Mission Report

Awareness Creation of Conservation Agriculture – TCP/SWA/2909

FAO

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1. Introduction

This report gives an overview about the activities developed in two of Swaziland's communities, Shewula and Kambhoke where the project "Awareness Creation of Conservation Agriculture – TCP/SWA/2909" has been carried out. Main findings, comments and suggestions are shown in order to have success with Conservation Agriculture in these two communities.

2. Farmer's training

One of the most important goals of this project was training the farmer's for adoption of Conservation Agriculture (CA). In this first phase of the project, the most important principles of CA were stressed to the farmers in meetings and field activities. The intensive farmer's participation in the whole process was one of most positive aspects of the project at this moment. It was made possible because before project start-up, the COSPE staff had already initiated very strong cooperative work with these communities. In this way, the farmer's hopes were focused on learning of these new agricultural concepts as they felt this will help them to solve one of their biggest problems –hunger. It is a very important step in order to have success in the project.

The farmer's were trained to operate Conservation Agriculture (CA) equipment such as the hand jab planter and animal traction planter. Also, they were trained to adjust different fertilizer and seeds rates in this equipment.

The farmers also learnt to build terraces and the importance of contour planting in order to increase soil moisture and avoid runoff.

Weed control was explained as a key component to establish CA. The importance of maize stand plant population and management of top dressing with nitrogen fertilization was stressed. The importance of residue management was frequently reinforced. After all, Brazilian no-tillage is based on high mulch addition. It is the key-stone to soil and moisture conservation and for nutrient recycling. Farmers understand very well these principles of CA and they are ready to start it in their farming.

These aspects are summarized in the sequence of this report.

3. Main Pre-requisites to adopt Conservation Agriculture.

3.1 Field preparation.

3.1.1 Stone removal.

In order to prevent damage to the conservation agriculture equipment, it is important to remove the stones prior to starting any operation. Some fields such as that of Mrs Jabu Mamba and Agnes Gumbi, had big stones that should be removed in order to allow the chisel plow to operate. The stones removed can be used to reinforce regular terraces, to build stones terraces or to reduce water runoff at the end of the terraces.

3.1.2 Breaking the soil compaction

When starting to introduce CA, it is very important to check for the presence of soil compaction. There are many techniques to do it; among the simplest ones are the observation of root system deformation and the resistance of knife penetration into the soil profile. In general, all the fields were diagnosed with a compacted layer at a depth of 12 to 18 cm. It was probably a consequence of many years operating a plow at the same depth. Besides that, the low organic matter, soil degradation and the lack of use of cover crops have all contributed towards maintaining the compacted layer along the years.

It is very important to break this compacted layer before starting CA. The reason for this is that in CA, if the soil is not mobilized vertically by equipment, then the compacted layer tends to persist for a long time, reducing the infiltration rate and the depth of plant the root system. In this way, a high concentration of nutrients is necessary to attend to the plant's demand. It means a high input of chemical fertilizer is necessary, something unaffordable in African conditions. Besides breaking mechanically the soil compaction, it is also important to use crops which develop rooting systems that promote soil aggregation and add organic matter at depth.

Breaking the soil compaction is a critical issue in order to allow water infiltration. The best season to do it is in October, just before the rainy season.

3.1.3 Breaking Soil Surface Sealing

In order to allow good conditions for the operation of the CA equipment, it is important to have a soil surface without rills (depressions on the soil surface) due to erosion or clods. In this way it is possible to keep the depth of seed deposition uniform. It is more critical for the performance of the animal drawn planter than for the hand jab planter.

In this project we made an adaptation to the chisel plow by adding an iron bar, trailed behind the implement. In this way, in just a single operation it was possible to break the compacted layer and at same time, to leave the soil micro- relief with little roughness. It was possible to save fuel, time, labor and soil moisture.

In most of the fields, we found the soil surface sealed. This is the result of many years of bare soil that allows the rain drops to fall directly onto the soil surface, so reducing infiltration, gas exchange and water storage capacity. Other causes of the sealed soil surface is over-grazing, a general problem in Africa. This sealing of the soil surface is an obstacle to germination and soil respiration, reducing the biological activity. After some years of CA, the mulch prevents the formation of soil surface sealing.

Avoiding soil surface sealing is another key point for the success of CA.

