover crops were planted in a number of the areas, where it was too dry to plant maize.

The summer cover crop mix consisted of millet, sunnhemp and Dolichos/cowpeas and the winter mix of saia oats, fodder rye, and fodder radish.

In some areas summer and winter cover crops were planted separately, but where planting was done around February-March 2016 all five crops were mixed together.

Growth and performance of the cover crops varied greatly.

The table below outlines a summary of all participants in the Bergville area who planted cover crops, the mix they used and the 5 germination and growth

Table 10: Cover crop planting in the Bergville area for the 2015-2016 season

Name	Area	Millet	Sunhemp	Fodder rye	Radish	Sunflower	overall growth
		% Germination					
Neliswa Msele	Stulwane	30	6	44	20	-	Fair
Thulani Dlamini	Stulwane	70	20	5	5	-	Fair
Khulekani Dladla	Stulwane	-	-	90	-	-	Good
Bongani Dlamini	Stulwane	73	<10	<6	<3	-	
Mthuleni Dlamini	Stulwane	77	20	<5	<5	-	Good
Makhethi Dladla	Stulwane	80	<5	15	<5	-	
Cuphile Buthelezi	Stulwane	50	36	10	5	-	Fair
Madolozana Gumbi	Stulwane	32	15	<25	40	-	Good
Phumelele Hlongwane	Ezibomvini	35	25	-	-	40	Good
Mthumeni Nkabinde	Ezibomvini	80	<5	-	-	<5	Good
Velephi Zimba	Ezibomvini	68	30	-	-	-	Good
Thobile Mthembu	Ngoba	40	30	<20	6	3	
Fikile Bhengu	Ngoba	55	<10	<10		10	
Sebenzile Hlongwane	Ngoba	60	10	<5	<2	25	
Tombakhe Zikode	Eqeleni	16		-	-	30	Poor
Thulile Zikode	Eqeleni						Fair

NOTES:

1. Participants highlighted in light grey planted their cover crops in rows using the animal drawn planter, while the one highlighted in dark grey planted the cover crops in between the maize rows using the broadcasting and weeding method and the rest of the participants planted on a separate piece of land using the hand weeder.
2. In households where an animal drawn planter was used, the germination percentage seems to be low for the crops with small seeds. The millet seems to be concentrated in certain rows of the plot and absent in others, while those with larger seeds (e.g. dolichos) are found in almost every row in the plot. This shows that plate used on the planter was selected based on the diameter of the largest seed in the mix. This caused seeds with a smaller diameter to come out in larger quantities and were finished before covering the whole plot. Therefore, absence of millet in other rows might not be associated with poor germination per se.

3. The growth of the cover crops planted using the oxen drawn planter was poor compared to those planted using the broadcasting and weeding method. This could be related to soil moisture deficiency which results from excessive soil evaporation as a result of large spacing between the rows.

Left: Using the no till animal drawn planter to plant cover crops in Stulwane.

Far left: Using the hand weeder to "plant" the cover crop seeds after broad casting seed in Stulwane.

Above left: Sibenzile Hlongwane from Ngoba intercropped her maize with a relay planting of winter cover crops (saia oats, fodder rye and fodder radish) that grew quite well and provided ground cover in this dry season. Above centre: Mrs Zimba from Ezibomvini intercropped her maize plot with rows of summer cover crops. Here sun hemp appears to have dominated the mix. Above Right: Nthombakhe Zikode from Eqeleni standing in her summer cover crop plot. Millet and sunnhemp are flowering and cowpeas are visible in-between. CC's are stunted and will not produce seed.

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Far Right:Thulile Zikode in Eqeleni planted the scc mix (millet, sunnhemp and cowpeas) using an animal drawn planter. In this case the spacing between rows was round 90cm.

Right: Mrs Simephi Hlatshwayo's (Eqeleni) single block planting of Babala (finger millet) grew very well and also provided ample seed for replanting.

Case studies

Mrs Phumelele Hlongwane; Ezibomvini

Phumelele Hlongwane who joined the Grain SA CA project in 2014, has experimented with a wide range of practices in the 2015 – 2016 growing season. The practices experimented with at Phumelele's site include:

- Intercropping of maize with beans
- Intercropping of maize with cowpea
- Planting cover crops 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.

Mrs Hlongwane planted the Colorado, a yellow OPV maize variety in both the control and the CA trial plots. Due to poor germination in some of the plots a PAN53 white maize hybrid was planted in the open spaces. The total area of the trial plots is 1 000 m^2 while the total area for the control plot is 600 m^2. Both the trials and the control were planted on the 19th of December 2015.

25kg of MAP fertilizer (40kg/ha P) was applied in both the control and the trial plots at planting. An inter- and intra-row spacing of 50 cm × 50 cm was used for planting the maize. Two seeds were planted per basin. These were thinned later to one plant per basin. Mrs Hlongwane top dressed her trial plots with 12,5kg of LAN around 8 weeks after planting.

The freely-drained red soil in Mrs Hlongwane's plots has a good potential for crop production with minimal traces of erosion in the plots (both control and trial). During monitoring done on the 4th of February 2016, there was a 60 – 80% weed infestation on the trial and control plots. Chemical weed control was not used on either the trial or the control plot. Weeding on the plot was done manually using hand hoe and a hand weeder.

Minor hail damage on the crops, particularly beans and cowpea was observed in the later stage of crop development

In early February of 2016, the winter and summer cover crops were planted in plot 3 and 7 respectively.

The trials and the control were laid out and shown in the figure below.

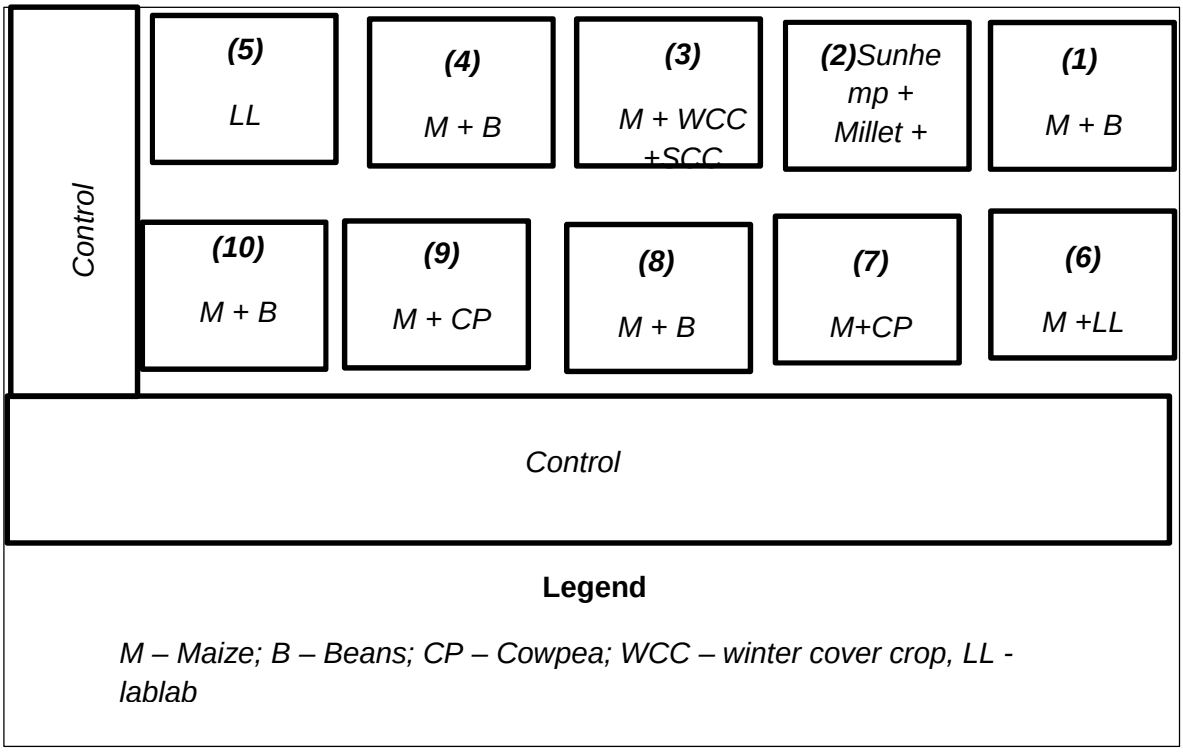


Figure: The layout for the trial and control plots at Phumelele Hlongwane's (Ezimbovini – Bergville)

Clockwise from left: Sun hemp in the cc plot flowering. Michael Malinga standing in the maize field during tasselling. A view of the bean and maize intercrop plot in the fore ground with the cover corps (millet and sunnhemp) behind that. Mrs Hlongwane standing in her maize and lab-lab bean intercrop plot towards the end of the season in May 2016.

Soil compaction and tilth

Soil compaction was monitored to get an estimate of soil tilth and root resistance with a very simple test using a pen. When compaction was measured a day after a rainfall event, it was observed that the soil was a softer (less resistance) in the CA intercropping plots as compared to the maize sole crop planting (control).

Right: The depth to which a pen - or any narrow short (20cm long) rod could be pushed into the ground in the intercropped (trial) plot vs Far right: the depth to which the pen could be pushed into the soil in the single planting (control) plot.

The difference in soil compaction and therefore root resistance between the control and the CA trial plot could be attributed to less runoff, higher infiltration and increased soil water content under the intercropping plot as result of extra soil cover provided by the secondary crop and the crop residues, and an increase in root mass. It is even possible that an increase in SOM has already been realised after a few years under CA, but further soil analyses will have to verify this statement. Little soil compaction was also measured in Plot 5 (the lab-lab plot).

In summary, soils tend to be softer and wetter in the CA maize intercropping plot compared to the maize sole crop (control). This could be associated with a number of different factors as mentioned above. Considering that measurements were taken a day after a rainfall event, the soil compaction can be associated with below- and above-ground biomass and their effect on soil water content. This very qualitative result is to be expected, but it still warrants further analyses of the bigger set of project M&E indicator data to confirm similar trends.

Yields for the different experimental and control plots at Phumelele Hlongwane's (Ezibomvini – Bergville)

The maize was harvested and weighed separately for each of the experimental and control plots. Bean and cowpea harvests were very low due to the difficult season. The Lab-lab beans had also not yielded seed prior to the commencement of grazing by cattle.

Experiment	Number of bags	Average weight (kg) of bag	Avarage weight of cob (kg)	Avarage weiht of grain (kg)	Weight of Cob + grain (kg)	% Grain (weight)	Grain weight (kg)	Area (m2)	Area (ha)	Weight (t)	Yields (t/ha)
control	16	35,73	0,06	0,22	0,28	0,79	450,90	575,00	0,06	0,45	7,84
Plot 10	2,4	26,7	0,06	0,20	0,26	0,78	50,01	60,00	0,01	0,05	8,33
Plot 9	2,5	26,7	0,06	0,20	0,26	0,78	52,09	60,00	0,01	0,05	8,68
Plot 8	3	26,7	0,06	0,20	0,26	0,78	62,51	60,00	0,01	0,06	10,42
Plot 7	2	26,7	0,06	0,20	0,26	0,78	41,67	60,00	0,01	0,04	6,95
Plot 6	1	26,7	0,06	0,20	0,26	0,78	20,84	60,00	0,01	0,02	3,47
Plot 4	2,5	26,7	0,06	0,20	0,26	0,78	52,09	60,00	0,01	0,05	8,68
Plot 3	2	26,7	0,06	0,20	0,26	0,78	41,67	60,00	0,01	0,04	6,95
Plot 1	2	26,7	0,06	0,20	0,26	0,78	41,67	60,00	0,01	0,04	6,95

Table: Yield calculations for each of the different plots in Mrs Hhlongwane's experiment.

