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Soil cover

A PERMANENT YEAR-ROUND soil cover is central to conservation agriculture. It is important for several reasons:

- It **protects** the soil from rain, sun, and wind.
- It reduces **soil erosion** and protects the fertile topsoil, so preventing the silting of rivers and lakes.
- It stops the soil surface from **sealing**, and reduces the amount of precious rainwater that runs off.
- It suppresses **weeds** by smothering their growth and reducing the number of weed seeds. This reduces the amount of work needed for weeding.
- It increases the **soil fertility** and the organic matter content of the soil.
- It increases **soil moisture** by allowing more water to sink into the ground and by reducing evaporation.
- Decomposing vegetation and the roots of cover crops improve the **soil structure** and make the clumps and lumps in the soil more stable – making it harder for rain to break them up and wash them away.
- **Earthworms** and other forms of life can prosper in the cover as well as in the soil.
- Soil cover stimulates the development of **roots**, which in turn improve the soil structure, allow more water to soak into the soil, and reduce the amount that runs off.

Like an umbrella

Soil cover protects the soil and micro-organisms that live in it from the heat of the sun and the impact of rain. A good farmer gives her soil an umbrella to keep it healthy. Only a healthy soil can produce a good crop.

There are two main types of soil cover:

- **Living plant material:** crops and cover crops.
- **Mulch,** or dead plant material: crop residues and prunings from trees and shrubs.

You will often use a combination of mulch and living plants to keep the soil covered.

To obtain a good soil cover, you should leave **crop residues** such as maize and sorghum stalks in the field. You might also be able to add **mulch** from outside the field: for example, you can cut grass from nearby, or bring in leaves and prunings from trees and shrubs. They will decompose after a while, so you will have to replace them regularly.

In addition, you can plant a **cover crop**, either during the cropping season (to cover the area in between the crop rows), or afterwards to cover the whole field. During the cropping season itself, the **crops** themselves act as soil cover. An intercrop of tall plants (such as maize) and low-growing plants (such as beans) makes a good cover.

It can be difficult to keep the soil covered, especially in semi-arid areas. It may be necessary to compromise: some cover is better than none.

Cover crops

Cover crops are planted to provide a soil cover, improve soil fertility and produce food and feed. They are normally grown during the dry season or as intercrops. They may be allowed to grow throughout the cropping season, or they may be killed and left on the soil surface as mulch.

Africa has many different cover crops. They fall into four main groups: legumes, shrubs, grasses, and other. The type of cover crop you choose influence the quantity and quality of mulch it provides. The most common cover crops in Africa are listed in the [table on the next page \(see also Photos 21–27\)](#).

Some farmers already intercrop maize with beans, where the beans may act as a cover crop for part of the year.

Feed the soil to feed the people

Cover crops are the food of the soil. Only a healthy soil can provide the necessary food to the people. Soil has life, which needs to be fed.

Farmer slogan, Swaziland

How to choose the right cover crop

Small-scale farmers prefer a cover crop which fits into their normal cropping system and which has multiple purposes:

- Edible seeds and vegetables
- Soil fertility
- Animal fodder
- Firewood/fencing material
- Weed suppression
- Medicines.

First, check **which cover crops grow well** in your area. This depends on the soil type, rainfall, temperature and altitude. If you live in an area with little rainfall, select a cover crop that grows quickly, such as cowpea, desmodium, lablab, lucerne, mucuna, or pigeonpea.

Then check **how much work** each cover crop will need: for land preparation before planting, weeding, and producing and harvesting the seeds. Species with big pods and grains (such as pigeonpea and mucuna) are easier to deal with than species with small pods (such as vetch and grasses). Most farmers prefer species that cover the soil quickly and completely, and which can also be used for food and fodder.

