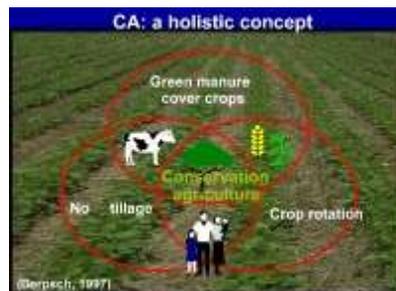


10. Conservation agriculture (CA)



Features of conservation agriculture

Conservation agriculture is the *simultaneous* practice of permanent soil cover, minimal soil disturbance and crop rotations. This is achieved by:

- maintenance of a permanent vegetative soil cover or mulch to protect the soil surface; direct planting without seedbed preparation through the soil cover to minimise the disturbance of the soil
- crop residue management and weed control, to stimulate soil structure formation, improve soil fertility, and to control weeds (with dependence on herbicides)
- pest and disease control based on Integrated Pest Management, crop rotations and inter-cropping

Inputs include cover crops, the use of draught animal powered knife rollers or herbicides to crush or kill weeds and cover crops, and no-till planters.

Farmers require extensive training and change in mindset to shift from traditional practices to conservation agriculture.

No tillage practices are suited to areas with high rainfall (> 1000 mm to ensure high levels of biomass production and minimum competition from livestock for crop residues), long growing period (more than 6 - 7 months for biomass production), soils with more than 20% clay content (to reduce risk of soil compaction).

Minimum tillage, rather than no-tillage, systems are considered to be more appropriate in semi-arid and arid regions with 300 - 800 mm annual rainfall.

Conservation agriculture is suitable in areas where there is a capacity to grow cash crops (in order to purchase inputs), markets for a diverse range of crops (to support crop rotation), secure access to land and limited value on crop residues (as livestock fodder and firewood).

It is possible to adopt components of conservation agriculture in a piecemeal manner: for example, inter-cropping cover crops or using conservation tillage equipment or herbicides. These components may act as entry points for moving towards full conservation agriculture.

Features of conservation tillage

There is a range of tillage operations that reduces the losses of soil and water, in comparison to conventional tillage, including (in order of reduced soil disturbance):

- **Reduced tillage:** tilling the whole surface but eliminating one or more of the conventional tillage operations
- **Semi-permanent planting basins:** known as tassa in Mali, zai in Burkino Faso, demi-lune in Niger, potholing in Zambia, the Matengo pit system in Tanzania
- **Ridge tillage:** a system of annual or semi-permanent ridges and furrows, resulting in some residue cover
- **Tined tillage:** land is prepared with implements which do not invert the soil and which cause little compaction, resulting in a good cover of residues on the surface in excess of 30%. Equipment used includes chisel plough, vibro-cultivator and draught animal powered ripper
- **Strip tillage:** strips 5 - 20 cm wide are prepared to receive the seed and the intervening bands are not disturbed
- **Zero tillage** (or no-tillage): planting the seed into the stubble of the previous crop without any tillage or soil disturbance. Weed control relies heavily on herbicides. This approach is broadly equivalent to conservation agriculture

Sub-soiling may be necessary before switching to conservation agriculture to remove hardpans caused by years of hand hoeing or ploughing. Plough pans are broken up using use ripper tine with draught animals or tractors at the end of the cropping season when the draught animals are in peak condition and before soil hardness increases during the dry season. Alternatively, where time allows, cowpeas may be planted to break up the hard pans.

Excessively uneven land that could lead to water logging (possibly resulting from previous poor ploughing practices) are corrected using damscoops or levellers with draught animals or tractors at the end of the cropping season before switching to conservation agriculture.

Conservation tillage equipment includes:

- **hand operated jab planter:** plants through crop residues and crop cover with no tillage and removes the need to prepare the land for planting. Can also be used to apply fertilizer
- **knife roller** drawn by draught animals: bends over and crushes crop residues and cover crops prior to planting (which then remain on field as soil cover), saves the removal of crop residues by hand and residues act as cover to suppress weeds
- **draught animal powered ripper** to make planting strips in reduced tillage systems by cutting furrows rather than inverting the soil. A planter attachment places seed directly in ripper furrow. Wings can be attached for ridging and weeding which reduces time by half because do both sides of row in one pass
- **draught animal powered seeder/no till planter** to plant directly through the cover crop: plant through crop residue and crop cover with no tillage and removes the need to prepare the land for planting.

Features of cover crops

A cover crop is any crop grown to provide soil cover, regardless of whether it is later incorporated into the soil.

Cover crops and green manures can be annual, biennial or perennial herbaceous plants grown in a pure or mixed stand during all or part of the year.

They are grown primarily to prevent soil erosion but they also reduce soil surface temperature and water losses, add organic matter to the soil, stimulate soil life, suppress weeds and some fix nitrogen.

Examples include dolicos lablab and mucuna.

Weed, disease and pest problems need to be addressed before switching to conservation agriculture.

Advantages

- *Labour saving:* reduced labour inputs for land preparation and weeding once system becomes established, more even distribution of labour across the year, more timely operations and a reduction in drudgery. Changes in draught animal power systems from the mouldboard plough to shallow ripping saves labour.
- *Livelihood strengthening:* represents move towards more sustainable farming system with increased yields. Quality of environment is improved and previous degradation reversed.
- *Livelihood diversification:* more time available to undertake off-farm work and hire out services (for example, draught animals). Opportunity to move into growing organic produce with payment premiums.
- *Cost:* reduced requirement for herbicides and fertilisers once system established.
- *Risk:* change land over to conservation agriculture gradually (one plot at a time) in order to minimise risk of using a new farming system.

Disadvantages

- *Labour:* additional labour inputs initially whilst establish system for application of lime, farmyard manure, weeding, breaking hand pans and constructing planting basins. Manual and draught animal powered minimum tillage systems (without cover crops) increase labour requirements for weeding because they do not bury weeds by inverting the soil during land preparation. Initial investment of time and energy to construct some of reduced tillage system.
- *Attitude:* other farmers may regard retention of cover crops and crop residues as a lazy form of farming.
- *Equipment:* more complex draught animal drawn equipment requires skilled local manufacture or import. Farmers require access to seeds of green manure/cover crops, herbicides, liming or farmyard manure to adjust soil acidity and fertilisers when crop residues left in field until new equilibrium reached.
- *Cost:* purchase of conservation tillage equipment and herbicides.
- *Skills:* farmers need extensive training and change in approach to conventional farming system.
- *Risk:* ability to grow cover crop compromised by strong demand for crop residues as forage for livestock and communal land tenure system limits right of land use to growing season. Higher levels of surface trash may result in higher plant disease and pest infestations, if not managed properly. System not suited to low precipitation, short growing season, sandy soils and soils at risk of water logging.
- *Infrastructure:* access to appropriate inputs and skilled extension service.