

Conservation Agriculture – a Sustainable System

What is conservation agriculture?

Conservation agriculture (CA) is a crop management system based on three principles: a) minimum soil movement (no soil inversion by tillage) b) soil surface cover with crop residues and/or living plants and c) crop rotations to avoid pest and diseases.

What land is suitable for CA?

The principles of CA appear to have extremely wide adaptation, and CA systems are currently used by farmers under a wide range of conditions (soil types, and environments) and with numerous crops. Nevertheless, the techniques to apply the principles depend on climate, soil and farmer circumstances (wealth, land size, traction owned, labour availability etc.). CA does not work well under waterlogged and very arid conditions or on completely degraded soils.

What crops can be grown under CA?

Most crops can be grown successfully under CA. Worldwide there are huge areas of maize, wheat, soyabeans, cotton, sunflower, rice, tobacco and many other crops grown under CA. Even root crops including potatoes and cassava are successfully produced under CA, although the harvest of these crops causes considerable soil movement.

What benefits can be expected from CA?

Immediate benefits

- Increased soil water infiltration due to the protection of soil surface structure by residues and the maintenance of continuous pores with the absence of tillage.
- Reduced water run-off and soil erosion due to increased water infiltration and the ponding effect¹ of residues.
- Reduced evaporation of moisture from the soil surface as the residues protect the surface from solar radiation.
- Less frequent and intense moisture stress because of the increased infiltration and reduced evaporation.
- Reduced traction and labour requirements for land preparation, and thus savings in fuel and labour costs.

Medium to longer-term benefits

- Increased soil organic matter (SOM) resulting in better soil structure, higher cation exchange capacity and nutrient availability, and greater water-holding capacity.
- Increased and more stable crop yields.
- Reduced production costs.
- Increased biological activity in both the soil and the aerial environment leading to improved biological soil fertility and pest control.



Photo: Patrick Wall

A maize crop seeded without tillage into good residue cover— an excellent starting point for CA.

¹ Residues hamper water flow and cause small ponds of water on the soil surface

What challenges have to be faced?

• *Mindset*

Many farmers, extension agents and researchers find it difficult to understand that crop production is possible without ploughing, let alone that it can be just as, or more, productive. The change in the way we think about agriculture is one of the biggest challenges to overcome. CA is not a recipe – first one needs to find out how to manage CA under particular conditions and only then will it work. Understand the principles and work towards applying them.

• *Residue retention*

CA generally does not work well without residues, as many benefits come from surface mulch. However, most smallholder farmers manage mixed crop-livestock systems and depend on the residues for fodder during the dry season. To reduce this conflict, CA needs to be started on a small part of the farm and adequate nutrients supplied. Once the farmer can manage the system well and yields have increased, then (s)he can use part of the residues for feed, leave enough on the land as ground cover, and start another small plot with CA.

• *Weed control*

In the first seasons of CA much attention needs to be paid to weed control, as this is one of the principle reasons for tillage. Weed control in CA can be effectively managed through herbicides, cover crops and/or manual weed control. Weeds should not set seed, so year round weed control is very important. If controlled effectively, the weed populations decrease after the first two or three seasons (see bulletin on Weed Control).

• *Nitrogen management*

Crop residues and soil organic matter (SOM) are broken down by soil organisms and, with time, the nitrogen from the organic material is made available for crops. With tillage this process is very fast and excessive: it is so fast that SOM levels are reduced and the soil is degraded. Without tillage in CA the lower mineralization and breakdown provides nitrogen (and other nutrients) for crops but the availability is slower and more even. However, in very degraded soils with little SOM, the nutrient turnover may not be sufficient for crops, and it may be necessary to apply more nitrogen (manure, compost or fertilizer) in the first years of CA. Normally one extra bag of AN or Urea/ha will be enough.

Requirements to start CA:

Information:

It is very important to get information about the system from experienced farmers and technicians and stay informed. The farmer should start with a small area of land (about 10% of the property) and first learn how to manage the system.

Preparation:

- ✓ Prepare the field beforehand (get rid of compaction, unevenness, perennial weeds and acidity problems).
- ✓ Obtain the right equipment for seeding (and for weed control).
- ✓ Produce sufficient ground cover.

Implementation:

- ✓ It is important to achieve good weed control.
- ✓ Start with a good crop rotation to provide nutrients, additional residues and weed control.
- ✓ If the soils are very sandy or degraded apply extra nitrogen fertilizers, manure or compost.
- ✓ Prevent weeds from setting seed.



Photo: Christian Thierfelder

Farmers standing in front of a demonstration plot with conventionally ploughed farmers' practice without residue retention (right) and a direct seeded CA treatment (left).