Characteristics of cover crops

Cover crop	Botanical name	Climate	Altitude	Uses (apart from cover)	Characteristics
Legumes					
Butterfly pea	<i>Clitoria ternatea</i>	Semi-arid to sub-humid	Low to medium	Fodder	Climbing and shrubby legume. Range of soils. Tolerates salinity and acidity but not flooding
Centro	<i>Centrosema pubescens</i>	Sub-humid to humid	Low to high	Fodder	Trailing legume. Wide range of soils, sandy to clay
Cowpea	<i>Vigna unguiculata</i>	Semi-arid and sub-humid	Low to medium	Food	Legume has both creeping and erect types. Sandy to clayey soil. Long-maturing varieties best for intercropping with cereals
Crotalaria	<i>Crotalaria retusa</i> , <i>C. ochroleuca</i> , <i>C. paulina</i>	Semi-arid to sub-humid	Low to medium		Erect legume. Wide range of soils. Deep roots break compact soil layers. Adapted to infertile soils. <i>C. ochroleuca</i> can be eaten as a vegetable
Desmodium	<i>Desmodium intortum</i>	Sub-humid to humid	Medium to high	Fodder	Trailing and climbing legume. Wide range of soils
Jackbean	<i>Canavalia ensiformis</i>	Semi-arid to humid	Low to high	Food, fodder	Erect legume that can grow to 1 m high. Slow growth at first. Drought-tolerant and immune to most pests. Dry before using a fodder. Young pods can be used as food

Characteristics of cover crops (continued)

Cover crop	Botanical name	Climate	Altitude	Uses (apart from cover)	Characteristics
Jugo bean, bambara groundnut	<i>Vigna subterranea</i>	Sub-humid to humid	Low to medium	Food	Wide range of soils. Drought-resistant. Beans high in protein
Lablab, hyacinth bean	<i>Dolichos lablab</i>	Semi-arid and sub-humid	Low to medium	Food, fodder	Creeping legume that spreads quickly. Sandy to clayey soils. Suited for intercropping with cereals and sugarcane. High in protein
Lucerne, alfalfa	<i>Medicago sativa</i>	Semi-arid to sub-humid	Low to medium	Food	Erect legume. Wide range of soils
Mucuna, velvetbean	<i>Mucuna pruriens</i>	Semi-arid and sub-humid	Low to medium	Food	Creeping legume that spreads quickly. Sandy to clayey soils. Suited for intercropping with cereals and sugarcane. More sensitive to soil fertility than lablab. Excellent soil cover, suppresses weeds
Mungbean, green gram	<i>Vigna radiata</i>	Sub-humid to humid	Low to medium	Food, fodder	Wide range of soils. Edible beans and leaves
Pigeonpea	<i>Cajanus cajan</i>	Semi-arid to humid (depends on variety)	Low to high	Food, fodder, firewood	Erect legume. Grows in sandy to clayey soil. Deep roots break compact soil layer (biological plough). Good at recycling phosphorus. Rich in protein
Siratro	<i>Macroptilium atropurpureum</i>	Semi-arid and sub-humid	Low to medium	Fodder	Creeping/trailing legume. Range of soils. Tolerant to drought

Characteristics of cover crops (continued)

Cover crop	Botanical name	Climate	Altitude	Uses (apart from cover)	Characteristics
Stylo	<i>Stylosanthus guianensis</i> , <i>S. hamata</i>	Semi-arid to humid (depends on species)	Low to high	Fodder	Creeping coppicing legume. Does well on coarse textured soils and can tolerate acid soils. Takes 1–2 rainy seasons to cover the soil
Tropical kudzu	<i>Pueraria phaseoloides</i>	Humid	Low to high	Fodder	Creeping/trailing legume that spreads quickly. Wide range of soils. Not drought tolerant
Wild groundnut, peanut	<i>Arachis pintoii</i>	Semi-arid to sub-humid	Low to medium	Fodder	Coppicing legume, permanent green cover crop. Does well on coarse textured soils. Takes 1–2 rainy seasons to cover soil
Leguminous shrubs					
Calliandra	<i>Calliandra</i> spp.	Semi-arid to sub-humid	Low to medium	Fodder, firewood, mulch	Wide range of soils, often on contours
Gliricidia	<i>Gliricidia sepium</i>	Semi-arid to sub-humid	Low to medium	Fodder, firewood, mulch	Coppicing shrub
Sesbania	<i>Sesbania sesban</i>	Semi-arid to sub-humid	Low to medium	Fodder, firewood, mulch	Wide range of soils

Characteristics of cover crops (continued)

