

African Organic Agriculture Manual Booklet Series
No. 4 | Soil organic matter management

HOW DO I IMPROVE THE SOIL ORGANIC MATTER?

What do I need to know about soil organic mat

Soil organic matter is essential to the soil's capacity to hold water and nutrients and supply them to plants when they need them.

Any plant and animal material added to the soil is decomposed and partially transformed into soil organic matter (also called humus).

Under natural conditions the organic matter content of soils increases slowly as a result of continuous addition of organic materials to the soil. Warm and humid climates encourage the decomposition of these materials. But these same conditions also enhance decomposition of soil organic matter (called mineralisation). Excessive tillage speeds up this process as well, as it brings much oxygen into the soil. Therefore, because of the high temperatures and humidity in most parts of Africa, frequent addition of organic materials and reduced soil cultivation are needed in order to maintain appropriate soil organic matter levels.

Why soil organic matter is so important:

Soil organic matter:

... acts as a reservoir for nutrients and releases them in a balanced way, thus contributing to good plant health.

... binds soil particles together improving the soil's structure, which increases water infiltration, resistance to erosion and enhances root growth.

Does your soil have enough organic matter? If not, why do you think it is not enough?

ter?



... regulates the acidity or alkalinity of the soil, improving the ability of nutrients to become soluble and available to plants.

... provides food and a favorable environment for soil organisms, improving nutrient mobilisation from organic and mineral sources, and soil health.

... acts like a sponge with the ability to absorb and hold up to 90 percent of its weight with water, thus increasing the water holding capacity of soil.

How do I maintain soil organic matter?

Building soil organic matter is a long-term process. But investing in it is highly beneficial to crop and forage production.

The amount and the quality of organic materials supplied to the soil influences the content of organic matter in the soil. A regular supply provides the best conditions for maintaining the organic matter level in the soil. In humid tropical climates greater efforts are necessary to maintain soil organic matter than in arid climates.

Organic farmers apply a variety of measures to ensure that soil organic matter is maintained or even improved. In particular they:

- › Grow **green manures**.
- › Grow **cover crops** within regular crops.
- › Cover the soil with **mulch**.
- › Make **compost** from plant materials and animal manures.
- › Plant **leguminous trees** for pruning and mulching.

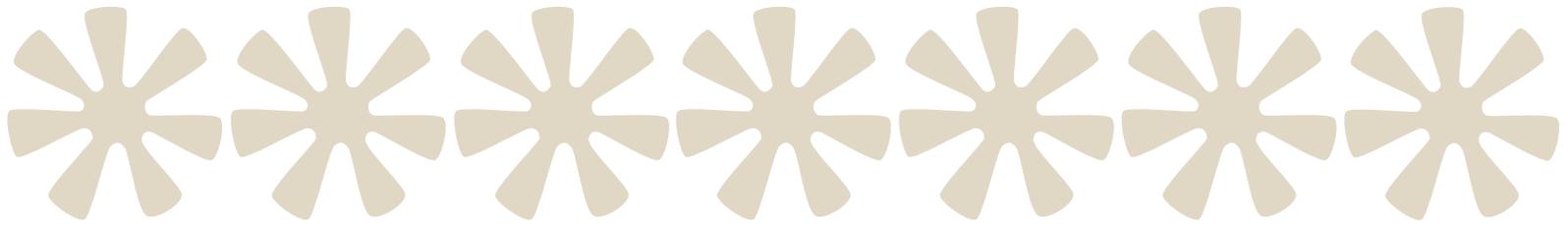
How do you feed the soil? Have you ever thought of applying organic materials to the soil?



A mulch cover can be made by cutting a green manure crop or spreading grass or twigs.



Composted animal manure makes a highly valuable soil amendment.



Crop residues should be used as mulch, chopped and mixed into the soil or composted, but not burnt.



Cover crops such as velvet bean, tithonia, lablab or others are grown as living mulch.



Compost has a very positive and long-lasting effect on the soil organic matter content.



Green manures are cut at full biomass to cover the soil or be incorporated.

What do I need to know about compost?

Compost is more than a fertiliser, it builds the soil. Its main value lies in its long-term improving effect on soil fertility.

Compost is a common name used for decomposed organic materials. Compared with uncontrolled decomposition, as it naturally occurs, decomposition in the controlled composting process occurs at a faster rate, reaches higher temperatures and results in a product of higher quality.

Compost is a high value soil amendment for smallholder farmers with no access to manures and fertilisers. It has proved to be the best type of organic fertiliser in dry climates.

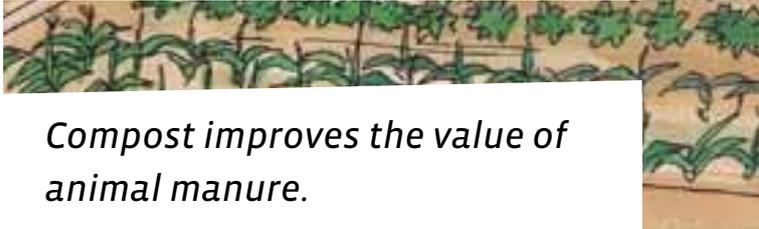
Compost making relies on materials that are available on the farm and does not require any special equipment, making it a cheap method. But compost making requires a lot of work for collection and preparation of the materials.

