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APPENDIX 4:
MAHIKENG ANNUAL PROGRESS REPORT
Participatory systems research on conservation
agriculture (CA) with the Mahikeng study group in
the Ngaka Modiri Molema District Municipality,
North West Province



September 2023

ANNUAL PROGRESS REPORT

Participatory systems research on conservation agriculture (CA) with the Mahikeng study group in the Ngaka Modiri Molema District Municipality, North West Province, Year 1

For period:

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Submitted to:

The Maize Trust



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1. Introduction

In many parts of South Africa (SA), cropping systems are characterised by mono-cropping of maize, vigorous ploughing of soil as well as bare soils (Saharawat & Gupta, 2017). Continuous maize farming could be attributed to maize being the staple food in SA. Farmers have traditionally used ploughing of the soil as a method to remove weeds, facilitate water infiltration and prepare a seedbed. Due to the dual farming that includes livestock, farmers usually use crop residues injudiciously as feed for these animals, resulting in bare soil. All these factors lead to serious soil degradation hazards including nutrient depletion, nutrient imbalances and soil erosion (Bhandari et al., 2002). These, in turn, result in depressed yields, exacerbated by low and erratic rainfall (Sapkota et al., 2004). The area of Ngaka Modiri Molema District Municipality, North West Province, is not immune to these practices. Sustainable cropping systems such as Conservation Agriculture (CA) can improve crop production and productivity in the area. CA employs simultaneous application of minimum soil disturbance, permanent soil cover as well as diversified crop rotation (Hobbs et al., 2007). Minimum disturbance of the soil can also improve soil carbon sequestration, which is an important element in improving soil health. Retention of plant residue in cropland after harvesting can have immeasurable benefits to the soil and the subsequent crop. This is because plant residue contain nutrients like N, P and K as well as C in their dry matter (Torma et al., 2017). Crop rotation is another important component of CA due to its impact on soil fertility and soil-borne pathogens (Riedell et al., 2009; Bullock, 1992).

2. Project aim and objectives

This project aims to research, develop and adapt appropriate and profitable CA systems for a range of diverse and unique contexts in the Ngaka Modiri Molema District Municipality of the North West Province.

The following short-term objectives will assist the project in achieving its aim:

- i. To establish and facilitate appropriate on-farm trials with the Mahikeng CA study group.
- ii. To monitor and analyse a series of appropriate indicators from on-farm trials on selected farmers' fields.
- iii. To create wider awareness and innovation capacity among the target group and the broader farming communities on the practices and benefits of locally adapted CA systems.
- iv. To support farmer facilitation, administration and reporting processes.

2.1. Research work packages

To effectively implement the above short-term objectives, a couple of cross-cutting work packages were designed and implemented with each having a designated person or institution to implement and manage the specific activities and budget. Table 1 shows the different work packages and the responsible champions.

Table 1: Work packages and lead partners in the Mahikeng project

Work package	Lead partner
Coordination and management	ASSET Research (Hendrik Smith), Edzi Nemadodzi (ARC) and CA study group committee/chair
Assessment of soil health	Gerhard du Preez (NWU)
Agronomic statistics and data management	Edzisani Nemadodzi (ARC Grain Crops)
Facilitating, monitoring and evaluation	Phonnie du Toit (ASSET Research)
Cover crops and livestock integration	Liane Erasmus (ASSET Research)
Farmer coordination, representation	Benjamin Booizene, Mahikeng CA study group chair and trial co-worker

3. Materials and methods

3.1. Study area and trial location

At a project planning workshop held in Lichtenburg on 25 May 2023 a decision was made regarding the farmer trial co-worker and site. It was decided that the trials will be conducted at one site in Ngaka Modiri Molema District Municipality of the North West Province at Weltevrede (Delareyville), in collaboration with the Mahikeng CA study group. The farm lies in the summer rainfall area of South Africa. The long-term average rainfall is 519 mm for the nearby Baberspan-silo of NWK (*Noordwes Nuus Redaksionele Komitee, 2005*). The average daily maximum temperatures vary between 30.3°C for January and 19.7°C for July. The average daily minimum temperature varies between 16.8°C for January and 2.2°C for July. Frost can be expected over a period of 100 days of the year. The earliest onset date of frost is 22 April and last date of frost is 15 September. The cumulative heat units for October through to March are 2 226 units (Landtipe-opnamepersoneel, 1984).