3.1.4 Terraces

Terraces are another very important component of CA. The terraces reduce runoff and increase infiltration. The terraces are important to keep plants along the contours. In CA, especially in the first few years when mulch production isn't high, the terrace is very important. The farmers were trained to build terraces using a pipe level, a very simple, economic and efficient technique. The first step is determining the declivity line. The second step is determining the slope. Based on the slope, the spacing of the terraces is established. Common spacing is between 20 and 40 m. The tractor driver was trained to build terraces. It was an important step as he had never built a terrace before. In Shewula, Domicio and William Masimula learnt very well how to build terraces. In Kambhoke Phineas and Bik Dlamini were also well trained. The farmers learnt to reinforce the terraces. One stone terrace, as an example, was built in Tandhie's field.

3.1.6 Weed control

In CA, it is very difficult to control perennial weeds like *Cynodon dactilum*. It demands a lot of chemical input to control. I had the opportunity, as FAO consultant to TCP/SAF/2902, to visit farmers in South Africa in dry areas where *Cynodon dactilum* infestation was the biggest problem in no-tillage system. This weed starts growing early in the rainy season with very low moisture. Then, when the farmers are planting their crops, this weed has already established itself and dominates in the field.

It is very important to keep this weed under control in Thandie's and Ennie's field. As herbicide is not a common practice in the Shewula community, we decided to control this weed using manual control and remove the residues from the area. This option was chosen with the farmer's participation.

After some years of using cover crops, the soil will be permanently covered and than the weed infestation will decrease.

Controling *Cynodon dactilum* is another key point to have success in CA. It is a strong recommendation to avoid that *Cynodon dactilum* be sprayed in the Shewula farms.

3.1.7 Cover crops

One very important aspect of the project is the use of cover crops, specially the ones that are native to the region. The cover crops will supply the amount of biomass necessary to increase the organic matter. The cover crops are a key component to avoid erosion. Another positive aspect of the use of cover crops is the reduction of the soil temperature during the day and as a consequence, the evaporation is reduced and soil moisture is retained. Legume cover crops will supply nitrogen through biological fixation. In the first years of CA, the organic matter content also needs to be increased and the cover crops will supply this demand of biomass. In the first years of CA, the demand for nitrogen is high and therefore it is important to use legumes as the most rational source to supply this initial demand. Another important aspect is that the legumes are a protein source to feed the local people.

3.1.8 Fertilization

The soil analysis in the Shewula fields showed that their pH is low to medium. This is acceptable to CA. Following the Brazilian Soil analysis, the calcium concentration < 2,0 cmolc L^{-1} is low, 2,1 – 4,0 $cmol_c$ L^{-1} is medium, > 4,0 $cmol_c$ L^{-1} is high. Therefore Duduzile and Thandie's fields are high in calcium. Otherside, Emely, Ennie and the Secondary School are medium. The magnesium concentration <0.5 $cmol_c$ L^{-1} is low, 0.6-1,0 $cmol_c$ L^{-1} is medium and >1,0 $cmol_c$ L^{-1} is high. All the fields had a high level of magnesium. The level of calcium and magnesium is adequate for legume crops, which demand a lot of these two nutrients. The potassium concentration > 80 mg L^{-1} is sufficient. Therefore, Emely, Ennie and the Secondary School are low in potassium concentration, specially Emely's field. Duduzile and Thandie's field are high in potassium. The phosphorus concentrations in all fields are low. It is a common characteristic of tropical soils from Brazil and Africa. Therefore, the chemical fertilization should be chosen to increase phosphorus availability. The organic matter lower than 2.5% is low, 2.5-5,0% is medium and >5.0% is high. Duduzile and Thandie's field are medium in organic matter, while Emely, Ennie and the Secondary School are low. In my opinion, there are problems with the results of organic matter in the Secondary school (too low) and with phosphorus in Ennie field (too high). This soil analysis should be repeated.