The yields were calculated using the effective plot size for each crop, so about 60% of each of the intercropped experimental plots and 100% for the single crop control plot.

The yield summaries, averages and Land Equivalent Ratio (LER) are presented in the table below.

Experiment	Description	Area (m2)	Yields (t/ha)	LER
control	Maize sole crop	600	7,84	
Trial Plot 10	Maize (with beans intercrop)	100	8,33	1,08
Plot 4	Maize (with beans intercrop)	100	8,68	
Plot 8	Maize (with beans intercrop)	100	10,42	
Plot 1	Maize (with beans intercrop)	100	6,95	
Plot 7	Maize (with cowpea intercrop)	100	6,95	0,99
Plot 9	Maize (with cowpea intercrop)	100	8,68	
Plot 6	Maize (with lablab intercrop)	100	3,47	0,44
Plot 3	Maize (with cover crops)	100	6,95	0,88
	Ave maize yield under inter cropping (t/ha)		6,7	
	Ave maize yield sole crop		7,84	
	Ave LER			0,85

Table 11: Yield summaries, averages and LER ratio for Mrs Hlongwane's plots.

Generally, the cobs from the maize single crop (control) plot were bigger than those from the intercropping plots. However, the weight proportion of grain to cob for both maize from the control and the trial were fairly similar (78.8% grain 21.2% cob for control and 78% grain and 22% cob for trial). The maize yields from trials (intercropping plots) ranged from 3.5 t/ha to 10.4 t/ha with an average of 6,7 t/ha while that of the control was 7.8 t/ha. The maize yield from the control plot is slightly higher than the average maize yield from the CA intercropping trial plots (6.7 ton/ha) resulting in an LER (land equivalent ratio) of 0.85.

Above right: Maize cobs harvested from Mrs Hlongwane's control plot

Below right: Maize cobs harvested from Mrs Hlongwane's trial plots, separated according to plot number.

Yields of beans

A total of 7 kg of beans was harvested from a total area of 120 m^2 (Plot 10, 8, 4 and 1) area of land under intercropping. This indicates that under intercropping systems, the bean yields are around 0.58 t/ha.

Yields of cowpea

A total of 2kg of cowpea seed was harvested from an 80 m^2 area, under the intercropping system, indicating a yield of around 0.25 t/ha of cowpea.

Yields of cover crops

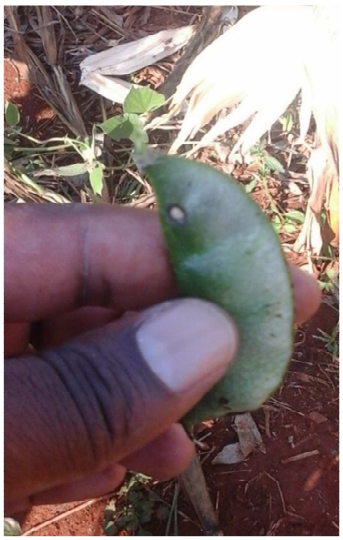
Mrs Hlongwane planted a mix of three cover crops (sunflower, millet and sun hemp in a single block (plot 2) and as an intercrop with maize (plot 3). The winter cover crop mix planted also in plot 3 (radish, black oats and fodder radish - did not germinate).

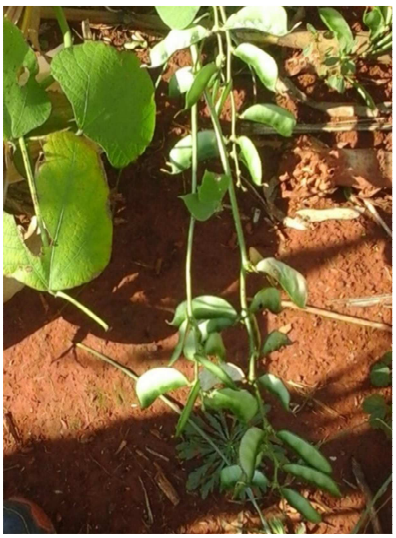
The harvested seed of sunflower, millet, and sun hemp weighed 2.53 kg, 1.2 kg and 1 kg respectively. This translates into yields of sunflower, millet and sun hemp of 0.316 t/ha, 0.15 t/ha and 0.07 t/ha respectively. The lower yields of millet could be due to that fact that birds ate most of the millet before it was harvested. Bird damage seems to be a major cause of farmers not realising good yields in the fields.

Lablab

During the last visit at Phumelele's fields the lablab had been uprooted from the field and waiting to dry before the seed was harvested. Most of the seeds were still green but were harvested by Phumelele due to her fear that livestock would eat her seed.

Soon after flowering Phumelele observed that the lablab seeds and the pod produces a considerable amount of oil (see photo below). She asked if there were options for growing the lablab in a large field and extracting the oil from the seed. This shows that during experimentation, there are some lessons that smallholder farmers learn on their own and that knowledge could help them explore more options for improving their livelihood.





Far left: lablab seeds still attached to the vine and

Left: MDF facilitator checking the oil in lablab seed with the farmer

Uses of cover crops

Lablab leaves have been used to feed her goats and Phumelele realised that they also love the sunhemp seed. Cowpea leaves are cooked as 'imifino' or traditional greens and the seeds cooked like beans. As the millet seed harvest was quite small these will be kept for replanting. She would like to use the millet in future to feed her chickens. Sunflower seed is also a good poultry feed.

Mr Dlezakhe Hlongwane (Stulwane)

Mr Hlongwane planted the PAN 53 maize hybrid, PAN 148 beans and a millet, sun hemp, raddish, fodder rye and sunflower mix of cover crops. This makes his trial interesting for evaluating crops' performances under CA compared to traditional planting methods under drought conditions. Mr Dlezakhe Hlongwane experimented with the following:

- Intercropping of maize and beans vs. maize single crop
- Beans single crop under CA vs. beans single crop under traditional planting method

All the trial and control plots were planted on the 27th of January 2016, with the exception of the maize single crop which was planted on the 30th of January 2016. Mr Hlongwane applied Round-up herbicide three days prior to planting. The most dominant weed in his plots is blackjack. He also applied Decis Forte pesticide 3 times during and after flowering of the beans.

Both the trial and the control plots were planted using a CA oxen drawn planter. 20l of MAP fertilizer was applied in both control and trial plots.

The yield data for the various plots are sown in the table below

Table: Yield data for maize single crops vs. maize and beans intercropping in Mr Dlezakhe Hlongwane's fields (Stulwane), for the 2015-2106 season.

	Area (m^2)		Yields (kg/m^2)		Yields (t/ha)		LER
	Trial	Control	Intercrop	Sole crop	Intercrop	Sole crop	
Maize (intercrop vs. sole crops)	540	900	8	2	0.15	0.02	7.5
Beans from intercropping	360		29.971		0.83		
Beans (CA vs. traditional planting method	450	450	18.74	15.067	0.42	0.33	1.27

Looking at individual plots, there was a maize yield of 0.15 t/ha from the inter-cropped plot, while there was a maize yield of 0.02 t/ha from a control plot (maize sole crop). This indicates a significant improvement in yield in inter-cropping compared to mono-cropping. However, it should be taken into account that the intercropping plot in Mr Hlongwane's plot was planted using an oxen drawn No till planter, while the control was planted using the traditional planting methods. Therefore, there improvement in yields could also be associated with methods of planting. The LER for these maize plantings is 7.5, which is an extremely high value that should continuously be verified.

The maize yields from both the control and the CA trial were low which could be attributed to late onset of rainfall and late planting. There was a good germination of maize in both plots but the maize became water stressed at the flowering stage. The yield of PAN 148 beans from the intercropping plot was 0.83 t/ha which is significantly higher that of maize in the single cropped plot (0,42t/ha). This gives an LER for the beans of about 1.27 showing that 27% more land (or yield) would be needed to yield the same amounts as the yield from the inter-crop; it again points towards significant synergistic effects between the crops in the intercropped plots.

The results also show that Mr Hlongwane obtained a yield of 0.42 t/ha of PAN 148 beans from the trial (CA plot) compared to a 0.33 t/ha yield of PAN 148 beans obtained from the control plat (planted using traditional planting methods). These results show that Mr Hlongwane has obtained a 0.09 t/ha higher yield of beans from the CA plot compared to the control plot. The percentage germination from both the trial and control plots were fairly similar, even though the plant population differed slightly.

In summary, under the drought conditions experienced in the 2015–2016 growing season, CA has shown much higher resilience and produced better yields for both the maize and beans compared to traditional planting methods and intercropping has shown a marked increase in yields compared to single block plantings.

LEARNING GROUP OBSERVATIONS FOR EACH AREA

Towards the end of the season a focus group review session was conducted with each of the learning groups. Themes discussed included a review of their CA trials compared to the normal planting practices and an assessment of the strengths and weaknesses of the approach. A discussion on inputs, supply, costs and a cost benefit analysis of CA was done. Discussions regarding saving for inputs and bulk buying options were included as were questions on joint actions in the learning group including joint storage, marketing and potential for milling in the area. Cover crops were discussed including their potential for food and fodder production and potential grazing management options in the community. See the Focus group discussion outline in Appendix 3.

In addition individual interviews were conducted for learning group members who agreed (See Appendix 4), to glean more detail regarding specific practices for each farmer. In particular, food provisioning, sales and incomes, and specific costs for each farmer was explored, as was other livelihoods information and specifics regarding their farming practices.

Interviews and focus group discussions were facilitated by the project team. The review also sets the stage for the more detailed planning for the coming season and for starting to do entrance interviews, layout of plots, soil samples and payment of subsidises.

STULWANE.

A summary of farmer participation during the 2013-2015 period is shown in the table below.

Year started	No of new farmers	Years under CA	No of farmers active in 2015/16
2013	12	3	5
2014	7	2	6
2015	3	1	3
Cumulative no	22		14

A total of 22 farmers in Stulwane have participated in the CA trials from 2013 to 2015/16 season. Of this total 7 farmers have now practiced CA for 3 consecutive years, 9 for 2 years and 4 for one season. 2 Farmers have not continued with the CA. For the latest season, 2015-2016. Some of the participant farmers did not plant due to the adverse weather conditions, which is why the numbers in this paragraph differ from those in the table above.

In this community initial success in implementation was somewhat hampered this year by drought and internal strife. 14 of the 22 participants paid for inputs. They did not plant maize, but planted beans (end January 2016) and a winter/summer cover crops mix (millet, fodder radish, black oats, fodder rye, sun hemp, cowpeas)

Cover crops are being accepted to a greater extent. Male farmers prefer these as fodder for their livestock and the women prefer to grow food. It is difficult for farmers to conceive of cutting and storing fodder although a few have already started to do this. Most of them let their animals graze in their fields, which is also a preferred practiced if managed correctly.

