What is conservation agriculture?
Maria Erro used to struggle to grow enough food on her half-hectare plot in Karatu district, in northern Tanzania. She had no oxen to plough her soil. She had to borrow seed from kind-hearted relatives and her neighbours in Rhotia village. After her husband died, she could not do all the work – planting, hoeing, weeding – by herself.

She managed to grow enough maize and beans to feed her six children and four grandchildren for only four months of the year. The family had to make do with only two meals a day. Sometimes there was only enough food for a single meal. She was late paying school fees. When her children fell ill, she couldn’t afford medicine.

It was a tough life.

Maria’s life changed dramatically in October 2002, when she learned how to use an approach called conservation agriculture. Instead of hoeing the soil, she left the dried stalks and leaves from the previous crop on the surface. She learned how to plant maize seed directly through this mulch, using an implement called a jab-planter.

Between the maize rows, she planted lablab – a legume that spreads quickly, covers the soil with a dense, leafy mat, and produces an edible seed. The lablab smothered the weeds, freeing her of the backbreaking task of weeding the plot. The lablab also fixed nitrogen in the soil, so her maize crop benefited. She harvested six bags of maize, instead of the two or three she had got in previous years.

She planted beans during the short rains, and for the first time, she was able to harvest enough for her family to eat. There was enough left over for the next season’s seed, and some to sell as well.

Thanks to conservation agriculture, Maria has to do less work, her yields have gone up, and she has become an independent, confident member of the community.

“It was a miracle”, she says, “I will practise conservation agriculture forever.”
CONSERVATION AGRICULTURE 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.

Conservation agriculture has three basic principles:

- Disturb the soil as little as possible
- Keep the soil covered as much as possible
- Mix and rotate crops.

We will look at each of these in turn.

**Disturb the soil as little as possible**

In conventional farming, farmers plough and hoe to improve the soil structure and control weeds. But in the long term, they actually destroy the soil structure and contribute to declining soil fertility.

In conservation agriculture, tillage is reduced to ripping planting lines or making holes for planting with a hoe. The ideal is to plant direct into the soil, without ploughing.

**Keep the soil covered as much as possible**

In conventional farming, farmers remove or burn the crop residues or mix them into the soil with a plough or hoe. The soil is left bare, so it is easily washed away by rain, or is blown away by the wind.

In conservation agriculture, crop residues left on the field, mulch and special cover crops protect the soil from erosion and limit weed growth throughout the year.

**Mix and rotate crops**

In conventional farming, the same crop is sometimes planted each season. That allows certain pests, diseases and weeds to survive and multiply, resulting in lower yields.

In conservation agriculture, this is minimized by planting the right mix of crops in the same field, and rotating crops from season to season. This also helps to maintain soil fertility.
Conservation Agriculture

To gain the full benefit of conservation agriculture, all three principles have to be applied at the same time. This is the case with the ideal practice: direct planting through a soil cover – what Maria Erro does (page 2).

This ideal is not possible everywhere. But farmers should try to go into that direction as far as possible.

Because each farmer faces a different situation, this may mean different things. Some farmers may find it best to introduce a cover crop first. Others might gain by reducing their tillage to “rippling” (using a narrow plough-like implement that creates a small furrow without turning the soil over) or “pitting” (digging planting holes with a hoe) as a first step towards conservation agriculture. In a second step, these farmers can leave crop residues in the field and start planting cover crops.

Practising conservation agriculture can be a challenge. It means a different way of farming. Farmers may be reluctant to make the switch, and they need to learn new skills. It also means a new mindset: for example, they have to learn that a “clean” field is not the best.

But the benefits are real. Farmers quickly find that by applying these principles, they can save labour, reduce costs, and improve their soil’s fertility and ability to hold water. That means higher crop yields. They can use the time they have saved to expand the area they cultivate, or even to start other enterprises that earn more money. Conservation agriculture may at last give them a chance to break out of the vicious circle that binds them in poverty.
Why start using conservation agriculture?

You might start using conservation agriculture for many reasons.

To improve your yields

Unlike the rest of the developing world, crop production in Africa is not keeping pace with population growth. Yields in many areas are actually falling. A major cause of this is declining soil fertility, often caused by the way of farming. The rising population has forced farmers to abandon traditional practices that left the land fallow for several years, and to cultivate ever-smaller plots. Intensive tilling and hoeing year after year can produce a hardpan in the soil. That restricts root growth and stunts plants. Rainwater pounds the bare soil, forming a surface crust that the water cannot penetrate. It runs off, taking the valuable topsoil with it. Erosion in some places is so severe that there is little soil left.