What materials do you have on your farm, which you could use to make compost?

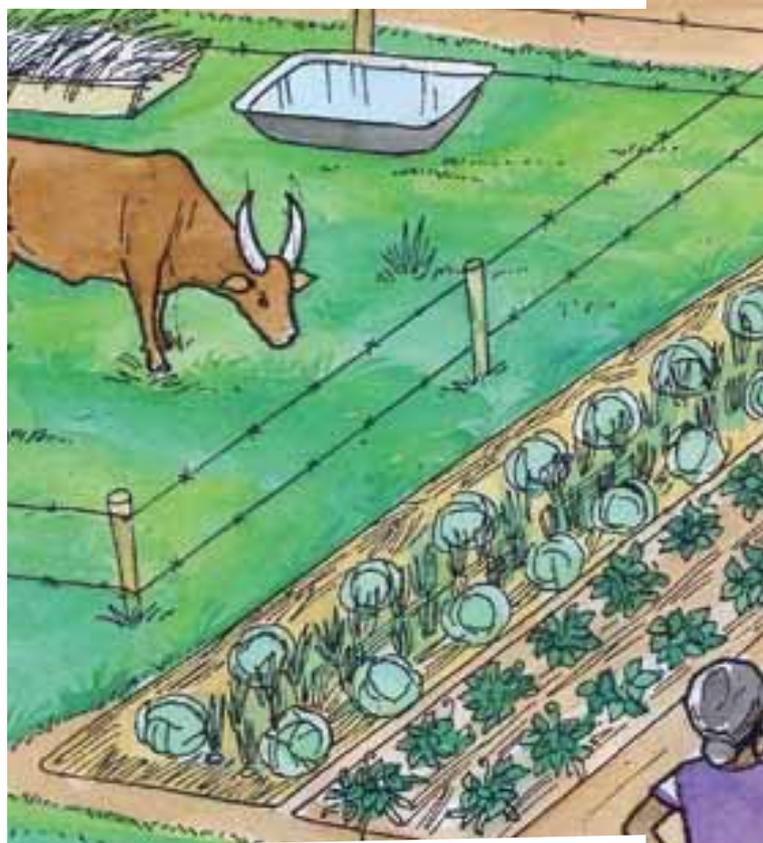
Why invest into compost production?



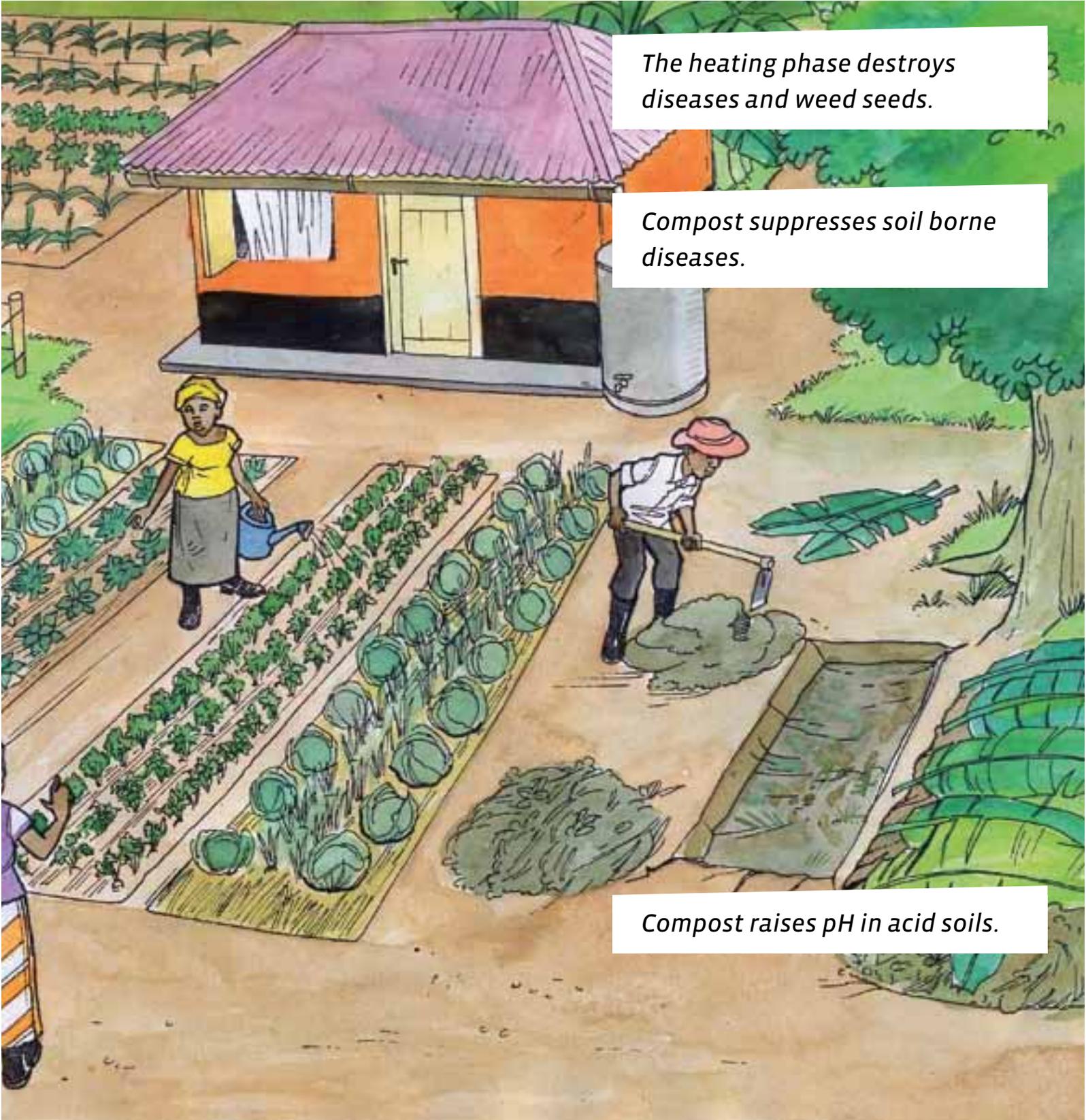
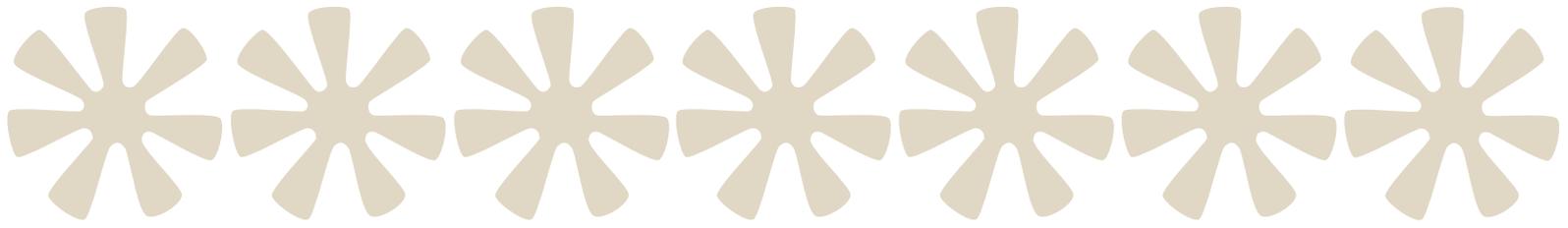
Compost is a well balanced fertilizer.



