

Project number	M106/80
Project title	Revitalising cropping systems in selected areas of Limpopo and Mpumalanga through conservation agriculture (CA)
Project manager	APN du Toit
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Project status	Completed
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### **Final abstract**

On-farm experimental plots were established to serve as focus points to verify the potential of conservation agriculture (CA) as an alternative to the conventional production system. Due to repeated seasonal dry spells, the experiments resulted in data of limited value. However, the valuable learning opportunities created by the project, made a significant contribution to increase the knowledge and practical experience of all involved. Purposeful interaction with farmers at various occasions clearly indicated that farmers have become more aware and knowledgeable about specific technologies and practices. Although farmers responded positively on some of the advantages of CA, they were also concerned about the limitations of CA and the obstacles they will have to overcome to implement the new system. A shift towards the adoption of CA among this group of farmers is likely to be slow and much more time and effort is needed to give proper support to farmers who might consider CA as an alternative production system.

### **Keywords**

Conservation agriculture, soil degradation, soil quality, on-farm experiments, farmer groups, farmer field schools.

## **1. Introduction**

The sustainability and economic viability of many farming communities in rural South Africa are at stake. As low grain production levels at the selected target areas prevail, the project was designed to investigate an alternative production system to replace the traditional approach to grain production. One important motivation to establish CA as an alternative production system is to stop the degradation of soils as this natural resource is the foundation of agricultural production. Many soil and crop scientists today agree that the rigorous manipulation of soil by means of the traditional mouldboard plough is the fundamental cause of soil degradation. CA is regarded as an approach that can make a significant contribution to replenish the soil towards its original vigorous state. In this way sustainability of production can be restored.

In addition, it is argued that the Implementation of a well-tested and appropriate CA system is regarded as the best way to revitalise crop production in the selected target areas. CA as opposed to conventional cultivation practices implies a significant reduction in soil tillage actions, improved soil water conservation, increased soil quality and input-cost savings. These effects of CA in turn have the potential to improve crop yields, increase profit margins and contribute to lower risks as crop performance stabilises. Increased production levels and profitability at lower risk can motivate benefiting farmers to opt for commercialisation of their systems and in so doing, to enjoy a higher living standard.

At the beginning of the project it was envisaged that the project will make a significant contribution to increased grain production and soil conservation in the selected (7) target areas. This long term objective was to be obtained by testing and promoting the CA system comparing it to the conventional methods applied by participating farmers. This objective, however, proved not to be achieved in a span of four production seasons.

## **2. Material and methods**

### **2.1 On-farm experimentation**

On-farm experimentation is a form of adaptive research in which the technology is tested on the farmer's doorstep. It provides an opportunity for farmers to participate in the process of technology development. As such, the experimental plots also serve as communication platforms to ensure effective interaction between researchers, extension workers and farmers.

#### CA Experimental plots:

In these experiments, conventional agronomical practices were compared to CA practices in terms of soil preparation, soil surface protection, planting methods and specialized planters, weed control practices and yield level. The emphasis was on CA as an integrated production system built on the three basic principles of minimum soil disturbance (reduced tillage or no-till), establishment of an organic soil cover and crop rotation.

#### Crop management trials:

In addition, various crop management trials were planted in order to promote good production practices. These trials were planted at project localities where CA trials were not planted.

### **2.2 Communication and training**

Effective communication and interaction with farmers was adopted as an important key focus area of the project. The farmer's opinion was rated high through all stages of the project. Experiential learning and regular reflection during the implementation phase ensured active farmer participation and continuous flow of communication among all parties.

#### Farmer field schools:

These hands-on training sessions, from planting stage to harvesting, served to expose farmer groups to the technologies investigated and the cropping practices applied.

#### Feed-back and planning sessions:

These events which normally occurred in August and September, provided opportunities to both farmers and project management team to reflect together on all project results and activities. These sessions also served as occasions of decision making in terms of project re-planning, change of project direction or objectives as well as recommendations on the technical level.

### 2.3 Diagnostic survey and land use planning

In September 2009 a soil and climate characterization was done at three of the original targeted farming units. This survey undertaken by the ARC-ISCW served to provide valuable diagnostic information with regards to soil potential and land use approaches at the respective farming units (ARC-ISCW Report no.GW/A/2009/78).

### 2.4 Monitoring and evaluation

Two farmer focus group interviews were conducted as a mid-term investigation into the opinions and perceptions of farmers on the two production systems compared in the project (CA and the conventional system). This was seen as a monitoring and evaluation of the project since the farmers were able to provide valuable insight into their views on CA as compared to the conventional system. Their active participation in the interviews gave a good indication of their knowledge level of the topic concerned.

### 3. Results and discussion

#### 3.1 On-farm CA experiments (see Table 1):

A total of 10 on-farm experiments on CA, at four localities, were planted with variable results. Unfavourable climatic conditions at some of the trial sites, in 2010, 2011 and 2012, had a serious impact on the results that were obtained.

##### Limpopo - Tafelkop

During the first three seasons of the experiment (2008/09 - 2010/11) the no-till plots performed progressively better than the conventional plots which had a declining trend towards the third season. In the 2011/12 season a severe drought caused the very poor yield results obtained. Due to the poor soil nutrient status of the soil at the Tafelkop trial plot, a purposeful effort was made to improve the fertility of the soil. Additional phosphorus and potassium were applied. The low pH of the soil (4.5 KCl) and the relative high level of acid saturation (10.42) required the application of lime at a rate of 5000 kg ha<sup>-1</sup> applied over two seasons.

