

APPENDIX 3: MATATIELE 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, Eastern Cape



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

Work in the Matatiele (EC) site continued with a scaling out (horizontal expansion) process put in place, to include selected villages and also expanded into other areas including Swartberg/Mzongwana, Mt Ailiff and Mt Frere. The farmer centred innovation systems research process underpinning the programme, which is based on working intensively with farmer learning groups and local facilitators in each of the villages has been continued and strengthened

Again, as in previous years in the Eastern Cape, the collaboration processes initiated with NGOs- Lima RDF and those with the Eastern Cape Department of Agriculture were disappointing in the implementation phase with little to none of the promised implementation and support. In addition, the extremely harsh climatic conditions prevailed - drought followed by severe storms and hail, which provided for a further dampening effect.

Experimentation continued with a number of new elements: mulching trials to improve the groundcover, planting of drought tolerant summer cover crops, crop rotation compared to the intercropping and single block plantings of winter cover crops as well as continued support for the local maize milling operation for maize meal and cattle feed in Khutsong.

Of the 43 participant farmers who volunteered to conduct trials this year, 29 (67% of participants) followed through to initiate their trials; 23 of these farmers actually planted and continued with their trials, 20 farmers achieved germination of crops (70% of those who planted); and only 9 farmers realised yields (39% of those who planted). The season was extremely challenging with early season drought and extreme hail storms later in the season. Even the drought tolerant cover crop mixes (summer and winter) that were planted to accommodate for low crop germination and ground cover, did not grow very well.

Mulching trials were conducted for 4 participants in Nkau and Sehutlong. Yields on the mulched plots for both beans (1,54t/ha) and maize (4,38t/ha) were higher than un-mulched plots of beans (0,8t/ha) and maize (3,5t/ha). Average maize yields this season were low at 1,37t/ha. Average bean yields were 0,69t/ha. These yields however have shown a steady increase for those participants who have practiced CA for more than one season. And yields this season were higher in the trial plots than previous seasons, despite the drought.

Soil samples have been taken for 63 participants from 11 villages over the last three seasons. An average or generic fertilizer recommendation has been used based on these results: 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 of these results showed the validity of the generic recommendation. Interestingly the variation between samples taken in the same villages across years was higher than the variation in samples taken across villages. Thus there is little spatial difference in soil sample results and the difference depends more on the history of the particular land use. 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.

Soil health tests (Haney tests) were conducted for six participants in the Matatiele area towards the end of 2015. The SOLVITA tests (CO₂ respiration – indicating microbial activity) indicate that the biological or organically-bonded soil fertility is the lowest in the control plots of the participants (those plots under conventional tillage and planting practices) and that the CA intercropped plots provide for microbial activity and biological 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. This result is borne out as well in the total organic C and N fractions as well as the soil health score, which is the highest for the CA intercrop plots.

An analysis of the total N and the available organic and inorganic N fractions give an indication of build-up of soil organic matter in the soil. The participant sample analyses indicate that there aren't presently any local

cropping/pasture systems (including the veld baseline) that builds up the nitrogen reserve in this soil and under these environmental conditions. It can be seen that the intercropping starts to build the reserve while also increasing N release. This indicates that legumes need to be favoured strongly in crop rotation and cover crop mixes and that the build-up of the soil health here would take a number years.

Participant smallholders in the Eastern Cape are mostly women (70%), around 54 years old on average and with a household income of around R1 820 /month for a household size of around 6 members. They rely heavily on government grants for their survival and none of the participants have household members that are employed. Participants belong to local savings and credit groups and save around R300 per cropping cycle for their production inputs. Cropping areas are consequently also quite small and crops are produced almost entirely for household consumption only.

The building of innovation platforms has again included the hosting of local farmers' days where CA participants showcase their trials and crops for their broader communities and participants form stakeholder groupings in the area also attended. This year a few farmers and facilitators from Lima RDF attended as did the extension staff from the ECDAE. Partnerships have been initiated with KwaNalu, DRDLR (Dept of Rural Development and Land Reform) as well as specific municipalities in southern KZN to embed the CA SFI programme within these structures in the coming season.

The use of the two monitoring frameworks for the CA scores and the VSA- Visual Soil Assessment scores were continued into the third season. Similar to the situation in the Bergville area, but even more pronounced is the weather dependence of the CA scoring system. As a number of participants had complete crop failure their scores have been a lot lower than in previous seasons. When comparing the ground cover and canopy cover with overall growth for example, there is an expectation of finding similar trends, where good ground and canopy cover is reflected in good growth of the crops. This year, due to the extreme weather conditions however, these trends have been largely obscured. 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. 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 as well as the three overarching CA principles.

KEY ACTIVITIES

Implementation has continued in four areas (Mt Ayliff, Mt Frere, Swartberg/Mzonganwa and Matatiele) in 8 villages using the model of working more intensively with fewer farmers initially and also of using adaptive researcher-managed trials alongside the farmer trials to ensure adoption of best practices in the CA planting methods and processes used.

The table in Appendix 1 outlines the key activities and deliverables planned and implemented for the period. The last column summarises actual expenses.

Progress

Drought and severe weather conditions have seriously hampered implementation as have strikes and unrest related to the then upcoming local elections. This meant that only 65% of the participants for whom inputs were bought actually planted their trials. The adaptation trials however fared reasonably well and very interesting results were obtained using the summer and winter cover crop mixes. A few farmers had reasonable maize yields, but only around 39% of those who planted managed to obtain some yields.

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-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	<ul style="list-style-type: none"> - Finalisation of CA manual English version - Translation of all chapters into isiZulu - Soil Symposium presentation in Stellenbosch - CA chapter in CABI book 	<ul style="list-style-type: none"> -100%. Two small print runs (100 copies) -90%. Finalise translation of last chapter. Print run of 150 copies -100%. Further information sharing options through collaboration with PID process (Kit- Netherlands), Lima RDF- CA demonstrations at farmers' days, articles and conferences
	Exploration of PES model	<ul style="list-style-type: none"> - PES chapter for CA manual – draft1 - Exploration of funding options - Farmer level monitoring forms produced, translated and facilitated at farmer level 	<ul style="list-style-type: none"> -95%. Continuation of framework design -100%. Ongoing- proposals to USAID and WRC -50%. Ongoing- still needs more fine tuning
	Final report	-At end of project	100% (August 2016)
2. Increase the sustainability and efficiency of CA systems	Set up jointly managed adaptation trials (x9)	<ul style="list-style-type: none"> - 6 trials set up in Saphukanduku, Mzongwana, Nkau, Khutsong, Ntenentyana and Lutateni 	<ul style="list-style-type: none"> -100%. Completion of trials to be done with harvesting and monitoring. - response in Mt Ayliff communities was limited due to drought and lack of response from DoA
	1 st level experimentation ; basic CA system (15 villages x 5 farmers)	-8 villages , 22 farmers	<ul style="list-style-type: none"> 100%. Basic CA design- intercropping with maize beans and cowpeas on a 100m² plot, with a control plot manage entirely by the participant. Adaptation trials included using mulch for ground cover, and introducing crop rotation that

			includes winter and summer cover crops.
	2 nd level experimentation; incl cover crops, rotations, organic options and livestock integration, own contribution (15 x5)	- 3 villages, 5 farmers	100%. Adaptation trials included using mulch for ground cover, and introducing crop rotation that includes winter and summer cover crops. Participants opted to continue with intercropping practice from their 1 st year.
	3 rd level experimentation; own contribution, larger plots, own ideas (2 villages, 7 farmers in total)	- 2 villages, 2 farmers	100%. Larger level plantings using oxen drawn planters and including cover crops of own choice such as Lucerne. Intercropping still practised. As well as crop rotation and summer and winter cover crops.
	Further development of M&E system	- VSA used actively for all farmers - M&E forms redesigned and used	100%. Planting and growth monitoring completed, including cover crops and adaptive trials. Yields measured where possible
	Facilitation of innovation platforms	- Learning group meeting and training workshops - Attendance of No till conference with farmers and staff - Attendance of sustainable soil symposium - Linked with Eastern cape Dep't of Agriculture and with a Grain SA study group in Matatiele	-100%. 1 local farmers day at Sehutlong. Inters group meetings for setting up cooperatives, savings groups and enterprise development at community level in Mzongwana Liaison with study group in Matatiele to provide support to their fledgling company – GrainCo.
	CA working group, and reference group	-Attended and presented in Feb and Sept 2016	100%

RESULTS ACHIEVED

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

TABLE 2: PERFORMANCE DASHBOARD; SEPTEMBER 2016

Outputs	Proposed (March 2015)	Actual (September 2016)	Percentage of group
Number of areas of operation	5	4	80%
Number of villages active	9	8	89%
No of 1 st level farmer experiments	42	22	52%
No of 2 nd level farmer experiments	30	5	16%
No of 3 rd level experiments	1	1	100%
No of local facilitators	5	1	
No of direct beneficiaries	43	29	67%
No of farmers who actually planted	43	23	79% (of those who started)
No of farmers whose crops germinated		20	70% (of those who planted)
No of farmers who realised any crop yields		9	39% (of those who planted)

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

The table below summarises the planned and actual farmer trial implementation for the 2015-2016 planting season. A total of 43 trial participants volunteered through the planning processes across 8 villages in three areas. 29 of these farmers planted trials. The implementation has been disappointing due to the severe drought conditions and many participants opted not to plant in these conditions despite our urging. For those that planted quite a number had 0% germination. Generally germination was extremely poor and crops have been further devastated by subsequent severe storms.