Compost improves the value of animal manure.



Compost improves long-term soil fertility.



The heating phase destroys diseases and weed seeds.

Compost suppresses soil borne diseases.

Compost raises pH in acid soils.

How do I make compost?

Compost making requires some experience. But it teaches you also a lot about the natural processes of transformation of organic materials into fertile soil.

Compost making requires adequate quantities of materials and a suitable site.

Compost is made from equal amounts of animal manure and fresh plant materials, and dry materials. Wood ashes and some old compost may be added as well.

The composting site should be close to the fields, easily accessible, situated on level ground, near a water source and well-shaded. If natural shade is not available, a removable shelter is needed.

Composting requires humid conditions. In dry weather regular watering is crucial for ensuring a proper process.

Do you know somebody who is good at making compost? Ask him or her to show you, how to do it. Is the quality of his or her compost good?

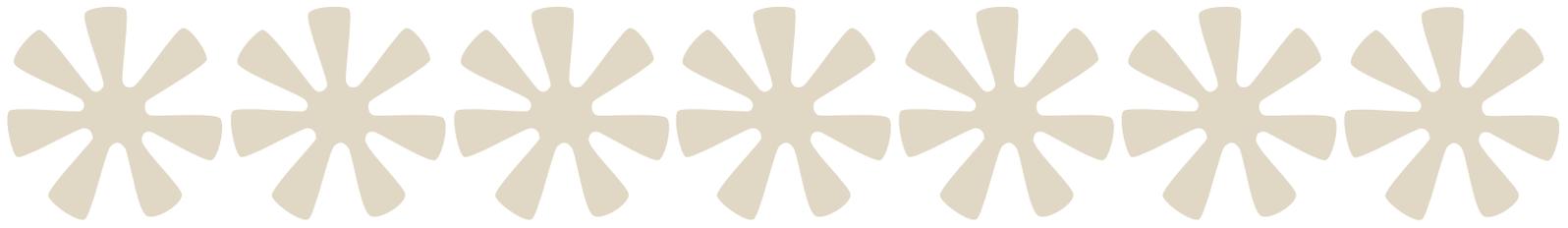
The main steps of compost making



1. Chop the plant materials to the size of a finger.



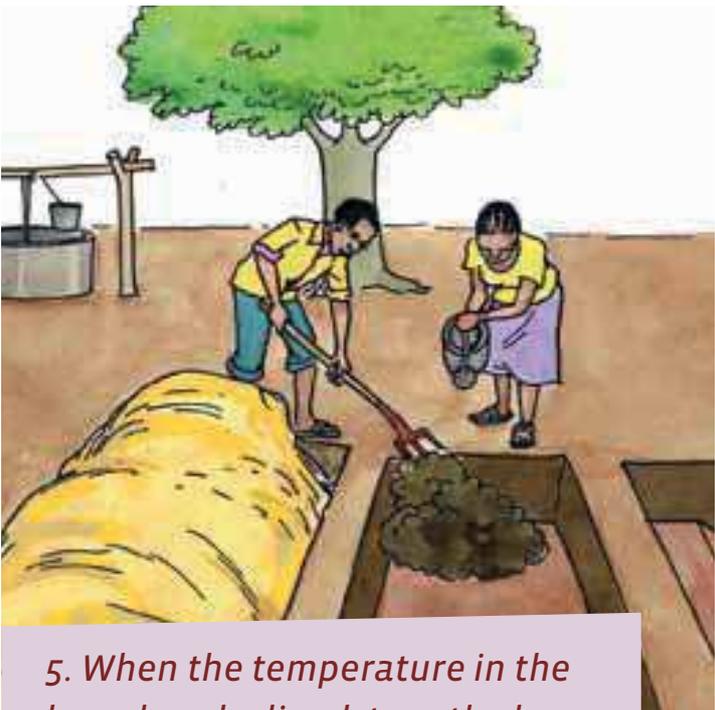
4. Place a metal stick in the heap and check its temperature daily.



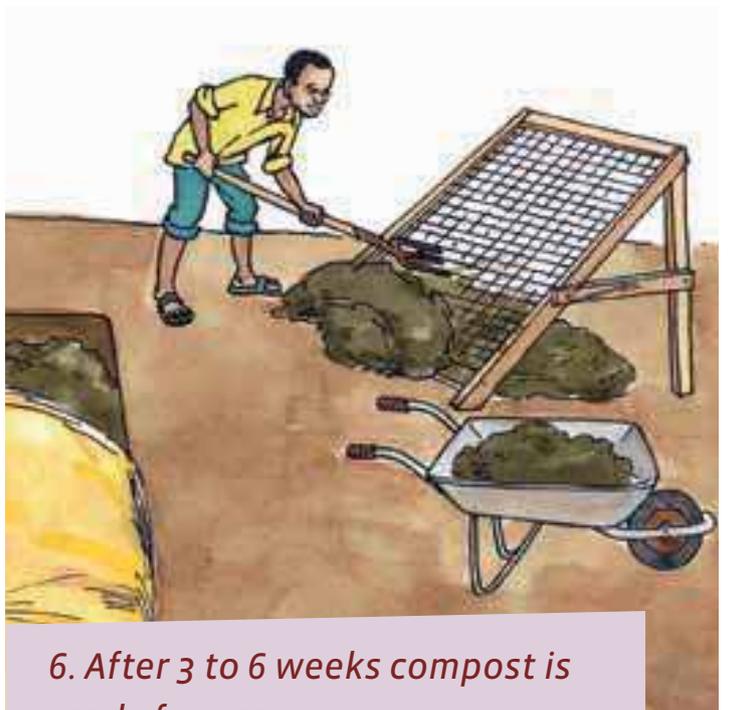
2. Mix and water the dry and fresh materials separately.



3. Mix the different materials by layers starting with dry material.



5. When the temperature in the heap has declined, turn the heap.



6. After 3 to 6 weeks compost is ready for use.

What do I need to know about green manures?

Green manures are an invaluable source of food for soil organisms and thus of nutrients for the following crop. They are a farm-grown fertilizer.

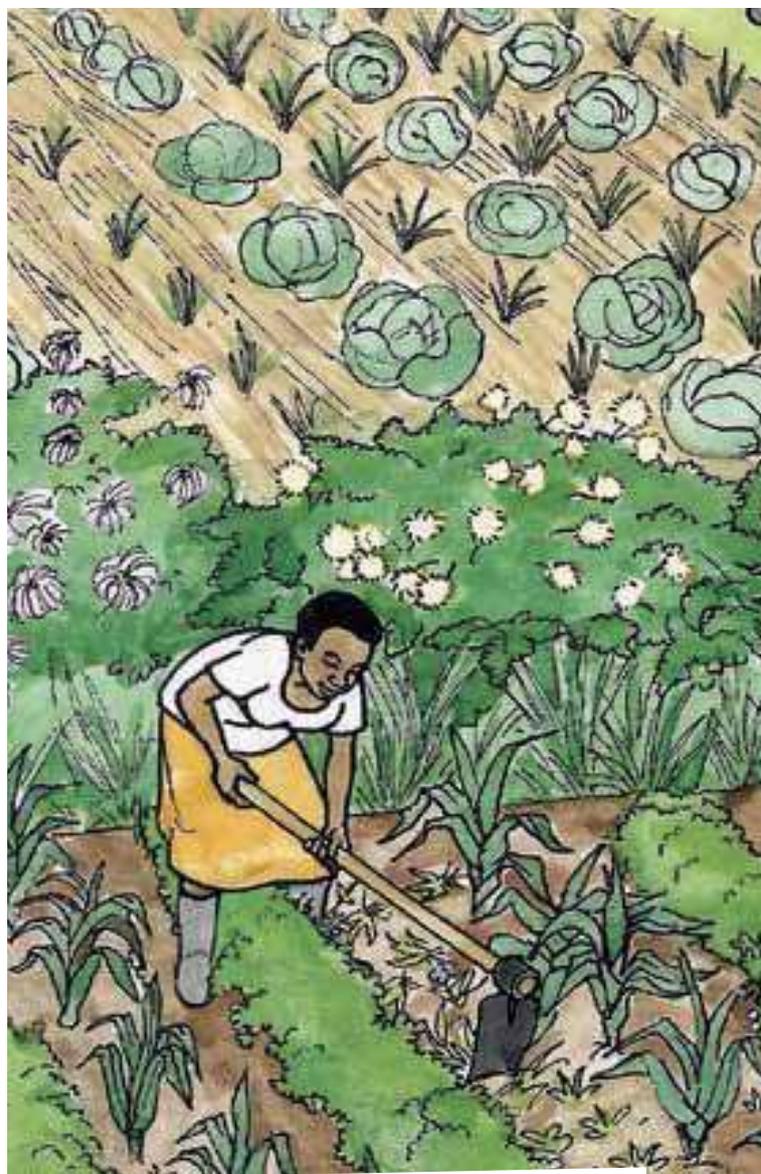
Green manures are plants that are grown with the main purpose of building maximum biomass to provide plenty of food for soil organisms. If green manures are cut before or at flowering, they are easily decomposed by soil organisms – within about two weeks under humid and warm conditions – after being dug into the soil.