Cover crop	Botanical name	Climate	Altitude	Uses (apart from cover)	Characteristics
Sunn hemp	<i>Crotalaria juncea</i>	Semi-arid to humid	Low to high	Fodder, firewood	Wide range of soils. Dry before using as fodder
Tephrosia	<i>Tephrosia candida</i> , <i>T. vogelii</i>	Sub-humid to humid	Low to high	Fodder, pesticide, firewood	Wide range of soils. Does not tolerate acidity
Grasses					
Andropogon, gamba grass	<i>Andropogon gayanus</i>	Semi-arid to sub-humid	Low to medium	Fodder	Wide range of soils
Brachiaria	<i>Brachiaria ruziziensis</i>	Semi-arid to humid	Low to medium	Fodder	Grass with multiple tillers. Wide range of soils
Cenchrus	<i>Cenchrus ciliaris</i>	Arid to sub-humid	Low to medium	Fodder	Grass with multiple tillers. Takes time to establish. Wide range of soils
Finger millet	<i>Eleusine coracana</i>	Semi-arid to sub-humid	Low to high	Food, fodder, thatch	Grass with multiple tillers. Wide range of soils

Characteristics of cover crops (continued)

Cover crop	Botanical name	Climate	Altitude	Uses (apart from cover)	Characteristics
Pearl millet	<i>Pennisetum glaucum</i>	Arid to semi-arid	Low to medium	Food, fodder, thatch	Grass with multiple tillers. Wide range of soils
Sunn hemp	<i>Crotalaria juncea</i>	Semi-arid to humid	Low to high	Fodder, firewood	Wide range of soils. Dry before using as fodder
Other cover crops					
Pumpkin	<i>Cucurbita</i> spp.	Semi-arid to humid	Low to high	Food	Creeping edible plant
Watermelon	<i>Citrullus lunatus</i>	Semi-arid to sub-humid	Low to medium	Food	Creeping edible plant

Men and women choose different cover crops

Men and women may have different reasons for choosing a cover crop. Farmers in northern Tanzania gave these as their top priorities:

Rank	Women	Men
1	Source of food	Source of food
2	Reduce time for weeding	Market
3	Moisture conservation	Soil cover
4	Soil fertility	Soil fertility
5	Erosion control	Moisture conservation

Source: FAO/IFAD, 2001–3

Make sure that the cover crop does not **interfere with the main crop**. For example, avoid growing a tall cover crop that might shade the main crop. You can also prevent the cover crop from interfering with the main crop by planting it later ([see page 92](#)).

If you cannot prevent **livestock** from getting into your fields, you might want to choose a cover crop that they do not like to eat, such as jackbean (*Canavalia*) or sunn hemp (*Crotalaria*).

When they die, some cover crops rot quicker than others. Legumes decompose more quickly than grasses. This means that the next crop can use nutrients such as nitrogen from the legumes quickly. A mixture of legumes and grasses is best to ensure a lasting soil cover.

Seed supply

It can be difficult to get hold of good quality seed – especially for cover crops. You may be able to find seeds from these sources:

- **Research institutes or the extension service** Ask extension agents or researchers if they can get seeds for you. Research stations may have a collection of varieties and be willing to let you have some seed.
- **Seed dealers and farm supply stores** Good seed companies provide only certified seed, which has been treated with fungicide and insecticide to prevent problems in germination and early growth. If the seed seller doesn't have any seed in stock, perhaps they can get some from elsewhere. Don't be afraid to ask!
- **Wild sources** Leguminous trees such as calliandra, sesbania or gliricidia may grow wild in your area, or they may be planted as hedgerows or wind-breaks. Collect the seed, dry it and store it ready for planting.
- **Farmer groups** You can organize a group of neighbours to produce seeds for the group members. You may be able to sell any extra seed to other farmers.

Cover crops improve the soil

“Since I stopped ploughing and started growing cover crops, the colour of my soil has changed. It has become much darker, and when I walk across the fields, I feel that the soil is no longer hard and has become soft.”

Farmer from Karatu, Tanzania

- **Grow your own** If you already have some cover crops, you can harvest your own seed and plant it again in the next season. You may be able to sell surplus seed to neighbours. If there is a lot of demand for seed in your area, it may be worthwhile to plant a special field with a pure stand of a cover crop so you can harvest and sell the seed. Ask your extension agent for training on how to produce good-quality seed.