The amount of chemical fertilizer necessary is 5O kg ha^{-1} of P_20_5 and 60 kg ha^{-1} de K_2O. In general, the concentrations of nutrients in chemical fertilizer commercialized in the Swaziland market are low. The fertilizer bought had nitrogen 7%, phosphorus 10% e potassium 8%. With the farmers participation, we decided to use doses of fertilization that farmers could afford. Because of this, we

decided to apply 300 kg ha^{-1}. Therefore the total amount of nutrients applied will be 21, 30 and 24 kg ha^{-1} of nitrogen, phosphorus and potassium respectively. However, we recognize that the soil really needs at least double the fertilization actually applied to support high yields. With the amount of nutrients applied, probably we can achieve a maize yield of around 4 t ha^{-1}. This can be considered a satisfactory yield because some farmers are used to harvest only 1.5 kg ha^{-1}. One important point to consider about the Swaziland's fertilization strategy, is building the soil fertility in a longer term. Thus, even with a limited quantity of chemical fertilizer applied yearly, it will be possible to increase the nutrient concentration using cover crops and conservation agriculture. This is because CA will improve the recycling process, increase organic matter, biological activity and promote erosion control. In conclusion, CA and cover crops will increase the efficiency of chemical fertilizer.

Another possibility is to combine organic fertilizer, a common fertilizer in Africa, with chemical fertilizer. Besides increasing the nutrient supply, the organic fertilizer can help to restore physical and biological soil proprieties. This strategy will be used in the Kambhoke community. As labor and organic fertilizer are readily available in this community, this strategy will be economically viable.

The increase of soil fertility is a key point to the success of CA in Swaziland. It is necessary to achieve a minimum status of soil fertility in order to produce the amount of cover crop biomass that will provide the mulch to protect the soil and to build the soil organic matter. Then the system works by itself.

With the help of philosopher Giorgio, we formulated the statement that summarizes this thinking:

"Feed the soil to feed the people".

3.1.8 Top dressed nitrogen

At beginning of introduction and transformation to CA, the process of nitrogen immobilization is dominant over nitrogen mineralization. Besides that, the soil organic matter content was decreased by many years of conventional agriculture. As a consequence, the yield of maize can be limited by the nitrogen available. This process will last for a few years but when new organic matter content is achieved, the soil N availability will increase, thus the dependence of mineral nitrogen input will decrease.

Another point to be considered is that the legumes (mung bean, cowpea, mucuna, pigeon pea, etc…) will supply the major amount of nitrogen necessary to the crops and to build up the soil organic matter content. The nitrogen demand of maize can be cut by 50% if the maize is cropped after a legume cover crop. But this benefit of legume cover crosp will happen only in the following year. So, in the first year it will be necessary to add nitrogen input (either chemical or organic).

The summer conditions of Brazil and Africa are very favorable to N volatilization when urea is used as the main N source. In CA, this process can be even more intense than in conventional agriculture, especially if the fertilizer is applied broadcast on the soil surface. In dry and hot weather conditions, the urea-N volatilization can achieve more than 60% of total N applied.

In order to increase the efficiency of mineral nitrogen fertilization, it is recommend that the urea be applied close to the row of maize and when the soil is wet (before or after) a rain. Splitting the N fertilization into two applications is strongly recommended, the first application could be three to four weeks after the seed is planted and the second, four weeks later. It can be done when the farmers are undertaking manual weed control, adding soil over the fertilizer. The rate of nitrogen should be at least 50 kg ha^{-1} of urea (22,5 kg of N ha^{-1}) in each application. The total amount of nitrogen fertilizer

will be 2 bags ha^{-1}. In this range of nitrogen application, we can expect 30 to 40 kg of maize to each kg of N applied.

The top dressed nitrogen is a keystone to increase the maize yield in the first years of CA.

3.1.9 Evaluation of the maize population

Maize is very susceptible to low population. The stand of plants in Swaziland should be in the range of 40.000 to 50.000 plants ha^{-1}. The maize population shouldn't be higher because there are fertilizer and water limitations, and then the risk of competition is high. For example, a dry season with high maize population would be a disaster. On the other hand, the maize population shouldn't be lower than 40.000 plants ha^{-1} because in the regular rainfall years, the yield will be limited by poor stands. Using the hand jab planter is very practical to correct the plant population. The ideal period to replant is during the two weeks after emergence. It is strongly recommendation that farmers do an evaluation of the plant population in their fields. A practical way to check the plant population is using a ruler stick 1,0 m in length. Then the maize population should be 4 to 5 plants m^{-1}, with a spacing of 1 m between rows.

3.1.10 Critical weed competition period for maize

Maize is a crop very susceptible to weed competition, especially during the first 45 days. This means that the maize potential yield is defined at an early stage of the growing season. The weed competition to nutrients and water is a problem in Swaziland because these resources are very scarce. If the weeds take them up before the maize, the yield will be seriously decreased. In order to achieve the maize yield projected it is very important to plan two or three manual weeding controls. The first one would be around 20 days and the second at 40 days. Keeping the fields free of weeds is an important strategy to get the maximum return in food production with the rainfall available.