3.2. Experimental design

The fully scientific collaboratively managed trial (CMT) will be laid out as a randomised complete block design with three replicates on the farm indicated above. Three treatments (cropping systems) will be compared in order to quantify their ecological (soil health, carbon sequestration), production (grain yield, cover crops, meat, water and nutrient use efficiency) and financial performances.

3.2.1 Treatments (cropping systems):

1. **CT:** Maize – sunflower (two-year conventional till rotation systems)
 - Typical CT system found in the NWP.
2. **NT:** Maize – sunflower (two-year no-till rotation systems)
 - Typical NT system found in the NWP.

3. **CA1:** Maize+CC (intercropping) – Sunflower+CC (intercropping) (two-year no-till rotation systems)
 - Aimed towards farmers with higher preference or suitability for cash crops, but also have a need for livestock integration.
 - All cover crops are utilised by cattle and perhaps other livestock, such as sheep and chicken.

4. **CA2:** Sunflower+CC (intercropping) – SCC+WCC (double cropping)
 - Aimed towards farmers with higher need for livestock integration, including communal farmers who have problems with theft of maize.
 - All cover crops are utilised by cattle and perhaps other livestock, such as sheep and chicken.

The treatments have been arranged such that each crop will be present in the trial every year. The trial layout is shown in **Annexure 1**.

4. Progress

4.1. Planning workshop

Due to the late approval of Maize Trust (MT) funds (in December 2022), the project could not start its planned activities on time, especially the planning, design and implementation of on-farm trials. Consequently, a project planning workshop was held in May 2023 to kick-start a number of activities in preparation of and in time for the 2023/24 growing season and trial establishment. The workshop was attended by key stakeholders including representative farmers, NWU co-workers, ASSET Research, ARC-GC as well as representatives from NW Department of Agriculture (see Photo 1). The attendance list is shown in **Annexure 2**.



Photo 1: Key stakeholders attending the planning workshop at Lichtenburg on 25 May 2023

At the workshop, the trial design was created aiming to address the project objectives. The workshop was also used as an opportunity to select the suitable on-farm trial site. The farm of Mr

Benjamin Booizene at Weltevrede (Delareyville) was selected because of his willingness, and the available resources required for a conservation agriculture project trial.

An action planning exercise was facilitated before the close of the workshop by Dr Smith (ASSET Research) to steer the immediate activities of the project (see Table 2 below).

Table 2: Mahikeng action plan, done on 25 May 2023

WHAT	WHEN	WHO
Soil survey & baseline sampling	After harvest	NWK
Trial design & layout	June	ARC, ASSET
Treatments detail description	July	ARC, ASSET
Costing and logistics/inputs	July	ARC, ASSET
Planters/mechanisation	July	Richard, Hendrik
Planning and preparation of sites	August	Edzi, Phonnie, Richard (DARD)
Indicators decision	August	NWU, Hendrik, Edzi
Soil/land preparation	From November	Farmers, Edzi, Phonnie, Richard (DARD)

The prospective trial farm and site was visited and inspected on 26 May (by all available key stakeholders) to check available resources including livestock and mechanisation as well as the soils. The following was found: livestock, no-till planter, tractor and availability of 15 ha of land where the trial will be established.

4.2. Collection of baseline information

4.2.1 Soils

NWK was commissioned to conduct a soil survey at the identified trial site to get a comprehensive understanding of the characteristics of the soil. This survey included a soil map and report. The soil mapping was done on 18 August 2023. NWK provided a comprehensive report on the soil characteristics including geology, base map, soil form, soil depth and clay percentage. The results indicate that the soil is fairly homogeneous with moderate yield potential. The dominant soil forms are Avalon and Bainsvlei. Figure 1 shows the soil types found on the site, while Photo 2 below shows the activities during soil mapping in the trial site with farmers' participation. **Annexure 3** shows the soil map and legend. The full soil survey report is available for all interested stakeholders.