If you do not know the quality of your seed, you can test it for germination before planting. Count out a certain number of seeds (e.g., 50 or 100). Plant them in a container of soil. After the seeds have started to sprout, count how many germinate. If only a few germinate, you can either increase the amount of seed you plant, or try to get new seed.

Seed treatment

Inoculation

Legumes are valuable because they fix nitrogen from the air and make it available for other crops. They do this in nodules (bumps) on their roots that contain special bacteria. Most types of legumes can make nodules by themselves, but some types may need some help. If you are planting a particular legume for the first time, you may need to inoculate the seeds first.

Growing your own seed

- 1 During the growing season, walk through the fields and mark with a piece of cloth or string good, healthy plants that have the characteristics you want. Be careful! Select only from pure stands of a single variety, where there is no mixing with other varieties, and no chance of cross-pollination. Do not collect seed from hybrids, as the result will usually be very poor.
- 2 Harvest the marked plants separately, before harvesting the rest of the crop.
- 3 Dry the seed carefully. Treat it with suitable fungicides and pesticides recommended in your area. You may be able to use natural insecticides such as neem extracts.
- 4 Store the seed in a safe place.
- 5 Dry seeds at regular intervals to prevent them from getting damp.

Spreading mucuna in Benin

Mucuna (velvetbean, *Mucuna pruriens*) is one of the most promising cover crops in West Africa. Soils here are fairly infertile, farmers use little fertilizer, and the soil degrades easily if it is used intensively. Farmers traditionally use shifting cultivation, clearing land to grow crops, and then allowing it to lie fallow for several years so the fertility can recover. However, rising populations mean that farmers can no longer leave the land fallow for long enough for the soil to rebuild its fertility.

Researchers and extensionists first tested mucuna with farmers in southwestern Benin in 1988–1992. Farmers in densely populated areas were interested in adopting the crop because they could no longer practise shifting cultivation.

The farmers like using mucuna as a fallow crop because it suppresses speargrass (*Imperata cylindrica*), a major weed in this area. They are more likely to adopt the crop in areas with a long growing season (7 months or more), where the soil fertility is declining, inorganic fertilizers are expensive, and where weeds such as speargrass are a problem. Mucuna can also provide livestock feed, and suppresses *Striga* weeds and nematodes in intensified cereal cropping. Close contacts between farmers and development organizations are needed encourage the spread of mucuna, as are markets for the seed.

Source: Vissoh et al., in Buckles et al. (1998)

Inoculation is easy. Here's how to do it.

- 1 Sterilize some soil by pouring boiling water on it and letting it cool.
- 2 Find a good plant (or tree) of the species you want to inoculate (It has to be the same species, as there are different bacteria for each species of legume.) Dig to the roots and look for a nodule – a bump on the root. Squeeze it and check that it is pink inside. Collect several nodules from the plant or tree.
- 3 Gently crush the nodules and mix them with the sterile soil.
- 4 Mix your seeds with the soil before planting them. For seedlings, gently rub the soil over the roots before planting.

For some legumes such as soybeans and some tree species, it is possible to buy ready-made inoculant from farm supply stores. Make sure you get the right type of inoculant for the species you want to plant.

Note: In many cases, inoculation is often not necessary (and does not always work). If you are considering growing a legume, try growing a few plants in the field first, then check the plant roots for nodules. If there are nodules, you probably do not need to inoculate.

Speeding up germination

You do not need to treat most types of cover crop seeds. But if you need stylo and some types of sunn hemp seeds to germinate quickly, put them in hot water for 5–15 minutes before planting them. This is a good idea only in areas with reliable rainfall: if they don't get enough moisture to germinate, soaked seeds will rot.

When to plant cover crops

You can plant cover crops in many ways. Here are some possibilities:

Intercropping

Planting at the same time as the main crop. This is easy because you can plant both crops at the same time. It is suitable for sub-humid and humid areas. A possible problem is that the cover crop might grow so quickly that it smothers the main crop. Also, you cannot plant a cover crop this way if you are already intercropping a cereal (e.g., maize) with beans.

Relay cropping

Planting when you weed the main crop. This is suitable for sub-humid and humid areas. You can plant the cover crop when you do the first weeding (usually about 4 weeks after planting the main crop). Or if you are intercropping maize and beans, you can plant the cover crop when you harvest the beans.