Right above: Livestock graze freely and have caused a lot of damage as they remained in the village due to lack of grazing during the drought

Right below: the late season beans that were planted realised reasonable yields and farmers have been very satisfied by this

People have observed that the CA has improved their yields and reduced erosion. A few farmers are convinced that the intercropping process works and they feel it increases their maize yields and protects beans from heat and wind. It is difficult to weed and harvest in these plots however. Some may not use the intercropping in their control plots, even though they have taken on the CA. **22% of participants for this season feel that they will not continue with intercropping, 14% feel they will expand intercropping also into their control plots and 64% feel that intercropping is good for maize production, but that beans should be produced as single crops.** Even though they see that weeding is reduced with intercropping, they feel that

yields are also reduced, especially with beans and thus want to revert to single crop block planting, specifically for beans.

With the animal drawn planting, the close spacing of rows becomes very complicated and about 70cm between row spacing is the minimum that can be done. Most still use 1m row spacing with the animal drawn planters.

All participants who have been able to, have increased the sizes of their cropping plots and will expand again in the future.

The savings group and bulk buying have assisted a lot in buying of inputs, despite poverty in the area, that has been exacerbated by the drought. They prefer to work together in teams to reduce the workload and would welcome a system of buying input packs and tools (either jointly or individually) within the community.

They do however not want to do storage jointly and feel that lockable storage drums for each household would work well. There are individuals who would welcome starting a small business selling tools and inputs.

Generally, the communities find it difficult to trust individuals to provide this service for them. It is not easy to choose a trustworthy person for the farmer centre; it appears that the women were more comfortable with working with Makethi Dladla and some men more comfortable with Khulekani Dladla who took over in the 2nd year. He assisted with spraying, but there was some unhappiness among the women participants that he did not pass on their inputs to them as he should have. This process will need to be reviewed in the area.

COMMENTS FROM FARMERS

Bangeni Dlamini (49yr old woman): *I have learned that it is possible to plant/ grow crops without disturbing your soils and get more yields from it*. I think Conservation Agriculture can be a solution to food insecurity and soil erosion. Intercropping helps a lot in weed control. But with single plantings we get higher yields for the beans than with the mixed planting and doing the weeding is easier. The planters are good because they save energy and time.

Thulani Dlamini (50year old man): *It is the best way of planting. I have learnt that it prevents soil erosion and rehabilitates the soil.* In addition, I can work alone as it does not require that much labour, and my yields have improved. My soil now has a darker colour which means it is more fertile and it is also wetter. I have seen better germination of my crops in the CA plots. It saves on costs and time and produced high yields. Previously we would eat beans for about two months after harvesting; now we eat beans for about six months. Yields have increased by about 12%.

It has been very helpful working together in teams; we share ideas and experiences, we help each other and it is fun to work together. We have meetings to discuss issues together and try to resolve these problems

Dlezakhe Hongwane (50 year old man). *I am keen to continue using CA and am already advising other community members to use this method*. Soil is protected by cover corps and residues and there is no erosion. The production is increasing and the soil has no clods and hard structures anymore.

With the cover crops (CC's) I cut and store this in bags to feed my cattle at times when fodder is scarce. This helps a lot with keeping livestock alive and healthy in winter.

Because of the drought we have not sold maize or beans this year, but have managed to grow enough beans for eating. Next year I would like to increase my fields to grow crops for sale.

Phasazile Sithebe (55 year old woman): *I have been doing CA for 3 years now. The roots of plants go deeper into the soil and there is much less wind damage on the crop in the intercropping plots*. I have noticed that this practice controls soil erosion.

Makhethi Dladla (47 year old woman): *I have learnt how to apply fertilizers according to a given generic recommendation, the importance of soil samples, the dangers of herbicides and the importance of covering the soil*. I used to experience a lot of soil erosion on my field with conventional agriculture caused by up and down movement of tractors. Now that I use no-till I experience no erosion and my soils have recovered a lot, the dongas are filled with soil now.

Cupile Buthelezi (43 year old woman): *I use less fertilizer and put detail to everything that I do. The intercropping has retained much more moisture compared to the single crops*. Bean and maize residues have increased the soil organic matter. Nutrients have also been replenished through minim tillage. We are more concerned with our trials but we want to incorporate CA in our control plots as well. CA saves time, gives good yields and is sustainable.

Nokwaliwa Hlongwane (62 year old woman): I would recommend this practice for other poor families to also have food to eat every day. No till can be a solution to poverty in this community.

EQELENI

A summary of farmer participation during the 2013-2015 period is shown in the table below.

Year started	No of farmers	Years under CA	No of farmers active in 2015
2013	9	3	4
2014	8	2	2
2015	7	1	7
Cumulative no	24		13

Eqeleni is the 'seed' community for starting to work with Conservation Agriculture in the area. Here a group of women in savings groups worked with Mr Madondo prior to starting this process. The ladies have been extremely enthusiastic and committed to this process.

Right: Nomavila Ndaba (Eqeleni) built a storage structure to be able to store her much improved yields under the CA process

Right: Thembelephi Ngubane (Eqeleni) (2015). She practiced CA also on her control plot (0,86ha) which she planted using a hand hoe. Her maize yield here increased from 0,54t/ha in 2014 to 1,2t/ha in 2015 for traditional maize

They regularly save R100 per month per person in their savings groups for production inputs. The women have mostly planted by hand using MBLI planters or hand hoes and have expanded their plots considerably from their starting points. It is however not easy to manage very large fields under hand tillage.

This past season has been extremely difficult due to the low rainfall. Planting only commenced around the 6th of December and due to lack of grazing, cattle were not sent into the higher mountain pastures. This meant that the women struggled continually with cattle invasions into their fields. They would like to fence off their fields, but cannot afford this. They are prepared to save towards fencing if some support can be provided. Participants also feel that it would be very useful to have input packs available in the community for sale.

For these participants, conservation agriculture is important as it turns field cropping into a viable operation as long as one has the strength and commitment to work. It cuts on costs as tractors do not have to be hired for land preparation and planting which increases the chances of reducing production costs enough to have some returns. Environmentally CA has positive effects on the soil as it maintains soil structure, reduced the chemicals in the soil, reduces erosion, saves water and rehabilitates the soil.

Above left: Busisiwe Mvelase's intercropped plots towards the end of the growing season, showing good growth. Above middle. Tolwephi Mabaso, also a 3rd year participant has done very well with her crop despite the drought. Above right: Some participants battled with high levels of weed infestation towards the end of the season when there were some rains – as can be seen in Khishiwe Cebekhulu's plot.

CA also builds up organic matter in the soil to increase the water holding capacity which makes it easy for crops to grow when there is drought as water is retained in the soil.

The one drawback experienced is the weeding pressure and the need to weed 3-4 times per season. The women understand well that this improved production considerably but feel the pressure of this increased labour. They would like to experiment with more ways to reduce the need for weeding.

This year, with the introduction of the subsidy payment a number of participants shed away from planting. They had already paid for the Grain SA farmer support programme and feared production risks in the drought.

Cover crops were planted this season for the first time and include sunflower, sun hemp and millet, but seeds were not kept as the crops either did not seed or were grazed by livestock. They would like to try out single cropping as they have difficulties with the intercropping system, mulching (grass) to cover the soil and also planting of sweet potato.

COMMENTS FROM FARMERS

Simephi Hlatswhayo; (61 year old woman). *I thought it was hard at first, but now I think it is actually easier and a useful way of growing crops for food.* There is no more erosion, the soil becomes more fertile, it is wetter and promotes better germination of seeds and my yields have increased dramatically. There is more food now and one can plant without using tractors.

Busisiwe Mvelase (32 year old woman): *This method is affordable and provides higher yields. It is also less work.* The fertility in my soil has increased and so have my yields. Erosion is controlled to an extent where a flood came and did not damage the crops. Intercropping is great for production and maize yields but it makes it difficult to hand weed and yields for beans are low, single planting for beans is great and yields are better

Tolwephi Mabaso: *In the three years that I have been part of CA I have not bought any maize. I now grow my own.*

EZIBOMVINI

A summary of farmer participation during the 2013-2015 period is shown in the table below.

Year started	No of farmers	Years under CA	No of farmers active in 2015
2014	11	1	8
2015	8	1	8
Cumulative no	19		16

This group has been active for two years and this year saw very enthusiastic implementation. One of the programme's local farmers' days was held in Ezibomvini to showcase their intercropping, crop rotation and cover cropping trials. Reasonable growth and yields have been obtained despite the drought and extremely difficult planting and growing conditions. A few farmers did particularly well, with Phumelele Hlongwane for example realising an average yield of around 5,45t/ha of maize on her CA control and trial plots. Mrs

Hlongwane is one of the individuals who now uses CA in her control plots as well. See the case study in the above section for an outline of all her different trial plots and yields.

Initially her beans did not germinate but she continued to plant cover crops and other combinations. Below are a few pictures of her experimental plots

Above left to right: Phumelele Hlongwane's experimental plots of maize and cowpea intercropped, sun hemp, millet and Dolichos all growing very well

Farmers planted later than usual to adapt to the drought conditions which prevailed. CA worked well under these drought conditions as the farmers did get yields from their plots. Mrs Hlongwane pointed out that CA has a positive effect on crops in terms of retaining moisture in the ground. She has witnessed a build-up in soil organic matter which has increased fertility. There have been real changes drawing from the results she witnessed in the previous seasons; her hybrid maize for example has done just as well as the GM maize she planted in front of her house. Her soil is much softer in the intercrop and cover crop plots.

Better yields are obtained under CA practices and less weed competition has also been observed by most group members.

Three farmers planted cover crops and they understand the significance of planting cover crops replenishing nutrients in the soil. Sunflower, sun hemp and millet are among the cover crops that were grown and all these grew well. Even though indigenous chickens and small stock fed on millet and sun hemp seed broadcasted on field at planting, seed that survived this grew well. School going children in the area appreciated the aesthetic value of sunflower and harvested most of the mature flowers. Cutting and storing of CC's for winter is what farmers would rather do as opposed to cutting and carrying to the kraals.

Sunflower is the most preferred CC, as it can be fed to the chickens. Cowpeas and Dolichos are used for human consumption, with Dolichos likened to 'imifino' or traditional greens. Cowpeas on the other hand are appreciated due to its low fat content, but some dislike it because of its taste which farmers believe has traces of soil granules. Most farmers have not kept their seed while some reported that they still have cover crop seed - Mama Phumelele Hlongwane has kept 5l sun hemp, 3l cowpeas and 5l of Dolichos; Baba

Nkabinde has kept only 1 cup of cowpeas seed, while Mama Velephi Zimba also kept 5l of sun hemp seed

Right: Mrs Zimba planted sun hemp as a relay crop between her maize and also did strip planting of single cover crops. Visible here are Dolichos and sun hemp.

Group members consider CA to be much more economically viable than conventional tillage quoting as much as 60% saving on costs although it is likely to be less than that as farmers didn't factor in herbicide and CA equipment costs into their estimations.