##### Mpumalanga - JS Maroka Municipality

Apart from the 2008/09 production season (See results at Koedoeport, the original CA site selected) experiments were marked by poor yield results despite the selection of soils very suitable for maize production as well as the application of good production practices. At the end of the 2011/12 season, due to a severe dry period in February and March, no crops were harvested at the experimental sites of Diekeng and Nokaneng.

Table 1 Maize crop yield results at four localities (2008/09 - 2011/12)

Province/Locality	Production season	Conventional (kg ha <sup>-1</sup> )	Reduced tillage (kg ha <sup>-1</sup> )	No-till (kg ha <sup>-1</sup> )
<b>Limpopo</b>				
Tafelkop	2008/09	2978	3064	2029
	2009/10	2109	2503	2579
	2010/11	1715	-	2794
	2011/12*	1046 (1374)**	-	990*
<b>Mpumalanga</b>				
Koedoespoort	2008/09	5422	-	4234
Nokaneng	2009/10*	1372	1567	1760
Diekeng	2010/11*	1234	-	1910

\* During these production seasons, very dry conditions occurred during the reproduction stages of the crop at the respective locations (dry spells specifically in February).

\*\* The slightly better yield reported in brackets is the result of the rotational effect of cowpea on maize (cowpea planted in the 2010/11 season on a portion of the trial plot)

### 3.2 Mid-term evaluation

In March 2010 two farmer focus group interviews were conducted. This was seen as a mid-term monitoring and evaluation activity in which the majority of participating farmers took part. Farmers were given the opportunity to express their views on CA as an alternative to the conventional approach. Although farmers identified a number of advantages of CA to come forward, they were more concerned about the limitations of CA and the obstacles they will have to overcome to implement the new system. The investigation clearly indicated that much more time and effort is needed to give proper support to those farmers who might consider CA as an alternative production system.

### 3.3 Communication and training of farmers

Although seven farmer groups (104 project beneficiaries) were identified to participate in the project some groups were combined while some discontinued their participation which resulted in four target groups involved during the period 2010 - 2012. Table 2 gives a summary of the activities that took place in order to ensure active farmer involvement in the project.

Table 2 Interaction with farmer groups (2010 - 2012)

Project year	Locality	Farmer field schools/training sessions (February - April)	Feedback and planning sessions (August - September)
		<b>Number of farmers reached</b>	
<b>2010</b>	Nokaneng	44	23
	Diekeng	16	25
	Troya	-	20
	Tafelkop	32	27
	Legolaneng	31	-
<b>Total</b>		<b>123</b>	<b>95</b>
<b>2011</b>	Nokaneng	42	-
	Diekeng	24	20
	Tafelkop	44	29
	Legolaneng	14	23
<b>Total</b>		<b>124</b>	<b>72</b>
<b>2012</b>	Nokaneng	16	Project discontinued
	Diekeng	21	-
	Tafelkop	24	-
	Legolaneng	31	-
<b>Total</b>		<b>92</b>	

A significant overall result achieved with the project is an increased level of awareness and knowledge gained in terms of crop production in general and CA as an alternative practice in particular. The exposure of farmers to CA principles and practices through

the farmer field schools and other events, created a learning environment in which farmers could gain practical, hands-on experience of the advantages and constraints of the production systems tested.

Purposeful interaction with target farmers at various occasions (see Table 2) clearly indicates that farmers have become more aware and knowledgeable about the following technologies and practices:

- **No-till planters**  
The Vence Tudo no-till planter purchased in 2010 (in the first two seasons of the project a demonstration model was used) served as a valuable example of no-till equipment available. Used to plant all the experimental plots, farmers gained hands-on experience of the planter's mechanism and performance.
- **Spraying equipment for the application of chemical products**  
Various small-scale sprayers, including boom sprayers were used to apply various herbicide products at the experimental sites.
- **Weed control practices**  
Effective weed control practices remain a crucial component of the CA system. Much emphasis was placed on this aspect. Pre- plant weed control practices as well as pre-emergence and post emergence herbicides were applied in the on-farm experiments. These activities motivated some of the participating farmers to do their own experiments with some of the herbicides in their own fields.
- **Roundup ready maize cultivars**  
The advantages of Roundup Ready maize varieties, such as PAN 6P-563R, were clearly demonstrated in the on-farm experiments. The application of glyphosate products such as Roundup served as good examples of what can be achieved with this form of advanced technology.
- **Management of crop residue and mulches (soil cover)**  
The establishment and maintenance of a soil cover was a prominent component of the experiments. As a result of the no-till practices applied farmers could observe and monitor the level of soil cover development. Due to the dry conditions during most of the seasons and the low yield levels as a result, the development of a soil cover proved to be one of the difficulties of the CA system, especially in low rainfall areas.

- The role and value of legumes in crop rotation systems

A purposeful attempt was made to promote the value of grain legumes in rotation with maize in a CA system. As some legume crops such as groundnut (*Arachis hypogaea L.*) and cowpea (*Vigna unguiculata (L.) Walp.*) were planted in rotation with maize in the CA experiments, farmers became aware of the advantages of these grain legumes in a rotation system. Table 3 is a clear illustration of the role these legumes can play to improve maize production.

Table 3 The effect of legume crops in rotation with maize on the yield of maize at Tafelkop 2011/12 production season.

Treatment	Yield of maize (kg ha <sup>-1</sup> )
Maize in rotation with Cowpea	2 246
Maize in mono culture**	893
Maize in rotation with groundnut	2 933

\* A limited amount to the equivalent of 20 kg ha<sup>-1</sup> was applied to all treatments

\*\* The low yield of maize in the mono culture plot was also negatively affected by the occurrence of a high infestation of witch weed (*Striga asiatica*), also the result of mono cropping.

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