TABLE 3: SUMMARY OF FARMER INNOVATION NUMBER AND AREAS PLANTED PER VILLAGE IN THIS CA PROCESS; EASTERN CAPE, 2015-2016

Area	Village	Farmers selected	Farmers planted (1 st level)	Farmers planted (2 nd level)	Farmers planted (3 rd level)	Experimentation	Comments; incl planters used.
Matatiele	Khauoe, Pontsheng, Lubisini, Mapeng, Moeaneng and Ghobo					Discontinued due to low levels of participation	
	Sehutlong	4	1	3		Summer cover crops, crop rotation, OPVs, winter cover crops, intercropping	
	Nkau	8	6	1		Summer cover crops, crop rotation, OPVs, winter cover crops, intercropping	Bulelwa Dzingwa – local facilitator for Nkau and Sehutlong PID process
	Jabulani	1	1			Intercropping and summer cover crops	Used hand weeder and MBLI. Crops eaten by livestock
	Khutsong	5	1		1	Summer cover crops, crop rotation, OPVs, winter cover crops, intercropping	Mapheele also experimenting with Lucerne Animal drawn planters used here in larger areas
Mr Frere	Ntenentyane	4	1			Mulching, intercropping, cover crops	Partnership with Lima RDF- and PID process.
	Lutateni	5	3			Intercropping with OPVs, MBLI planters,	Partnership with Lima RDF and PID process
Swartberg	Mzongwana	6	6		1	Intercropping, summer and winter cover crops,	
Mt Ayliff	Saphukanduku	10	4			Intercropping, winter cover crops	
TOTAL	8	43	22	5	2		Total area planted~ 0.37ha

Results for the 2015-2016 season

Of the 29 participants who planted trials, only 9 participants (31%) managed to harvest their crops and have their yields recorded. Some others, such as Matshepo Futhu in Sehutlong (*photo on the right*) for example realised such low yields that maize was eaten 'green' and not recorded as a yield, or livestock were allowed to eat the maize plants from the field (e.g. Thabiso Diholo from Jabulani). 13 Participants realised no yields at all.



Severe hailstorms around February and March decimated some of the crops that had survived the early season drought.

Right: Mr Moshoeshoe from Saphukanduku's field in April 2016, with some recovery post a large hailstorm. No maize could be harvested from this plot and cattle were allowed to graze there. His roof is also being re-tiled as a consequence of the storm

Far right: A view of the same plot in February 2016 before the storm. The crops were growing very well.



Yields

Crop yields varied considerably for the 9 participants for whom yields could be measured. The yields were generally higher and more consistent for the mulched plots, both for the maize and beans. This indicates the positive effect on growth and production in the mulched plots. Germination of crops was not better in the mulched plots as compared with un mulched plots. See the figure below.

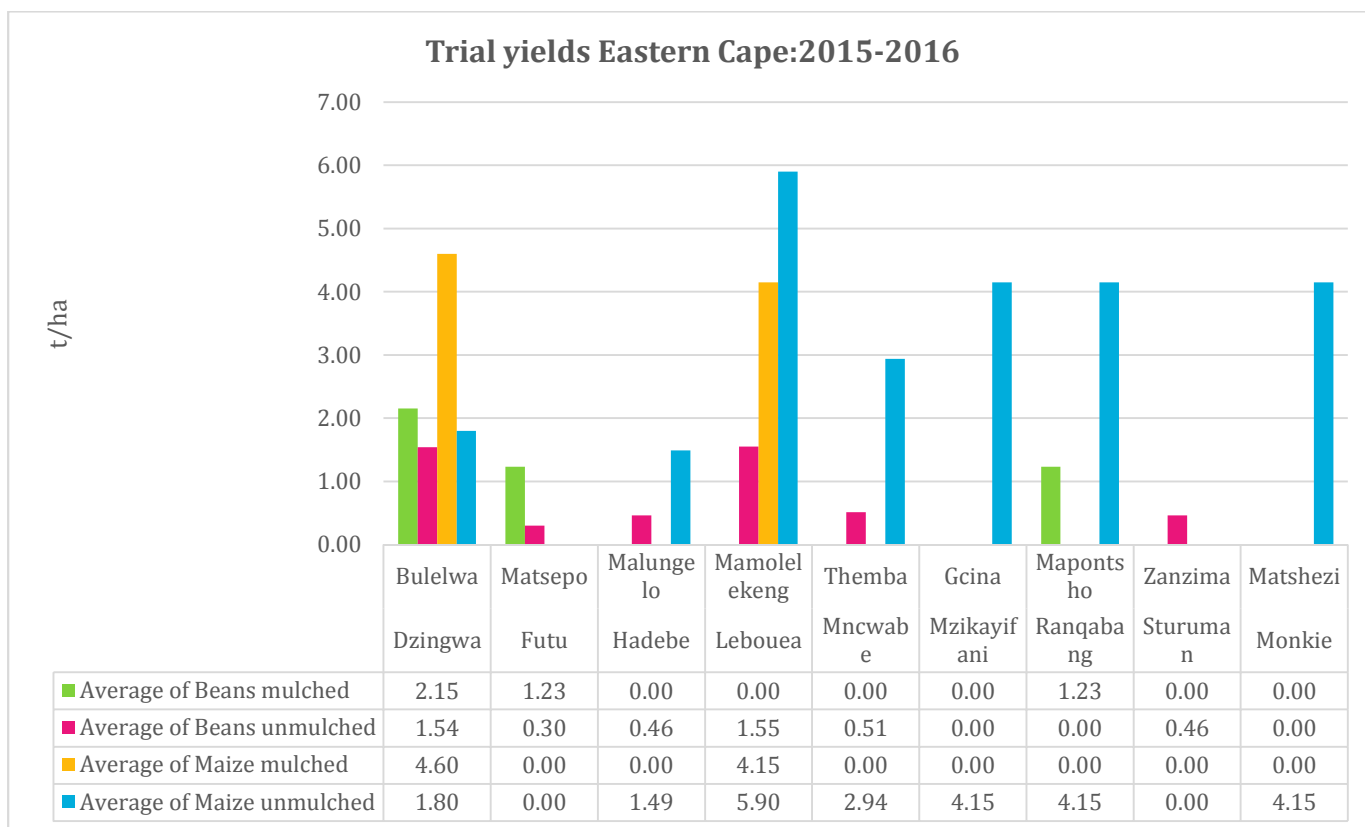


Figure 1: Trial plot yields for 9 participants who harvested in the eastern Cape for the 2015-2016 planting season.

An observation for this season that was different to the previous seasons is that in some cases the control plot maize grew and yielded better than the trial plot maize. In this instance with the small amounts of moisture available in the soil tilling increased the likelihood of germination of the seed and subsequent growth, given the general lack of soil cover and soil organic matter.

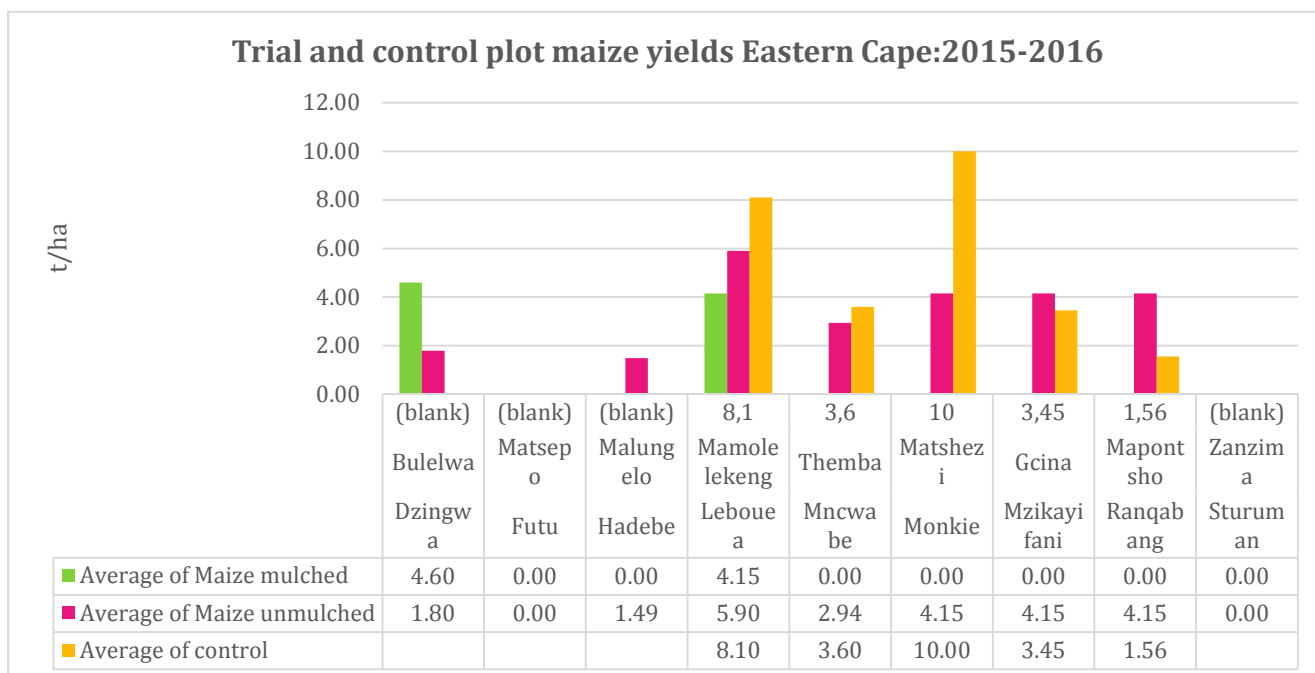


Figure 2: A comparison of maize yields for trial and control plots in the Eastern Cape for the 2015-2016 growing season.

What can be seen in the small summary table below is that the maize and bean yields were higher in the mulched plots than the un-mulched plots and that the control plot maize yields (under conventional tillage) were higher than the CA trial plots.

Right: Bulelwa Dzingwa (left), the local facilitator with Mrs Ranqabang in Nkau to weigh and record her crop yields.



TABLE 4: YIELD COMPARISONS FOR THE MULCHED AND UN MULCHED TRIAL PLOTS FOR 2015

Yields (t/ha	Mulched	Un mulched	Control
Beans	1,54	0,80	
Maize	4,38	3,5	5,3

Some of the participants have been part of the CA process for 2 to 3 seasons. A comparison of the yields from their trials shows a year on year increase in their yields for both beans and maize. It is interesting to note that yields this season, despite the drought, have mostly been higher than in previous years. This is a good indication that the continuation of CA over a number of season has provided the participants with positive spin offs in terms of soil structure, fertility, soil health and water holding capacity in their soils.

TABLE 5: YIELD COMPARISONS FOR THE CA TRIALS FOR 2013-2015 IN THE EASTERN CAPE

MATATIELE: 2013-2015	Bean Yields (ton/ha)				Maize Yields (ton/ha)			
	Year 1	Year 2	Year 3	Ave	Year 1	Year 2	Year 3	Ave
Lelatso Thuso		0,12	0	0,12		0	0	0
Bulelwa Dzingwa		1,6	1,8	1,7		1,01	3,2	2,1
Mamolelekeng Lebueoa		0,35	1,55	0,95		1,2	5	3,1
Manyalleng Sikhosana		0,16		0,16		0,73		0,73
Matshepo Futhu		0,21	0,76	0,49		0,53	0	0,53
Thabiso Dihollo	0,67	0,83	0	0,75	0,66	1,84	0	1,25
Tsoloane Mapheele	0,16	0	0	0,08		0,78	0	0,78
Grand Total	0,42	0,47	0,69	0,61	0,66	0,87	1,37	1,21

Notes: Mrs Sikhosana from Sehutlong died tragically before she could harvest her trials this year.