Farmers have a savings group where each member contributes R100 - R300 on a monthly basis towards sourcing of inputs, which they think is enough for what they will need for planting. The amount contributed is determined by the costs of production inputs in the local market. Input subsidies do assist them because they end up having money to buy other inputs such as the preservative pill which prevents stored maize from pests and fungi and they are also able to cover other needs. Farmers believe some of them wouldn't afford the inputs at the market prices because it is too expensive.

Currently the farmers do not sell any of their harvested yields simply because they do not produce enough to be able to do so. They have however sold some maize to desperate neighbours given the difficult season – at around R60/20l of maize grain.

A commercial mill in Bergville town is accessible to the farmers even though quality control rules of the mill present a barrier for farmers to be able to use its services, as they do not accept maize grain which is mixed (white and yellow maize grain) due to consumer preferences for white maize meal.

Farmers feel that it would be a good idea to have their own mill established in the area. They feel having a mill belonging to the project is better because it will be making money for the SCG (the savings and credit group), but the question of where it is to be installed is still there. They are aware that individually owning a mill is also an option.

MHLWAZINI

This area started the CA experimentation process in 2014 with 5-6 participants albeit not as part of the formal trials. This year however the group was very active, despite the drought conditions and 19 participants planted maize, beans and cover crops. Of these 19, 15 participants managed to keep their crops growing under the drought and grazing pressure and 12 of these 15 managed to produce a harvest.

Rainfall variability in the Bergville area, at a local level, was quite extreme. Mhlwazini for example received enough rain to realise reasonable harvests, while areas like Vimbukhalo (about 3km away) had no rain whatsoever until the end of January 2016.

Intercrop plots of 400m^2 were planted between 7-16 December 2015. Although germination was somewhat patchy due to the dry conditions, subsequent growth was good.

Right above: Thembi Mbhele's maize and cowpea intercropped plot in Mid January 2016. Germination is somewhat patchy but very good considering the season.

Right below: Mantombi Zimba's plot in March 2016. Growth of beans and maize has been good, despite initial patchy germination

Farmers are looking at CA as a viable alternative not only for reducing costs but also replenishing nutrients in the soil and maintaining soil structure. In terms of labor, CA is not hard to do, especially if they work in groups. Planting and preparation are easy but maintenance is more difficult. Generally, on their control plots, farmers only weed once a season. After having seen the CA impacts they go in to weed a number of times in the season. Weeding intercropped plots presents a problem where bean crop flowers are disturbed; it's also hard to weed properly as everything is planted so closely together.

Mhlwazini is the only area where all members paid for their subsidized inputs. They are aware that input costs are most likely to go up given changes in markets and they are willing to pay the requested amounts every year. They feel subsidised inputs are affordable and proper; they get enough inputs for their plots that can actually yield food. Sourcing inputs individually would prove rather difficult for farmers who are mostly dependant on pensions and child support grants.

There is a savings group in the area where some farmers have membership. They are planning to start a savings group specifically for inputs in the near future. They know that projects come to an end and want to be prepared to continue on their own after the completion of the 4 CA project.

Open storage of harvests in the traditional "ohlakeni' leads to a lot of wastage and spoilage. Rat infestation is high and farmers lose a lot. They requested assistance with buying closed drums for storage.

Right: there is an existing small scale mill in the community that has been running for around 8 years. This room sized hammer mill can process around 1000kg of maize a day and produces super fine maize meal. Mr Mabaso who runs the mill also sells the grit as animal feed. He is planning to upgrade the building and the mill as it works well as a source of income for him.

NDUNWANA

This is a new expansion area around Bergville for 2015. Of the 15 participants who registered, 11 planted their basic 400m^2 intercropping trials of maize, beans and cowpeas and managed to obtain some yields.

Most of the participants did not expect much because of the drought; they had no hope of their maize growing so they planted partly for the programme's sake, not expecting much from it. Others added that they would rather have taken the chance and failed as oppose to failing to try.

The PAN 6479 hybrid seed seemed a good enough strategy to deal with the drought as it was more tolerant to the drought when compared with the traditional seed. Having not disturbed the soil much also worked in their favor; moisture was preserved in the plot. This was evident in the yields obtained by the farmers regardless of the high temperatures and poor rainfall. The CA worked well since they had food to eat and required no tractors to plough the soil.

Above left: Matozo Zondo's plot in Ndunwane despite somewhat patchy germination of the intercropped plots the maize and beans are growing quite well. Planting was done in December 2016. Above right: Shiyiwe Mazibuko's plot. Here the lack of soil organic matter and relative dryness of the plot has favoured the growth of the cowpeas. Maize and beans have not germinated well.

For these farmers growing maize conventionally has a lot of costs associated with it and the yields and incomes are too small to justify these costs. They have witnessed that CA requires more labour, but even in a bad season such as this last season they had maize and beans to eat with their families. Farmers do feel CA has made a difference; their maize cobs have more lines of pips/seeds in them, usually a cob has ten lines at most 12, but with this one season there are more than that. Also the cobs fill up very close to the tip which is not the case with maize grown conventionally.

Farmers start measuring yields in their plots by looking at how many cobs one plant produces as well as how many 50kg bags can be filled. They have not been getting anything for a few years now, but with CA they can now say that they have bags full of maize.

Buying inputs at normal prices for crop production is not affordable for these farmers – which is why they do not buy seed and fertilizers. They appreciate the subsidised input packs and are willing to pay every year. Presently they do not save for inputs, but are willing to start a savings group where they could save specifically for inputs, up to a R100 per month. Having cheaper inputs helps a lot as they could now focus on other problems that need money and also enables them to save for the future.

The mill in Bergville where they are milling at present is a bit far for them. They are interested to work together as a group to run a local mill as a small enterprise that can make an income for the group and assist with sourcing inputs.

VIMBUKHALO

This area joined in the experimentation in 2014, which was a very good season for them. This season however, due to drought only 3 people in the group planted. For the most part, they planted beans only as it was too late to plant maize. Their beans did remarkably well. There is still interest to continue into next season and a number of new people have joined the group.

Above left: A view of one Mrs Zimba's fields in Vimbukhalo in Mid January 2016. Beans have just been planted. The lack of growth and rain in the area is visible in the complete lack of vegetation. Above right; Sibongile Mpulo stands in her bean plot. To the left is their maize (not CA) that was also produced this year.

For this area participants have noticed the following advantages for CA: softer soil, better germination and growth of crops and much cheaper production costs. It costs around R1/m^2 for hired ploughing and planting services and most farmers cannot afford the R1000-R2000 that this would cost them for their fields.

Members are aware of the subsidized input packages as a way to cushion the costs of catering for new participants coming into the program and also that of getting farmers used to the idea of budgeting as well as increasing their independency as a collective to plan and save for and source inputs.

They feel paying the required amounts per trial size and clubbing together to save for inputs is way better than working individually. They are planning to set up a savings group to assist. Cheaper inputs help them because they can spend that cash on other requirements. They also appreciate the fact that the input packages provide the required fertilizer, herbicides and good seed to ensure good yields. Farmers mentioned that conventionally they are tempted to stretch one bag of fertilizer to their whole field to save costs. They feel that with CA they get more than they put in.

Harvests are kept strictly for household consumption. They can sell to neighbors who are in desperate need, but not those who have not taken the effort to farm. Rats are a serious problem in their open traditional maize storage structures. This group also would prefer individual storage of their yields in closed drums as an option.

NGOBA

Ngoba is a new expansion area for 2015. The area was chosen in an attempt to create a positive collaborative relationship with the KZN Department of Agriculture staff in the area who have also been introducing no-till in their areas. For this area there was a group of farmers who wanted to start a cooperative and buy no till planting equipment together and were working with Mr Bheki Msimang from the Department. This relationship did however not materialize, but we continued to work with 6 participants from the group.

The area battled with the drought and cattle invasions into the fields. Of the initial intercropping trials, only 1 person managed to keep her maize alive and her cowpeas did quite well. The other participants replanted their plots to cover crops and beans later in the season.



Above left to right: Ntombenhle Hlongwane's cowpeas grew well despite the severe conditions and cattle invasions. Sebenzile Hlongwane replanted her plot to a summer cover crop mix that di reasonably well and Thobile Hadebe's scc mix seeding with sun hemp, sunflowers and millet in evidence.

Right: Mr Celani Mtambu was not part of the experimental group but took on the CA planting of his maize in his fenced field. As can be seen, he grew a good crop of maize.

NKANDLA

Vulamhlamvu

The Vulamhlamvo group, a cooperative of community gardeners supported by the Siyazisiza Trust had opted to do all their trials in one field donated by a member of the purpose. Trials were thus quite small. One joint field was planted as a control plot. Initial growth was promising but due to cattle invasions, crops were completely decimated in the latter half of the season and no yields were realised.

Members of the group are to continue (6 of 11 initial volunteers) and with some new volunteers, a total of 10 participants are to continue. A relative of one of the group members is to donate a further field to increase the size of this demonstration and the trials will be undertaken again after Siyazisia has assisted in securing fencing for the group.

Given the intense livestock pressure in the area and also the lack of real results it was considered that a further 'demonstration' year be attempted prior to people undertaking the CA on their individual homestead plots. The latter are presently small and shared within the family – as husbands have not been involved, their interest in CA is small. The demonstration would be combined with stakeholder interactions and a farmers' day to ensure community awareness and buy in and also to start dealing with the issue of grazing management in the community.

Mphotolo

The 6 farmers involved in this CA process continued with their animal drawn planting process on bigger fields of 1-5ha. Summer cover crops (millet, sunnhemp and sunflower) were introduced in the fields in February 2016 to ensure some cover, as the growth of the maize had been extremely patchy. Even the cover crops planted did not germinate or grow well due to the harsh weather conditions. Although interested, these farmers could not assist in broadening the interest into the rest of the community being primarily focussed on their work for and with the Department of Agriculture. A decision was made not to pursue activities with this group any further.

SUMMARY OF FARMERS COMMENTS

Benefits of CA

- Greater yields
- Fewer weeds in the intercropped plots as compared with sole crop plantings
- Greater water holding capacity and improved moisture retention in the CA plots. This is great in drier years. In wetter seasons however, the beans tend to rot if there is a lot of rain towards the end of the season.
- Although growth is better in the intercropped plots, beans tend to pod less in those shaded conditions.
- CA maintains and improves soil structure. It reduces erodibility and 'compaction' of soil.
- Soils in CA plots are softer than in conventional plots
- Participants have noticed that maize grows better and stronger and that the cobs increase from 1 to 2 or 3 per plant. The cobs are also bigger.

Seed varieties

- In the Bergville area farmers prefer the two white hybrid maize varieties over the OPV maize. Specifically, PAN 53 has outperformed PAN 6479 and they like the larger seed type.
- Some farmers prefer Ukulinga beans over the PAN 148 that has also been tried as they feel that it grows well. It is however more susceptible to disease and wind damage and thus works better as an inter-crop. PAN 148 is a short season variety and also liked by a number of participants. It is easier to harvest as it matures over a short period and can be higher yielding than Ukulinga. A number of farmers commented that PAN 148 appears to be more drought resistant than Ukulinga, as it yielded better under this season's dry conditions
- Cowpeas grew a lot better than beans in general in this drier season. Very few however set seed and as a result are not preferred by the women farmers even though they are a great cattle fodder.
- The OPV yellow maize (Colorado) grows and performs well. It is used as animal feed primarily.
- OPV white maize (Border King) was not preferred by farmers, as yields were lower and large hard kernels proved difficult to mill. Commercial mills will not accept this grain.