To get a good yield, farmers often apply more and more fertilizer. With less moisture in the soil, plants are more vulnerable to drought. They start to wilt after a few days without rain.

Conservation agriculture enables farmers to reverse this trend. It prevents hardpans from forming, protects the soil, increases soil moisture, and restores soil fertility, so stabilizing yields and improving production over the long term.

To reduce your production costs

Tilling the soil is expensive. Fuel and fertilizer prices and labour costs rise continuously, while market prices of farm products have fallen. Many farmers cannot recoup their production costs by selling what they produce, so they end up making a loss.

Conservation agriculture helps these farmers cut costs while increasing their yields.

To overcome shortages of labour and farm power

Many farm households suffer from a severe lack of labour and farm power. Hunger and malnutrition combine to make people weak, unable to work hard, and vulnerable to disease. Young people are moving out, and HIV/AIDS and malaria create a severe labour shortage. Many draught animals have died be-
cause of disease, or their owners have had to sell them to pay for medical treatment and burials. A lack of farm power forces farmers to look for other ways to farm. Conservation agriculture enables these people to grow more food with less work. It offers them a real chance to improve their lives.

How conservation agriculture works in different types of farms

The three principles of conservation agriculture (disturb the soil as little as possible, keep the soil covered as much as possible, and mix and rotate crops) can be applied in a wide range of conditions. How farmers put them into practice will vary from place to place, depending on many factors.

Conservation agriculture can be practised on different types of farms, with different combinations of crops and sources of power. Here are some examples.

Hoe farming

Many African farmers cultivate by hand, using hoes. These farmers can practise conservation agriculture by digging small planting holes in lines, at carefully measured distances, leaving the rest of the soil unturned. If hoeing in previous years has produced a hardpan, the holes must be deep enough to break through this hard layer.

The farmers can put compost or manure in the holes to raise the soil fertility and the water-holding capacity, then sow maize or beans.

They can sow cover crops between the planting holes to protect the soil from erosion and to suppress weeds. They can pull weeds out by hand, or slash them with a machete.

The next season, they can plant different crops in the same holes. It is not necessary to dig through the hardpan again, because the first season’s crop roots will have penetrated deep into the soil and will help water to seep into the soil. So it is necessary to do hard work of digging the pits only once.
Smallholder farming with draught animals

Farmers who own (or can hire) oxen or donkeys to pull implements can use a different set of conservation agriculture practices.

They can use a subsoiler to break up the hardpan (if there is one). This is usually necessary only in the first year.

If there is no hardpan, the farmers can use an animal-drawn ripper to open up a narrow furrow for planting seed. The soil between these furrows is left alone. It is possible to use rippers and subsoilers that sow seeds and apply fertilizer at the same time, so saving time and work.

Before planting the crop, the farmers can use a hoe or knife-roller to kill weeds, or apply herbicide using a sprayer or wiper. They sow a cover crop with the maize crop to smother weeds and to reduce evaporation from the soil surface. When harvesting the main crop, the farmers leave the residues and cover crop on the field. That protects the soil from the sun and rain, and further controls weeds.

Mechanized farms

Farmers with tractors can use conservation agriculture too. They can replace their mouldboard ploughs, disks and harrows with rippers, subsoilers and direct-drill planters.
At the outset of the season, larger scale farmers use a knife-roller, sometimes in combination with herbicides, to kill the previous season’s cover crop and weeds. In the first season of conservation agriculture, they may need to use a subsoiler to break up the ploughpan. They then use a direct-drill planter to sow seeds. A post-emergence herbicide kills any weeds that come up after planting and before the crop canopy can cover the surface.

After harvest, the crop residues stay in the field. The farmer then sows a cover crop to protect the soil until the next planting season.

Many farmers are able to use a combination of implements and different types of power. For example, a hoe farmer may be able to hire a neighbour with a tractor to subsoil her field. She can then choose among various options so she gets the full benefits of conservation agriculture (see the table on page 9).