Mr Mapheele from Khutsong has once again not realised a harvest. He has persistent fertility issues in his fields, despite his enthusiastic implementation and repeated plantings.

Cover Crops

A number of participants planted cover crop mixes into their fields in late February. The cover crops grew reasonably well in most cases. The mix used included 5 species (a winter and summer mix); sunhemp, millet, fodder rye, saia (black) oats and fodder radish. Participants did not harvest or keep seed of the cover crops, as was the case last season, but have allowed their livestock direct access to what was available.

Of the mixture, millet, fodder rye and saia oats were the most consistent in terms of germination and growth. Sunhemp growth was very patchy as was the fodder radish. It appears that in a number of cases the radish was either washed out of the ground during rainfall events or eaten by birds or other small wildlife in the fields.



Above left: The cc mix growing in Mr Moshoeshoe's field (Saphukanduku). Oats, rye and sun hemp are visible. Above middle: Mr Mncwabe's (Mzongwana) cc's. Here the oats, millet and rye grew best. The radish was washed out of the planting lines into a patch at the bottom of the field and Above right: Sun hemp, and oats seedling in Mrs Mtshepo Futu's (Sehutlong) cover crop mix, with radish also visible.



Mrs Malelekeng Lebouea from Sehutlong tried a number of different variations of the cover crops. Similar to last year, she also bought some of her own cc seed and planted that. Above left: Mrs Lebouea's maize and cc relay cropping plot worked very well. And Above right: A plot of the winter cc mix is shown. Again as in other places in Matatiele the fodder radish seed washed out of the ground and congregated in a clump towards the bottom of the plot.

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- so 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 Matatiele), 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.

In the Matatiele area 63 samples have been taken across 11 villages over the last three years. See the summary of samples in the table below.

TABLE 6: SUMMARY OF SOIL SAMPLES TAKEN IN MATATIELE 2013-2015.

Area	Village	Year	Total no. of samples	No. of samples which required		
				P(t/ha)	K (kg/ha)	Lime(t/ha)
Matatiele	Nkau	2015	7	7	-	3
	Jabulani	2015	4	4	-	-
	Khutsong	2014	4	4	-	1
	Phontseng	2014	9	9	1	2
		2013	5	5	3	3
	Khauoe	2014	2	2	-	-
		2013	5	5	-	-
	Lubisini	2014	5	5	3	3
	Lutateni	2015	7	7	-	1
	Mapeng	2015	1	1	-	-
	Moyaneng	2015	5	5	-	-
Mzongwaneng	2015	6	5	-	-	
Sekhutlong	2015	3	3	-	1	
	Total		63	62	7	14

On the strength of a general analysis of average requirements from 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 87% 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.

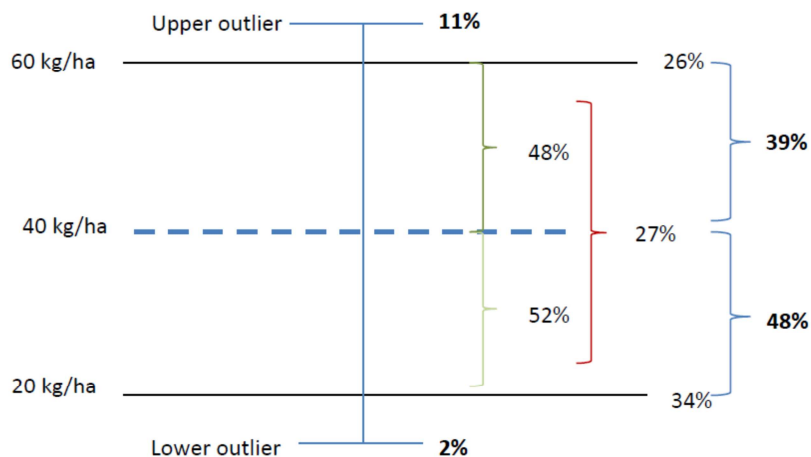


Figure 3: Derivation of Generic fertilizer recommendation for P application for dry beans and maize in the Matatiele area.

For Potassium (K); 88% of the samples had a 0kg/ha requirement of K while the remaining 12% of the samples have a K requirement which lies between 5kg/ha and 100kg/ha. According to the recommendation report from the Soil laboratories at Cedara, not applying K while P and lime recommendations are followed, could potentially reduce the relative yield by up to 6%. This means that following a recommendation of 0kg/ha even for the samples with a K requirement which lies between 10kg/ha to 100kg/ha, a relative yield of 94% would be obtained.

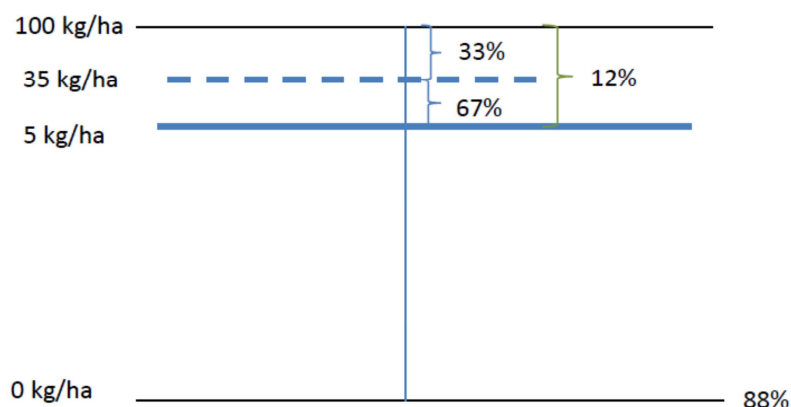


Figure 4: Derivation of Generic fertilizer recommendation for K application for dry beans and maize in the Matatiele area.

For lime: In the Matatiela area, 75% of the samples have a lime requirement of 0t/ha, while 25% of the samples have a lime requirement which lies between 1 t/ha and 6.5 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. the generic recommendation is thus 0t/ha and attention is to be given to those participants whose soils have a pH lower than 4.5

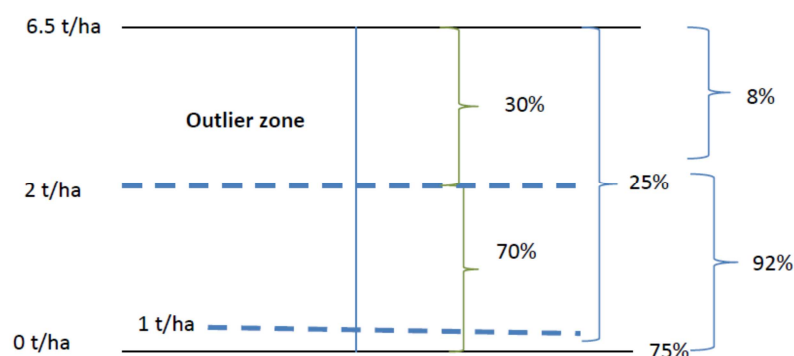


Figure 5: Derivation of Generic fertilizer recommendation for lime application for dry beans and maize in the Matatiela area.

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 11 villages in Matatiela.

TABLE 7: GENERIC P REQUIREMENTS FOR DIFFERENT VILLAGES IN MATATIELE

Area	Village Name	Sample distribution in terms of P requirement							Lower boundary	Upper boundary	GR (kg/ha)
		Lower outlier (b)	X (20kg/ha)	i (%)	l (%)	u (%)	Y (%)	Upper outlier (a)			
MATATIELA	JABULANI	0	25	12	0	100	25	38	25	37	60
	KHAUOE	0	25	50	50	50	25	0	50	50	40
	KHUTSONG	11	44	23	100	0	22	0	57	22	20
	LUBISINI	0	0	38	20	80	0	62	8	30	60
	LUTATENI	0	100	0	0	0	0	0	100	0	20
	MATATIELA	0	33	59	57	43	8	0	67	33	20
	MOYANENG	0	40	10	100	0	50	0	50	50	40
	MZONGWANA	17	67	16	100	0	0	0	83	0	20
	NKAU	5	15	55	55	45	25	0	45	55	40
	PONTSENG	5	40	10	50	50	45	0	45	55	40
	SEKHUTLONG	0	67	0	0	0	33	0	67	33	20

In Matatiela, it was found that 45%, 37% and 18% of the samples have a generic recommendation of 20kg/ha, 40kg/ha and 60 kg/ha, respectively. Variation in P requirement from 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 of course is still 40kg/ha.

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

TABLE 8: DERIVATION OF LIME GENERIC RECOMMENDATION FOR MATATIELE 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)
			<i>Excluding samples with lime requirement of 0t/ha</i>					
	Jabulani	100	-	-	-	0	0	0
	Khauoe	79	1	1	1	10	11	0
	Khutsong	90	1	1	1	5	5	0
Matatiele	Lubisini	82	1	1	1	9	9	0
	Lutateni	86	1	1	1	7	7	0
	Moyaneng	100	-	-	-	0	0	0
	Mzongwana	100	-	-	-	0	0	0
	Nkau	45	1	2	5	35	20	2
	Potseng	75	1	3	7	15	10	0
	Sekhutlong	50	1	3	5	17	33	3

It can be seen that although the generic recommendation remains 0t/ha lime for most of the villages, there are 2 villages where lime requirements are 2 and 3t/ha respectively.

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 samples 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.

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.

Soil health tests

New laboratory based tools are available for exploring soil health. This is a test derived in the USA called the Haney test and has now been taken on by 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. In most cases, 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 carbon 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.

