

Research Application Summary

**Climate variability and Tillage practices: Effect on soil moisture, carbon dynamics and crop productivity in semi arid Zimbabwe**

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**Abstract**

To improve on low yields of rainfed agriculture which are a result of soil degradation, low fertility and low moisture levels in semi-arid areas and increased climatic variability due to climate change, conservation agriculture (CA) is being promoted in Zimbabwe. Under CA water harvesting techniques such as planting basins which can achieve considerable improvement in water use efficiency are being incorporated. Planting basin technologies with varying size are being promoted for the vulnerable farmers with poor or no access to animal draft. This research focuses on the effect of climatic variability and different tillage practices on soil moisture retention, crop yield and carbon dynamics. The study will specifically focus on farmers coping strategies to climatic variability and effects of different basin sizes on moisture retention and yields. This study will also evaluate the long term effects of CA on soil carbon dynamics.

Key words: Basins, climate change, climate variability, conservation agriculture

**Résumé**

Afin d'améliorer les faibles rendements de l'agriculture pluviale, qui sont le résultat de la dégradation des sols, la faible fertilité et les faibles taux d'humidité dans les zones semi-arides et une variabilité climatique accrue due au changement climatique, l'agriculture de conservation (CA) est promue au Zimbabwe. Dans l'agriculture de conservation, les techniques de récolte d'eau telles que les bassins de plantation qui peuvent parvenir à une amélioration considérable de l'efficacité d'utilisation de l'eau sont intégrées. Les technologies bassin de plantation avec différentes tailles sont promues pour les agriculteurs vulnérables avec pauvre ou sans accès à traction animale. Cette recherche porte sur l'effet de la variabilité climatique et les pratiques culturales différentes sur la rétention d'humidité du sol, le rendement des cultures et la dynamique du carbone. L'étude

se concentrera particulièrement sur les stratégies d'adaptation des agriculteurs à la variabilité climatique et les effets de différentes tailles du bassin sur la rétention de l'humidité et les rendements. Cette étude évaluera également les effets à long terme de CA sur la dynamique du carbone du sol.

Mots clés: Bassins, changements climatiques, variabilité du climat, agriculture de conservation

## Background

As an adaptation method to climate change and climate variability especially the bridging of dry spells, conservation agriculture is being promoted in Zimbabwe. The farmers are moving away from the intensive soil preparation which is major driver of land degradation. Often, farmers unknowingly through hoeing or ploughing with combined removal or burning of crop residues leaves the soil exposed to climatic hazards such as rain, wind and sun (Rockstrom *et al.*, 2009). Rainwater harvesting techniques such as planting pits and basins which can achieve considerably high rainwater use efficiency are sometimes incorporated under conservation agriculture (Rumley and Ong, 2007). Conservation tillage increases soil water retention in the face of drought while also sequestering carbon below ground (IFRI, 2009). However, little is known about the effects of the different basins sizes and the optimum sizes of basins for different agro-ecological regions in Zimbabwe in terms of moisture retention and yield. Thus this study will investigate the different sizes of basin in terms of moisture retention, yield and long terms effects of conservation agriculture on soil carbon.

## Literature Summary

From the analysis of precipitation data from 14 South and West African countries over the period 1961-2000, New *et al.* (2006) provided evidence of decreasing total precipitation and increased average dry spell length. Although numerous studies have been carried out in Zimbabwe on impacts of climate change on agriculture and adaptation strategies, there has been little focus on farmers' views and perceptions which is vital in terms of coming up with effective climate adaptation policies to climate change. Mutekwa(2009) in study carried out in Midlands province of Zimbabwe found that there was need to sensitize farmers about climate change and design adaptation strategies that take cognizance of existing local knowledge and practices on land and water management. Different basins sizes are being promoted by different NGOs and include the 15cm x 15cm x 15cm (Twomlow *et.al.*, 2008) and the river of life basin which is a 15cm x 15cm x 8cm. Nevertheless, little is known about

## **Study Description**

their effectiveness. Moreover, there is need to establish optimum sizes for different agro-ecological regions since there has been blanket application regardless of rainfall regimes.

The study will be carried on-farm in Nyanga district which falls under Agro-ecological regions III and IV receiving rainfall of 450-650mm and 650- 800mm, respectively. The experiment will consist of 4 treatments which will include 3 different basin sizes and conventional tillage. The experimental design will be a Split-plot design with four fertilizer levels (0N and 0P, 0N and 42kgP, 100kgN and 42kgP, 200kgN and 42kgP) replicated four times. A mulch of 2 ton/ha will be applied to all plots under basins. Soil moisture will be measured fortnightly and the biomass determined at different phenological stages. The test crop will be maize.

To capture the farmers' perceptions on climate change focus group discussion and a survey will be conducted using a semi-structured questionnaire. To assess the long term effect of tillage on soil carbon the farmers who will have been practicing conservation agriculture for over 3 years will be sampled and grouped into 3 categories namely the well- to- do farmers who have livestock and implements; those having livestock but struggle to prepare their land; and, the vulnerable farmers who do not own any livestock. For each category 8 soil samples will be taken from mainly 2 soil types namely clay and sandy soils. For the two treatments that is conservation agriculture and conventional tillage soil samples will be obtained at depths of 0-10 cm, 10-20cm and 20-30cm depths and analyzed.

To capture all the range of basin sizes, sizes 10cmx10cmx 10cm, 15cmx15cmx15cm and 25cmx25cmx 25cm are being prepared for testing at the university farm under irrigation.

## **Research Application**

The results of this study will be used to design recommendation to guide use of conservation agriculture under different agro-ecologies in Zimbabwe.

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