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### Challenges to agriculture in Africa…

...and how conservation agriculture can help overcome them

**African agriculture faces three major challenges:**

- **Lack of labour** – or rather, lack of farm power  
  Most African farmers cultivate their fields by hand. Unlike farmers in many other parts of the world, they do not have machines and equipment to help them. Many young people do not want to become farmers. They move to town in search of education and less laborious work. The AIDS pandemic and malaria make this labour shortage even more acute.

- **Low yields**  
  African grain yields are low – perhaps no more than 1 ton/ha. That is less than half what is needed to achieve the Millennium Development Goal of halving the number of malnourished and hungry people by 2015.

- **Environmental degradation**  
  Many older farmers remember when their villages were surrounded by trees, and their soils were rich with humus. Today, slopes are bare and rivers run brown with eroded soil.

### Conservation agriculture

Conservation agriculture eliminates ploughing and controls weeds better than conventional farming, so it needs less labour. Farming may become more attractive to young people, and more profitable too.

Conservation agriculture can significantly raise yields and can provide many different types of food and feed.

Conservation agriculture protects the land and feeds the soil. It can halt and even reverse land degradation. That means cleaner rivers and less sediment to clog reservoirs and irrigation channels.
Different options for conservation agriculture

<table>
<thead>
<tr>
<th>Options</th>
<th>Land preparation</th>
<th>Planting of main crop</th>
<th>Planting of cover crop</th>
<th>Weeding</th>
<th>Initial investment cost</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple hand tools (smallholder and vulnerable households)</td>
<td>Hoe</td>
<td>Stick, jab-planter</td>
<td>Hoe, stick or jab-planter</td>
<td>Hand hoe for shallow weeding</td>
<td>Low</td>
<td>Most farmers have hoes and sticks. Jab planters may not be readily available. Slashing and spreading of crop and cover crop residues in year 2 and beyond, followed by planting directly through residues. Complete weeding may not be required; roguing and shallow weeding instead.</td>
</tr>
<tr>
<td>Simple hand tools with herbicides (smallholders)</td>
<td>Hoe to make planting pits</td>
<td>Hoe or stick</td>
<td>Hoe, stick or jab-planter</td>
<td>Weed wiper</td>
<td>Low</td>
<td>Needs training to use weed wiper. Planting of cover crops is possible after applying herbicide. Weed wiper is commercially available.</td>
</tr>
<tr>
<td>Animal driven reduced tillage (small- to medium-scale farmers)</td>
<td>Ripper or subsoiler (rented), and herbicide application</td>
<td>Hoe, stick or jab planter</td>
<td>Hoe, stick or jab-planter</td>
<td>Shallow weeding (scraping), herbicides</td>
<td>Low to medium cost, depending on implements and whether hired or owned by individual or group</td>
<td>Good animal health and husbandry practices needed. Subsoiling may be done once every 5 years. Herbicide application depends on weeds. Cover crops might replace other weed control after few years.</td>
</tr>
<tr>
<td>Animal driven no-tillage (small- to medium-scale farmers)</td>
<td>Herbicide application, knife-roller</td>
<td>No-till planter</td>
<td>Hoe, stick or jab-planter</td>
<td>Hand pulling (roguing), knife-roller, herbicides</td>
<td>High cost of no-till planter</td>
<td>Lower power requirement than for ploughing. Knife-roller is needed only for well-established soil cover. Knife-roller used in year 2 and beyond to crush residues before planting. Knife-rollers may not be readily available.</td>
</tr>
<tr>
<td>Tractor-operated implements (large-scale farmers)</td>
<td>Subsoiler Herbicide (boom sprayer) before planting</td>
<td>No-till tractor-mounted direct seeder</td>
<td>Tractor-mounted direct seeder</td>
<td>Hoe for shallow weeding, knife-roller, herbicides</td>
<td>Very high initial investment</td>
<td>Subsoiling done every 4–5 years, depending on soil. Small-scale farmers can hire implements rather than buying them.</td>
</tr>
</tbody>
</table>


Conservation Agriculture

Different situations

Conservation agriculture can be used in all parts of Africa, except where it is too dry to grow crops. It can be applied in various climatic zones and under different conditions, though it may look very different from place to place.