Instead of digging green manures into the soil, they may also be spread to act as mulching material, especially when they are grown as intercrops within perennial crops.

Legumes such as sunhemp, jackbean, velvet bean, lablab, cowpea and other nitrogen fixing plants provide considerable amounts of nitrogen to the soil and are particularly beneficial.

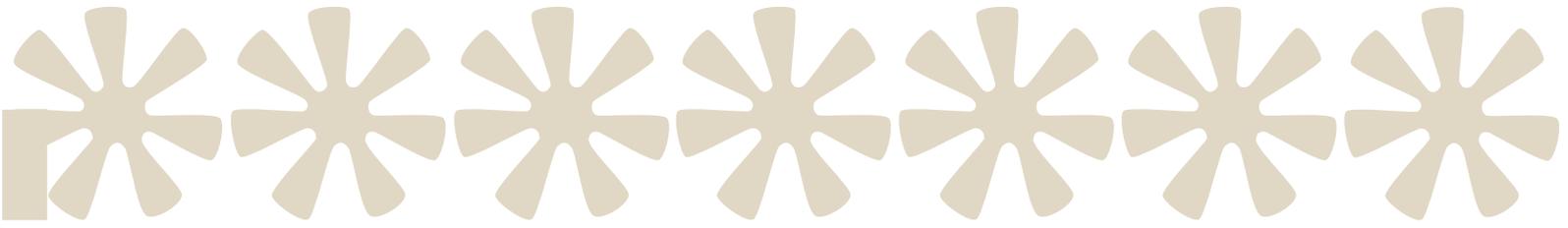
Have you ever thought of mixing green plant material into the topsoil? Do you know anybody, who grows green manures?

Why grow green manures?



They provide lots of food to the soil organisms and bring life into the soil.

Leguminous green manures fix lots of nitrogen from the air.



They take up nutrients and release them when they are cut.

They complement animal manures well.

They cover the soil, preventing erosion and suppressing weeds.

Some green manures provide high quality fodder.

They are of high value where animal manures are scarce.

They are a cheap alternative to purchased fertilisers.

How do I integrate them into my farm?

Green manures can be integrated into the existing farming system. No extra land is needed to grow green manures.

Integration into a crop rotation

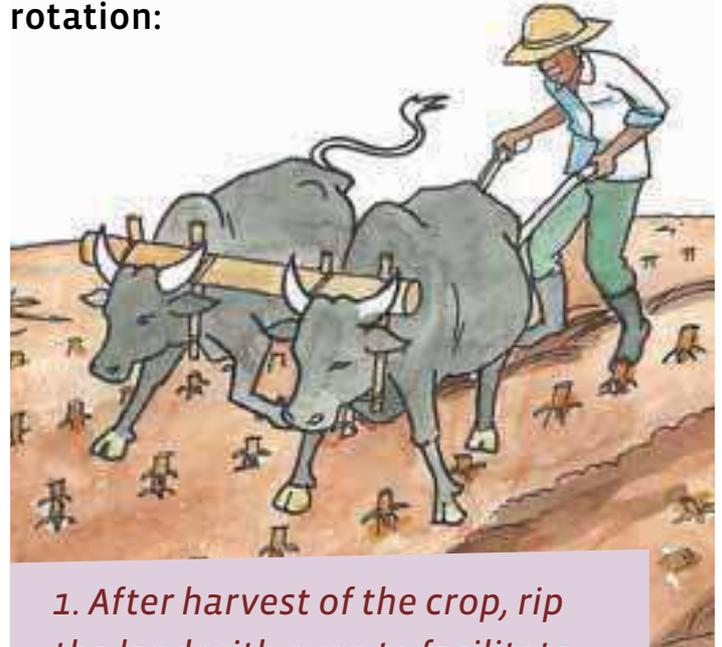
Growing green manures as part of a crop rotation is very useful particularly when planted before crops that need a lot of nutrients.

The green manures are planted whenever there is no crop in the garden, rather than leaving the land bare and allowing weeds to grow and nutrients to leach out of the soil. They are also grown as break crops in a rotation between closely related crop species for pest and disease control.

Intercropping or relay cropping in annual crops

Green manures can be grown between row crops such as maize, millet and sorghum. To reduce competition with the crop, the green manures are usually sown when the crop is well established. Sowing is sometimes combined with weeding and the green manure continues to grow during the dry season.