SOIL LEGEND : Welikong CA
 FARM NAME: Welverdiend

TABEL 1: PARAMETERS OF THE MAPPING UNITS

Potential	Unit	Dominant Soilform	Dominant Soil family	Drainage Depth (cm)	Clay %		Phase	Subdominant Soilform	Family	Drainage Depth (cm)	Clay %		
					A	B					A	B	
Medium	Av01	Avalon	2120	40-60	15-18	22-38	rSoil sinteric 30-40 thick						
Medium	Bv01	Bainsvlei	2120	40-60	18-22	22-38	rSoil sinteric 30-40 thick	Baindel	2120	40-60	15-18	10-22	
Medium	Bd01	Bloemdal	2120	40-60	15-20	25-38	rGleyic 30-40 thick						

TABEL 2: SOILFORMS AND HIDROLIC SOILCHARACTERISTICS

SOIL UNIT NUMBER	SOIL VORM	HORIZON SEQUENCE	HIDROLIC CHARACTERISTICS						COMMENTS
			INFILTRATION	INT. DRAINAGE	EKST. DRAINAGE	SOILWATER STORAGE			
						VWC mm/m	PWP mm/m	AW mm/m	
Av01	Avalon	Orthic A / Yellow-Brown Apedal B / Soft Plinthic	Good	Good	Slow	200	80	120	WATERLOGGING DANGER
Bv01	Bainsvlei	Orthic A / Red Apedal B / Soft Plinthic	Good	Good	Slow	200	80	120	WATERLOGGING DANGER
Bd01	Bloemdal	Orthic A / Red Apedal B / Gleyic	Good	Good	Limited	220	100	120	WATERLOGGING DANGER

Figure 1: Soil forms and characteristics classified on the trial site



Photo 2: Activity during soil mapping and sampling for soil classification at the trial site

4.2.2 Farmer surveys using a questionnaire

Apart from agro-ecological related baseline information, a questionnaire was also developed to explore the perception of farmers on CA as well as assessing their current farming conditions and production levels. This was done in the following three steps:

- Step 1 – a proper consideration of the purpose and goals of the questionnaire.
- Step 2 – the development of the respective questions.
- Step 3 – the design of the questionnaire.

The questionnaire was divided into the following five distinct sections:

- A. To obtain information with regards to on-farm conditions and practices to determine the level of crop production experienced by farmers.
- B. To obtain a clear insight into the current tillage and cropping practices applied and constraints thereof.
- C. To identify the factors causing the farmers to use current cropping systems (reasons for current approach).
- D. To determine to what extent farmers are prepared to change to CA/RA as an alternative production system.
- E. To determine the perceived obstacles on the way to implement CA.

4.2.2.1 Pre-test of questionnaire

On 10 August 2023, a pre-test of the questionnaire was done at the farm (Weltevrede, Delareyville) of Mr Benjamin Booizene (trial co-worker). The event was attended by 19 farmers, invited by Mr Booizene. In addition, the new project was presented to the group (all potential future participants in the project). In particular, the importance of their active participation in the project was emphasised. Although more interaction with the target group should take place, the farmers agreed on their required collaboration and all participated positively in the pre-test of the questionnaire.

4.2.2.2 Interviews

The final design of the questionnaire was done by the statistician at Agricultural Research Council – Biometry Unit. Only 9 farmers from representative farmers were interviewed as part of the first batch of farmers to be interviewed. The interviews were done on 12 September 2023. More farmers will be interviewed in October 2023 so that a minimum of 25 farmers are interviewed.

4.2.3 Stakeholder meeting

A meeting was organised between ASSET Research (Dr Smith), the ARC and the National LandCare coordinator (Mr Klaas Mampholo), to meet the NW Department of Agriculture and Rural Development (NW DARD) under the leadership of Ms Botho Pule, chief director of Agricultural Support Services, to communicate and sensitise the Department on the project and to foster collaboration and support. The main objectives of the meeting were: a) to involve and collaborate with their technicians/extension/management, and b) to access CA equipment for the trial. The meeting was held on 11 July 2023 at Potchefstroom College of Agriculture (see the meeting agenda attached in **Annexure 4**). The meeting was attended by 18 people.

4.2.4 Physical layout of trial and dimensions

On 11 August 2023, basic observations of the field at the trial site were done. An assessment of the circumference was made in order to identify the most suitable area on which the trial could be established. The high infestation of couch grass on the planned trial site was clearly observed.