- In semi-arid lands, conservation agriculture retains water in the soil, keeps the soil temperature even, and protects the land from erosion during heavy downpours. Maintaining soil moisture is the main challenge in these areas, so rainwater harvesting methods can be very useful to increase the amount of water available for crops. Crops may be planted with wide spacing, and there may not be enough moisture to grow a cover crop, so farmers may have to rely on mulch or residue to keep the soil covered. Livestock are important in these areas. Farmers may have to restrict grazing on their fields to keep as much soil cover as possible.

- In sub-humid and humid areas, weeds and erosion are likely to be more of a problem. Crops are planted at closer spacings, and cover crops help suppress weeds and protect the soil.

- On slopes, conservation agriculture can be used in association with terraces, contour grass strips and other erosion-control methods. Terraces already exist in many places; conservation agriculture can be used on them.

- Where labour is scarce, perhaps because of HIV/AIDS, conservation agriculture enables farmers to produce good yields with less labour.

- In densely populated areas, conservation agriculture increases yields on small plots of land under intensive cultivation.

- On good soils, conservation agriculture keeps the soil healthy and maintains yields. On poor soils, it is a good way to rebuild soil fertility and enhance water-holding capacity, so increasing production.

Conventional vs conservation

Both conventional farming and conservation agriculture include a very wide range of operations: field preparation, planting, fertilization, weeding, harvesting, and field operations after the harvest. The table on the next two pages compares practices common throughout Africa with conservation agriculture. There are, of course, many variations in both “conventional” and “conservation” approaches, so the descriptions are simplified and may not depict what happens in a particular area.

Conservation agriculture means less work because it is not necessary to plough the soil and weed as many times. It suppresses weeds and reduces erosion. It improves the soil structure, ability to retain water, organic matter content and fertility. All these lead to higher and more stable yields.
## Conventional farming vs conservation agriculture

<table>
<thead>
<tr>
<th>Operation</th>
<th>Conventional farming</th>
<th>Conservation agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Field preparation</strong></td>
<td>Grazing animals on the stover of the previous crop, or burning it. Plough or hoe the soil to turn it over and bury organic matter. Harrow or disk to prepare a seed bed.</td>
<td>Lay the stover on the soil surface. Control grazing to prevent animals from eating it all. Open a narrow planting furrow with a ripper, without turning the soil. Or use a hoe to make small planting holes, soon after harvest.</td>
</tr>
<tr>
<td><strong>Planting</strong></td>
<td>After rains begin, plough to open a furrow for sowing seed, then cover the seed with soil.</td>
<td>Planting before the rains is possible in some areas. Sow seed directly into the ripped lines or planting holes, or drill seeds into undisturbed soil using direct planters. Sow a cover crop a few weeks later in the growing season to protect the soil.</td>
</tr>
<tr>
<td><strong>Fertilization</strong></td>
<td>Apply basal dressing before or at planting. Apply top dressing 3–4 weeks after germination. Soil fertility management relies mainly on inorganic fertilizer.</td>
<td>Apply basal fertilizer, manure and compost long before the rains. Soil fertility management relies on compost, manure and green manure, supplemented by inorganic fertilizers. Legumes are a major source of</td>
</tr>
</tbody>
</table>
### Conventional farming vs conservation agriculture (continued)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Conventional farming</th>
<th>Conservation agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weeding</strong></td>
<td>Weed 3–4 times by hand or using hoes or cultivators This causes a lot of soil distur-</td>
<td>Cover crops and mulch prevent most weed growth. Control weeds while disturbing the soil as little as possible. Use slasher to cut weeds, or use herbicides. Remove weeds when they are small to prevent seeding and save work.</td>
</tr>
<tr>
<td></td>
<td>bance. Or use herbicides to control weeds.</td>
<td></td>
</tr>
<tr>
<td><strong>Harvesting and</strong></td>
<td>Harvest by hand or using equipment. Remove the straw and stover from the field and</td>
<td>Harvest by hand or using equipment. Leave straw and stover in the field to cover the soil and increase organic matter. Leave cover crops growing as additional cover.</td>
</tr>
<tr>
<td><strong>afterwards</strong></td>
<td>use as livestock feed. Burn residue that</td>
<td></td>
</tr>
<tr>
<td><strong>Livestock</strong></td>
<td>Allow livestock onto the field to gaze on stubble. Animals provide manure, but trample and compact the soil and remove the cover, leaving the soil open to erosion.</td>
<td>Control grazing by livestock. Fence land to keep them out completely: graze them elsewhere, cut some of the cover crop to use as feed, or feed them with fodder grown in separate plots. If it is not possible to keep animals out of the field, restrict grazing to keep as much soil cover as possible.</td>
</tr>
</tbody>
</table>
Effects of conventional farming and conservation agriculture

In African conditions, conventional farming can produce high yields in the first few years after a virgin soil is ploughed. But then – all too often – the problems begin. The table on the next few pages summarizes some of these problems, and shows how conservation agriculture avoids them. Again, the descriptions are simplified: not all conventional farming suffers from the problems listed in the table.