Manual weed control is important in this first year when we don't have soil cover by mulch. In the following years the mulch will help to control the weeds.

4. Soil organic matter functions in CA

One very important point to the success of CA is building the soil organic matter (SOM). The SOM is very important to improve soil quality and cut the inputs in Swaziland. The SOM is a source of N, S and micronutrients. The SOM, in tropical soil, is important to increase the CEC (Cations exchange capacity), 60 to 80% of soil CEC is due to organic matter content. When the CEC increases, the soil will hold the nutrients added by chemical fertilizer, preventing the leaching. The SOM is very important to increase the infiltration by improving the soil aggregation. The infiltration capacity is critical in limited rainfall conditions. Another important process is the increase of moisture holding capacity provide by SOM. Therefore, if the soil has moisture, the fertilizer will be used more efficiently. The SOM is very important to improve soil biology. The soil biology will help to keep the soil physics in good condition in the absence of soil tillage. This way, the root system will develop better and again the fertilizer will be used more efficiently.

The use of cover crops and mulch are the main strategy to build SOM. It is very important to avoid the animals grazing the stubble. Therefore fencing is a critical issue for the success of CA in Swaziland.

In Brazil the no-till farmers have a saying:

"The grain is to man, the stubble is to soil".

5. Final Comments

The general evaluation about the establishment of the project "**Awareness Creation of Conservation Agriculture"** is positive. The farmers were trained, some Unit Test Validation's were established and principles of CA were well understood. There are still some activities that must be done in order to have success in our project. Most of these were stressed in this report. Although we had some limitation about climatic conditions (lack of rain) and equipment availability, the support of COSPE staff and the farmers' dedication helped to overcome any limitations.

6. Acknowledgements

I would like to express my deeply felt acknowledgement to FAO for the opportunity, to Ademir Calegari for the invitation and his confidence in my work, to Giorgio Menchini, Francesca Nicolai and Lisa Zannerini for their assistance in Swaziland, to the wonderful Shewula and Kambhoke farmers for their dedication in learning the principles of CA, to Ruy Casão for his comprehension and friendship, and finally to John Ashburner for his technical support.

7. Annex

List of participants

Shewula Community

1. Ndumiso Masimula – Shewula – Field Co-ordinator – Steering Committee member
2. Thandie Mabila – Shewula – Field Supervisor
3. Dduduzile Nhlabatsi – Shewula – Agricultural Facilitator
4. Margaret Dladla - Shewula – Agricultural Facilitator
5. William Masimula - Shewula – Agricultural Facilitator
6. Franzina Sambo - Shewula – Agricultural Facilitator
7. Ennie Tfumbatsi - Shewula – Agricultural Facilitator
8. Catherine Mfukoen - Shewula – Agricultural Facilitator
9. Emely Dladla- Shewula – Agricultural Facilitator
10. Catherina Magagula- Shewula – Agricultural Facilitator
11. Khisimuzi Dlamini – Shewula – Rural extension officer
12. Peter Khathawanes – Shewula – Rural extension officer
13. Coleen Mamba – Kambhoke – Field Supervisor
14. Katherine Mamba – Kambhoke – Agricultural Facilitator
15. Agnes Kumbi – Kambhoke – Agricultural Facilitator
16. Nester Mabaso - Kambhoke – Agricultural Facilitator
17. Lot Mamba - Kambhoke – Agricultural Facilitator
18. Dumasane Simelane - Kambhoke – Agricultural Facilitator
19. Sipho B. Dlamini – Kambhoke – Rural extension officer
20. Fineas Mabusa – Kambhoke – Rural Extension officer
21. Sipho Mamba – Khamboke – Steering Committee Member

Mozambique

1. Sergio Mondlane – Goba – Agricultural Facilitator
2. Jose' Domingo Boane – Goba – Agricultural Facilitator
3. Joao Fernando – Goba – Agricultural Facilitator

Kambhoke Community

1. Boy Mamba
2. Petros Gumbi
3. Masitsela Dvuba
4. Dumisami M. Simelame
5. Nomusa Khumaso
6. Nester Mabaso
7. Jabu Mamba
8. Collen Mamba
9. Agnes Gumbi
10. Luck Gamebze
11. Sipho Dlamini
12. Phireas Mabuza
13. Lottic Mamba
14. Cathrine Mamba

