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

CEPHaS Project Briefing

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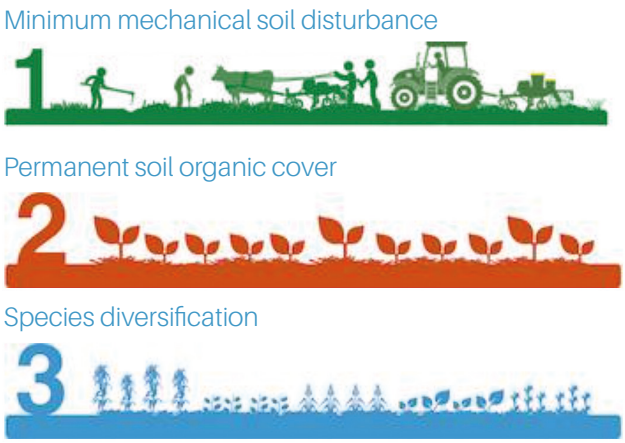
WHAT IS CONSERVATION AGRICULTURE?

Conservation Agriculture (CA) includes various farming practices around the world, but there are three common features. First is minimum or zero tillage whose aim is to reduce soil disturbance. The second is maintenance of soil cover in order to protect the soil surface against erosion. The last one is diversification of the plant species for reasons given by rotation or intercropping, particularly to control pests and diseases. CA enhances biodiversity and natural biological processes above and below the ground surface for improved and sustained crop productivity.



Three principles of conservation agriculture. Figure from FAO.

Why CA?

Historically farmers have opted for CA practices mainly to conserve soil and water by reducing soil degradation and enhancing soil ecosystem performance. Application of CA dates back to 1930 when farmers in the USA realized the need to control soil loss. CA has been widely adopted in many countries to improve crop yield through better soil fertility, the retention of soil moisture and prevention of pests and diseases. CA is now in particular focus as a 'climate smart' agronomic strategy by which large- and small-scale farmers can improve the resilience of crop production during increasingly frequent episodes of erratic rainfall and drought under a changing climate.

Crop residues at Chitedze CA plot in Malawi. (Photo by Innocent Sandram, CEPHaS Research Fellow).

Principles of CA

CA is based on three main principles which are adapted to local conditions and needs as follows:

Minimum tillage/soil disturbance: This ensures soil conservation by limiting soil erosion and preservation of soil organisms. Soil structure is not disturbed by cultivation, or such disturbance is minimized by direct planting of a crop through the stubble of the previous one. Mechanical disturbance is limited to the placing of seed or fertilizer. It is recommended that the disturbed area must be less than 15 cm wide or less than 25% of the cropped area (whichever is lower).

Permanent soil cover: A protective layer is retained on the soil surface to suppress weeds, and to protect the soil from the direct

impact of rain which can cause erosion and capping. Cover also protects the soil against direct effects of wind and high temperatures, which can reduce evaporative loss of water. Cover material should always be organic — either crop residues or other cut biomass or live cover crops. Cover crops increase and maintain soil fertility and productivity through addition of Soil Organic Matter. They add fresh plant residues to the soil and reduce soil erosion and nitrogen fixation by legume cover crops. It is recommended that the area should have over 30% cover.

Crop rotation/intercropping: A well-designed crop rotation promotes good soil structure, fosters a diverse range of soil flora and fauna that contribute to nutrient cycling and plant nutrition, and controls pests and plant diseases. Rotations are recommended between legumes and cereals, for example, maize and groundnuts. Intercropping, on the other hand helps to achieve crop diversification and a reduction in chemical/fertilizer application. It also provides complementary sharing of plant resources, such as Nitrogen from N fixing plants, as well as weed suppression, and a reduction in susceptibility to insects and disease.

Crop rotation between maize and groundnuts (top) and maize-cowpea intercrop (above) at Chitedze CA Plot in Malawi. (Photos: Innocent Sandram, CEPHaS Research Fellow).

Different perceptions on CA

Despite evidence that CA improves crop yields, its adoption is limited by different factors ranging from real experienced limitations to mere perceptions. Some of the real limitations include high labor demand associated maintaining soil cover by using crop residues; increased use of herbicides to control weeds as they complement other CA practices; competing uses of the mulching materials (animal feed, fuel); and temporary reduction in yields during the first years of practicing CA. In addition to these, the perceptions affecting adoption of CA are confounded by limited understanding of how CA enhances soil performance to increase crop yield. For instance, there is a knowledge gap among researchers on the effects of CA on soil water dynamics. To this cause, CEPHaS project is at an advanced stage to understand how CA practices affect soil moisture regimes and ground water recharge. *See briefing documents Number 2 to Number 7* which can be accessed through our webpages as per link below.

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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

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GCRF Global Challenges Research Fund
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