Improving food security

Conservation agriculture creates a win–win situation with numerous advantages. Here are two particular ways it can improve food security:

Conserving soil moisture  Maintaining cover on the soil protects it from heavy rain and conserves the moisture during dry spells. It reduces the soil temperature under the intense sun. Combining conservation agriculture with measures to prevent erosion and harvest water can raise yields significantly.

Increasing crop diversity  The crop rotations and intercropping in conservation agriculture enables farmers to broaden their own diet, and sell a greater variety of produce. Different crops have different rooting depths, so draw nutrients and moisture from different layers. Overall yield levels should rise, even on depleted soils.

Indigenous conservation agriculture practices in Côte d’Ivoire

Many indigenous practices have elements of what we now call “conservation agriculture”. It may be possible to build on or adapt these.

In the rainforest zone of southern Côte d’Ivoire, for example, Ebrié farmers traditionally clear the land, then build small mounds 30 cm high before the rainy season starts. They plant a combination of crops on the mounds: cassava, maize, groundnuts, okra and tomato. The mounds ensure good drainage and enable humus to accumulate, concentrating fertility around the crops. The soil stays covered for 2 years. A bush or tree crop, such as coffee, cacao, palm or rubber, is often introduced later.

Organic matter breaks down quickly in the hot, wet conditions. Heavy rain washes nutrients away, leaving a poor, acidic soil and causing gullyling. Farmers often abandon the land after a few years.

One way to keep land productive is to continue growing cereals, cassava and other crops, closely spaced to cover the soil. Leaving mulch on the surface and growing a permanent cover crop of legumes such as *Pueraria* and *Centrosema* protects the soil and increases the organic matter level. Applying organic and inorganic fertilizer several times during the season (instead of all at once) allows crops to use the nutrients before they are washed away. Planting tree crops can also help protect the soil from heavy rain.

More information: Anne Nomel
## Effects of conventional farming and conservation agriculture

<table>
<thead>
<tr>
<th>Operation</th>
<th>Conventional farming</th>
<th>Conservation agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil structure</strong></td>
<td>Repeated ploughing, diskng, harrowing and harvesting reduces soil organic matter and destroys the soil structure. Very fine, unstable particles result. A hardpan – a hard layer that water cannot pass through – forms at the ploughing depth.</td>
<td>Deep ripping may be necessary to break up a hardpan. Deep-rooted legumes can also break it up. The soil is disturbed very little, so its structure stays intact, and no hardpan forms. Organic matter builds up because crop residues and cover crops stay on the soil. A range of soil particle sizes are present.</td>
</tr>
<tr>
<td><strong>Soil moisture</strong></td>
<td>Ploughing destroys many of the pores and cracks in the soil, making it hard for water to seep in. Much of the rain runs off and is lost, instead of being stored in the soil. Ploughing turns the soil over, allowing much of the moisture to evaporate in the air. On flat land, water forms pools on the surface, or is trapped above the hardpan, causing waterlogging and erosion.</td>
<td>Organic matter binds soil into stable clumps. Water can soak into the soil easily through pores and cracks. It is stored in the soil, so is available for crops. There is no hardpan, so water can percolate deep into the ground. Mulch and cover crops shade the soil surface, so less water evaporates.</td>
</tr>
</tbody>
</table>
### Effects of conventional farming and conservation agriculture (continued)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Conventional farming</th>
<th>Conservation agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Erosion</strong></td>
<td>Heavy rainfall pounds the soil, breaking up lumps of soil into fine particles and creating a crust that seals the surface and prevents water from seeping in. On slopes, water runs downhill, carrying precious topsoil with it. Rills form and develop into gullies, which carry the soil into rivers. The silt clogs reservoirs and irrigation canals, and causes flooding when the next rains come.</td>
<td>Cover crops and mulch protect the soil surface from heavy rain. Roots bind the soil together, so it is less easily eroded. Less water runs off, so there is less</td>
</tr>
<tr>
<td><strong>Soil fertility</strong></td>
<td>Ploughing buries organic matter and exposes the soil to the sun and rain. It breaks up organic matter into simpler compounds, which are easily washed away. Removing or burning crop residues depletes the soil fertility. Planting a single crop year after year removes valuable nutrients from the soil. There are few earthworms, burrowing beetles, microbes, and other soil life that are vital for a healthy</td>
<td>Crop residues and cover crops stay on the soil, adding to the organic matter. Adding compost, manure or mulch from outside further improves fertility. There are many earthworms and other forms of soil life. Legumes improve fertility by fixing nitrogen.</td>
</tr>
</tbody>
</table>