Samples were taken from 6 participants in the Matatiele CA trials in July 2015. Veld samples provide a baseline for comparison of natural activity and nutrient availability in the area. The table in Appendix 2 indicates the Soil health / Haney test results

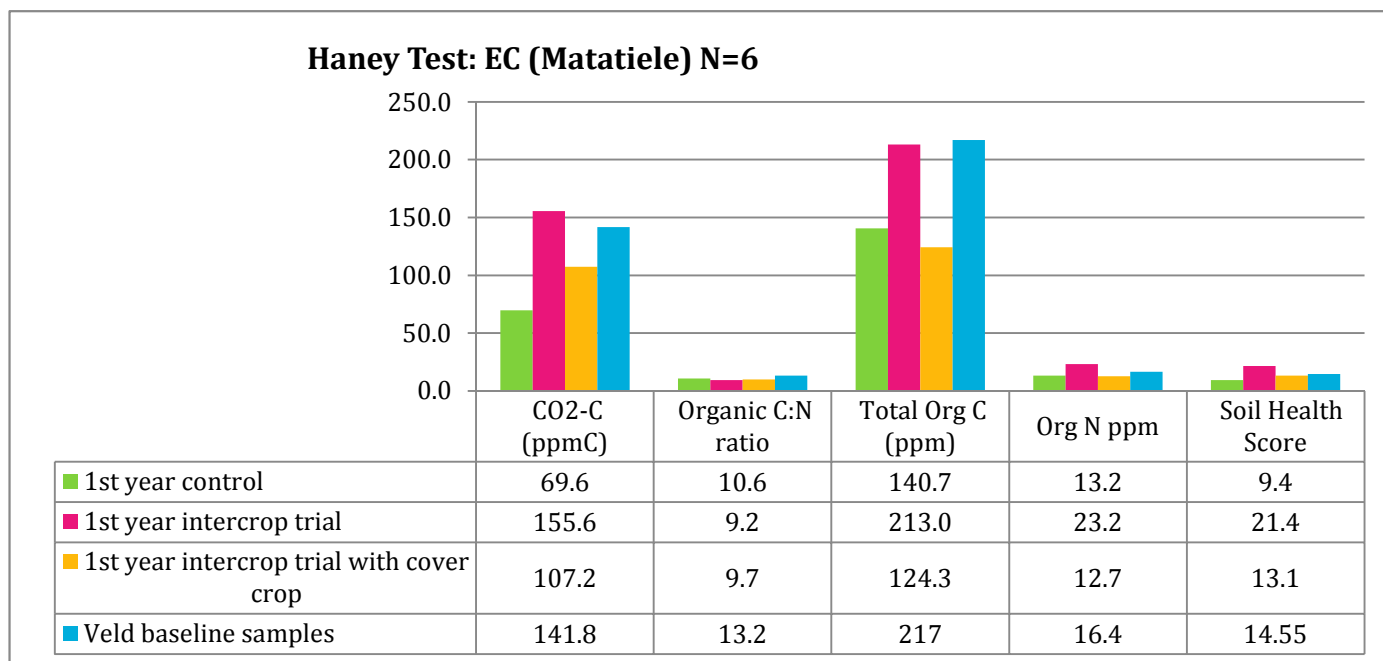


Figure 6: Results for the soil health tests for 6 CA participants in Matatiele; 2015.

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 natural soil fertility is the lowest in the control plots of the participants (Those plots under conventional tillage and planting practices) and 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. This result is borne out as well in the total organic C and N fractions as well as the soil health score, which is the highest for the CA intercrop plots.

2. The low Organic C:N ratio means that the nutrients are mineralize, thus available for use in the cropping period. Adding cover crops to the intercropped CA trial plots reduces the CO₂ respiration as well as available organic C:N, which indicates that in this 1st year of CA the cover corps use nutrients made available through microbial activity promoted by the intercropping system.
3. Both CA plots (intercrop and intercrop with cover crops) provide for greater soil health than the conventional cropping system.
4. In the medium term more organic matter will need to be incorporated into the soil to be able to reap the full benefits of planting cover crops for soil health and fertility.

An analysis of the total N and the available organic and inorganic N fractions give an indication of build-up of humus 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 graph below shows this analysis for crop mixes with ratio of legumes to grasses ranging from 30/70 to 80/20.

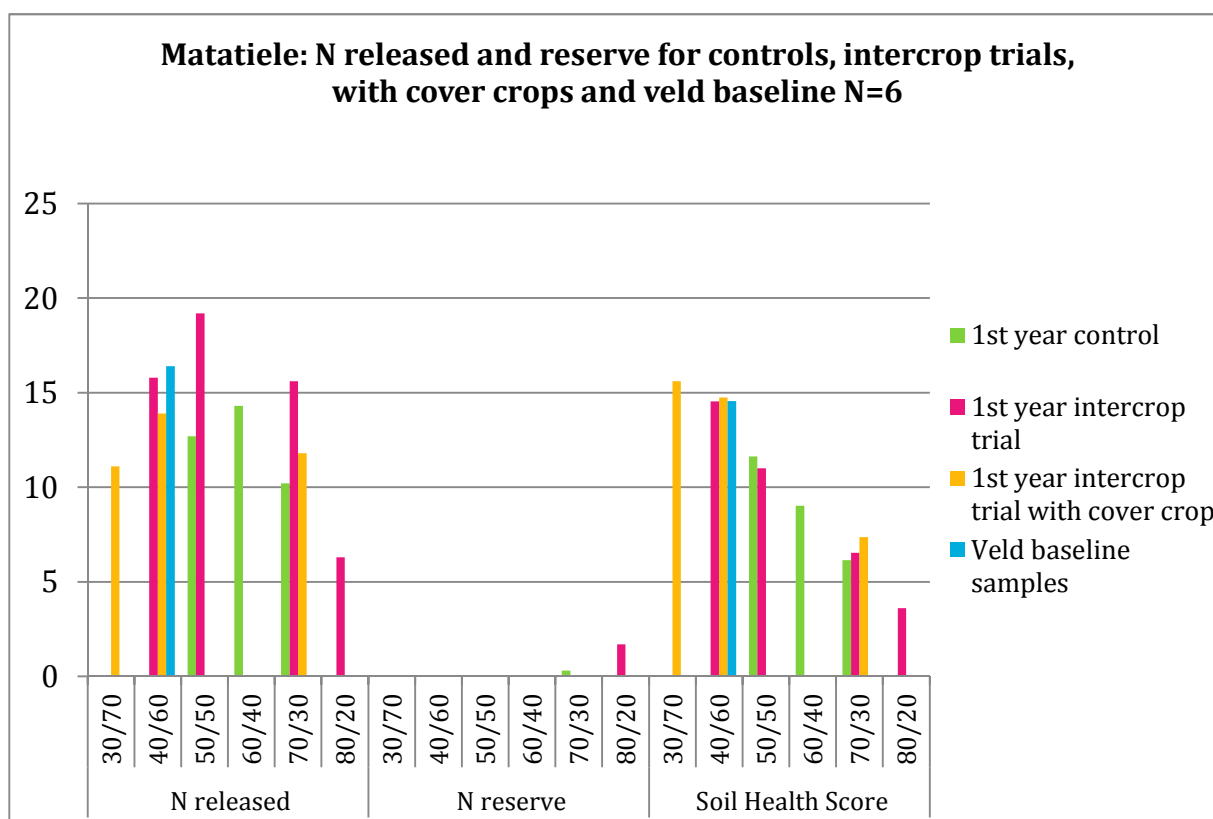


Figure 7: An analysis of N released and N reserves for trial control and veld plot samples in Matatiele; 2015.

From this graph it can be seen that there aren't presently any cropping systems (including the veld baseline) that builds up the nitrogen reserve in this soil and under these environmental conditions. It can be seen that the intercropping starts to build the reserve while also increasing N release. This indicates that legumes need to be favoured strongly in cover crop mixes and that the build-up of the soil health here would take a few years.

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.

PROGRESS PER AREA OF IMPLEMENTATION

Mt Frere;

Lutateni

In this area there was extremely low germination of maize and beans due to the drought. 5 Participants initially planted but only 3 had any germination and only 1 participant Matshezi Monkie realised a harvest



Above left: Lucy/ Mashezi Monkie's maize germinated in late January when the rains came and although germination has been patchy and weed competition high she has realised some harvests. Above middle: Makaula Mbhele's trial plot is visible in the right of the picture- with very patchy germination and high weed pressure. Again germination was delayed considerably until the rains came. Above Right: Mrs Mbhele's control plot did substantially better, with better germination and growth than the trial.

Ntenentyane

In this area participants did not take the CA trials very seriously, despite combined input from our team and the lima RDF fieldworkers. None of the 5 participants managed to harvest any of their crops and 4 of the 5 discontinued their trials before the end. Activities in this area will not be continued

Right: Planting demonstration at Mamasoka Manyala's trial plot in Ntenentyana



Mt Ayliff

Saphukanduku

In Saphukanduku only 1 of the 4 participants achieved germination and surprisingly good growth in his crops. Mr Moshoeshe planted at the same time as the other participants who achieved 0% germination. His victory

however did not last long as a major hailstorm completely decimated his crop. He subsequently planted in the cover crop mixture into his field with reasonable germination and growth.

Swartberg, Mzongwana

This is the area where Mr Mongoata who belongs to the Ongeluksnek study group in Matatiele farms. As the rest of the study group members were not very interested in either CA or cover crops, Mr Mongoata offered that we work with him on his 200ha farm and also set up a group for homestead level trials in the village nearby. Six (6) farmer level trials have been set up, along with the larger scale cover crop trials in Mr Mongoata's fields.

Cover crops were planted in February 2016 by most of the participants. A mixture of winter cover crops (fodder radish, saia oats and fodder rye) was used.

Right: A view of maize plantings done by Mr Mongoata. The green section in the middle of the photograph represents about 1ha of a mixture of cover crops planted in February 2016.



Three of the participants, Mr Hadebe, Mr Mncwabe and Mr Mzikayifani, managed to harvest their crops. They also planted in the cover crop mixtures around February 2016. These cover crops germinated and grew, albeit under duress.

Younger members of the community have been drawn in. They are specifically interested to pursue a process of linking their small enterprises and growing fodder for livestock and poultry as well as food. A cooperative has been formed in the community to continue with this process.



Above left to right: Mr Mlungelo Hadebe's plot in April 2016. Maize has not grown well and plot has been invaded by kikuyu grass. The cover crops planted in shallow furrows has struggled to grow, showing yellowing and stunting (fodder rye and saia oats are visible); some cowpeas have survived in between the grass and are still growing and around 1,5kg of beans have been harvested from the plot.



Above Left: Mr Gcina Mzikayifani’s trial plot on 15 January 2016. He planted in mid December. The plot shows poor germination and growth due to drought and heat, but now with evidence of run-off due to recent rains. Above middle: In April 2016 the growth of the trial plots of maize and cowpeas were reasonable, given two hailstorms followed again by very hot and dry conditions. Beans have been harvested. Above right: the cover crops planted at the ned of February 2016 have not grown well in Mr Mzikayifani’s plots. Some fodder radish and saia oats are visible.



