By Dr Hendrik Smith, Grain SA (Article courtesy of FarmBiz)

CONSERVATION AGRICULTURE
and sustainable crop production

There are increasing concerns about the alarming rate of environmental degradation around the globe. One of earth's finite natural resources, soil, is especially under threat, posing great danger for feeding the world's growing population.

No-till planters planting directly into maize residues on Hannes Otto's farm in the North-West Province.

Each year 12 million hectares of land in the world where 20 million tons of grain could have been grown, are lost to land degradation. In the past 40 years, 30% of the planet's arable (food-producing) land has become unproductive due to erosion. Unless this trend is reversed soon, feeding the world's growing population will be impossible.

Worldwide there is consensus that plough-based farming, still widely practised, is unsustainable. Its continued promotion and application endangers global capacities to respond to food security concerns. Ploughing and removal of crop residue after harvest leave soil vulnerable to wind and rain, resulting in gradual, often unnoticed, erosion of soil. This is like tyre wear on your car — unless given the attention it deserves, catastrophe is only a matter of time. Erosion also puts carbon into the air where it contributes to climate change.

In South Africa, crop production systems based on intensive and continuous soil tillage have led to excessively high soil degradation rates in grain-producing areas. This adds to the growing problems with profitability and poverty in rural areas.

According to a recent study by the Agricultural Research Council (ARC) in South Africa, the average soil loss under annual crops (such as grain and cotton) in the country is 13t/ha/yr, which is much higher than the natural soil formation rate. If we have to offer farmers a better chance to survive and if sustainable and economically viable agriculture and food security is to be achieved, then the paradigms of agriculture production and management must be changed.

An ideal vehicle

There is general agreement among key role-players, such as government, research institutions and producer's organisations (such as Grain SA), that these outcomes will be achieved through the adoption and implementation of Conservation Agriculture (CA). CA is seen as an ideal system for sustainable and climate-smart agricultural intensification, through which farmers can attain higher levels of productivity and profitability (i.e. 'green prosperity') while improving soil health and the environment.

Conservation Agriculture (CA) is an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security, while preserving and enhancing the resource base and the environment. CA is characterised by three linked principles, namely:

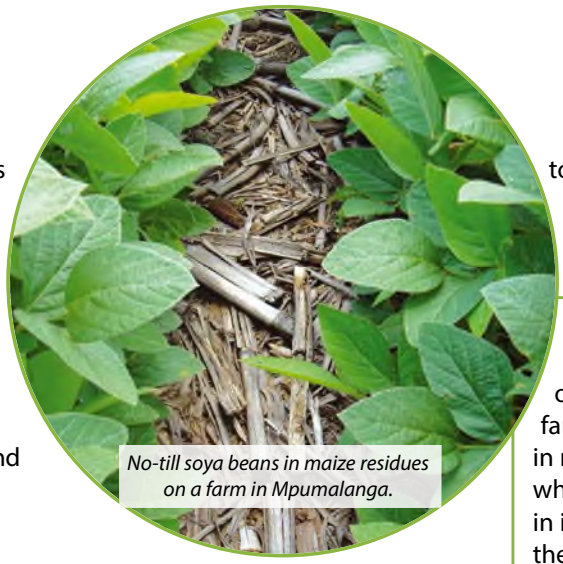
- Continuous minimum mechanical soil disturbance.
- Permanent organic soil cover.
- Diversification of crop species grown in sequences and/or associations.

CA principles are universally applicable to all agricultural landscapes and land uses with locally adapted practices. CA enhances biodiversity and natural biological processes above and below the ground surface. Soil interventions such as mechanical soil disturbance are reduced to an absolute minimum or avoided, and external inputs such as agrochemicals and mineral or organic plant nutrients are applied

optimally and in ways and quantities that do not disrupt biological processes.

CA facilitates good agronomy, such as timely operations, and improves overall land husbandry for rain-fed and irrigated production. Complemented by other known good practices, including the use of quality seeds, and integrated pest, nutrient, weed and water management, CA is a basis for sustainable agricultural production intensification. It paves the way for increased integration of production sectors, such as crop-livestock integration and the integration of trees and pastures into agricultural landscapes.

Ample evidence now exists of the successes of CA under many diverse agro-ecological conditions, justifying a major investment of human and financial resources in catalysing a shift, whenever and wherever conditions permit, towards CA.



No-till soya beans in maize residues on a farm in Mpumalanga.

More profitable system

Economic analyses indicates that CA is a more profitable cultivation system when compared to conventional tillage (CT). Net farm income increases considerably under CA within a period of ten years, while under CT, it has been shown to decrease. The changes in the returns on capital of CA compared to that of CT are also quite impressive.

No-till hand- and animal-drawn no-till planter for smallholders at Matatiele in the Eastern Cape Province.

The following economic advantages emerge when comparing CT to CA in long-term experiments:

- Investments in machines are 39% lower in CA.
- Power requirements are 75% lower in CA.
- Working time is 60-80% lower in CA.
- Fuel consumption is 60-84% lower in CA.
- Variable costs: wages are 70–84% and repair costs are 60-65% lower in CA.

Increasing crop diversity (rotations) even out marginally. Building soil organic matter content and biotic activity lead to higher natural soil fertility. These can have large financial and environmental impacts. Cover crops (legumes) can contribute up to 250kg of soil nitrogen per hectare annually, amounting to cost savings of above R2 000/ha on N-fertilisers (2014 prices), reduced weed seed banks and reduced crop losses to pests and diseases when compared to mono-cropped farming systems.

These values will certainly change from one region to the other, but the trend will probably be the same in most parts of the world. When making economic comparisons between CT and CA, we have to compare the whole system over several years and attach a monetary value to such things as loss/gain of organic matter and soil fertility.

Influence of CA

In general, comparing results over several years (e.g. ten years), farm income decreases under CT in response to declining crop yields, while it increases under CA. Changes in income and variable costs between the first and tenth years under CA reflect increasing crop yields, a higher cropping intensity and savings per crop in fertiliser, herbicide and insecticide.

CA will also reduce carbon emissions, ensure less erosion, increase crop water availability and thus resilience to drought, improve aquifer recharge and reduce the impact of the increased volatility in weather associated with climate change. It will lead to more reliable harvests and reduce risks, especially for smallholders.

The latter point is critical for the household food security of around three million smallholder families in South Africa. It simply means that CA could sustain yields (and household food supply) at acceptably high levels, using minimum external inputs.

Because of the multiple benefits that CA systems generate in terms of yield, land use sustainability, income, cropping practice timeliness, ease of farming and eco-system services, the land under CA systems has been growing exponentially in many countries, largely as a result of the initiative of farmers and their organisations. In South Africa, the total area under CA is still small compared to land farmed using tillage. There is, however, a significant upswing in the number of farmers practising CA, as well as key research and development initiatives, promising significant improvements in promoting it.

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