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Notice: The text is based on a table that is inferred from the images provided. The descriptions are simplified and may not cover all the details accurately.
### Effects of conventional farming and conservation agriculture (continued)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Conventional farming</th>
<th>Conservation agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yield</strong></td>
<td>Yields fall over time as fertility declines. Farmers are forced to rely on expensive artificial fertilizer – which few can afford. Planting is often late because farmers have to wait until the soil is moist enough for ploughing.</td>
<td>Planting can be earlier because it is not necessary to wait until the soil is moist enough for ploughing. Soils are fertile and contain more moisture, so produce higher and more stable yields.</td>
</tr>
<tr>
<td><strong>Weeds</strong></td>
<td>Keeping the soil bare allows weeds to grow unhindered. Planting the same crop year after year encourages certain weeds, pests and diseases.</td>
<td>The cover crop or mulch smothers weeds and prevents them from growing quickly. Careful use of herbicides can also control weeds. Rotating crops breaks the life cycle of pests and disease organisms. A healthy soil helps control pests and diseases that</td>
</tr>
</tbody>
</table>
## Effects of conventional farming and conservation agriculture (continued)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Conventional farming</th>
<th>Conservation agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Costs and labour</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ploughing and weeding are expensive (if it is necessary to hire workers to do it), take a lot of time, and are hard work. Fuel costs are high, and there is a lot of wear and tear on equipment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is not necessary to plough, so there is no need to buy expensive mouldboard ploughs, disks and harrows (though farmers may have to invest in new equipment such as planters and rippers). Less work is needed for weeding and most other farm operations. The costs of fuel or of hiring animal traction are lower, and there is less wear on equipment. Farmers are able to cultivate a larger area than with conventional farming.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Crop diversity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monocropping produces one staple crop, with the risk of failure if there is a drought or pest attack. Farmers' incomes and diets depend on a single crop.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop rotations and crop mixes produce a range of crops. They reduce the risk of ruin if one crop fails, and provide a more diverse diet.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Effects of conventional farming and conservation agriculture (continued)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Conventional farming</th>
<th>Conservation agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Conventional farming is unfriendly to the environment. It encourages erosion, pollutes water supplies, reduces soil fertility, and destroys ecosystems. It releases carbon dioxide (CO₂) into the atmosphere, which changes the climate and contributes to global warming.</td>
<td>Conservation agriculture is environmentally friendly. It reduces erosion; streams and rivers are cleaner and flow throughout the year. It maintains soil fertility, and conserves natural ecosystems. It raises the amount of organic matter in the soil, so acts as a “carbon sink”, and reduces global warming.</td>
</tr>
<tr>
<td>Livestock</td>
<td>Animals provide manure, but trample and compact the soil and remove the cover, leaving the soil open to erosion.</td>
<td>Controlled grazing prevents trampling and compaction, and leaves the mulch and cover crop to protect the soil and enrich the organic matter. Livestock owners have to find alternative methods for waste management.</td>
</tr>
</tbody>
</table>
Other types of sustainable agriculture

Conservation agriculture is not the only type of “sustainable” agriculture and resource management. It overlaps with various other approaches. Here are some:

**Sustainable land management** (or “land husbandry”) is a broad term that includes various types of crop and livestock production that aim to produce good yields year after year, while conserving soil and water resources. It does not necessarily include all three principles of conservation agriculture (don’t turn the soil, keep the soil covered, and rotate crops). Conservation agriculture is a type of sustainable land management.

**Organic farming** involves growing crops and livestock without using agrochemicals. It is possible to do conservation agriculture in an organic way (without using fertilizers, herbicides or pesticides), but many types of conservation agriculture use these agrochemicals – but in small amounts and with care.

