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CONSERVATION AGRICULTURE

A PROMISE FOR INCREASED YIELDS WITHOUT DEPLETING NATURAL RESOURCES

Introduction

Food production and nutrition among Africa's growing populations continues to decline at alarming rates resulting in reduced food availability per capita! This decline in food production has mostly been associated with declining crop yields yet the rest of the world continues to experience increased yields that match their increasing populations (Figure 1). To be more precise, sub-Saharan Africa has not seen increased agricultural productivity in the last three decades, at a time when the rest of the world is benefiting from improved production technologies. One might therefore want to ask why sub-Saharan Africa portrays such a gloomy picture. Key determinant factors include soil degradation and climate change variability.

The advance of soil degradation endangers biological diversity, natural resource resilience and promotes desertification. This is increasingly putting at risk the achievement of central development policy goals such as food security, poverty alleviation and the protection of natural resources. Besides soil degradation droughts associated with short term climate variability often result in complete crop failures in sub-Saharan Africa's rainfed cropping systems, a problem often more pronounced in regions with semi-arid and arid conditions. Worse still climate change (long term climate variability) extremes evidenced through increased temperatures and variable rainfall is predicted to bring about more climatic disasters to Africa through floods, droughts and higher temperatures desiccating the environment.

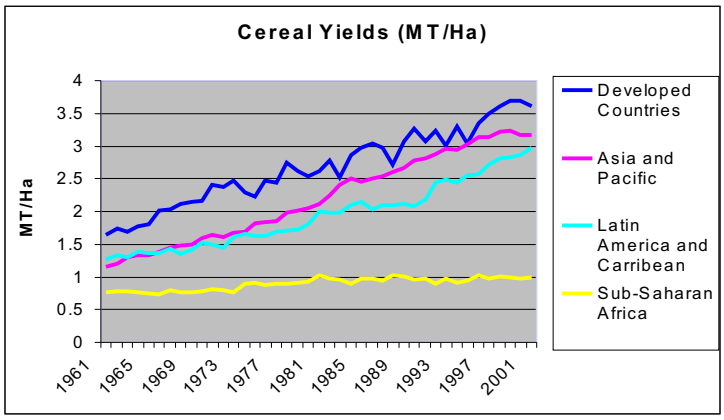

Figure 1. Cereal productivity in different parts of the world
Source: FAOSTAT (2001).

It is clear therefore that unless Africa takes urgent and stern measures to address its food production problems, its future remains bleak. It is thus high time that Africa's governments took decisive policy measures to employ agricultural technologies which not only sustain productivity but also mitigate against climate change impacts through technologies such as Conservation Agriculture.

What is Conservation Agriculture?

Conservation agriculture (CA) aims to produce high crop yields while reducing production costs, maintaining the soil fertility and conserving water. It is a way to achieve sustainable agriculture and improve livelihoods. It is a technology being practiced and benefiting many smallholder and large scale farmers particularly in North and Southern America. Adoption of the technology is also expanding in Africa.

Conservation agriculture has three basic principles which are defined by the conservation agriculture manual (IIRR and ACT 2005) as:

1. Disturb the soil as little as possible. The ideal is to plant direct into the soil, without hoeing or ploughing. Tillage is reduced to ripping planting lines or making holes for planting with a hoe.
2. Keep the soil covered as much as possible. Mulch, special cover crops and/or crop residues left on the field protect the soil from erosion and limit weed growth throughout the year. This is opposed to conventional farming practices, whereby farmers remove, burn crop residues or mixes them into the soil with a plough or hoe. As a consequence, the soil is left bare, so it is easily washed away by rain, or is blown away by the wind.
3. Mix and rotate crops. Planting of the same crop each season - as sometimes practiced in conventional farming is minimized by planting the right mix of crops in the same field, and rotating crops from season to season. This allows a break down of survival and multiplication cycles of pests, diseases and weeds resulting in higher yields and maintenance of soil fertility.

To gain the full benefit of conservation agriculture, all three principles have to be applied at the same time. This ideal is not possible everywhere, but farmers should try to go into that direction as far as possible.

