



CEPHaS Project Briefing

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RECENT ADVANCES IN FARMING SYSTEMS

Working Group 6 (WG6) research activities focus on conservation agriculture (CA) in the setting of farmers' socioeconomic realities. The aim is to help translate scientific knowledge generated by the CEPHaS project on the behaviour of water in soil, crop and groundwater systems into farming practices that are compatible with farmers' socioeconomic circumstances, and which can deliver real benefits for livelihoods and food security. Additionally, WG6 looks at how best to package the generated knowledge into simple messages for farmers and policy makers to ensure improved adoption and impacts of conservation agriculture.

Recent activities: conservation agriculture literature review

WG6 has completed a systematic review of CA literature, which aimed to characterize the different types of CA being practiced, their extent and effects of CA agriculture on key soil properties, crop yields, and economic benefits to farmers in Malawi, Zambia and Zimbabwe. The review drew on published studies conducted in the region since CA was introduced about 15 years ago. A literature search on CA was done using Google as the main search engine. The study retrieved 21 journal articles which were done in 42 locations (Figure 1).

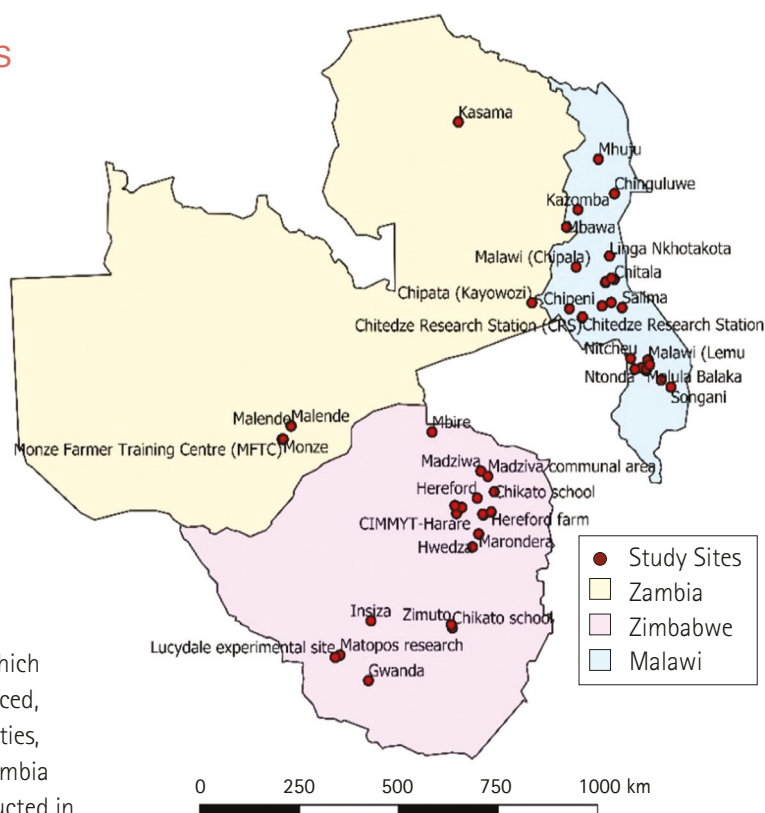


Figure 1 The location of sites covered by the 21 studies in Zimbabwe, Zambia and Malawi.

Highlights of the findings

Practices

Different CA practices in Malawi, Zambia and Zimbabwe (Figure 2) were evaluated in the published studies. Direct seeding dominates experiments in Malawi and Zambia, while basins and rip-line seeding dominate experiments in Zimbabwe. In Zambia and Zimbabwe there were no experiments that reported on tied ridges. In the three countries an expert analysis shows that farmers are innovating around CA to suit their agricultural systems. For example: using the mouldboard for ripping, preparing basins after winter ploughing, changing positions of basins to build fertility across the field, and rotating basins with convention tillage.