**Agroforestry** is a combination of trees and crops (or livestock), and is a form of “sustainable land management”. Agroforestry promotes soil cover and crop rotation, so may contribute to a conservation agriculture system.

History of conservation agriculture

In the 1930s, soil erosion in the **United States** reached crisis proportions. The problem was particularly severe in the Midwest, where millions of tons of top-soil were blown away by the wind or washed into rivers, in what came to be known as the “Great Dust Bowl”. Supported by the government, American farmers started abandoning their traditional practice of ploughing. Instead, they left the crop residues on the soil surface, and planted the next crop directly into the stubble.

Faced with similar problems, farmers in **South America** also took up conservation agriculture. They sowed cover crops to protect the soil, and rotated crops in order to maintain soil fertility. Because of the benefits, knowledge passed quickly from farmer to farmer.

By the year 2000, conservation agriculture was practised on about 60 million hectares of land worldwide, mainly in North and South America. Government support has been important: in some states in Brazil, conservation agriculture is official policy. In **Central America**, Costa Rica’s Ministry of Agriculture has a Department for Conservation Agriculture. Conservation agriculture is used to cultivate over half the crop land in Paraguay, about one-third of the land in Argentina, one-third in Brazil, and one-sixth in the United States.

The many South American conservation agriculturists are well organized in local and national farmers’ associations. They are supported by institutions from North and South America and have links with international agencies such as FAO, GTZ and the World Bank. This support is essential to help farmers to adopt quickly new approaches and technologies that many see as a radical change in the way they farm.
Conservation agriculture has great potential in Africa because it can control erosion, produce stable yields, and reduce labour needs.

The story of conservation agriculture in Africa is not new. Across wide areas of Africa, conservation agriculture principles used to be normal practice, before ploughs were introduced. Farmers would cultivate by hand, often with hoes, rotating crops and fallowing fields for several years. Rising populations and ploughs changed all that. European settlers and colonial regimes introduced ploughs, and they quickly came to dominate farming because they enabled farmers to open up more land quickly and cheaply. But just as in the United States, the plough has gradually eroded Africa’s soils. Fertility and yields have fallen, and many countries now face critical food shortages.

But not all Africa’s farmland was put to the plough, or to the deep-till hoe, and pockets of conservation-friendly farming still remain.

Conservation agriculture emerged in several different places around the same time in Africa. The most dramatic story comes from Zimbabwe and Zambia, where conservation agriculture came to the rescue of the land. Starting on one large-scale commercial estate in Zimbabwe, a combination of zero-tillage and direct planting into deep straw mulch meant a slow but sure recovery for de-

Lesotho’s lost soil

The first missionaries arrived in Lesotho in 1833. They introduced ox-ploughs to the Basotho people. The ploughs were a welcome alternative to hand cultivation. They spread very fast, and Lesotho became a breadbasket for South Africa. It exported tons of food.

Soon people believed this was the only way land could be cultivated. Some women would refuse to marry a man who did not own a plough. Tractors followed, and more and more land was ploughed.

But the tractors and ploughs compacted the soil. Rain fell on the bare land, and washed Lesotho’s precious topsoil into the rivers. Millions of tons of soil a year are lost now each year. According to one estimate, there will be no topsoil left in Lesotho by 2040 [see Photo 19].

Soil fertility began to fall, and crop yields declined. More and more fields were planted to maize, instead of a variety of crops in rotation. Farmers started to rely on artificial fertilizer and other chemicals as the only way to increase the poor yields.

Lesotho can potentially produce an average of 4 tons of maize per hectare, but in 2003 to 2004, it produced less than one-tenth of that.

Recently, a few farmers have begun to practise conservation agriculture. They have found that they can get good yields without ploughing: they dig small planting holes in lines, add manure or compost, and sow maize seeds. They protect the soil surface with cover crops or residues from the previous crop. They have begun to restore the fertility of their soils and to stop erosion. For the first time in decades, there is hope for Lesotho’s farmers.

More information: August Basson
Conservation agriculture in Ghana

Conservation agriculture has spread rapidly in Ghana. In 1996, only a handful of farmers grew a single crop – maize – using conservation agriculture. With support from Sasakawa Global 2000, Monsanto and GTZ, their numbers had risen to 350,000 by 2002. They grow a broad range of crops, including root crops, legumes, vegetables and tree crops.