15. Bik Dlamini
16. Peter Khathware (Extension office)

Table 1 FIELD CARACTERISTICS IN SHEWULA COMMUNITY

FIELD	FARMER	Landscape	Soil Texture	Soil Fertility	Organic matter	Soil compaction	Capacity of retention of water	Presence of stones and weeds	Depth of soil	Impediments to the mechanization
1	**Mrs Duduzile Nhlabatsi**	Gently slope	Clay	Regular	Good	Presence at 15 cm	High	A little stones	> 60 cm	Low
2	**Mrs Thandie Mabila**	High slope	Clay	Regular	Good	Presence at 15 cm	High	Frequent stones > 20 cm and perennial weeds	> 60 cm	High
3	**Mrs Emely Dladla**	Gently slope	Loam sandy	Limited	Regular	Presence at 15 cm	Limited	Frequent stones < 10 mm	> 60 cm	Low
4	**Mrs Ennie Tfumbatsi**	High slope	Loam sandy	Limited P looks a mistake	Low	Presence at 15 cm	Limited	A little stones and permanents weeds	> 60 cm	Regular
5	**Secondary School**	Gently slope	Loam clay	Regular	Very Low Looks a mistake	Presence at 15 cm	High	Frequent stones > 20 cm and permanents weeds	> 60 cm	Low

Table 2 FIELD CARACTERISTICS IN KAMBHOKE COMMUNITY

FIELD	FARMER	Landscape	Amount of clay	Soil Fertility	Organic matter	Soil compaction	Capacity of retention of water	Presence of stones and weeds	Depth of soil	Impediments to the mechanization
1A	**Mrs Jabu Mamba**	High slope	Clay	Good	Regular	Presence at 15 cm	High	Frequent stones > 20 cm	> 60 cm	Regular to high
2A	**Mrs Agnes Gumbi**	Gently slope	Clay	Good	Low	Presence at 15 cm	High	Few stones > 20 cm	> 60 cm	Low
3A	**Mrs Mester Mabaso**	High slope	Loam sandy	Limited	Low	Presence at 10-15 cm	Limited	Few stones > 20 cm	> 60 cm	Low

Table 3. Shewula's soil chemical analysis.

Field	pH	pH	Exch. Cations			P		
			Ca	Mg	K			
	(Water)	($CaCl_2$)	$cmol_c\ kg^{-1}$			$mg.kg^{-1}$	%C	%SOM
Mrs Duduzile	5.6	5.2	6.64	2.88	0.73	4.5	1.74	2.90
Mrs Thandie	5.6	5.1	5.90	3.07	0.95	5.3	1.96	3.38
Mrs Emely	5.1	4.5	2.16	2.41	0.28	7.5	1.32	2.28
Mrs Ennie	5.4	4.8	2.85	1.87	0.59	21.8	0.70	1.21
S. school	5.7	5.1	2.23	1.36	0.47	7.6	0.15	0.28

Table 4 ACTION PLAN TO SHEWULA COMMUNITY

SITE	FARMER	Crops sequence	Spacing	Density (seeds/m)	Recommendations	Traction in sowing
1A	**Mrs Duduzile Nhlabatsi**	Maize + peanuts, after peanuts harvesting / lab lab	1 meter between rows for each crop	Maize: 6-8 Peanuts: 15-20 Lab lab: 20-25	Ripper Terraces Fencing area	Tractor, animal or manual
1B		Sorghum, after 40 days seed mucuna pruriens	1 meter between rows for each crop	Sorghum: 15-20 Mucuna: 8-10		
2A	**Mrs Thandie Mabila**	Maize + (jugo bean+mucuna pruriens) intercropped 40 days after maize	Maize: 1 m Jugo bean: 2 m Mucuna: 2 m	Maize: 6-8 Jugo bean: 20-25 Mucuna: 8-10	Ripper Terraces Fencing area	Animal or manual
2B		Cowpea, after harvest will seed finger millet	0,5 meter between rows	Cowpea: 20-25 Finger millet: 50-70		
3A	**Mrs Emely Dladla**	Pear millet+cowpea, after cowpea will seed pigeon pea+mucuna	Pear millet: 1m Cowpea: 1m Pigeon pea: 2m Mucuna: 2m	Pear millet: 30 Cowpea: 20-25 Piegon pea: 20-25 Mucuna: 8-10	Ripper 30 cm Terraces Fencing area	Tractor, animal or manual
3B		Sorghum+jugo bean, 30-40 days intercropped mucuna	1 meter between rows for each crop	Sorghum: 15-20 Jugo bean: 20-25 Mucuna: 8-10		
4A	**Mrs Ennie Tfumbatsi**	Maize + pigeon pea	1 meter between rows for each crop	Maize: 6-8 Pigeon pea: 20-25	Ripper Terraces Fencing area	Tractor, animal or manual
4B		Sorghum + mung bean, after mung bean will seed lab lab		Sorghum: 15-20 Mung bean: 20-25 Lab lab: 20-25		
5A	**Secondary School**	Cassava + lab lab	1,5 meter between rows	Cassava: 3-4 sticks/m Lab lab: 20-25	Ripper Terraces Fencing area	Tractor, animal or manual
5B		Sesame + pear millet	1 meter between rows	Sesame: 20-25 Pear millet: 30		
5C		Sunflower + finger millet	1 meter between rows	Sunflower: 10-15 Finger millet: 50-70		