The trial layout was physically measured at the trial site so that soil samples can be taken from each plot prior to the start of the first planting season. This was done on 13 and 14 September 2023, respectively, in conjunction with two Agricultural Specialists and an Extension Officer from NW Department of Agriculture and Rural Development (see Photo 3). The trial comprises 8 plots per replicate with 3 replicates, giving a cumulative 24 plots. Each plot is 150 m long with 16 rows and an inter-row spacing of 0.9 m giving a cumulative area of 2 160 m². The distance between each plot is 2 m to cater for livestock mobility when grazing on cover crops. The distance between each replicate is 5 m to allow easy movement of a tractor between replicates. Key activities to be concluded before establishing the trial are: a) finalising the treatments details including production inputs; b) costing and logistics of inputs; c) establishment of trial at the start of the rain (growing) season.



Photo 3: Measuring out the trial plots

4.2.5 Data collection

Due to the late approval of the funding of this project, trial establishment for the 2022–2023 season could not be done. Accordingly, no data collection related to crop growth, soil parameters or yield and yield components were done. The sampling of soils at each trial plot will be conducted before the establishment of the trial and submitted for baseline soil analyses.

The soil health work package, led by NWU (Dr Gerhard du Preez) will consider the most relevant and affordable analyses from Sporatec (<https://www.sporatec.co.za/soil-microbial-analyses/>). It will probably be analyses from the microbial community and soil enzymatic activity analyses, but will be finalised in October 2023.

5. Conclusions

- Trial establishment for the first year of this project could not be done due to late funding. Accordingly, no trial results could be assessed and reported on at this stage.
- The project planning meeting on 25 May 2023 laid the foundation for a series of project activities which immediately started and will hopefully lead to the anticipated project objectives and outcomes.

6. References

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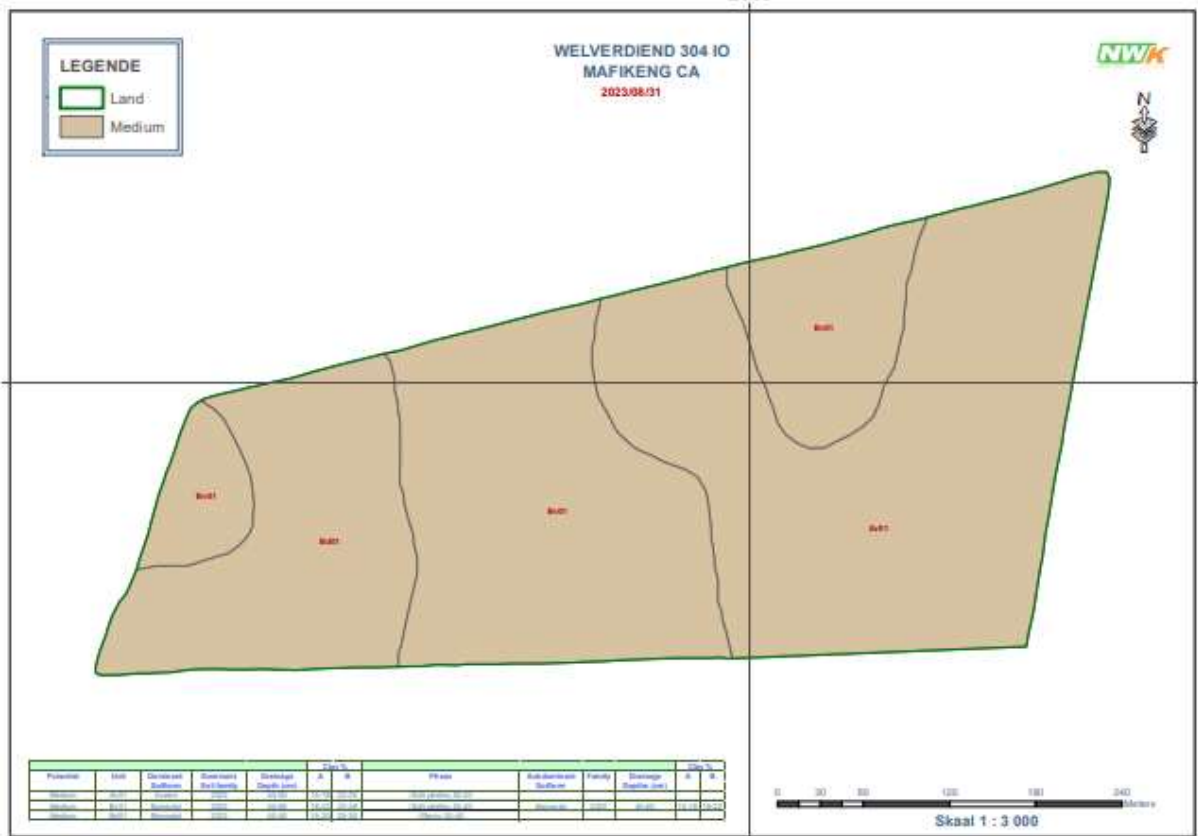
Annexure 1: Trial design of the Mahikeng collaboratively managed trial