Integrating green manures into a crop rotation:

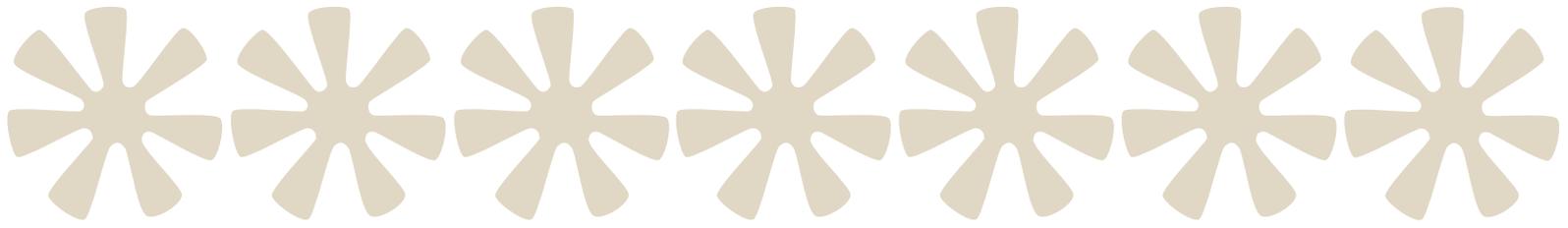


1. After harvest of the crop, rip the land with oxen to facilitate growth of the green manure.

Relay cropping of green manures:



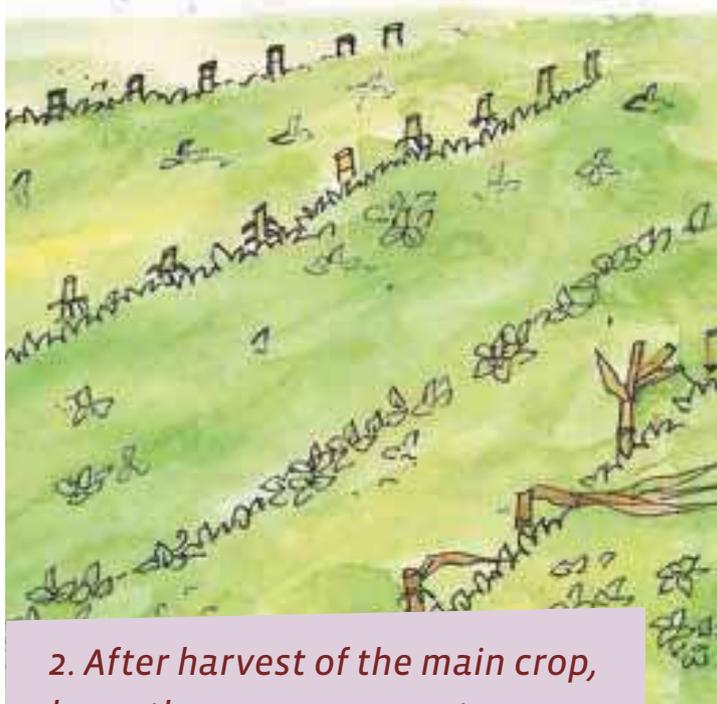
1. Sow 1 or 2 rows of green manure between the rows of the established main crop.



2. Sow the green manure with remaining soil humidity or first rains.



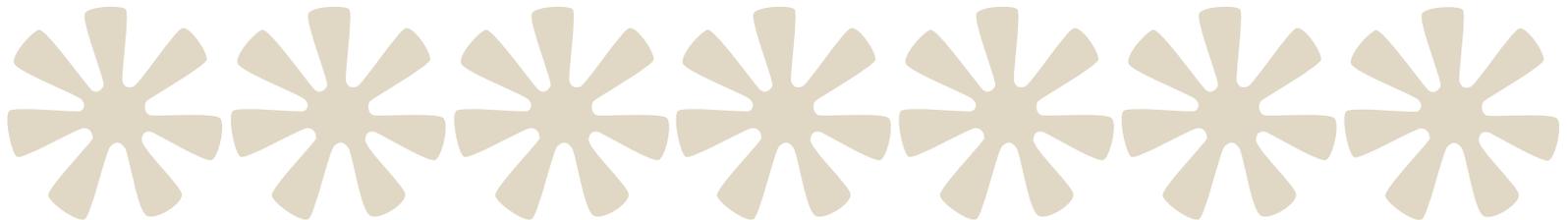
3. Cut the green manure – at the latest – at flowering and leave it as mulch or work it into the soil.



2. After harvest of the main crop, leave the green manure to cover the entire soil surface.



3. Cut and dig the green manure crop into the topsoil.



Green manures in agroforestry

Agroforestry is the practise of growing trees or shrubs together with crops. The trees or shrubs act as long-term green manures, where the leaves are distributed on the field and dug into the soil. For example, in every sixth row either pigeon peas or grilicidia can be intercropped with maize.

Long-term green manures

Green manures can also be grown for more than one season by:

- › Planting the green manure in a bush-fallow system to restore poor soils. The seeds are broadcast onto the fallow land and left to grow uninterrupted for as long as required.
- › Growing the green manures on new land before it is prepared for use, especially to help control difficult perennial weeds such as couch grass and spear grass.
- › Growing green manures to build biomass, which is cut and carried to other fields, fed to livestock or used for composting.