Above left: A similar situation of patchy and limited germination was evident for Mr Themba Mncwabe, who planted on the 8th of December. Above right: Mr Mncwabe’s plot on 4 February 2016. Here it is evident that the control is doing better with patchy germination showing in the CA trial plot in the foreground, though subsequent growth has been reasonable.

Right: Mr Mncwabe shows the Matracca jab planter that he bought for himself at a store in Kokstad.





Far left: Mr Mncwabe's plot in April 2016, shows the effect of hail storms and subsequent heat and drought. A lot of run off has occurred and the soil is hard and capped. Middle left: The Fodder radish seed planted in shallow furrows using

hand hoes had all washed out towards the bottom of the plot nod germinated there. Near left: Rows of saia oats and fodder rye showing severe drought stress and lack of growth.

List of members for the Mzongwana cooperative

1. Mr Joseph Macala
2. Shadrack Hlenti
3. John Hlenti
4. Themba Mncwabe
5. Malungelo Hadebe
6. Wilfred Mabese
7. Mngankosi Hadebe
8. Tryphina Wawa
9. Nkosinathi Macala
10. Zwelakhe Zwajani

Matatiele; Nkau progress

For this season, the local facilitator Bulelwa Dzingwa took it upon herself to find more enthusiastic people and set up an experimentation group with 7 participants. Six (6) participants have implemented the basic 1st level experiment and Mrs Dzingwa has worked on the adaptive trial as well as a number of other options.

The group has now set up a cooperative with the assistance of the Department of Agriculture to continue their farming and experimentation process with CA into the future. See a list of cooperative members below.

Bulelwa Dzingwa also did the mulching experiment and a 5x10m plot of the summer cover crops. The latter however did not germinate at all.

Right: Bulelwa's mulching trial. In the foreground is the beans plot and behind that the Maize and bean intercrop. On the right hand side are the same plots without mulch.



The mulched plots germinated and grew better than their unmulched counterparts. Mulch had to be redone a few times during the season given the tendency to blow away and get washed away in storms.

Clockwise from top left: Bulelwa's maize and cowpea intercrop plot in March 2016. The cowpeas have recovered, but maize has not done well. The beans in the mulched plot performed a lot better than the un-mulched plot. Both plots however did show signs of stress and yellowing of plants.



List of cooperative members in Nkau

Nkau Coop (Matatiele)

1. Jacki Ndlovu
2. Jabulani Hlathi
3. Makamelo Nkejane
4. Mapontso Ranqabang
5. Zanzima Sturuman
6. Nuh Mpitsa
7. Bulelwa Dzingwa
8. Nomzwakhe Sturuman



Above: Mr Zamama Sturuman in fact had reasonable germination in his trial in spite of the weather and lack of weeding. Left: Maphontso Ranqabang's trial plot, shows reasonable growth but patchy germination. Her ploughed control plot shown here has shown impressive growth for this season

Khutsong

Mr Mapheele invited a number of the slightly larger maize farmers from the area who have their home plots of around 1200m² to join the CA experimentation process. These farmers had also recently started to participate in the Department of Agriculture supported process in their fields. Again interest waned considerably when farmers realised that the Grain SA process does not do the actual ploughing and planting for farmers. Given also the drought conditions in the area, only Mr Mapheele implemented in this group.

Below left and right. Mr Mapheele planted his trials as a maize and bean intercrops with tramlines using an animal drawn planter. The results were extremely disappointing and there was almost 0% germination





Above left to right: The low organic matter content and sandiness of Mr Mapheele's soil reduces germination and growth considerably; germination of a winter cover crop mix planted end February 2016, in the plot where maize did not germinate; A large plot of Lucerne has been planted to build up soil fertility over a period of time before trying to plant maize again. This will be provided with supplementary irrigation during winter and a bag of teff fodder harvested from his plots, ready for grinding for fodder.



Mr Mapheele installed an electric pump linked to a borehole close by and has been irrigation his cover crops with remarkable results, Above left: Visible are the three plots – the cc mix (saia oats, fodder rye and fodder radish), turnips and lucerne. Above middle: A view of the cc plot – now showing almost complete cover. And Above right: Mr Mapheele's pump for irrigation.

Mr Mapheele has also planted a large plot of turnips in his household plot. This has grown well. He sells greens to the community and also uses the greens as fodder for his livestock – sheep, horses and cattle.

Right: Mr Mapheele's household plot of turnips, used as a winter rotation crop for his maize.



Sehutlong

In this area we continued with three of the participants from the 2014-2105 season and one new participant who all continued with the basic layout of close spaced intercropping of maize, beans and cowpeas.

In addition, two participants conducted a mulching trial (Matshepo Futhu and Mamolekeng Lebeoua). Only 3 participants continued due to lack of germination for the other participants.

In February 2016 a mixture of cover crops (both winter and summer) were planted into the unmulched trial plots. Cover crops used were sunnhemp, babala/millet, dolichos beans, fodder rye, saia oats and fodder radish. These were either scattered and raked into the soil in between the maize crops at the same time as weeding, or planted in rows using hand hoes to open small furrows depending on the conditions in the fields at the time of planting. Germination and growth of the cover crops were good considering the seasonal constraints. Percentage germination of the different cover crops in the mixtures were very tricky to determine as different combinations of the crops grew in different small patches within each plot.



Above left: Mtshepo Futhu's mulching trial; the maize and bean intercropped plot shows somewhat patchy germination but reasonable growth. Weed suppression was very good with no weeding required. Above Right; Mrs Futhu's maize only unmulched plot. Weeding had to be done 2-3 times, germination was worse than the mulched plots and consequent ground cover was very little.



Left: A view of Mrs Futhu's mulched maize and bean plot in April 2016. The mulch has worked well to suppress weeds and improve growth of both the maize and the beans for the whole season. Mrs Futhu did not weed this plot.

Above right: Here the border between the mulched and unmulched plots of maize only plantings are clear- in the centre of the picture. The crops on the left hand side in the un mulched portion have bene swamped by weeds, despite earlier efforts to do weeding.



Above left: A view of the cover crops planted into an un mulched maize plot in Mrs Futu's trial. Here sunhemp, fodder radish, fodder rye and Dolichos are visible. Above middle; a part of the plot showing a slightly different combination of cover crops with Dolichos being more prevalent. And Above right; the saia oats in this view is seeding along with fodder rye and Babala.

Mamolelekeng Lebouea's field and trial plot were well looked after and general soil condition and fertility in her field is better. This year her husband agreed to plant the entire field using CA having seen the potential from last year.



Far left: Mrs Lebouea's mulched plots in her trial with maize only in the foreground and maize and beans intercropped in the top half of the picture. Germination was reasonable, albeit a little patchy and subsequent growth has been good. Left: In the unmulched plots of the trial maize grew well, but somewhat shorter with some signs of water stress.



Above left: Mrs Lebouea's cover crop mixes grew well as relay crops in the unmulched plots of her trial. This picture shows a patch where fodder radish and saia oats is dominating. Above middle: Here Dolichos and sunhemp are thriving in the maize and bean intercrop plot, along with some fodder rye. Above right: A mixture of flowering sunhemp and millet, with fodder rye and Dolichos visible.

Learning Group observations for specific areas

Towards the end of the season a focus group review session was conducted with the learning groups in the Eastern Cape. 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 3.1.

In addition individual interviews were conducted for learning group members who agreed (See Appendix 3.2) 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.

Mzongwana

This community also faced the harsh realities of the past dry season. Participants planted their control plots a bit earlier than trials but growth was not good. Generally, people in the area do not grow their own food as

much as they did previously. A lot of fields are lying fallow and people buy way more as opposed to working the land. The maize they grow is mostly eaten green, or dried and fed to livestock, horses and poultry.

Farmers typically keep their own seed for planting their control plots, so not much is actually spent on inputs. The fertilizer is sourced in Kokstad and Matatiele and participants have been using 2:3:2, which they broadcast in their plots.

Farmers appreciate the decreased labour in planting CA trials and want to buy a couple more jab planters for their control plots. Herbicides are also part of the list of inputs they are after, but they need more training on their handling and use. They would also love to have a plot where they'll be using the animal drawn no till planter. Ideally they want to plant late October and early November. The participant farmers think it is a great idea to include fodder crops in their maize production system and are keen to continue and expand on this process. For their control plots they are leaning more and more towards using roundup ready seed.

There is no formal savings group in Mzongwana but participants want to start one up. Presently four men have been saving monies together for buying of inputs on a monthly basis. Each contributes what he can afford. So far they have saved around R1150 and are continuing to save after having learned that fertilizer prices have increased to around R480 in Kokstad and R520 in Pietermaritzburg for a 50kg bag of MAP. So farmers are aware that they have to contribute a bit more and they want to grow more maize in the hope that they will be getting more rain than last year.

Regarding storage, rats are a huge problem and the use of Rattex in the storage rooms has not been very successful. A better storage method would need to be used. Before people used to go to Hanover Farm to have their maize milled (R20/50kg bag), but as production has decreased so much this is no longer done. A local mill sounds like a good idea, but farmers are worried that not enough maize is being produced to justify this.

COMMENTS FROM FARMERS

Mr Themba Mncwabe: Mzongwana.(1st year). *“CA is great for me. It is less work and it costs less. There was less erosion in the CA plot and the crops grew well. We planted in these dry sandy soils, knowing that little would come up but did so in recognition of our animals. Cover crops were good enough to provide grazing for my animals for about two weeks. This past season was a terrible one; yields were very low while others didn't get anything at all. I cannot say my yield has increased with CA, it was my first attempt and an unfortunate dry one as well”.* Mr Mncwabe feels that his control did



somewhat better than the trial because he happened to plant early and his crops were able to recover from the hail events more than the CA trial with maize. All the maize produced will be fed to livestock and is currently stored in feed bags that are kept in dry and cool rondavel huts. He has bought a jab planter and has already started to use this for planting his control plots as well.

Mrs Bulelwa Dzingwa: Nkau, 3rd year: *“I feel excited and grateful that such a project has found its way to our area. We were used to planting our maize but it yielded very little. I would always encourage my neighbours to do CA as it is an easy way to work the land and an affordable way to feed our children. I feel the three years I've been part*



of the project have been worth it. I thought it wouldn't work for us. I knew of herbicides but thought it required heavy big machinery. Through the CA project I've worked with herbicides and the smaller planters suited for us. My yield specifically beans has increased a lot, maize cobs have just slightly increased with big full cobs. We all want more for less, so mixing cropping with maize and beans is a complimentary combination also to rebuild and cover the soil as much as we can".