Replicate	Plot no	Crop system	
		2023/24	2024/25
1	1	NT - maize	NT - sunflower
	2	CA1 - maize+CC	CA1 - sunflower+CC
	3	CA2 - DCC	CA2 - sunflower+CC
	4	CT - maize	CT - sunflower
	5	NT - sunflower	NT - maize
	6	CA2 - sunflower+CC	CA2 - DCC
	7	CT - sunflower	CT - maize
	8	CA1 - sunflower+CC	CA1 - maize+CC
2	9	CA2 - sunflower+CC	CA2 - DCC
	10	CA1 - maize+CC	CA1 - sunflower+CC
	11	NT - sunflower	NT - maize
	12	CT - maize	CT - sunflower
	13	NT - maize	NT - sunflower
	14	CA2 - DCC	CA2 - sunflower+CC
	15	CT - sunflower	CT - maize
	16	CA1 - sunflower+CC	CA1 - maize+CC
3	17	CT - maize	CT - sunflower
	18	CA2 - DCC	CA2 - sunflower+CC
	19	NT - sunflower	NT - maize
	20	CT - sunflower	CT - maize
	21	CA1 - sunflower+CC	CA1 - maize+CC
	22	CA2 - sunflower+CC	CA2 - DCC
	23	NT - maize	NT - sunflower
	24	CA1 - maize+CC	CA1 - sunflower+CC

Annexure 2: Planning workshop attendance list, 25 May 2023, Lichtenburg

Name and Surname	District/ Institution	Email and/or number
Liané Erasmus	North West (Rustenburg) ASSET Research	lianeerasmus@yahoo.com 079 404 3039
VINCENT BAAS	TSWANE (DEELMAN) FARMER	baasbaasfarming@gmail.com 0721568604
Mlungisi Mzonda	Ngaka modiri Molemo Candjewe	mhlungisipatrick@gmail.com 078 57 91 207
LABIUS METSWAMEBE Benjamin Xekane Booizene	Tswaing Witran Farm Tswaing Welverdiend Farm	lesetihelabisa@gmail.com 0716324979 benbooizene@gmail.com 072 938 0647
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Herdluk Smit	ASSET Research	072 285 5414 072 3310 456
Gertsd de Ruyter	NWU	072 657 3628
LINDAH MZANGWA	NWU	0710054011

Annexure 3: Soil map and legend of the Mahikeng trial site



Annexure 4: Agenda of Mahikeng stakeholder meeting held on 11 July 2023 in Potchefstroom



AGENDA

MAHIKENG CA RESEARCH PROJECT
VENUE: POTCHEFSTROOM AGRIC COLLEGE
DATE: 11 JULY 2023
TIME: 10H30 – 16H00

CHAIRPERSON:

DAY ONE			
TIME	ITEM	SUBJECT	PRESENTER
10:30 – 11:00	1.1	Opening and Welcome	Chairperson
	1.2	Attendance and apologies	
	1.3	Logistical arrangements	
11:00 – 13:00	1.4	<ul style="list-style-type: none"> Background to the Mahikeng CA project Goal, objectives, project team and work packages of the Mahikeng project NW LandCare and CA programme; alignment with Mahikeng project 	Dr Hendrick Smith
13:00 – 14:00	LUNCH		
14:00 – 16:00	2.3	<ul style="list-style-type: none"> On-farm trial design Support requirements for infrastructure and other Opportunities and solutions Other matters 	
	2.4	Closure and Departure	Chairperson