5D		Seed multiplication Field: Pigeon pea Mucuna Lab lab Cowpea Mung bean Pear Millet Finger Millet Jugo bean	 Pigeon pea: 0,6-0,8 Mucuna: 0,8-1,5 Lab lab: 0,6-0,8 Cowpea: 0,5 Mung bean; 0,5 Pear Millet: 0,7-1,0 Finger Millet:0,5 Jugo bean: 0,5	 Pigeon pea: 20-25 Mucuna: 8-10 Lab lab: 20-25 Cowpea: 20-25 Mung bean; 20-25 Pear Millet: 30 Finger Millet: 50-70 Jugo bean: 20-25		

Table 5 ACTION PLAN TO KAMBHOKE COMMUNITY

SITE	FARMER	Crops sequence	Spacing	Density (seeds/m)	Recommend-ations	Traction to sow
1A	**Mrs Jabu Mamba**	Maize + cowpea, after harvesting cowpea will seed mucuna	1 meter between rows for each crop	Maize: 6-8 Cowpea: 20-25 Mucuna: 8-10	Remove stones Terraces Fencing area	Tractor, animal or manual
1B		Sugar bean, after harvesting will seed finger millet	0,5 meter between rows	Sugar bean: 14-18 Finger millet: 50-70		
2A	**Mrs Agnes Gumbi**	Sorghum+cowpea, after cowpea harvesting will seed mucuna	1 meter between rows for each crop	Sorghum: 15-20 Cowpea: 20-25 Mucuna: 8-10	Ripper Terraces Fencing area	Tractor, animal or manual
2B		Maize + pigeon pea	1 meter between rows for each crop	Maize: 6-8 Pigeon pea: 20-25		
3A	**Mrs Mester Mabaso**	Pearl millet, after 40 days intercropped mucuna	1 meter between rows	Pearl millet: 30 Mucuna: 8-10	Terraces Fencing area	Tractor, animal or manual
3B		Maize, after 40 days intercropped lab lab	1 meter between rows	Maize: 6-8 Lab lab: 20-25		
4	**Seeds production**	Pigeon pea	0,6-0,8	20-25	Terraces Fencing area	Tractor, animal or manual
		Lab lab	0,6-0,8	20-25		
		Mung bean	0,5	20-25		
		Jugo bean	0,5	20-25		

Table 6. Activities developed in the project "**Awareness Creation of Conservation Agriculture– TCP/SWA/2909"**

Data	Place/institution	Activity	Comment
14/10	Mbabane	Arrive	
14/10	FAO office	Presentation	
14/10	University of Mbabane	Send soil to analysis	Shewula samples
14/10	Mbabane/Cospe	Staff presentation Plan Action	Ademir, Giorgio, Francesca, Phillip, Lisa.
15/10	Kambhoke community	Farmers' meeting	Giorgio introduce the consultants Ademir explain about Principles of Conservation Agriculture (CA) Telmo explains the functions of soil organic matter in CA Casão explains the equipments used in no-tillage farms in LA.
15/10	Kambhoke community	Farmers' meeting	Analysis of opportunities/advantages and disadvantages
15/10	Kambhoke community	Farmers' field	Field selection to Unit Test of Validation (UTV)
16, 17 e18/10	Kambhoke community	Farmers' field	Soil description – texture, depth, agriculture potential, water infiltration, slope, SOM, limitation to CA adoption, soil cover estimation.
20/10	Shewula community	Farmers' meeting	Giorgio, Telmo and Casão made the same presentation did in Kambhoke about SOM, small farm equipments
20/10	Shewula community	Farmers' field	Soil description – texture, depth, agriculture potential, water infiltration, slope, SOM, limitation to CA adoption, soil cover estimation.
21/10	Shewula community	Ms. Emille' field	Chisel plow and remove small stones. Chisel plow was adapted a tail in order to allow the seedling without any other tillage operation The depth of chisel operation was 12-18 cm. Speed 5 km h^{-1} and chisel spacing 30 cm with 5 chisel. Slope 3%, sandy loam soil.
		Secondary School	Chisel plow, the depth was 12 to 20 cm.