I have learnt about the importance of not disturbing the soil and how one can maintain and rebuild the soil. CA saves a lot of money and labour. My soil has gone somewhat darker - a lot of organic matter has been replaced; especially on the intercrop plot. My soil is less prone to erosion and holds more moisture, especially in the intercropped and mulched plots of this last season.

She has learnt different ways of identifying fertile soil; soil colour, organic matter, holding 'shape' in the dispersion test and soil being more crumbly and less compact.



She felt that working with the MBLI hand planter was the best for them. It is easy also for the women to learn to change the plates for the different seeds. The Haraka planter was good as it is just pushed, so easier and can work larger areas, but changing the plates on that planter is a little complicated and it would be better if it could also dispense fertilizer as the MBLI does.

She finds planting cover crops important. She lets her sheep graze as there is little food available in winter and stray livestock will help themselves. But given the extreme winters it would be better to cut and keep fodder for livestock.

She feels that she continues to learn new aspects every season and is 'hungry' to continue.

Mrs Maphontsho Ranqabang: Nkau. (1st year) *"CA is the answer to effective crop production at reduced costs both to me and the soil, I have now realized that, unlike back when Bulelwa first told me about it."* This was her first season and so she could not see much yield difference compared to her control plots. She feels that the herbicides do work but believes it is better to do hand weeding to also remove the roots of the weeds. Because the soil was very dry and hard they were obliged to use hand hoes instead of the planters. The mixed cropping idea makes sense in terms of fighting weeds and better crop growth, but it makes the weeding more difficult.



Mrs Matshepo Futu: Sehutlong. (2nd year) *"CA works very well and I will continue to use this method even if the project leaves. Even if you are poor and have no money, if you work hard in your garden with CA you will harvest something to feed your family. CA protects the soil and the work is less. Yields are much better, except this last year because of the drought"* She feels that her soils are more fertile now and not eroded at all; there is too much work in weeding.



Mrs Mamolelekeng Lebouea: Sehutlong. (2nd year) *“There is a difference from before; weeds are reduced, water is held and stored in the soil a bit more and of course yields are higher. There is no erosion any more and the soil appears to be more fertile”.* The cover crops grew well, especially the saia oats and animals have been grazing on those plots. She has a kraal close to her fenced in garden and feels that cutting and feeding there would be a better idea, as then the cover crops will have a chance to regrow and produce more.

Mr Tsoloane Mapheele: Khutsong (3rd year). *“I had heard of CA, but was not sure it would work on the ‘beach’ sand I have for soil. I find that CA is great; there is no more erosion and the work is manageable. The weeds are reduced over time and the yields are slowly increasing. I have managed to try out many new crops; mostly fodder crops that are also good for the soil. The soils are more fertile through the introduction of cover crops and careful fertilizer use. My maize didn’t grow well this year, so I put cover crops on the entire plot where I had maize, broad casted then weeded. In the previous season I had planted it between maize rows. These cover crops grew really well. I included Lucerne and turnips as well.*



Mr Mapheele works on 0,2ha of land and also has a home plot. He uses animal traction and has a small maize mill. He still feels that there may be an issue with the planter and would like the suppliers to be there when he plants to ensure better germination in future. He allows his animals to graze on the plots, then removes them and waters the cover crops to allow them to regrow as a new strategy. Before he used to cut and dry the cover crops as fodder. Both strategies work well for him. He feels more confident about which herbicides to use, as before he depended on what others said and made many mistakes. He now understands the difference between some of the types of herbicides.

Mr Khotso Moshoeshe: Mt Ayliff (1st year). *‘Despite the hail storm I had a good experience with CA and I am ready for the upcoming season. I had been told about CA before but hadn’t tried it, so I was a bit uneasy. I noticed that the soil was a lot cooler and moister in the CA plots and the maize grew sturdy and strong. The mixed crops grew better than my control. I now know how you spray, I’ve sprayed before as I have my own sprayer but obviously after CA demos I saw that I was not doing it correctly. I can now work with the amounts required for spraying different sized areas that we work with in CA’*

Cover crops (saia oats and fodder radish) were grown as a relay crop after the hailstorm and the small livestock were put into the plot to graze. If the growth and yields are better in the future, then Mr Moshoeshe will cut and feed it to his livestock and keep some for winter.



Summary of learning points for the CA participants

- Intercropping reduces the presence of weeds. Maize in the inter-cropped plot grows better and is greener than maize in single block plantings
- Soil fertility is described in terms of darker soil, more organic matter present and the presence of soil life such as earthworms. A few farmers commented on the texture being more crumbly and soils being less compacted.

- Farmers have noticed a definite decrease in soil erosion in their CA plots, as well as an increase in soil moisture in these plots as compared to their conventionally tilled plots.
- Mulching suppresses weeds and increases moisture and thus growth of the crops.
- Hybrid seed can withstand different conditions as they are specifically crossed to be able to do that.
- It is not good to keep hybrid seed for replanting.
- OPVs are similar to traditional seed and seed can be kept. That is good in these areas where people keep and plant their own seed.
- Herbicides help a lot and farmers have noticed fewer weeds and also fewer types of weeds being present over time. They have learnt not to spray herbicides on fully grown plants, as it does not work and also to be careful about the type of herbicide they use. Mid-season weeding is an issue on the larger plots, as hand weeding is not possible and there are very few herbicides that work on the mixed plots.
- Cover crops work quite well in out competing weeds and is a good strategy for weed control.
- Farmers would prefer to store their own harvests. Presently rats are a big problem.
- Farmers would prefer to use storage bins where they would control access and fumigate their seed also against other storage pests.
- Labour for land preparation, planting and harvesting is reduced. Labour for weeding however is increased in the CA process.
- Hand hoes are sometimes still the best way of planting as the MBLI planters struggle in hard dry soils and in the areas where the soil is very sandy the seeds end up being too shallow and wash out of the soil when the rains come.
- The conception in the area is that any field larger than around 1000m² would need tractors for ploughing. This is a significant difference to the conceptions of hand cultivatable land sizes in the Bergville area for example.

INNOVATION PLATFORMS

The members of learning groups are all members of local savings and credit groups in the Matatiele area. In Mzongwana a new savings and bulk buying group has been set up. From livelihoods information gleaned from the individual interviews the following small summary of livelihoods information can be made.

Livelihoods criteria	Units
Male/female ratio of participants	30/70
Average age of participants	54 years
No of household members	6
No of children/dependants	3
Average monthly income	R1 820,00 – grants and farming; 0% employment
Savings for input costs	R300 per participant
Provisioning of food from cropping	2-3 months
Cropping for household consumption	95%

From the above it can be seen that participants are all poor, living in large households and there is a high dependency on grants for incomes. This leads to a decreased ability to save money for buying inputs and cropping on a small scale.

Time was spent trying to liaise with the Eastern Cape Department of Agriculture to set up a collaborative relationship in the communal fields in a number of villages. These fields are generally planted by and through the Department, with farmers paying a subsidised amount for the service. Farmer assist with weeding and harvesting. The idea was to allocate certain portions of the fields to CA. The agreement was further that the Department would provide the Ongeluksnek study group with two no-till planters (2 row). Although promises

were made actual actions were unforthcoming. Similarly, the relationship with the Ongeluksnek study group collapsed due to lack of focus from the group.

A decision was made to pursue relationships in southern KZN as extension of this implementation site, given the present difficulties in implementing a model of farmer experimentation alongside a model where the government departments provide inputs as well as doing cultivation for the farmers.

A relationship was initiated with Mr Roy Dandala from KwaNalu (The KZN agricultural Union) and the CA team joined in during an open day for the Creighton area and gave an introductory input on CA. Farmers in this area were very interested in this approach and this area will be incorporated as a site going into the future.



Above left: Field visits during the KwaNalu farmers’ day in Creighton. Above right: Mazwi Dlamini from the CA SFIP team demonstrates the use of hand held planters to the community gathering during the KwaNalu open day.

In addition, a direct relationship with the Harry Gwala DM and the Ubuhlebezwe LM (local municipality) is being set up through discussions with the provincial managers of the DRDLR (Dept of Rural Development and Land Reform) and Mr Nqe Dlamini (from StratAct). The concept here is to implement the CA SFIP process in these municipalities as an example of a model of agricultural development that builds on the concept of farmer centres and agri-hubs. A forum involving all the role players in this process is to be set up in the coming growing season.

Sehutlong/Nkau farmers’ day

The farmers day was arranged and managed by the community in Sehutlong, supported by the local facilitator Bulelwa Dzingwa and hosted at Mrs Lebueoa’s homestead. Around 48 participants from the local area, including the Nkosi for Nkau who opened the day and encouraged involvement. Bulelwa gave a presentation of the process and principles and a number of farmers talked through their experiences with CA. The field



demonstrations were visited and explained and a power point presentation was done to discuss the Grain SA SFI programme, the trial considerations and farming options available.

Clockwise from top left: Participants in the tent

listening to a farmer's presentation; Bulelwa Dzingwa presenting her poster on CA; the power point presentation and discussions and a group of farmers visiting Mrs Futhu's field –

Below Right: Bulelwa is explaining the trial layout.



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.

Similar to the situation in the Bergville area, but even more pronounced is the weather dependence of the CA scoring system. As a number of participants had complete crop failure their scores have been a lot lower than in previous seasons.

Right: Sylvester Selala works with a number of smallholder farmers to demonstrate how to work out the percentage groundcover using the small wire quadrant shown in the picture.



The table below outlines the CA scores for the participants for the 2015-2016 planting season. Canopy cover is generally low due to lack of growth of the crops as is the crop growth percentage. The dry season did have the advantage of reducing pest incidence in the crops.

TABLE 9: THE CA SCORES FOR CA PARTICIPANTS IN THE EASTERN CAPE FOR THE 2015-2106 SEASON.