The range of crops under no-till in Ghana has risen from year to year

Number of farmers in Ghana practising conservation agriculture
Conservation Agriculture

graded land. A moderate use of herbicides was needed to kill weeds. By the mid 1990s, nearly 4000 hectares were under conservation agriculture – all on large-scale farms. Efforts are presently being made to transfer this success to some of the many new small-scale farmers in Zimbabwe.

In Zambia around the same time, a dedicated extension unit, supported by donor funds, spread the message. Here, small-scale farmers found that conservation agriculture worked on their farms too. Currently more than 100,000 small-scale farmers in Zambia have converted to conservation agriculture.

Large-scale farmers in Kenya, South Africa and Namibia also use conservation agriculture practices. In South Africa, no-till farmers’ clubs similar to those in South America have been set up. Initiatives by government research and extension agencies, donors and the private sector promote conservation agriculture for smallholder farmers in Cameroon, Ghana, Kenya, Madagascar, Malawi, Namibia, Tanzania, Uganda, Zambia, Zimbabwe, and other countries. Various institutions conduct research on or promote conservation agriculture (see Chapter 14 for more information).

The most important researchers and promoters of conservation agriculture in Africa are farmers themselves. Every farmer is a researcher, who experiments every season on his or her farm. Farmers who find something that works are likely to repeat it the next season, and to tell their friends about it.

Challenges for conservation agriculture

Conservation agriculture has the potential to change the face of Africa. But its success is not automatic. It faces various challenges.

Change of mindset Switching to conservation agriculture involves a fundamental change of mindset. For example, farmers must drop their traditional practice of preparing the land with a hoe or plough, and instead rely on “biological tillage” by the plant roots and earthworms. The switch also encourages farmers to begin to see their farms as a business rather than merely a way to feed their families.

Conservation agriculture involves radical changes in what extension services do. An effective way to promote conservation agriculture is through farmer field schools and other approaches that put farmers and their needs at the centre, rather than seeing them as mere recipients of advice.

Such revolutionary changes require teaching, not only on the farm itself but also within schools and colleges. Extension staff will need intensive training so they can learn the necessary technologies. Field demonstrations and awareness-creation campaigns will also be needed. The mass media must be harnessed to support the campaign.
A certification system for conservation agriculture?

In some countries, farmers who grow food organically (without using fertilizers, pesticides and other chemicals) can apply for a certificate. This allows them to sell their produce as “organic” – which fetches a higher price than similar produce grown with chemicals.

Elsewhere, farmers who sign a contract not to plough their land for several years can be given cash rewards.

Could such systems be introduced for African farmers who practise conservation agriculture?

Conservation agriculture increases the organic matter content of the soil – so it stores carbon dioxide rather than releasing it into the air. That helps prevent climate change. Could conservation agriculture farmers someday be rewarded for storing carbon?

Do these ideas sound far-fetched? Farmers in South America are debating them already!

See Chapter 12 for more on changing mindsets, and Chapter 13 for more on promoting conservation agriculture.

Crop residues Keeping the soil covered is important in conservation agriculture. But it can be difficult. Farmers have many uses for crop residues: as fodder, fencing, roofing and fuel. Livestock keepers let their animals graze on stubble. In drier areas, it is impossible to grow a cover crop in the dry season, and crop residues are a vital source of animal feed.

If they are to keep the soil covered, farmers will have to protect their fields and find alternative sources of fuel and fodder. In wetter, sparsely populated areas, this is easy. In drier areas, it is more difficult. Alternatives include fencing animals out, reaching agreements with livestock owners on grazing rights, and growing special plots of fodder and fuelwood.

Land tenure Farmers can go a long way towards adopting the principles of conservation agriculture with a minimum of investment on their farms. But they may be reluctant to do so if they do not have clear rights to the land they cultivate.

The importance, however, of the land tenure issue varies widely throughout Africa. In some countries, lack of guaranteed tenure impedes all agricultural development.

Other challenges It can be hard to find seed (particularly of cover crops), inputs such as herbicides, and equipment. Crops such as tef, which has very small seeds, can be difficult to sow without disturbing the soil. And for various reasons, it can be difficult for farmers to work in groups, form organizations or get the support they need to begin practising conservation agriculture.