			Chisel works with 4 chisel, 40 cm spacing. Stones were removed. Students were informed about the activities. Loam clay soil with organic matter medium.
		Ennies' Field	Eliminate Small infestation of Cynodon dactilum Manual control of weed infestation Chisel plow, 12 to 20 cm depth. Remove stones. Clay soil with 12% slope. Remove stones. Terraces were building with 20 m spacing. Terraces were seeded by hand jab planter.
		Duduzile' Field	Training the farmers how to set terraces with pipe level. Training the tractor driver to build terraces. Field slope 7%. Chisel plow 12 to 20 cm. Stones were removed. Loam clay soil.
		Thandie's field	Clay soil, stones, with 13% slope. Severe weed infestation, hand control and burn the residues. Terraces with spacing of 15 to 18 m. Terraces were reinforcing by hand where have old rills of erosion. Terraces were seeded using hand jab planter
24/10	Shewula	Farmer's Meeting	Telmo explain the pre-requisites to start no-tillage Ruy explains about the equipments Giorgio planning action to next week.
28/10	Mbabane		Buy chemical fertilizer to Kambhoke. Formula 7-10-8.
	Kambhoke	Farmer's meeting	Planning activities Chisel plow, build terraces, training hand jab planter, animal planter, and germination test.

		Jabu Mamba's Field	Remove stones. Two terraces were building. Chisel plow 12 to 18 cm depth. Chisel with 5 chisels. There was problem with residues accumulation in the chisels.
		Mabaso's Field	The field was very compacted. Speed 3 km h^{-1}. The result of tillage let some clods, due to dry soil condition. Build terraces
		Agnes' Field	Remove stones and chisel the field. Training farmer's to operate hand jab planter and animal traction. Maize was set to drop 7 seeds/m (animal traction) Fertilizer rate was 300 kg ha^{-1} Mung bean 25 seeds/m (hand jab planter) Fertilizer 15 g/m or 3.7 g/hole Sorghum 60 seeds/m (hand jab planter) Cowpea 20 seeds/m (animal traction)
31/10		Farmer's meeting	Review the following items: Terraces – importance, how to build. Counter planter - – importance. Operate hand jab planter – seed and fertilizer regulations. Operate animal plant – seed and fertilizer regulations. Operate chisel plow- importance, how to do. Prepare the field to CA – prerequisites. Fertilization – rates, importance.
		Future Plan Action	Build terraces in other fields Seed Mrs Mabaso Field Verify the germination in Jabu Mamba and Agnes Field Establish check plots in Mabaso, Agnes and Jabu Mamba. Establish fences. Organic fertilizer in UTV's
01/11	Mbabane	Repair shop	Adapt the seed disc of hand jab planter to small seeds

03/11	Kambhoke		
		Farmers meeting	Plan action
		Tandhie's Field	Maize and cowpea seeded with hand jab planter Cowpea spacing 0,5 m fertilizer rate 15 g/m Maize 1,0 m spacing fertilizer rate 30 g/m Build one stone terrace.
		Ennie's Field	Seeding with animal planter. Training farmer to evaluate of stand plant in order to reseed or remove plants in excess.
05/11		Duduzile's Field	Manual weed control.
		Farmers' meeting	Review the following items: Terraces – importance, how to build. Counter planter - – importance. Operate hand jab planter – seed and fertilizer regulations. Operate animal plant – seed and fertilizer regulations. Operate chisel plow- importance, how to do. Prepare the field to CA – prerequisites. Fertilization – rates, importance.
		Future Plan Action	
06/11	Leaving		