Right: An example of cobs of maize (2015 season) for Border King (OPV) and PAN53 maize.

Inputs and input costs

Farmers are happy to follow the generic recommendations provided by facilitators and a number of farmers have now also started to use those recommendations in their control plots. They feel that fertilizers work better than manure. A number of farmers still place and incorporate small piles of manure in their fields as well.

Mostly they appreciate the use of pre plant spraying of herbicides and feel that this reduces the weeds initially. Weeding during the season however is intensive. For the most part spraying is done for community members by one or two individuals- so they are not aware of the herbicide used or how to do it. The women especially prefer to have it done in this way.

The farmers know that the project will come to an end but feel that with the savings groups specifically for inputs they are able to carry on after the project. They feel that having cheaper inputs save a lot as they have a lot of problems to take care of that requires money.

The farmers do not keep track of how much it costs them to produce and how much they make after subtracting inputs cost, mainly because most of them don't sell. They are not aware of how much it cost to cultivate a 1ha plot.

In the savings groups members choose a monthly amount to save according to affordability, rather than linking it to the costs of inputs. Thus amounts ranging from R50-R100/ month are saved. In some groups members have found this confusing, although it is in fact easy to record and manage

Labour

Generally this is reduced considerably except for weeding.

- With an animal drawn planter it is possible to plant 4 plots (x1000sqm or almost 0.5 ha) in a day with 3 people
- Generally a plot smaller than 5 000 m^2 can be planted by hand, but larger than 1 000- 5 000 m^2 needs to be planted using an animal drawn planter and larger than 1ha needs to be planted using a tractor.

Storage and marketing

- Farmers prefer to store their yields in their own homesteads in drums where the fungi and pests can be dealt with easily.
- There is a distinct reluctance for joint storage options as they do not believe that people will be honest and that conflict will arise.
- Most farmers use closed drums and place 'decab' pills in the drums to control storage pests. Rats are a major problem.
- They sell some of the produce locally although most is kept for household consumption
- This season beans were sold at R100/5l. (R21.66/kg)
- Farmers do not like taking their harvests to the commercial mill in Bergville as they feel they have to pay to have it stored and then also to buy it back as maize meal and feel that this is expensive for them. They would prefer to be able to mill their maize locally – STULWANE
- Although rats consume stored maize, most farmers do not see this as a major problem and feel that their storage practices are adequate

Drought

- Herbicides were extremely ineffective this season under the drought conditions
- For the CA plots there was more moisture than conventional and plants that did germinate, grew better.
- Germination was still somewhat reduced under drought conditions but better than for conventionally tilled plots.
- Variability of rainfall between villages, even within one locality, means that each village or person really has to make their own decision about taking a chance to plant.
- This year, those that took a chance to plant after extremely marginal rain in December were mostly rewarded for their efforts. Some participants had to plant a couple of times.
- Planting late season beans is a good strategy for this area and worked well for all participants who tried this strategy

- Summer and winter cover crops that are more drought tolerant than maize were grown and performed very well in some cases. These include millet, sun hemp, cowpeas, Dolichos, saia oats and radish. Sunflowers did not mature, as their germination was low in comparison to other cc's and also grazing pressure on these were the highest. Fodder radish also did not do that well under these extreme conditions.
- Stalk borer infestations in the maize that was planted was much higher than in previous seasons. This was attributed to the drought by the farmers

Cover crops, grazing, fodder and livestock management

There is a clear distinction in preferences for cover crop varieties between men and women. Women prefer food crops and feel that growing the fodder crops would invite the cattle to invade their fields.

Male farmers like the idea of providing extra grazing for livestock, but have a problem with the idea of cutting and feeding the cover crops as fodder, as they believe that this will still not solve the problem of cattle eating all crop residues leaving the soil bare again. They do however feel that this is a very real option for them in terms of providing extra fodder for livestock in winter so cutting and storage is a good option.

The main problem with the cover crops (apart from costs and accessibility) is that there is no livestock management in the area in winter and it seems like an insurmountable problem to them. People are starting to consider fencing their fields but do not have the finances for that and are asking for assistance. Participants have however already started to manage the movement of livestock in their fields to ensure that their own livestock benefit- as opposed to any livestock in the village and some have started to cut and store the fodder for later use. These practices can be promoted and built on to provide for a management process for cover crops in these areas.

Millet grows well, especially in drier season, but is very susceptible to bird damage. Dolichos is good as an animal fodder, but not a food crop as it is so slow to yield. In general terms women prefer food crops and thus find growing a mix of summer cover crops difficult as there is no food value in these plantings. Men appreciate the ability of the summer cover crops to provide fodder and feed for livestock (including cattle and poultry).

Participants like the idea of growing sunflowers. They would also like to try out turnips instead of fodder radish as this is also a good food crop.

Learning, new ideas, adaptation

Generally farmers are not comfortable with the closely spaced intercropped plots promoted in the experimentation. They do however see the advantages. Most groups would like to undertake implementation that compares intercropping with single block plantings and also relay cropping. They would also want to experiment with planting beans early and late in the season, having seen the late season beans perform very well in this last season. The value of cover crops for the soil has been well noted and farmers appreciate the additional benefits of food and fodder. Systems for setting up controlled winter grazing in the villages seem very unlikely and farmers have pleaded for adapting the cover crop plantings to accommodate for this. In effect the summer cover crops work well as they can be dried and stored in time for winter and can produce seed that can be kept for re-planting. Attempts to get farmers to grow the winter cover crops in fenced-in areas to produce and keep seed have as yet not borne fruit. Farmers are most willing to cut and store fodder for their livestock in winter.

Farmers that have been a part of the process for 2-3 years, felt that the process of CA is easy and straightforward and that they can now continue with this process by themselves. They feel confident that they can help others in their community to start this process. They would like support to increase their yields even more.

Soil health and fertility is still not understood well and farmers generally only relate soil fertility to yields, so greater yields means greater fertility. Some of the more observant farmers have included visual characteristics such as colour (darker means more fertile), lack of clods and 'softness' to fertility as well. A few farmers include ease of germination of seed as a soil fertility characteristic

Regarding seed and seed types (traditional, OPV, hybrids and GM) farmers do not understand the difference and use only visual criteria such as seed size to differentiate. There is extremely little appreciation for the fact that all these types cross pollinate or the effect of such crossing.

Generally the feeling is that herbicides used before and at planting helps a lot as it reduces the need for hand weeding. Some farmers have learnt the nuances of certain herbicides affecting certain plants and others killing everything they come into contact with. They are aware to some extent that beans are more sensitive to herbicides and especially Round-Up.

INNOVATION PLATFORMS

The building of social capital and self-organisation has been continuing and growing steadily through the learning groups, joint working groups and the local facilitators in terms of sharing resources, tools and equipment and provision of advice and monitoring support to the farmers.

Savings and credit groups (SCGs) with the purpose of saving for inputs for production have been set up and are now operational in three of the villages, with another four being set up for the coming growing season.

There are two groups respectively in Eqeleni (Masithuthuke and Masibambane) and Ezibomvini (Ukuzama, Ezibomvini). An example is given below of a savings meeting for one of the groups that is nearing the end of its yearly savings cycle. Shares are R100 each

Table 12: List of Masithuthuke SCG members that met on 8 JULY 2016

NO	NAME	SURNAME	TOTAL SHARES	TOTAL LOANS	GROUP INFO
1	Simephi	Nkosi	19	500	Share price: R 100
2	Busisiwe	Mvelase	9	500	Share bought in July: R4300
3	Thulile	Zikode	14		Loans repaid in July: R2 670
4	Thembeni	Zimba	11	500	Loans taken in July R1 400
5	Welile	Hlongwane	11		
6	Khonzaphi	Hlongwane	22	500	Cash in the box: R29 390.
7	Thembeni	Nkosi	12	400	
8	Zanele	Mvelase	6	500	
9	Nompumelelo	Hlongwane	13	100	
10	Thandayiphi	Mdakane	8		
11	Mzamo	Zikode	7		
12	Khathaleni	Mlambo	6	1000	
13	Kokiza	Zikode	11	300	
14	Lungile	Msimanga	7	1000	
15	Nelisiwe	Ngema	6	1500	
16	Mtshengiseni	Hlatshwayo	15	1000	
17	Hleziphi	Makhaye	9		
18	Zanele	Mdluli	30	400	
19	Nokuthula	Hlongwane	6	600	
20	Bongile	Mbhele	3	900	
21	Winile	Khumalo	24	1000	
22	Khumbuzile	Zikode	40	1000	
23	Nothando	Hadebe	5	1000	

24	Ntombi	Khumalo	43	500	
25	Sindi	Dlalisa	7	1000	

This example indicates that members of this group have saved an average of R1 300 each. The most saved is R4 300. There are still a number of small loans outstanding and already the value of cash saved is in the region of R29,000. As the group nears its share out date – in this case end September 2016 – to accommodate for buying of inputs, the number of small loans given is reduced considerably to ensure that all members repay their loans before the share out day. On that day all cash will be divided according the shares bought by members and the percentage interest they have earned.

These savings and credit groups are an extremely important factor in the coherence and sustainability of the CA intervention. These groups allow the participants to buy the subsidised inputs and continue production with a fair amount of independence from external assistance.

From individual household interviews conducted for 14 participants in Stulwane and 3 participants in Eqeleni (in early July 2016) the following information has been summarised. See table 10 on the page below.

The average age of the participants in the Bergville CA project study area is 50 years, and 75% of participants are women. Households consist of around 7-9 members of which 62% are children. Participants receive income primarily in the form of grants (pensions and child grants) with some remittances from employed members of the family. None of the participants themselves are employed. The average household income is around R2 000 per month.

70% of these 17 participants belong to SCGs and saved between R300-R1200 for inputs in the 2015-2016 season. 47% of these participants participated in a bulk buying group for their production inputs. Most participants use the harvests for household consumption. On average households have had 40kg of beans from this last season's trials. Maize and bean yields are enough to last households 5-6 months. Those who have sold beans have made between R250-R2700 from their sales.

This indicates that the harvests from the trial plots alone are providing a considerable amount of food for the families and contributing towards improving their livelihoods. Participants have provided maize and beans to neighbours who have been struggling due to the drought either for free or at reduced sales prices.

Table 13: Summary of livelihoods information for 17 participants from Stulwane and Eqeleni in the Bergville area.

