Strengthening Capacity in Environmental Physics, Hydrogeology and Statistics for Conservation Agriculture Research

CEPHaS Project Briefing

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CONSERVATION AGRICULTURE EXPERIMENT AT DOMBOSHAVA TRAINING CENTRE, ZIMBABWE

Domboshava is located 30 km north-east of Harare, and has a dry subhumid climate receiving 700–1000 mm of rainfall annually between November and April. The soils are sandy clay loams, Lixisols in the World Reference Base and classified as Paraferrallitic soils in the Zimbabwean Soil Classification (relatively highly leached with at least 5% weatherable minerals and the clays mostly kaolinites). Typical depths to the water table range between 5.8 and 8.6 m below ground level.

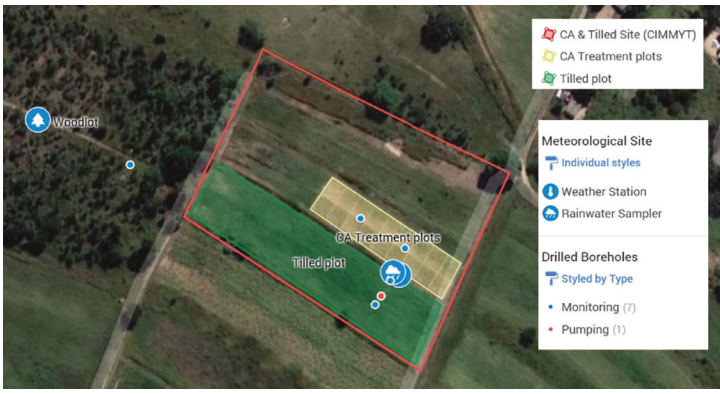

Figure 1 *Geographical position of the CEPHaS — CA experiment at DTC.*

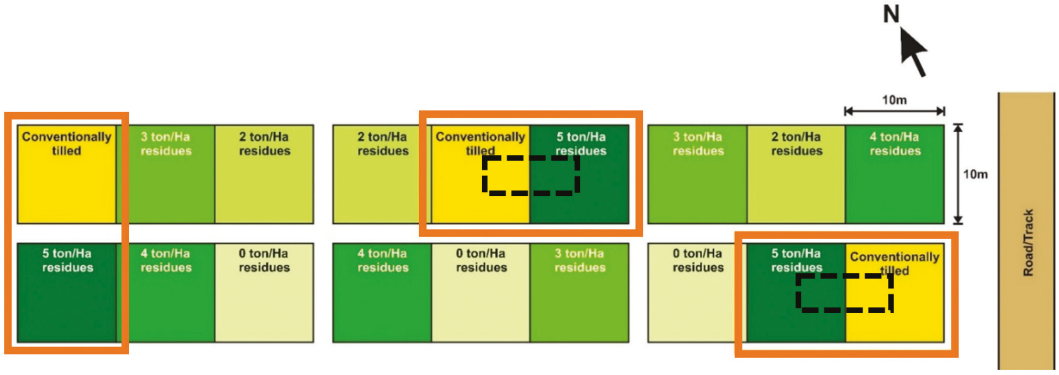

Figure 2 *Field layout of the CA treatment plots. CEPHaS is focussing on two treatments, outlined in orange. The black dashed lines delineate the extent of the shallow geophysics sensor arrays.*

The experiment at Domboshava Training Centre (DTC) was established by CIMMYT in 2010/2011. Originally the experiment was designed to assess the effects of minimum tillage (planting basins) with mulching on productivity of a maize-cowpea rotation. The design of the experiment allows the CEPHaS Project to examine long- to medium-term effects of these CA practices on soil water dynamics. The experiment is a randomised complete block design with six treatments namely: conventional tillage and five CA treatments with different quantities of maize residue applied as soil cover. Each treatment is replicated thrice in three blocks. The CEPHaS Project is focusing only on two treatments: conventional tillage and CA (planting basins) with 5t/ha of residue added.

Training in the installation of the soil physics at DTC, Zimbabwe.

Soil physics

Profile probes (measuring soil water content) and matric potential sensors (measuring soil water potential & temperature) were installed in the

Training in the installation of the ERT sensor arrays at DTC.

conventional till and CA (planting basins + 5t/ha residue cover) treatments. Three profile probes and nine matric potential sensors were installed in each plot. All the sensors in one block send data to one data logger, so there are three data loggers for the entire experiment.

Shallow geophysics

A surface array was installed in two of the three blocks of the CA experiment. An assemblage of Electrical Resistivity Tomography (ERT) cables and electrodes were installed on five middle crop lines on the two adjacent plots with treatments of interest. The inter- and in-row spacing of the plants are 0.9 and 0.6 m respectively, and electrodes are located between rows, equidistant between plant positions. The electrodes were positioned in such a way that they are present in both the manured and non-manured sub-plots of the conventional and CA plots. Using underground cables, the ERT is linked to wireless telemetry for remote measurement control and data retrieval housed in the PRIME cabin.

Hydrogeology

The key hydrogeological objective in the CEPHaS Project is to ascertain how conservation agriculture influences groundwater recharge. Two monitoring boreholes were installed in plots under CA management and a pumping and two monitoring boreholes were successfully completed in the conventional plot. By running pumping tests in the pumping borehole and monitoring water levels in the observation boreholes we can learn about the hydraulic properties of the aquifer at this site. Through the use of geophysical electrodes installed in the pumping borehole, the team can also visualize the behaviour of the water table during these tests. Additional monitoring boreholes were installed adjacent to other sites used by CEPHaS at DTC, and in a nearby wooded area (for comparison in a different land use setting). All boreholes are equipped with automatic loggers that measure groundwater level fluctuations every 30 minutes for the duration of the project. Water chemistry analysis on groundwater samples collected monthly will additionally be used in the groundwater recharge analysis.

Drilling groundwater boreholes at DTC, Zimbabwe and a flow-through cell in use during groundwater sampling.

WHO ARE WE?

We are soil scientists, agronomists, hydrogeologists, geo-physicists, statisticians and agricultural economists from the University of Zimbabwe, the University of Zambia, Lilongwe University of Agriculture and Natural Resources, the University of Nottingham, Rothamsted Research, Liverpool School of Tropical Medicine and the British Geological Survey. We are working with the Kasisi Agricultural Training Centre, Zambian Agriculture Research Institute, the Department for Agricultural Research Services (Malawi), and our commercial partner, Delta-T Devices (UK).

To find out more, visit our webpages at https://www2.bgs.ac.uk/CEPHaS and follow us on twitter @CEPHaS_Soil

ZARI Zambia Agriculture Research Institute
Researching Soils, Crops and Water in Zambia

Ministry of Agriculture

Delta-T Devices

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