Sequential planting

Planting after you harvest the main crop. In dry areas, you can plant the cover crop when you harvest the main crop. This prevents the cover crop from com-

A question of cover

Here are some questions to help you decide when to plant the cover crop.

Questions about the cover crop itself

- How much **moisture** will the cover crop need to grow and produce enough mulch and seed?
- At what **time of year** will there be enough moisture for the cover crop to grow?
- What **other factors** (temperature, frost) will favour or hinder its growth? Is it sensitive to the day length? To frost? To drought?
- How easy will it be to **manage** the cover crop while it is growing and afterwards (mulch management)?

Questions about the cropping system

- When will cover be most **needed**?
- How **fast** will the cover crop grow and provide the required cover?
- How **long** will the cover last?
- Might anything (grazing by animals, burning, etc.) **reduce** the amount of cover?
- How to stop the cover crop and main crop from **interfering** with each other?

peting for moisture with the main crop. You can use the cover crop to provide extra mulch and to produce livestock feed. Harvest water to make sure there is enough moisture to grow the cover crop ([see Chapter 8](#)).

If you live in a semi-arid area with only one rainy season, you can plant a drought-tolerant cover crop such as lablab between your rows of maize. Leave the cover crop in the field after the maize harvest so it covers the soil and suppresses weeds. Before the next season's rains, slash it or roll it, and leave it on the ground as mulch.

[See Chapter 6](#) for more information on different types of cropping systems.

How to plant cover crops

You can plant a cover crop as an intercrop (or relay crop) or in a pure stand.

For cover crops with large seeds, plant with a hand hoe, jab planter or animal-drawn direct planter (for pure stands).

You can broadcast cover crops with small seeds (such as finger millet), provided the soil cover is not too thick. If the soil cover is thick, sow the seeds in lines by hand or use a seed drill.

The plant spacing and number of seeds per hole depend on several factors.

- Use a narrower spacing in pure stands, and a wider spacing in mixed (intercropped) stands.
- Use a wider spacing in drier areas, so the plants don't compete with each other for moisture.
- The number of seeds per hole depends on the amount of moisture available: fewer seeds per hole in dry areas; more in wetter areas. In general, plant 2–4 seeds per hole.

Is there a market for cover crop seeds?

In 1998, a project in Uganda introduced farmers to lablab, mucuna, tephrosia and crota-laria. These cover crops were popular: demand for the seed was far greater than the supply. Some farmers and farmer groups agreed to multiply the seed. They sold the seed to local farmers and people in the neighbouring district. Lablab seed sold for the highest price.

But as more and more farmers produced seeds, the local market became saturated, and selling seed began to be difficult. Local community organizations and NGOs helped to market the seed in other districts and even abroad.

It is fairly easy for farmers in an area to produce enough cover crop seed for their own use, but they may need outside help if they are to market their seed successfully elsewhere.

Do cover crops need weeding?

Yes! You will need to weed cover crops at least once while they are becoming established. Once they have covered the soil well, they will prevent most weeds from germinating.

If you are intercropping or relay cropping your cover crop with maize or sorghum, plan to weed according to the requirements of the cereal crop. Make sure the cover crop does not tangle with the cereal crop.

Controlling pests and diseases

In parts of Kenya and Tanzania, farmers plant lablab as the only cover crop. In some villages, quite large areas are covered with the same crop. Farmers in these villages risk a pest outbreak that may ruin their cover crop.

How to reduce the danger of pests and diseases:

- **Rotate** the types of crops grown: food, cover and cash crops.
- Select cover crops that are unlikely to be attacked by **pests**.
- Plant various **different types** of cover crops.
- Use **chemical spray**.

Harvesting and seed storage

Harvest the seeds before you slash a cover crop to make mulch. You may need to harvest the seeds for several reasons: so you can plant the cover crop next season, if you want to use the seeds as food or fodder, or if you want to sell them to other farmers.

Store cover crop seeds well. Here are a few tips on how to handle them:

- Collect seeds from **several plants** so you get a range of seeds.
- Dry the seeds and treat them with **insecticide**. If you want to use the seeds for food, make sure that the insecticide is not harmful.
- Keep seeds for planting in partly opened bags or in containers in a **well-ventilated** store.
- Take the seeds out and **dry them again** regularly. Throw out any bad seeds.