Area	Surname	Name	Age	Gender	HH no	Children	Income from Grants	Savings group	Bulk buying	Amt saved for inputs	Costs	Sold	h/h use(kg)	Months of food
Stulwane	Dlamini	Bangeni	49	F	12	6	R1 500	Yes	yes	R 320,00	R 320,00	R 400,00	60	4
	Dlamini	Thulani	50	M	10	8	R2 000	Yes	yes	R 600,00	R 320,00	R -		6
	Hlongwane	Dlezakhe	50	M	7	5	R1 500	yes	yes	R 300,00	R 320,00	R -		6
	Dlamini	Mtholeni	66	M	9	4	R3 200	yes	yes		R 320,00			
	Gumbi	Matolozana	64	F	10	6	R2 200,00	yes	yes	R 300,00	R 320,00	R -	37	1
	Dladla	Khulekani	43	M	3	1	R 1 400,00	yes	yes	R 300,00	R 320,00			
	Hlongwane	Nokwaliwa	62	F	5	2	R 2 000,00	no	no	R -	R 220,00	R 200,00	28	3
	Nsele	Nelisiwe	44	F	6	4	R 2 700,00	Yes	no	R 300,00	R 220,00	R 160,00	37	3
	Miya	Kethabahle	65	F	13	6	R 3 700,00							
	Sithebe	Phasazile	55	F	11	5	R 2 250,00	yes	no	R 300,00	R 220,00	R -		1
	Dladla	Makethi	47	F	6	5	R 1 000,00	yes	yes	R 300,00		R -		10
	Buthelezi	Cupile	43	F	9	7	R 2 700,00	yes	yes	R 600,00	R 220,00	R -	55,4	6
	Dladla	Sithembile	34	F	4	3	R 750,00	no	no	R -	R -	R -	37	10
	Zondi	Nothile	32	F	4	3	R 750,00	no	no	R -	R -			
			50	**F=10, M=4**	**8**	**5**	**R 1 975,00**			**R 276,67**	**R 233,33**	**R 253,00**	**42,4**	**5**
Eqeleni	Hlatshwayo	Simephi	61	F	3	1	R 1 500,00	yes	no	R 1 200,00	R 318,00	R 2 700,00		10
	Mabaso	Tolwephi	55	F	10	3	R 2 000,00	no	no	R -	R 318,00			3
	Mvelase	Busisiwe	32	F	7	5	R 2 250,00	no	no	R -	R -			6
			49	**F=3**	**7**	**3**	**R 1 916,67**			**R 400,00**	**R 212,00**	**R 2 700,00**		**6,33**

Farmers days and stakeholder interactions

In Bergville, due to the difficult dry season, it was decided to hold local farmers' day's events, rather than one large event to ensure local participation and an opportunity to showcase the growth of the trials and cover crops in these communities.

- **Ezibomvini; 23 March.** Around 100 community members from Ezibomvini, Eqeleni, Stulwane, Vimbukalo, Magangangozi and Emangweni joined the farmers' day. In addition, Mr Bright Mashiyane from the KZNDARD gave a presentation on CA and other extension officers from Umzimkulu and Ixopo joined the proceedings. Field workers and farmers joined from NGO's – including Farmer Support Group (FSG), and ACAT. Testimonies were given by three farmers from Ezibomvini and Mrs Hlatshwayo from Eqeleni. Field walks were organised to three different small farms to observe a number of different trials including crop rotation, intercropping and summer and winter cover crops


Above left: Mrs Phumelele Hlongwane discusses her trials during the field walks; Above middle; the community gathered for the farmers day and Above right: Mr Mashiyane from KZNDARD gives a presentation on CA to the community at Ezibomvini

- **Mhlwazini; 6 April.** Around 83 community participants from Mhlwazini, Ndunwane and Ngoba joined the farmers' day. Field workers and farmers from Siyazisiza (an NGO partner) joined the proceeding as did local extension staff from the department of Agriculture



Above left: Mr Michael Malinga from Mahlathini addressed the farmer gathering. Above middle: Trekking up the hill to see the field trails and Above right: the community members attending the farmers' day

In addition farmers attended events hosted by other organisations;

- **Dundee Research Station Farmers day; 16 March;** A big open day hosted by the KZNDARD Presentation and demonstration by Mr NT Madondo of implements used in the smallholder farming programme- hand held and animal drawn no till planters.

Above left; Mr Bright Mashiyane discussing CA with the CA trials done at the Dundee research Station Above Right: Showcasing peanut production.

- **Reitz Green Tour, 17 March**; A group of 7 farmers from the SFIP programme in Bergville joined the Mahlathini field work team to attend this event. Here they could compare their implementation of CA as smallholder farmers to the work being done by commercial farmers also implementing CA. This was a great eye opener for them, providing them with insight into implementing CA at scale, but also an appreciation of the fact that many of the issues to be dealt with are similar.

Above left; Mr Egon Zunckle presenting at the Reitz CA farmer's day in the Free state. Above right: the group of smallholders and Mahlathini staff in the field walks of the day – assessing differences in long term CA trials done on the farm.

- **Hilton CA awareness raising workshop hosted by the KwaZulu-Natal Notill Club**: A presentation was given by Mr NT Madondo on this occasion on Smallholder implementation of CA and his trials and successes.

In addition a poster has been presented at the WITS University Climate Change colloquium in early July 2016, shown overleaf. A paper has also been accepted for presentation at the Landcare Conference in October 2016 entitled: **Smallholder farmer innovation promotes climate change adaptation in conservation agriculture.**

Smallholder farmer innovation promotes climate change adaptation in conservation agriculture

Erna Kruger[1], , Mazwi Dlamini [1], Hendrik Smith[2] Sylvester Selala[1]

Mahlathini Development Foundation[1]; 72 Tatham Road, Prestbury, Pietermaritzburg, 3201.
Cell:0828732289 Email: info@mahlathini.org

Grain SA[2] Block C Alenti Office Park, 457, Witherite Road, The Willows, Pretoria, 0184

INTRODUCTION

The Grain SA smallholder farmer innovation programme has been promoting the implementation of Conservation Agriculture (CA) in the Drakensberg foothills (KZN and EC) for the past three years. Working within an innovation development framework and integrating the farmer field school learning approach has enabled local groups of smallholder farmers to successfully implement conservation agriculture in their maize based cropping systems. Mainstreaming of climate change adaptation is central to this process.

METHODOLOGY

Figure 1: Description of model and process

Figure 2: Cover crops (left); crop rotation (middle); intercropping (right)

Table 1: Number of farmers participating in CA trails

Area	*Bergville (Cumulative no of farmers)*	*Matatiele(Cumulative no of farmers)*	*Nkandla*
2013	28	48	
2014	83	63	
2015-2016	166	106	17

Farmer level experimentation within learning groups (20 learning groups, 300 participant farmers) focuses on each farmer comparing their chosen trial options with their normal production practices and on integration of these new ideas into their farming system. Experimentation includes a number of aspects such as early planting, intercropping, close spacing, crop diversification, mulching, cover crops and no till planters, which are introduced systematically over three to four seasons.

The learning groups focus on a value chain approach that includes joint action in analysis and planning of activities, local level savings groups, bulk buying, labour and equipment sharing, local marketing and milling and integration of livestock (poultry and cattle) through fodder production.

RESULTS AND DISCUSSION

Table 2: Comparing yields from CA and control plots

Trial summaries - 2 seasons; Matatiele and Bergville				
	Bergville		Matatiele	
	2014	2015	2014	2015
No of villages	3	9	4	10
No of trial participants	28	83	23 (63)	16 (63)
Area planted (trials)	13,3ha	42,6 ha	0,36ha	0,3ha
Average yield maize	3,74 t/ha	3,63 t/ha	0,95t/ha	0,7 t/ha
Min and max yield maize	2-4,3 t/ha	1-6,7 t/ha	0,25-1,65 t/ha	0,34-1,84 t/ha
Actual amount of maize pp	233kg	579kg	15kg	64kg
Rand replacement value	R 1 609,00	R 4 492,80	R102,75	R 499,20

Each farmer level trial is monitored intensively using a peer review approach to include indicators around soil and water conservation, soil cover, soil health improvement, crop quality and yields, efficiency of weed and pest management practices, labour efficiency and an economic cost/benefit analysis. In this way increases in crop yields, crop diversification, soil health and water conservation have been realised and sustained across the local farming communities.

Results show that for 2014 and 2015 in Bergville, the yields were relatively higher in CA plots compared to control plots, while the yields for Matatiele were relatively higher for the control plot compared to the CA plots.

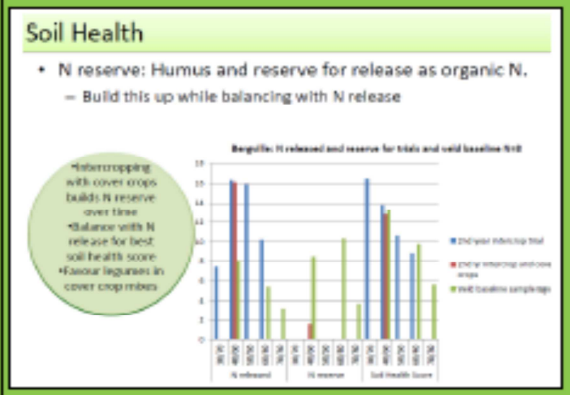


Figure 3: Results of soil health test for intercropping; intercropping with cover crops and baseline

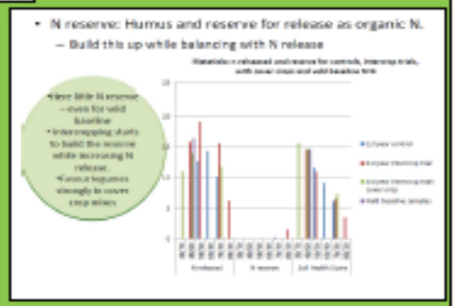


Figure 4: Soil health test results

Intercropping with cover crops appears to build N reserves over time, while balancing the N release. This is good for sustainable crop production and protection of the natural resources (soil). This can serve as a climate change adaptation strategy for small holder farmers

CONCLUSION

Working with CA farming practices and experimentation in smallholder farming systems supports climate change adaptation at a local level and builds resilience in environmental, agronomic, economic and social practices in these communities. The process of participatory innovation development based on the whole value chain for field cropping systems enables the development of best practice options for implementation. – And options that include adaptation to difficult conditions such as drought.

MONITORING

The use of the two monitoring frameworks for the CA scores and the VSA- Visual Soil assessment scores were continued into the third season.

The CA score results for the past three seasons for the CA trial plots are shown in the table below for the Stulwane participants .

Table 14: A comparison of the CA scores over 3 growing seasons in Stulwane; 2013-2015

Average of Overall score (10)	**Year**			
Name and Surname	**Year 1**	**Year 2**	**Year 3**	**Average**
Bangeni Dlamini	8,25	8,13	5,80	7,39
Cazile Zimba	7,13	7,00		7,06
Cupile Buthelezi	6,00	7,75	6,30	6,68
Dlezakhe Hlongwane	7,13	7,56	6,50	7,06
Khetabahle Miya	7,00	6,20		6,60
Khombisile Msele	8,20			8,20
Khulekani Dladla	7,13	7,25	6,30	6,89
Landile Nsele	6,75	4,25		5,50
Makethi Dladla	7,63	7,88	7,60	7,70
Matolozana Gumbi	6,50	5,90		6,20
Mtholeni Dlamini	6,50	7,50	6,26	6,75
Nelisiwe Nsele	8,50	6,70		7,60
Nokwaliwa Hlongwane	6,70			6,70
Nothile Zondi	5,70			5,70
Phasazile Sithebe	7,13	5,33	6,50	6,32
Thandiwe Mazibuko	6,56			6,56
Thulani Dlamini	7,46	6,30		6,88
Thulislie Hlongwane	7,13	7,45		7,29
Xabanisile Mabaso	6,60			6,60
Zamani Dladla	6,88	7,75		7,31
Average	**7,04**	**6,86**	**6,47**	**6,88**

For the third season, very few control plots were planted given the severe weather conditions and late planting. There has been a definite decrease in the scores for the CA trials between the 2nd and 3rd seasons. It is becoming apparent that using these scores to base incentives on- or as the basis of a PES (Payment for Ecosystems Services) model, is going to be difficult given the variances in weather across the years.