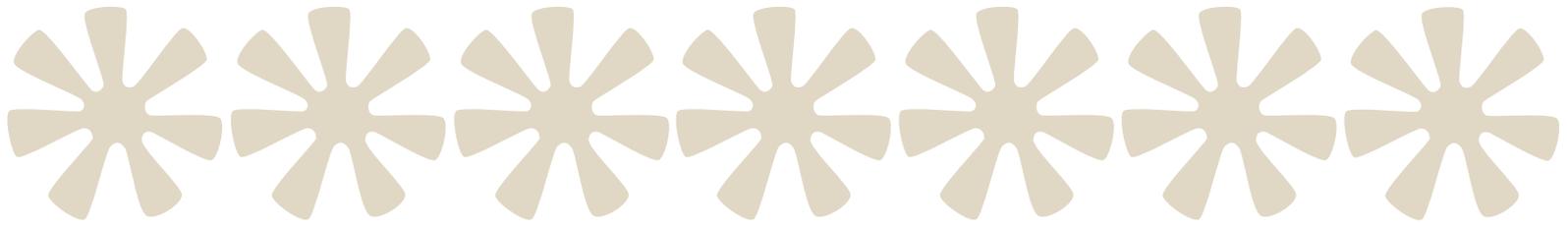
Growing green manures in an agroforestry system



1. Before rains, prune the legume trees and sow annual crops. You may use the tree prunings to cover the soil.



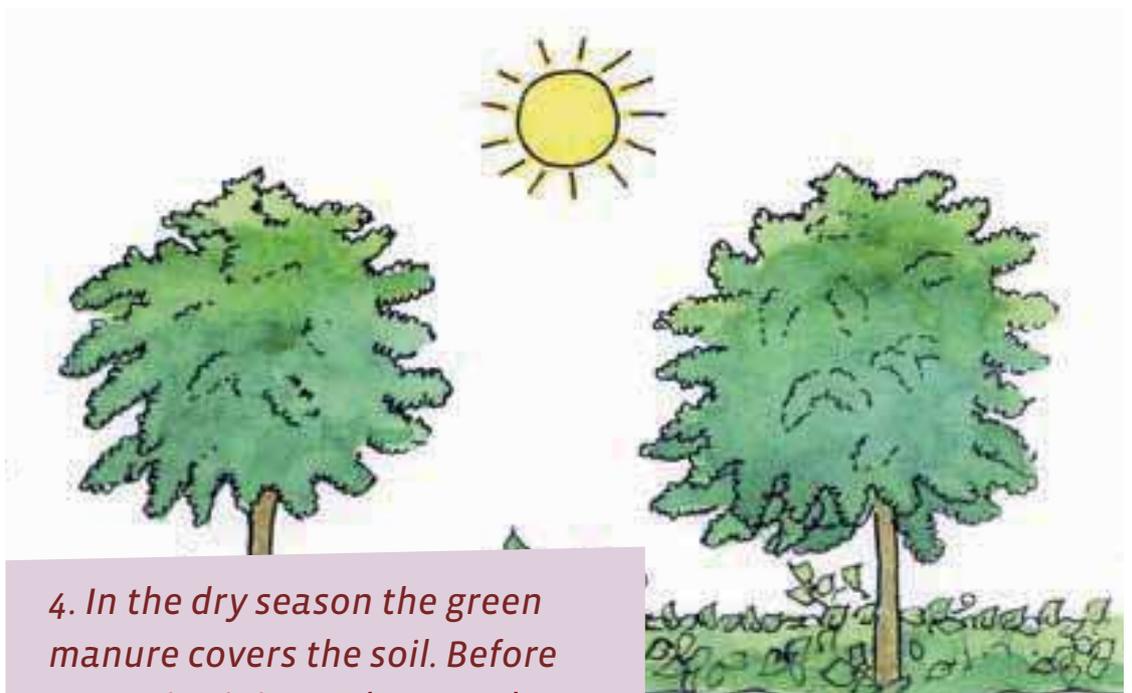
3. At the end of the rainy season when annual crops are ready for harvest, sow the green manure.



ystem:



2. During the rainy season the soil is covered and annual crops can grow without being shaded.



4. In the dry season the green manure covers the soil. Before new rains it is cut down and mixed into the soil.

How do I best manage green manures?

Management of green manures

Green manures are ideally allowed to grow up to flowering stage. At this stage, they have accumulated enough biomass and the plant material is still easy to decompose as it is still green and not yet woody. In the case of agroforestry trees, they should be regularly pruned before or as soon as they flower to increase the amount of green materials obtained and to reduce competition with the main crop. If plants become too old and tough, they will be difficult to dig under and soil organisms will find it difficult to break the down.

The green manure prunings can either be left to wilt for some days or incorporated into the soil immediately after cutting.

Wilting saves on labour for incorporation, but results in some nutrient losses. Incorporating the green manure should happen before the rainy season. When grown in a rotation, the period between digging the green manure into the soil and planting the next crop should not exceed two weeks to prevent nutrients from leaching out of the soil.



In case the green manure grows too old and tough, it should be chopped and composted or used as mulch.

Which green manures should I grow?