4. A fourth principle often also considered important is timely planning for early planting and weed management. Conservation agriculture thus provides a feasible and resource conserving option for redressing declining productivity through harnessing soil degradation and efficiently utilizing water and nutrients in cropping systems

Benefits of CA

The use of CA results in increased water infiltration, reduced run-off and soil loss, reduced evaporation losses and improved moisture storage in the soil. In this way CA helps to mitigate against climate variability and change. CA also helps to improve ground water recharge and so its widespread use may help to enhance water availability for domestic uses in rural communities dependent on groundwater as their main source of clean water. CA reduces labour requirements particularly the draught required for land preparation and hence enables farmers to timely plant. Studies in Zimbabwe and elsewhere have shown that significant yield reductions occur for every week's delay in planting maize. CA also helps to increase or stabilize soil organic matter levels and biodiversity. CA may thus contribute to carbon sequestration and thus help to reduce atmospheric CO2 levels thereby mitigating against global warming.

Challenges in the use of CA

- The major challenges with using CA relate to the need for change of attitudes. For many people it is difficult to imagine growing a crop without ploughing as ploughing has been a recommended practice for many years.
- Retention of crop residues in the field, to ensure there is at least 30% soil cover at planting, is another serious challenge for many farmers keeping livestock and practising communal grazing systems.
- Weed control is a problem for most farmers particularly during the first year. Elimination of ploughing, which is also practiced by farmers to control weeds, increases weed infestation. However, the use of winter weeding techniques and prevention of weeds from seeding helps to reduce the seed bank reservoir in the soil and thus subsequently reduces weed pressure in CA.

What are the Conservation Agriculture techniques?

The Conservation Agriculture principles stated above can be implemented in various ways depending on one's agro-ecological environment the resources available to farmers.

CA is not a technology for the rich or the poor only but rather is a technology that applies across farmers with a diverse resource base applying the 3 key principles in different ways!

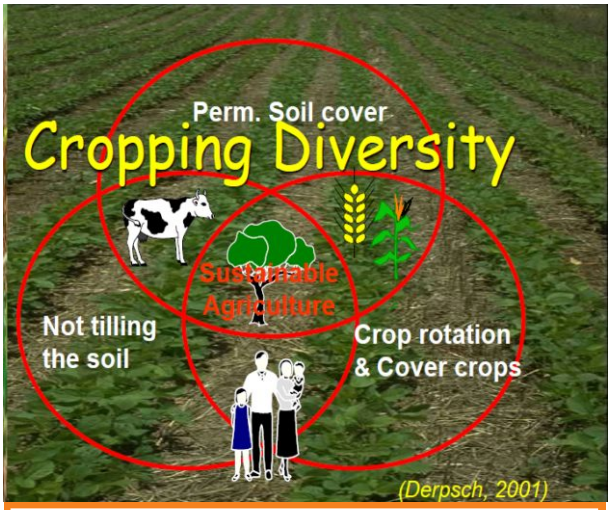

Figure 2. The three principles of conservation agriculture need to overlap for sustainability
Source: Derpsch, 2001.

Techniques for manual systems?

Conservation Farming (CF) BasinsFarmers with no other source of power except the human muscle and cannot hire draught animals or tractors can practise CA using hand hoes. With this technique, carefully and uniformly spaced planting stations, about 15 cm deep and 15 cm wide are placed along a straight line running across the main slope with the aid of a string and pegs at each end of the string. These stations are also known in Zambia and Zimbabwe as conservation farming basins or CF. With this system, preparation of basins can be done anytime during the dry season so that they are ready for planting at the beginning of the rainy season and weed control is carried out throughout the season. Experience shows that this system enables higher crop yields particularly during drier years due to improved water harvesting in the basins, precision placement of manure or fertilizer and timely planting. A typical layout soon after preparing the planting basins looks like the picture (Figure 3). Subsequent crops in the rotation are planted in exactly the same basins thereby ensuring more efficient utilization of residual fertility from the previous crops.