The scores for the CA trial plots, when compared with control plots are consistently higher for the first two years. These scores are a good indication of the improvements that CA can lead to. These results were presented in previous reports.

The VSA (Visual Soil Assessment) scores, both the set of soil scores and plant scores show a similar trend of reduction in this season as compared to the 2014-2015 season. The extreme drought conditions that reduced ground cover and crop growth considerably affected the scores. This is shown in the figure below.

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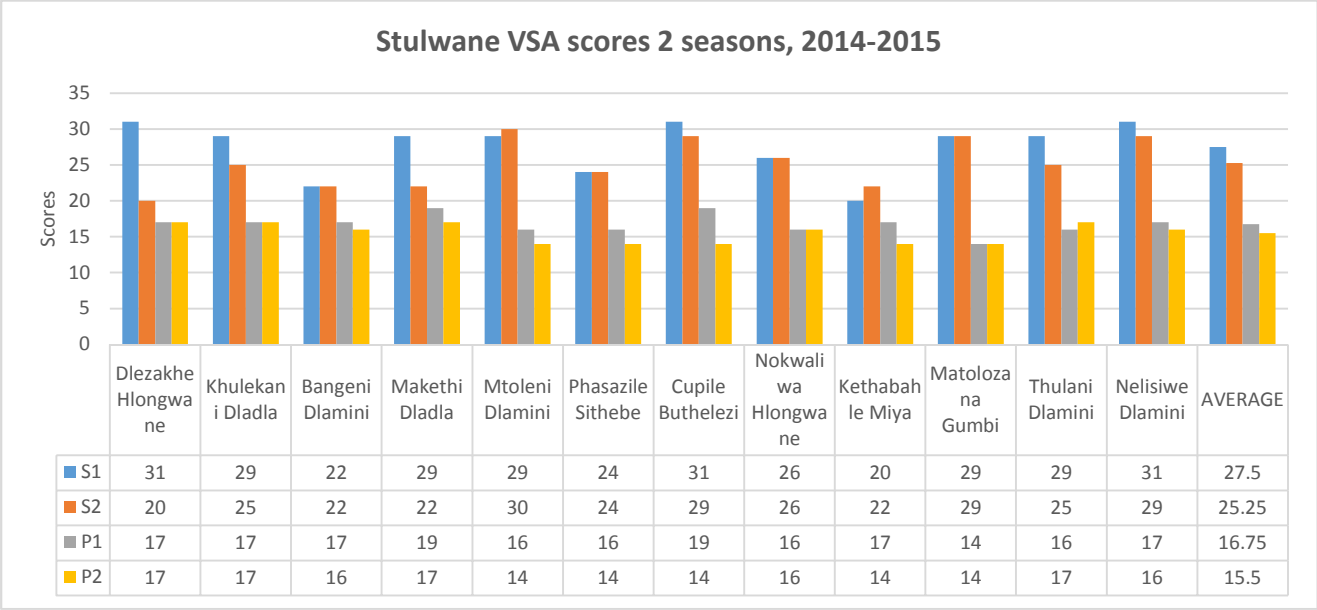

	Dlezakhe Hlongwane	Khulekani Dladla	Bangeni Dlamini	Makethi Dladla	Mtoleni Dlamini	Phasazile Sithebe	Cupile Buthelezi	Nokwaliwa Hlongwane	Kethabahle Miya	Matolozana Gumbi	Thulani Dlamini	Nelisiwe Dlamini	AVERAGE
S1	31	29	22	29	29	24	31	26	20	29	29	31	27.5
S2	20	25	22	22	30	24	29	26	22	29	25	29	25.25
P1	17	17	17	19	16	16	19	16	17	14	16	17	16.75
P2	17	17	16	17	14	14	14	16	14	14	17	16	15.5

Figure 9: A comparison of the VSA scores for two growing season in Stulwane.

NOTES: S1: Is the VSA soil scores or season 1 (2014-2015)
S2: Is the VSA soil scores for season 2 (2015-2016)
P1: Is the VSA plant scores or season 1 (2014-2015)
P2: Is the VSA plant scores for season 2 (2015-2016)

The generalised comparison of the CA scores, the VSA scores and yields that were made in the previous season is shown in the small table below.

	CA monitoring scores	**VSA Soil scores**	**VSA plant scores**	**Yields (Maize)**
Above average	≥7	>28	>15	3-8.9 tons/ha
Average	5-6.9	11-28	7-15	1-2.9tons/ha
Below average	3-4.9	<11	<7	≤1ton/ha

In general, these relationships still hold, but it is considered that a simpler process for the incentives and subsidy related criteria needs to be designed. This process will also need to include the social and organisational criteria, such as group work and savings.

Appendix 1: Table: Key activities, outputs and deliverables July 2015- September 2016; planned and actual.

Bergville Milestones: Farmer Centred Innovation in CA. July 2015- September 2016				INVOICES												EXPENDITURE		
Milestones/ Outputs	Key activities	OUTCOMES/ DELIVERABLES	Budgets	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Actual expenditure per budget item	Pd grainSA	TOTAL EXPENDITURE
Farmer experimentation Bergville	Documentaiton	Meeting and monthly reports	R 89 000,00	R 5 275,36	R 5 719,45	R 11 844,75	R 20 708,62	R 7 004,88		R 4 924,80	R 6 831,84		R 6 682,31			R 68 992,01		
	Expeirmentation	List of participants, interviews and contracts, PID plans, awarenes and training	R 337 000,00	R 40 250,23	R 23 362,09	R 21 725,00	R 24 200,00	R 29 500,00	R 37 989,06	R 11 054,56	R 7 483,76	29251,42	R 46 300,00			R 271 116,12		
	M&E	Quarterly reports, monitoring reports and forms, baselines , presentations	R 104 000,00	R 659,60	R 23 362,09	R 14 653,46	R 12 771,67	R 9 243,54			R 4 860,00		R 5 209,92			R 70 760,28		
	Platforms	Stakeholder meetings, platform building and events	R 20 000,00					R 1 889,00		R 182,00						R 2 071,00		
	Captial equipment			R 46 185,19	R 52 443,63	R 48 223,21	R 57 680,29	R 47 637,42	R 37 989,06	R 16 161,36	R 19 175,60	R 29 251,42	R 58 192,23			R 412 939,41		
		Sub - TOTAL: Oct2105-Sept2016	R 550 000,00	R 83 008,00	R 69 703,00	R 32 352,00	R 32 352,00	R 46 403,00	R 46 398,00	R 36 398,00	R 36 398,00	R 36 398,00	R 46 398,00	R 36 398,00	R 11 396,00			
														Aug-Sept	R 47 794,00	Workplan budget Oct-May	R 383 012,00	
																Actual Oct-April R	89 416,11	R 502 355,52
																	R47 644,48	
				Jul	Aug	Sept	Printing											
				14478,1	R74 249,24	R120 184,87	41087,79	R250 000,00										
		sub TOTAL: Jul-Sept 201	R 250 000,00	R61 916,00	R66 916,00	R121 168,00	R162 255,79	R250 000,00										
						Variance		R0,00										

Expenditure has been managed to be within the work plan and monthly budgets. An amount of R47 644,43 remains for the last two months August-September 2016.

Appendix 2: Soil health test results for 10 participants in Bergville, October 2015.

AREA	NAME	DATE	SAMPLE	CO_2-C (ppmC)	Organic C:N ratio	Total Org C (ppm)	Org N ppm	Soil Health Score	Cover crop (legume/ grass)	N released	N reserve	Total N (ppm)	N available (kg/ha)	Trad eval N (kg/ha)	Difference (Kg/ha)	Financial value for the difference	P available (kg/ha)	K available (kg/ha)
Bergville																		
Emmaus																		
	Hlatshwayo+Mabaso	*Sep-15*	*Veld baseline sample*	*128,9*	*21,5*	*268*	*12,5*	*9,94*	*60/40*	*6,2*	*6,3*	*13,4*	*16,13*	*0,2*	*15,9*	*R 285,38*	*11,60*	*229,50*
	Khonzaphi Hlongwane	*Sep-15*	*Veld baseline sample*	*26,4*	*17,5*	*368*	*21*	*7,3*	*70/30*			*30,2*	*27,55*	*16,69*	*10,9*	*R 194,65*	*21,73*	*175,84*
	Smephi Hlatshwayo	Jul-15	2nd year intercrop trial	179,1	10,7	92	8,16	18,44	20/80	8,6	0	14,46	33,26	10,1	23,2	R 415,03	117,94	285,49
	Smephi Hlatshwayo	Sep-15	2nd year intercrop trial	86,3	12,1	148	15,9	10,65	50/50	15,9	0	22,2	50,51	11,6	38,9	R 696,98	67,20	252,00
	Tholwepi Mabaso	Jul-15	2nd year intercrop trial	179,1	10,7	132	12,3	19,28	20/80	12,3	0	15,4	34,61	5,4	29,2	R 523,32	112,00	268,10
	Tholwepi Mabaso	Sep-15	2nd year intercrop trial	113,2	11,4	231	20,2	14,24	40/60	20,2	0	28,5	63,84	11,3	52,5	R 941,37	73,81	273,50
	Khonzaphi Hlongwane	Jul-15	2nd year intercrop trial	98,1	12,8	103	8	9,48	60/40	8	0	11,2	25,20	6,7	18,5	R 331,11	71,23	181,66
	Khonzaphi Hlongwane	Sep-15	2nd year intercrop trial	118,5	16,6	148	8,9	9,5	60/40	8,9	0	12,1	27,10	5,7	21,4	R 383,28	129,14	124,99
	Nomavila Ndaba	Jul-15	2nd year intercrop trial	62,7	10,7	124	11,6	8,24	60/40	11,6	0	14,2	31,808	2,688	29,1	R 521,75	32,93	303,18
	Nelisiwe Msele	Jul-15	2nd year intercrop trial	128,9	12,1	151	12,5	13,41	40/60	12,5	0	17,6	39,42	8,4	31,0	R 555,86	45,36	279,10
Stulwane																		
	Nokwaliwa Hlongwan	*Sep-15*	*Veld baseline sample*	*78,4*	*20,3*	*385*	*19*	*9,62*	*60/40*	*4,6*	*14,4*	*28,8*	*32,26*	*6,9*	*25,3*	*R 453,52*	*2,91*	*36,85*
	Makethi Dlada	*Sep-15*	*Veld baseline sample*	*82,3*	*25,9*	*177*	*6,8*	*5,63*	*70/30*	*3,2*	*3,7*	*7,4*	*8,51*	*0,3*	*8,2*	*R 146,49*	*2,91*	*86,24*
	Mtholeni Dlamini	*Sep-15*	*Veld baseline sample*	*179,1*	*22,5*	*374*	*16,6*	*13,35*	*40/60*	*8,1*	*8,5*	*18*	*21,28*	*0,22*	*21,1*	*R 377,26*	*4,37*	*249,87*
	Makethi Dladla	Sep-15	2nd yr intercrop and cover crops	134,1	16,8	305	18,2	12,85	40/60	16,1	1,6	26,8	56,34	15,3	41,0	R 734,46	24,19	76,27
	Nokwaliwa Hlongwan	Jul-15	1st yr intercorp	52,3	9,6	97	10,1	7,45	70/30	10,1	0	24	53,76	29,3	24,4	R 437,46	24,53	27,10
		Sep-15	1st yr intercorp	102,8	6,4	129	20,1	19,3	20/80	20,1	0	54,6	122,30	73,9	48,4	R 866,90	62,61	51,63
	Mtholeni Dlamini	Jul-15	2nd year intercrop trial	179,1	12,1	89	7,4	16,48	30/70	7,4	0	10,8	24,30	7,3	17,0	R 305,02	60,59	197,68
	Zamani Dladla	Jul-15	2nd year intercrop trial	155,6	9,8	111	11,3	18,05	20/80	11,3	0	34,8	31,58	5,8	25,8	R 461,55	121,86	311,81
	Dlezakhe Hlongwane	Jul-15	2nd year intercrop trial	179,1	13.1	161	12,3	16,15	30/70	12,3	0	21,3	35,84	6,6	29,2	R 523,75	63,84	274,40