Surname	Name	No of years under CA	Ground cover percentage at planting	Canopy cover percentage (when?)	Weed presence on trial plot (when?)	Percentage of pest present on trial plot on assessment	Percentage crop growth (germination, height, leaf colour)	CA scores 2015 (out of 10)	CA scores 2014 (out of 10)	VSA scores

Futu	Matsepo	2	4%	15%	10%	90%	60%	3,58	5,40	13
Lebouea	Mamolelekeng	2	2%	5%	90%	90%	80%	5,34	6,50	14
Lebueoa	Malerato	1	4%		80%	90%	0%	4,35		
Dzingwa	Bulelwa	2	5%	15%	75%	90%	55%	4,80	6,00	11
Nkejane	Makemelo	1	5%	40%	40%	90%	40%	4,30		11
Ndlovu	Jacky	1	10%	5%	90%	90%	30%	4,50		11
Hlathi	Jabulani	1	10%	75%	10%	90%	0%	3,70		6
Sturuman	Nomzwakhe	1	9%	15%	70%	90%	25%	4,18		11
Ranqabang	Mapontsho	1	15%	20%	40%	90%	60%	4,50		9
Sturuman	Zanzima	1	5%	15%	60%	90%	45%	4,30		11
Mapheele	Tsoloane	3	10%	10%	55%	90%	15%	3,60	5,50	11
Dihholo	Thabiso	2	8%	15%	70%	90%	25%	4,16	5,00	11
Manyala	Mamasoka	1	2%	2%	100%	90%	0%	3,88		11
Makaula	MaMbhele	1	5%	20%	50%	90%	20%	3,70		
Mbunjana	Nomakhosazana	1	0%	10%	90%	90%	45%	4,70		9
Monkie	Matshezi	1	3%	2%	100%	90%	45%	4,80		8
Zondeki	Nolungile	1	3%	1%	100%	90%	0%	3,88		11
Thiyane	Patricia	1	10%	70%	10%	90%	25%	4,10		6
Ntontela	Vuyelwa	1	5%	5%	90%	90%	15%	4,10		11
Moshoeshoe	Kgotso	1	0%	2%	95%	90%	75%	5,24		13
Mncwabe	Themba	1	4%	4%	90%	90%	50%	4,76		11
Hadebe	Mngankosi	1	15%	15%	55%	90%	35%	4,20		9
Mzikayifani	Gcina	1	2%	5%	90%	90%	35%	4,44		

From this table it can be seen that the percentage ground cover at planting was low this season. The percentage canopy cover achieved by February 2016 (6-8weeks after planting) was also low due to lack for growth which is further seen in the percentage crop growth column. 0% Growth means total lack of germination and the low percentages of crop growth indicate that no yields were obtained for these participants. Only 9 out of 23 participants who planted this season realised any yields at all. Weed pressure was high as indicated in the percentage weed column. A number of farmers neglected to do weeding due to low germination and overall growth of their crops as they expected no harvests.

When comparing the ground cover and canopy cover with overall growth there is an expectation of finding similar trends, where good ground and canopy cover is reflected in good growth of the crops. This year, due to the extreme weather conditions however, these trends have been largely obscured. See the figure below

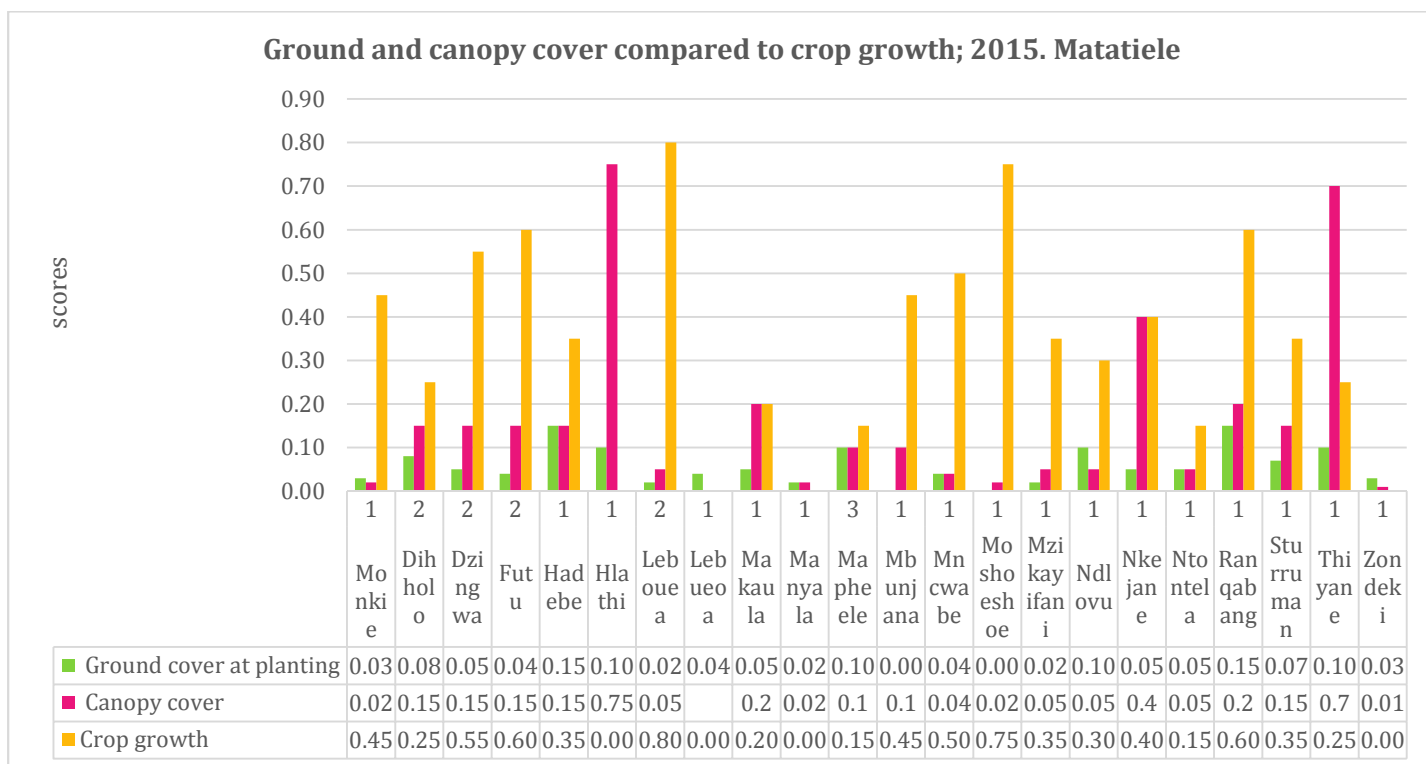


Figure 8: Comparison of ground and canopy cover scores with crop growth in Matatiele; 2015-2106 planting season.

The figure below compares the CA scores over three seasons with the maize and bean yields over that period. The sample size is somewhat small to make definitive conclusions but there is a clear upward trend in yields with average yields for beans being 0,42t/ha, 0,47t/ha and 0,69t/ha in 2013,2014 and 2015 respectively and the average yields for maize being 0,66t/ha, 0,87t/ha and 1,37t/ha for the same periods.

These is an equally clear downward trend in the CA scores. 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. 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 and should be based on implementation of the CA principles in cropping practices; such as soil cover crop diversification (inter-cropping and crop rotation) and inclusion of cover crops.

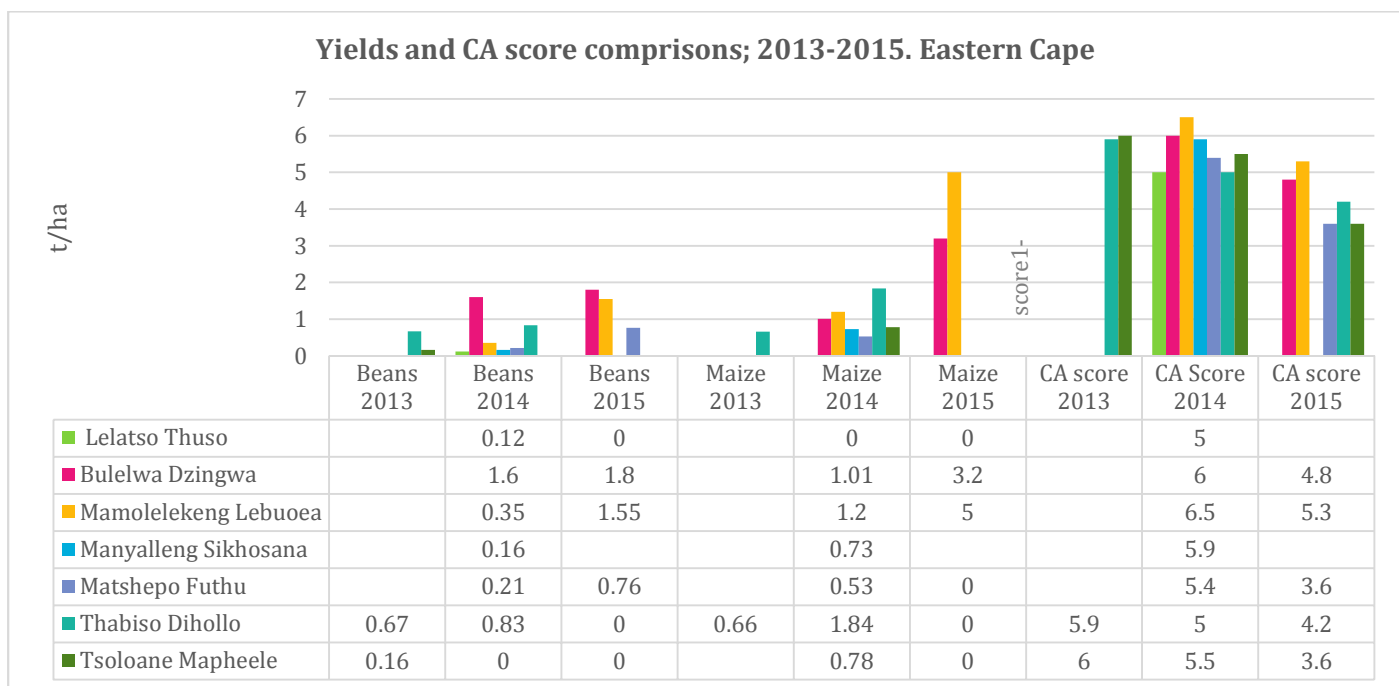


Figure9: Comparison of CA trial yields and CA scores over three seasons in the Eastern Cape.

When comparing the CA scores and the VSA scores we were interested to see whether the trends in using these two sets of scores are still similar to the trends noticed in previous seasons, as 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 and the scores fall within the same ranges as those presented in this table.