Preparing to plant the main crop

At the beginning of the next season, your field may have a cover crop, stalks still standing from the previous main crop, and of course, weeds. You need to prepare the field so you can plant the next main crop. You can do this in several ways: by slashing the cover crop and weeds with a machete or hoe,

Cover crop pros and cons

Farmers in northern Tanzania tried various cover crops. Here is what they thought of them.

Cover crop	Advantages	Limiting factors
Lablab <i>Dolichos lablab</i>	Grows fast, so covers soil and controls weeds effectively Easy to manage Tolerates drought Fodder for livestock Good market	Farmers not using it as food Needs special management before the next season Susceptible to pests; needs spraying with insecticide
Mucuna <i>Mucuna pruriens</i>	Grows fast, so covers soil and controls weeds effectively Easy to manage Dries off in a long dry season, so no need to kill it before planting the next crop Fodder for livestock Produces many seeds, which are easy to collect Some farmers grind seeds and mix with corn bran to feed oxen	Use as food not recommended (under research) Seeds not widely available and fairly expensive Weak market Not seen as a crop, so livestock owners may allow their animals to graze Not liked by cattle
Pigeonpea <i>Cajanus cajan</i>	Cash and food crop Protects land from grazing Market available (Asia) Seeds easily available Stems used for firewood	Erect type, so poor weed suppression Little impact on soil erosion
Pumpkins <i>Cucurbita</i> spp.	Traditional food crop intercropped with maize Covers soil and suppresses weeds Seeds easily available and affordable	Does not fix nitrogen in the soil

Source FAO/IFAD, Case study northern Tanzania, 2001–2

using a knife roller to bend over and crush the standing vegetation, or by using a herbicide.

It may be better to use a knife roller to crush the vegetation rather than slashing it, because equipment such as rippers and planters can easily drag pieces of vegetation along with them.

[See Chapters 3](#) and [7](#) for more information on how to prepare the land for planting.

Using cover crops for food and feed

Cover crops are new for many farmers who switch to conservation agriculture. Some (such as *Canavalia* and sunn hemp) need to be dried or processed before they can be fed to livestock. As more and more farmers take up conservation agriculture, you may be able to sell cover crop seeds to your neighbours or in the market.

Various cover crops can be used as food and feed. Livestock can be fed forage from many cover crops directly, though it is necessary to dry some, such as jackbean and sunn hemp, before giving them to animals.

Seeds from cowpeas, lablab, lucerne and pigeonpea can be cooked and eaten as part of a nutritious diet. *Mucuna* seeds need special treatment to remove poisonous substances (see the boxes below).

Making mucuna fit to eat

Mucuna seeds are very nutritious and can be fed to cattle, sheep and goats without processing. But they contain a substance that is **poisonous** to people, chickens or pigs. This poison can be removed in several ways:

- Soak the seeds for at least 48 hours, changing the water every 12 hours.
- Crack the seeds and soak them in running water (from a faucet) for 36 hours.
- Put the seeds in a cloth bag and leave them in a flowing river for 3 days.
- Crack the seeds, boil them for 90 minutes, take the hulls off, then grind them and make a soup.

Lablab recipes

Lablab seeds are used for food in the same way as dry beans. They are rich in protein and are especially suitable for HIV/AIDS patients, nursing mothers and old people. Some recipes from Tanzania and Kenya:

- Mix lablab seeds with shelled maize and cook for at least 1 hour. Then mix with sour milk. Serve hot or cold.
- Cook the seeds for 1 hour and serve with cooked banana and rice.
- Boil the seeds for 30 minutes. Give the soup to women early in their pregnancy to reduce bleeding.
- Cook lablab leaves and serve as a vegetable.

More information: Thomas Loronyo and John Odingo

Mulch

Mulch may come from different sources:

- **Cover crops**, slashed, crushed or sprayed to kill them.
- **Crop residues** from the field itself.
- Prunings from **trees and shrubs**.
- **Other plant materials** brought in from outside the field.

Mulch requires management for land preparation and planting of crops.