Appendix 3: Focus group discussion outline

Focus Group discussions: July-August 2016

Inputs

1) What did you spend on input costs this year for your trial and normal planting? And in previous years – under normal weather conditions (Divide them up into small groups to come up with figures if it is hard for individuals to come up with answers)
2) What did you expect from your trial compared to your usual planting?
3) How do you measure yields?
4) Are you aware of payments for input packages? What do you understand about them?
5) How much do you spend on input costs for 1ha?
6) How do you plan to pay or save for them?
    (a) Do cheaper payments/subsidies assist you? ……..
    (b) How does having cheaper inputs help you?
    (c) Does that mean that buying inputs at their normal price is not affordable? ……
    (d) Does what you get from your production cover cost? .....
    (e) Do you know how much you make after you have subtracted input costs?
7) Are you aware that the input subsidies programme is applicable for a certain period of time? (Yes/No)
8) If yes, do you have a plan to buy your own inputs? .....

Costing

1) Are you a member of a savings group? Yes/ No
2) If, yes how much are your monthly contributions in the group?
3) Do you contribute any funds directly towards the sourcing of the production inputs? Yes/No?
4) If yes, how much?
5) If no, why?
6) What factors determine the contributed amounts towards sourcing of inputs?
7) How does the amount contributed compare to actual cost of production inputs?
    a) Is it a predetermined amount? (Yes/No)
    b) Is it what savings group members can afford? (Yes/No)
    c) Is the amount determined per growing season? Or cost of production inputs in local markets? (Yes/No)

Yields

1) Did the use of the CA processes improve your yield? (Yes/no)
2) If yes, how has it differed compared to previous seasons?
3) How did you use your yield?
4) Do you store your yield? (Yes/no)
5) If yes, how?
6) If no, what do you do with your yield?
7) What storage issues do you face?
    a) How do you deal with them?
    b) From harvesting to eating, how much do you think you lose?
    c) Would you need assistance on how to do it better?
8) What are your views on joint-storage of yields?

Markets and marketing options

1. Do you sell your yield? Yes/no

a) If yes, where?
b) How much do you sell? How much?
c) If no, why don't you sell?

2. Do you know or use any local mills? ……
3. Is it a good idea to use a local mill?

Drought coping strategies

1. What has been the impact of the drought?
2. Did you plant during the drought? (Yes/No)
    a) If yes, what are your adaptation strategies to ease the impact of the drought?
    b) How have you tried to deal with drought?
    c) Did you change your farming in any way to accommodate for the drought?
3. How did organizations work with you during the drought?
4. How did the CA work during the drought? ……..

Cover crops

1. Did/ do you grow cover crops? (Yes/No)
    a) What do you understand about the purpose of cover crops? ……..
    b) Which one grew better? And why? ……
    c) Is there anyone still keeping seeds or is it possible to keep seeds?
2. Do you think using cover crops as fodder or as feed a good idea? (Yes/No)
   If no why?

Appendix 4: GrainSA Conservation Agriculture impact assessment questionnaire; July 2016

GENERAL INFORMATION

Name and surname……M/F……..
Area/Village ……ID No……..
Years under CA……Size of trial……

No of h/h members……..No of children……..
Main source of income……..No of grants (Pension and child)……., ……..
Member of Saving's group Y/N……Bulk buying group Y/N……
Amount saved for inputs……..

GENERAL CA

After one/two years being involved in this project, how do you feel about CA/No till?
What was your perception about CA before you join this project and what is your perception now?
What are the things you have learnt about CA?
Will you encourage your neighbours to practice CA and show them how to do it?
What change have you observed in you plots ever since it's been planted CA method? Eg (Positive and negative – and describe)

1. Erosion
2. Soil Fertility
3. Moisture…
4. Productivity/ yield ……..

SOIL HEALTH

Do you know how to identify a fertile/infertile soil? Yes/No
What are the characteristics that you look for to identify a fertile soil?

1. ……
2. ……
3. ……
4. ……
5. ……

By your own observation, has the CA improved the soil fertility in your trail plot?
Yes/No Why? ....

COVER CROPS

Have you planted cover crops? Yes/No……2015……2104……
If yes, which ones did you plant?

Summer	Tick	Winter	tick
Millet		Black oats	
Sunflower		Fodder raddish	
Sunnhemp		Fodder rye	
Cowpeas		Vetch	
Sorghum			

How did you plant the cover crops?(In between maize or separate)……

Please comment on the growth (Which ones grew well, which did not and why……
Which Cover crops do you prefer and why ?(Food, fodder)
Have you harvested seed from any of the cover crops?(Which ones, estimate amount or yield)
Grazing of summer and winter cover crops? Please explain how this happens
Is there a better way to manage the razing? (Give some ideas)
Cutting and taking to kraals? Or drying and storage for later use? – Please comment on these options

FARMER TRAINING

Has the training (demonstrations and workshops) helped you to increase you knowledge about CA
Yes/No How has it helped ?
Are you able to practice the principles/guidelines of CA training on your own? Yes/No
Why?
Did you follow principles that you learnt from CA training to plant your control plots at planting?
Yes/No Why? Would you want to get some more training about CA? Yes/No
Would you recommend CA training to other community members? Yes/No
Why? ……

EXPERIMENTAL PLOT QUESTIONS

Please describe which planters you have used and how this has worked for you (MBLI, Matracca, Animal drawn,.. Haraka) (Incl comments on how to use, how to calibrate, maintenance)
Do the planters work better than the hand hoes Y/N. Please explain why or why not
Based on your observations, are the herbicides/pesticides we have been using before planting effective?
Yes/No Why
Do you know the dangers/disadvantages of herbicides? Yes/No
Do you know how to use herbicides/pesticides? Yes/No
How effective are herbicides compared to hand weeding?
Has it ever happened that herbicides did not work in your plot? Yes/No
Do you know why sometimes herbicides don't work?
What is the contribution of inter crop in weed control?
Has the number or type of weeds decreased/increased in your tail plot ever since you started planting CA method? Yes/No
How do you think farmers can improve the method of weeding in No Till plots?
Which maize/bean seed did you like and you have seen more productive? (trad. OPV,Hybrid, GM) Do you know the differences in these varieties? Yes/No

1. ……
2. ……..
3. ……...
4. ……
5. ……
6. ……...

Why?
Which type would you prefer to continue planting?
1.
2.
3.
Do you know how planting all these different types of maize close together affects the seed?
Yes/No
Is the crossing between the different types of maize a problem? Yes/No
If so, what suggestions do participants have about keeping different types of seed pure?

What were the challenges you encountered during the planting season?
What time do you think is conducive to start planting?
How is planting using mixed planting method different from single planting?
Have you observed the benefits of mixed-cropping in your trial plots?
Yes/No Why?
Would you extend mixed cropping to your control plots? Yes/No
Why?……
Do you know any other methods of CA planting apart from mix-cropping and have you ever used them? Have the yields in trial plots improved? Yes/No ,... By how much?
If not what do you think is the problem?
If yes, what do you think has influenced the increased in yields?

CROP GROWTH
What are your perceptions on using generic fertilizer recommendations
Do you use these recommendations on your control plots Y/N…. .. If not, please explain why
Please describe what pest and disease issues you have noticed on the trial plots and what you did to solve these problems
Have you noticed any differences in crop growth and yields from the first and second years on your trial plots? (Please describe how crops have germinated and grown this season and compared previous years if you planted before) Yes/No
Have you wanted to commit to increasing your sizes of land for cropping? Yes/No
Give estimates of how much food there is now compared to previously (maybe in no of people in a household and how long they can eat form the harvest)
Is it possible to give an indication of what has been sold, some idea of how much and to whom? And the income you have generated (for both maize and beans)

HARVESTING AND STORAGE:
What is your perception around the harvesting process?
Do you have any suggestions to make it more efficient?
How do you tell whether the maize is dry enough, both for harvesting and later for storage?
Does the present system of storage work well?
What are the problems?
1.
2.
3.
4.
What are some suggestions to make storage more efficient?
1.
2.
3.
4.
5.
Are there problems with mould and fungi as well as pests in the stored maize? Please describe these problems and how participants deal with these?

Any further thoughts about individual/ joint storage options that would work for participants?

Social issues
LABOUR:
What are the issues with labour with CA as compared to conventional cropping?

1.
2.
3.
4.

Is there a saving in labour? Yes/No
Is it more or less for preparation, planting, weeding etc?
What size of land can one person comfortably work on by themselves?
How has working together in teams worked?
Do you have any suggestions about dealing with some of the problems that may arise with this?
What size land can be hand cultivated, cultivated with oxen drawn planters and what size will need a tractor drawn planter?
What is the present situation with access to tractors and ploughing, what are the options for using tractor drawn no till planters?

COSTS:

Do you have an idea of how much inputs costs for 1ha? Yes/No
What inputs do you normally buy?

1.
2.
3.
4.
5.

What inputs do you think you will need to buy as well to ensure that you maize grows better?

1.
2.
3.
4.

How much can you afford to pay? Please give a minimum and maximum range.

For those participants who are saving, how much will you save for your input costs?

EXPERIMENTATION:

Are there other people in the community who want to join in the experimentation?
Yes/No (List)
Can you as more experienced CA participants give advice to newcomers? Yes/No
Can you buy as a group/individually some of the tools and equipment? Yes/No
Is it an idea to have input packs available in the community for sale? Yes/No
Is any individual interested to try and run this as a business, or would they rather do it as a small group?