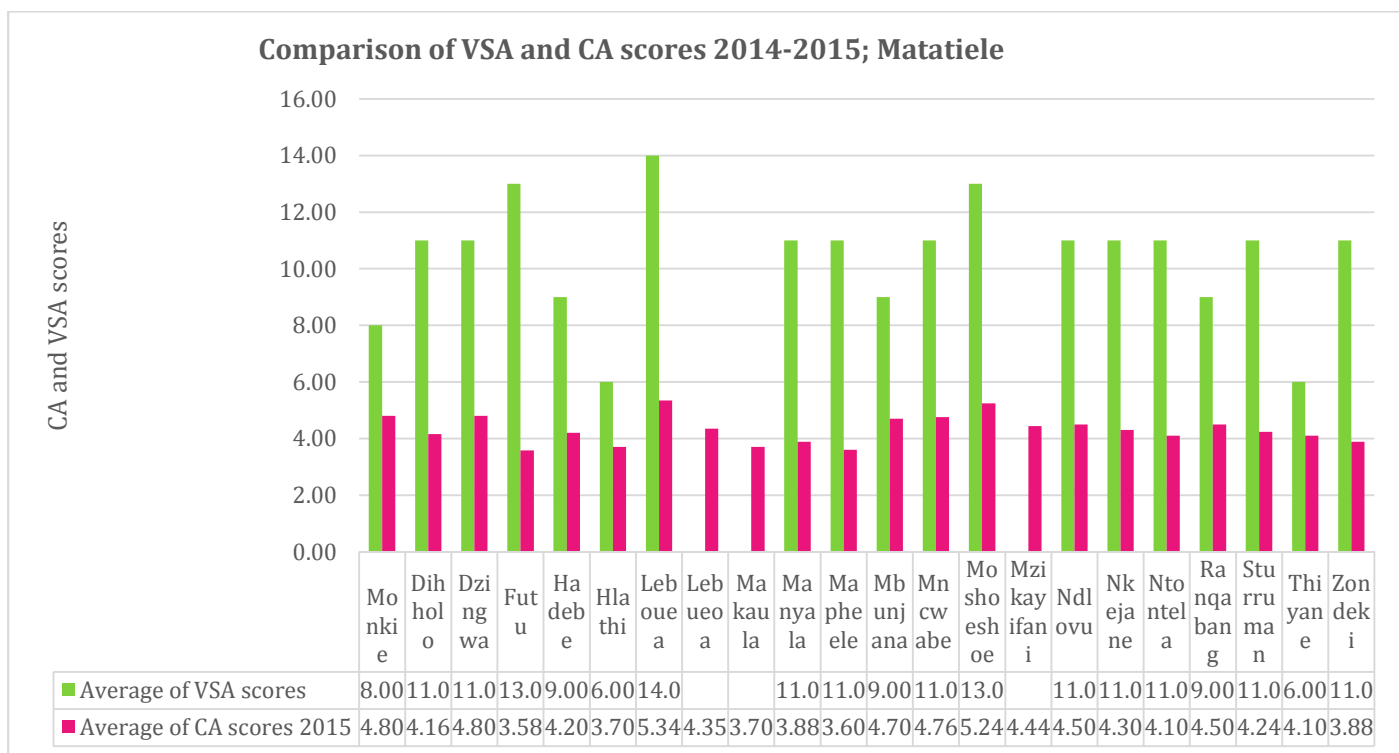


Figure 10: Comparison of VSA soil and CA scores for the 2015-2106 planting season in Matatiele.

These scores are all quite low, showing the below average performance of crop growth this year.

Considerations for future cycles

Generally the participation of farmers has been a lot better this season, but hampered by the extreme weather conditions. The relationship with Lima RDF has been fruitful and cooperative and will be continued into future seasons. Technically mulching has proved to be a key factor for the success of CA production systems in these settings and work will continue to improve this practice, as well as other CA principles. Water and soil conservation works will be included in the fields in future as it is a definite requirement. Work with cover crops and crop diversification is an ongoing process.

The process will be expanded into southern KZN in future cycles as working under the specific socio-political environment of the eastern Cape is considered unproductive at present. A focus on working with a limited number of innovative and interested larger smallholders is envisaged and also the inclusion of working with mechanised 2-row planters.

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

Matatiele Milestones: Farmer Centred Innovation in CA. July 2015-September 2016				INVOICES												Actual expenditure per budget item	Pd grainSA	TOTAL EXPENDITURE	
Milestones/Outputs	Key activities	OUTCOMES/DELIVERABLES	Budgets	Oct2015-Sept2016	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	August				September
<i>Farmer experimentation Matatiele</i>	Reporting, documentation, administration and sundries	Meeting and monthly reports	Administration and sundries	R 120 000,00	R 10 000,00	R 10 000,00	R 10 000,00	R 9 966,32	R 10 600,00	R 12 279,60	R 29 549,00		R 8 365,50	R 11 100,00			R 111 860,42		
	Farmer centred innovation systems (including inputs)	PID plans, awareness and training, delivery of inputs and materials	Farmer led experimentation	R 267 607,00	R 37 694,77	R 39 310,06	R 14 340,73	R 21 550,80	R 18 250,00	R 27 053,00	R 8 456,40	R 42 884,00	R 1 143,36	R 30 000,00			R 240 683,12		
	Innovation platforms and awareness	Stakeholder meetings, platform building events	Farmer led experimentation	R 10 000,00					R 6 509,28			R 4 440,17					R 10 949,45		
	Monitoring and evaluation, market based mechanisms, students and interns,	Monitoring forms, research outlines, workshop notes	Reporting and Administration	R 142 393,00	R 12 383,28	R 7 788,96	R 4 163,40		R 9 525,60	R 3 307,22	R 2 034,94	R 4 374,00	R 4 374,00	R 375,00			R 48 326,40		
Sub - TOTAL:				R 540 000,00	R 60 078,05	R 57 099,02	R 28 504,13	R 31 517,12	R 44 884,88	R 42 639,82	R 40 040,34	R 51 698,17	R 13 882,86	R 41 475,00	R 0,00	R 0,00	R 411 819,39		
	Work plan				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 36 398,00	R 36 398,00	R 47 794,00	R 383 012,00	R 63 395,40	R 475 214,79
	Difference														July remainder	R 41 497,37			
				Jul2015-Sept2015	July	August	September	October											
					R 40 480,40	R 38 174,90	R 51 381,54		R 130 036,84										
				R 106 749,00	R 33 916,34	R 38 916,33	R 33 916,33		R 106 749,00										
				TOTAL July 2015-Sept 2016	R 646 749,00														

An amount of R41 497,47 remains for August and September 2016. The project will be finalised within the allocated budget.

Appendix 2: Soil health test results for Matatiele; 2015.

AREA	NAME	DATE	SAMPLE	Soil pH	Organic matter %	CO ₂ -C (ppmC)	Organic C:N ratio	Total Org C (ppm)	PMN	N		Financial			Soil Health Score	Cover crop (legume/grass)		
									(potentially mineralizable N) ppm	Total N (ppm)	available (kg/ha)	value for P	K	difference				
Matatiele		Jul-15	Veld baseline samples	5,9	4,2	141,8	13,2	217	16,4	18,9	42,45	1,12	41,328	R 740,48	34,72	321,66	14,55	40/60
Sehutlong	Lelatsa Thuso	Jul-15	1st year intercrop trial	5,6	3,8	65,7	8,9	171	19,2	31,4	70,34	23,744	46,6	R 834,80	66,19	337,79	11,01	50/50
			1st year intercrop trial															
	Lelatsa Thuso	Jul-15	with cover crop	5,6	3,8	134,1	11,2	159	14,2	57,6	128,91	82,2	46,712	R 836,95	101,70	340,93	14,98	40/60
	Lelatsa Thuso	Jul-15	1st year control	5,7	3,9	74,6	12,9	185	14,3	65,9	147,62	108,9	38,752	R 694,33	46,59	337,83	9,03	60/40
	Matshupo Futu	Jul-15	1st year intercrop trial	5,2	2,3	47,8	10,8	109	10,1	11,7	30,80	6,7	24,08	R 431,44	20,72	152,43	6,53	70/30
			1st year intercrop trial															
	Matshupo Futu	Jul-15	with cover crop	5,3	2,8	141,8	10,7	119	11,1	16,2	33,94	8,3	25,65	R 459,54	63,17	179,31	15,6	30/70
	Matshupo Futu	Jul-15	1st year control	5,4	2,8	94,1	10,1	159	15,6	21	47,26	8,2	39,09	R 700,35	47,71	257,60	12,44	50/50
	Mamolelekeng Lebeoua	Jul-15	1st year intercrop trial	6,9	3,2	155,6	9,2	213	23,2	37,8	84,78	24,2	60,59	R 1 085,64	332,42	507,58	21,44	10/90
	Mamolelekeng Lebeoua	Jul-15	1st year control	6,1	3,1	86,3	12	180	15	54,2	121,52	83,6	37,97	R 680,28	91,17	556,30	10,51	50/50
			1st year intercrop trial															
	Manyalleng Sikhosana	Jul-15	with cover crop	5,5	2,5	113,2	9,5	130	13,6	21,7	48,61	16,4	32,26	R 577,94	62,72	215,71	14,52	40/60
	Manyalleng Sikhosana	Jul-15	1st year control	6	2,4	86,3	9,1	119	13	18,5	41,44	10,8	30,69	R 549,84	53,65	232,62	11,96	50/50
Khutsong	Tsoloane Mapheele	Jul-15	1st year intercrop trial	5,6	0,8	16,8	7,8	63	8,1	11,4	21,504	5,6	15,904	R 284,95	21,728	146,384	3,6	80/20
			1st year intercrop trial															
	Tsoloane Mapheele	Jul-15	with cover crop	5,9	1,3	39,8	7,5	89	11,8	17,9	40,32	11,4	28,92	R 518,16	52,192	147,28	7,36	70/30
	Tsoloane Mapheele	Jul-15	1st year control	6,2	0,9	34,7	7,2	81	11,3	16	35,728	7,6	28,128	R 503,97	40,656	179,984	6,75	70/30
Nkau	Bulelwa Dzingwa	Aug-15	1st year intercrop trial	4,9	3,6	98,1	8,4	133	15,8	45	100,688	52,64	48,048	R 860,88	87,024	145,04	14,54	40/60
	Bulelwa Dzingwa	Jul-15	1st year control	5	3,1	41,5	12,3	120	9,7	14,1	30,352	8,4	21,952	R 393,32	17,808	64,624	5,54	70/30

Appendix 3.1: 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 3.2: GrainSA Conservation Agriculture impact assessment questionnaire; July 2016

GENERAL INFORMATION

Name and surname.....M/F.....
 Area/VillageID 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 Why?
 1.
 2.
 3.
 4.
 5.
 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?

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?