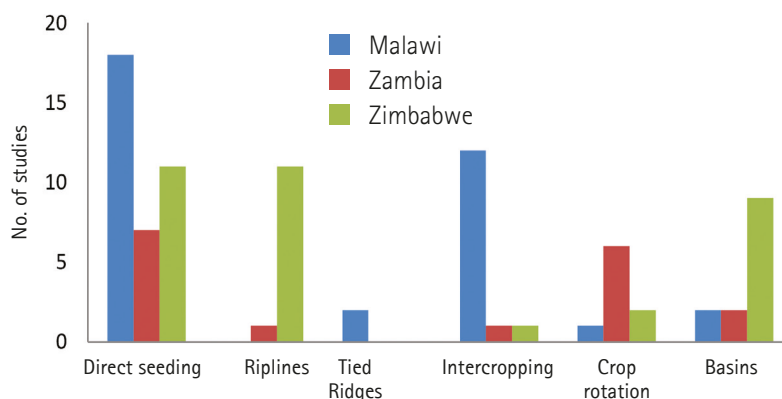
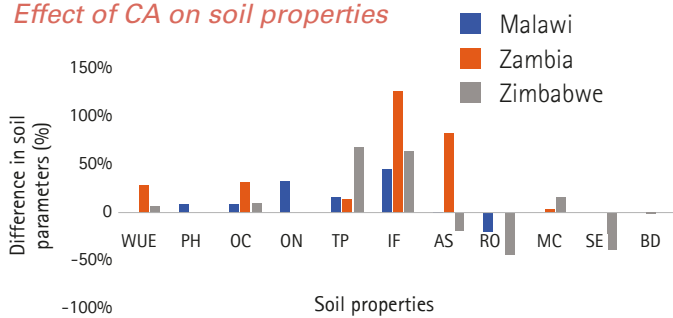


Figure 2 CA practices evaluated by studies in the three countries.

Effect of CA on soil properties



KEY: WUE = Water use efficiency; pH = pH; OC= Organic Carbon content; ON = Organic Nitrogen content; TP = Time to Pond; IF = Infiltration; AS = Aggregate stability; RO = Runoff; MC = Moisture content; SE = Soil erosion and BD = Bulky density.

We also summarised the effect of CA on soil properties in Malawi, Zambia and Zimbabwe. **Figure 3** shows the percentage change in the measured value of the soil property for conservation agriculture against conventional tillage in the three countries. The results show that CA increases water-use efficiency (WUE), pH, organic carbon content (OC), organic nitrogen content (ON) time-to-pond (TP), infiltration (IF) and soil moisture content (MC), and *reduces* bulk density (AG), soil erosion (SE) and runoff (RO) (**Figure 3**).

Figure 3 Percentage change in the measured value of the soil property for CA against conventional tillage.

Effect of CA on crop yields

The reviewed studies largely reported the effect of CA on maize yield, which is the dominant crop grown in the region. **Figure 4** shows the percentage maize yield gain of CA over the CT (the control in the study experiments) in different rainfall regions in the three countries. The results show that CA has positive yield benefits in all areas that receive more than 450 mm of rainfall (**Figure 4**). The yield gains were relatively high in Malawi, particularly in the medium(750–1000 mm) rainfall region. However, CA had negative yield gains in regions of less than 450 mm of rainfall in Zimbabwe. No study was done in areas that receive less than 450 mm of rainfall in Malawi and Zambia.

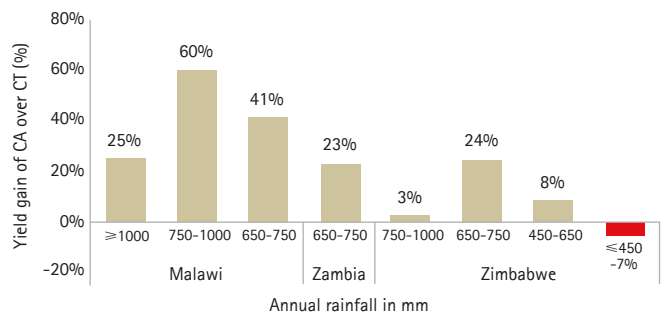


Figure 4 Yield gain of CA over conventional tillage under different rainfall regions in the three countries (Malawi, Zambia and Zimbabwe).

Livelihood benefits of CA

The livelihood benefits of CA are mainly expected through increased resource use efficiencies in soil, water, production inputs (seed and fertilizer) and labour. These positive effects are expressed as increases in crop yields combined with a reduction in production risks in comparison to the conventional practices. At the farm level, the net returns of CA are shaped by the extent of the yield responses and labour use savings. These are in turn dependant on the soil biophysical conditions and the economic variables such as prices. Both of these vary widely across the agroecological regions and economic environments farmers face in the region. It is likely that the returns to CA will vary across the different farming systems and types of farmer in the region. CA will be most beneficial where will it is carefully targeted, and tailored to the local conditions. Within the multiple farming systems present, we are working to understand the different patterns of CA adoption in the region in order to assess the full variety of economic return and where benefits may be significant.

WHO ARE WE?

We are agricultural economists and soil scientists from the University of Zimbabwe, the University of Zambia and Lilongwe University of Agriculture and Natural Resources (Malawi).

OUR PARTNERS

We are working with the Zambian Agriculture Research Institute (ZARI), the Department for Agricultural Research Services (Malawi), and our commercial partner, Delta-T Devices (UK).

HOW CAN I FIND OUT MORE?

- Contact us at cephas@bgs.ac.uk, or follow us on twitter @CEPHaS_Soil
- Look out for opportunities to attend project stakeholders workshops
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