Mulch from a cover crop

Some types of cover crop produce a thick layer of living and dead plant material on the ground. Before you plant a new crop, you have to flatten this mass and kill the living plants so they do not compete with your crop. You can do this in several ways:

- Slashing the cover crop with a machete.
- Breaking the stems with an animal- or tractor-drawn roller-chopper
- Applying herbicides.

You can plant the new crop directly through the mulch layer ([see Chapter 3](#)).

Mulch from crop residues

Many annual crops are good sources of mulch after harvesting. Cut the stalks of cereals and lay them on the ground to cover the soil. If you have not yet planted a cover crop, this may be the only source of soil cover.

In some areas, it may not be possible to grow a cover crop. For example, in semi-arid areas, there may not be enough water to grow a cover crop in the dry season. Leaving crop residues in the field is a good option in these areas.

Residues from different crops decompose at different rates. Cereal stalks decompose slowly, so stay on the soil for longer. Legumes rot quickly (so quickly release their nutrients, which can be used by the next season's crop).

To keep the soil covered for a long time, a mixture of legumes and grassy species is best.

Farmers in many areas remove as many of the residues as possible so they can use it as livestock feed or thatch. Or they allow animals into the field after harvest to graze on the stubble. Here are some better alternatives:

- Leave as much residue on the land as you can, given your other needs. Consider collecting some of the leaves (which are more palatable to livestock) but leaving the rest of the leaves and the stalks on the field.

- Control grazing to prevent animals from trampling and compacting the soil, and to stop them from eating all the crop residue.
- Find other sources of livestock feed and building materials. For example, plant a forage plot to feed to animals, and plant a woodlot for building poles.

Mulch from trees and shrubs

Trees and shrubs produce a lot of leaves and twigs that can be used as soil cover and as animal fodder. They also have many other advantages:

- Leguminous trees and shrubs fix nitrogen, improving soil fertility.
- Trees and shrubs improve the structure of the soil and reduce compaction.
- They shade the soil and act as windbreaks, so reducing the soil temperature and help to conserve moisture.
- They prevent erosion.
- They provide fodder ([see Chapter 9](#)), food, medicine, firewood, timber, thatch and fencing.
- They produce fruit and attract bees that can be used for honey.

Farmers can choose from many different trees and shrubs:

- **Multipurpose trees** Various types of trees provide timber, fruit, fodder, and shelter. Rows of trees planted along the contours reduce runoff and erosion. You can prune the branches or collect the leaf litter and spread it on the ground in between the rows to protect the soil.
- **Living fences** Species such as *Acacia*, *Ziziphus*, *Grevillia* and *Cassia* can be planted as live fences and windbreaks. You can prune them to produce fencing, firewood and fodder, as well as mulch.
- **Leguminous shrubs** Shrubs such as *Crotalaria*, *Tephrosia*, *Sesbania* and *Gliricidia* replenish the soil by fixing nitrogen from the air. You can grow them in rotation with maize and sorghum, then cut them to produce material for mulch, fencing and fodder. None of the leguminous shrubs are edible, but most can be used as fodder and firewood. When these shrubs flower, they attract bees – perhaps you can use them to produce honey?

Leguminous shrubs produce seeds 8–12 months after planting – longer than a single season. The seeds can be hard to find. You may be able to obtain them from the same sources as for cover crops ([see page 89](#)). It may be a good idea to set up a nursery, either by yourself or with a group of other farmers. Some farmers make money by selling seeds and firewood. You may be able to collect seeds of certain shrubs from the bush.

Farmers may be reluctant to plant leguminous shrubs because they cannot use the land to grow a food crop during the short rainy season. However, in most cases the legume will improve the soil fertility so much that the higher yields in

Crop rotation with leguminous shrubs

In western Kenya, many farmers leave their fields fallow for one or more seasons. They grow maize intercropped with beans in the long rainy season. When they harvest the beans, they plant leguminous shrubs in the former bean rows, and leave them to grow in the short rainy season. The most common shrubs are *Crotalaria grahamiana*, *Crotalaria paulina*, *Tephrosia candida*, *Tephrosia vogelii*, *Sesbania sesban* and *Gliricidia sepium*.

When they prepare the land in February or March, the farmers cut the shrubs. They use some of the leaves and twigs as fodder, and leave the rest on the ground as mulch. They use the stems as firewood, for fencing, or as stakes to support tomatoes and passion fruit.