Figure 3. Conservation farming basins soon after preparation in Southern Zimbabwe

Figure 4: Jab planting

Jab planting into residues

In situations where the farmer has good soil cover from residues or other biomass, planting may be achieved using a jab planter. This hand held tool (see picture) enables opening of a planting hole, placement of seed and fertilizer as well as covering, all in one operation. This technique thus enables easy direct seeding into unploughed soils covered with residues and helps to save labour leading to more efficient crop establishment.

Figure 5. Emerging seedlings of a crop direct seeded in fields covered with crop residues

In both systems weed control throughout the year is recommended and experience shows that the weed pressure drops considerably in subsequent years. Using these systems farmers in Zimbabwe and Zambia have been able to achieve very high yields even in very dry years.

Figure 6. A hand pulled sprayer for applying herbicides and other chemicals

Techniques for animal drawn systems?

Rippers and subsoilers

In situations where farmers are using animals for traction, various options are available. Planting rows may be opened using a ripper or subsoiler drawn by animals (Figure 7). The use of deep subsoiling operation (25-30 cm deep) is usually recommended only during the first season of implementation to break an existing hard layer at 15 to 20 cm depth caused by mouldboard ploughing, also known as a plough pan. In subsequent seasons a shallow furrow opening ripper such as the Magoye ripper can be used to prepare planting furrows. A variety of rippers for this purpose are available from various sources in the region (see figure 8). Planting is carried out manually into the furrows leaving the residues on the surface. Weed control can be achieved manually or chemically through use of appropriate herbicides. The key to good weed control is through weeding them when they are still small and preventing them from seeding thereby reducing the seed bank in the soil in subsequent seasons.

Figure 7. A Magoye ripper mounted on a conventional plough beam: Photo 3 I. Nyagumbo

Figure 8. Various types of rippers available in the SADC region from various manufacturers. Photo 2: S. Twomlow

Although rippers are relatively cheap and adaptable to the ox-drawn plough beam they also cannot be used effectively in systems with heavy loads of mulch since the residues get caught up on the implement. Such problems have been overcome with direct seeders which have a mulch cutting coulter.

Direct seeding into residues with animal drawn planters

Animal drawn direct seeders can also be used to opening a narrow (2-4 cm wide) furrow, precisely place seeds and fertiliser and cover them in one operation (refer figure 9). Direct seeders are available from many manufacturers in Brazil and dealers in South Africa, Kenya and Zimbabwe.. However it is desirable that such equipment is locally manufactured to enhance provision of adaption and repair services and reduce costs. The use of such equipment improves work rates and saves labour. Multi row seeders for crops such as maize, soyabean and cotton are also available on the market but the costs are also higher.

Figure 9. Planting using an animal drawn direct seeder Photo: I. Nyagumbo 2006

Techniques for tractorized systems

CA can also be applied in tractorized systems using the same principles. In Zimbabwe the use of CA in commercial farming systems was driven by the good availability of suitable direct seeding equipment and sprayers that could be mounted on the tractor. In such systems harvesting of crops such as soyabeans, wheat and maize is done by combine harvesters which help to chop up the stover into smaller units. This enables direct seeding equipment to function well. A variety of such equipment is available in many parts of the world such as Brazil, Australia, South Africa, Zimbabwe and Kenya (see figure 10). A major advantage of this equipment is its capacity to save fuel and machinery wear and tear.

Conservation agriculture can thus be implemented in various ways using whatever equipment a farmer has at his/her disposal. What is important is to ensure that the three key principles are adhered to. Suitable crop rotations also need to ensure that there is rotation for both the commercial and the cover crops. Planting the same crop every year may lead to build up of diseases and pests.

Figure 10. Tractor mounted seeding equipment from Bangladesh

The CA intervention thus presents an opportunity for boosting and sustaining food production among farmers in various sectors under the challenging production environment (see Brief 2). For further details the reader is advised to contact the African Conservation Tillage Network (www.act-africa.org) regarding the techniques and sources of equipment and seeds.

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