Some farmers like to plant *Crotalaria grahamiana* and *Tephrosia candida* because they flower early and attract bees, so increasing honey production.

More information: Anja Boye

the long rains more than make up for the loss of output in the short rainy season. Another attraction is that growing leguminous shrubs takes little work.

Pruning trees and using the leaves and branches as soil cover is common, but it can be a lot of work. To reduce the amount of work, plant trees on your farm and as living fences close to your conservation agriculture fields.

Mulch from other plant materials

If you do not have enough mulch from crop residues or a cover crop, consider bringing in extra materials from outside. You can slash vegetation growing around the field or nearby, and spread them on your field. You can also grow trees and shrubs especially to use as mulch (see the section above).

Bringing in mulch from outside takes a lot of work, but it may be possible to do it when you first start conservation agriculture, to protect the soil before you have been able to plant a cover crop.

Make sure you do not spread weeds or cause other problems when you bring in this vegetation.

- Do not use **Striga** or **couchgrass** (*Cynodon dactylon*) as mulch. Burn them instead.
- Do not use weeds that have already flowered and produced **seeds** as mulch. Slash them before they have had a chance to produce flower, or use them to make compost (composting kills most seeds).
- Do not use mulch that can spread **diseases** to your crop.
- You can use sawdust or rice husks as mulch, but be careful: they can cause **soil fertility** problems. For example, they can soak up nitrogen from the soil, leaving less for your crops.

Challenges for maintaining soil cover

Here are some problems you may encounter with soil cover, and ways to overcome them.

Semi-arid areas

In semi-arid areas, where there is little rain and most of it falls in one season, establishing a cover crop may be difficult. Crops, shrubs and trees produce few residues, and farmers often need them for feed or building materials. Cover crops use precious water.

- It may be impossible to maintain soil cover for the whole year. You may have to rely on crop residues and prunings from trees and shrubs as the main source of soil cover.

Diseases and pests

Diseases and insect pests might attack the cover crop and will require special attention. Farmers often use fire to destroy pests and diseases. But this leaves the soil bare and destroys valuable organic matter.

- Rotate crops rather than burning them to control pests and diseases. Consider using insecticides if necessary.

Rats

A dense cover crop may encourage rats, which may attack the crop.

- Slash the live cover crop as close to the ground as possible before planting the crop. It may also be necessary to trap rats or bait the rats with poison. Caution: Keep poisons out of reach of children!
- Rotating crops helps to control rats because it interrupts their food supply and disturbs their living conditions.

Termites

Many farmers fear that soil cover will attract termites.

- Termites are important because they break down plant material on the surface and carry into the soil, where it adds to soil organic matter. They also help aerate the soil and improve infiltration by water.
- Most types of termites are beneficial: only a few types attack crops. They may eat the stems or damage the grain. This normally happens towards harvest time. Leave plant material (such as cover crops) on the surface so

the termites attack this rather than the crop itself. The crop can be harvested before they do any damage to it.

Fire

Bushfires or uncontrolled fires on neighbouring fields can spread into a conservation agriculture field and destroy its soil cover. To prevent this, you can leave a buffer zone around your field.

- Once many farmers in the area practise conservation agriculture, burning will be less of a problem. Bylaws and education are needed to reduce damage by uncontrolled fires.

Livestock

Livestock need to be fed. Farmers often allow them to graze on stubble or on fallow fields, and other livestock owners may not keep their animals out of a field planted to a cover crop. This may especially be a problem in dry years or in semi-arid areas, where few alternative sources of feed are available.

- You can keep livestock out of your fields by planting living fences, by spraying the field boundaries with cattle urine, or by planting fences or cover crops that cattle do not like to eat.
- You can also try to negotiate with your neighbours (or persuade the village leaders) to find alternative grazing arrangements – such as identifying alternative sources of forage or pasture. Or you may be able to restrict grazing to those times when the soil cover is dense and the soil is not too wet.

[See Chapter 9](#) for more on livestock.

Information

Farmers need information and training on how to maintain soil cover.

- Try to get information and training from extension workers, non-government organizations, or nearby research institutes. Visit other farmers to find out how they maintain cover on their soil.