Most farmers do not effectively use green manures because they do not know which species to plant and how to include them in the farm. Knowing which species to plant, where, when and how is important in order to obtain good results. Green manure plants should:

- › Suit the local climate and soil.
- › Be tolerant to local pests and diseases.
- › Grow fast and vigorously and produce great amounts of leafy material.
- › Ideally fix nitrogen.

- › Not be closely related to the next crop to prevent transfer of pests and diseases.
- › Be shade-tolerant for intercropping.
- › Be drought-resistant, when grown into or through the dry season.
- › Be readily available and affordable and production of own seeds possible.

Try out different plants on a small plot to check which does best under your conditions.

Most common legumes used for green manuring

Sunhemp	High drought resistance, grows upright and does not coil, low shade tolerance, high nitrogen fixation, controls nematodes and weeds
Jackbean	Medium shade tolerance
Velvet bean	High drought resistance, good for poor or degraded soils, low shade tolerance, climbing
Lablab	High drought resistance, low shade tolerance, provides complete ground cover in three months, climbing
Desmodium	Long trailing and climbing perennial, grows on a wide range of soils, no tolerance to salinity, high nitrogen fixing potential
Cowpea	Annual plant with high variation including climbing, bushy prostrate and erect forms, high drought resistance, low shade tolerance

How do I benefit from farm manures?

Proper handling of farm manure is required to ensure nutrients are preserved for use in crop fields.

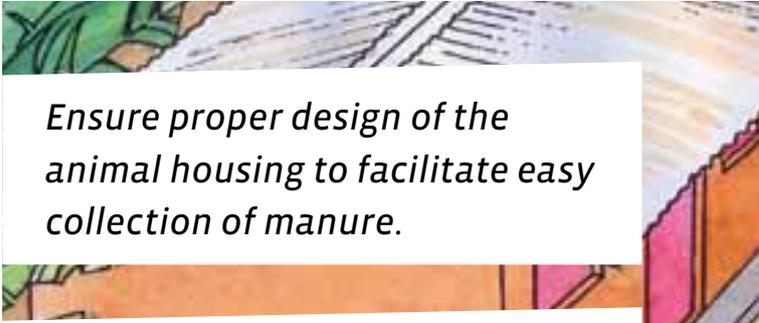
Many farmers underestimate the value of animal manure. In many places it is dried and applied to the garden or burned for cooking. This, however, causes large quantities of organic matter and nutrients to be lost that could be preserved with proper handling.

Farmyard manure contains large amounts of nutrients. Its availability of phosphorus and potassium is similar to that of chemical fertilizers. Chicken manure is rich in phosphorus. When dung and urine from cattle are mixed, they form a balanced source of nutrients for plants.

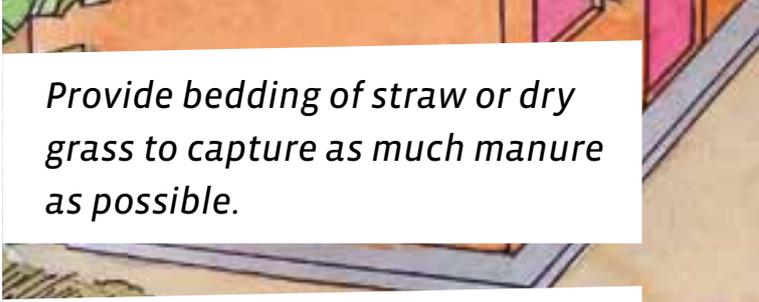
Fresh manure can inhibit crop growth considerably and does not contribute to improving soil humus. Therefore, animal manure should be kept under protected conditions for a while or composted.

Do you collect, store and apply farm manures properly? Do you see any possibilities to improve their handling?

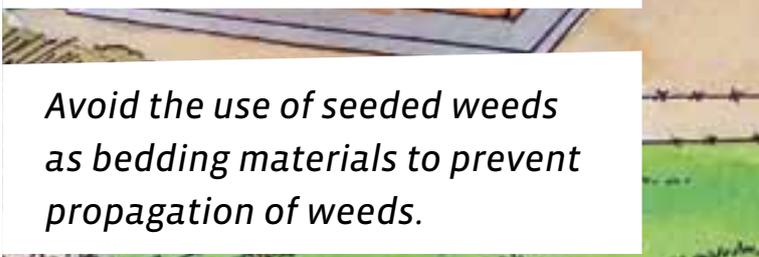
How to improve the value of animal manure:



Ensure proper design of the animal housing to facilitate easy collection of manure.



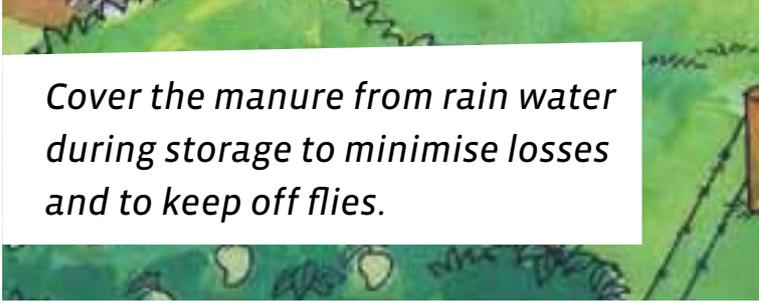
Provide bedding of straw or dry grass to capture as much manure as possible.



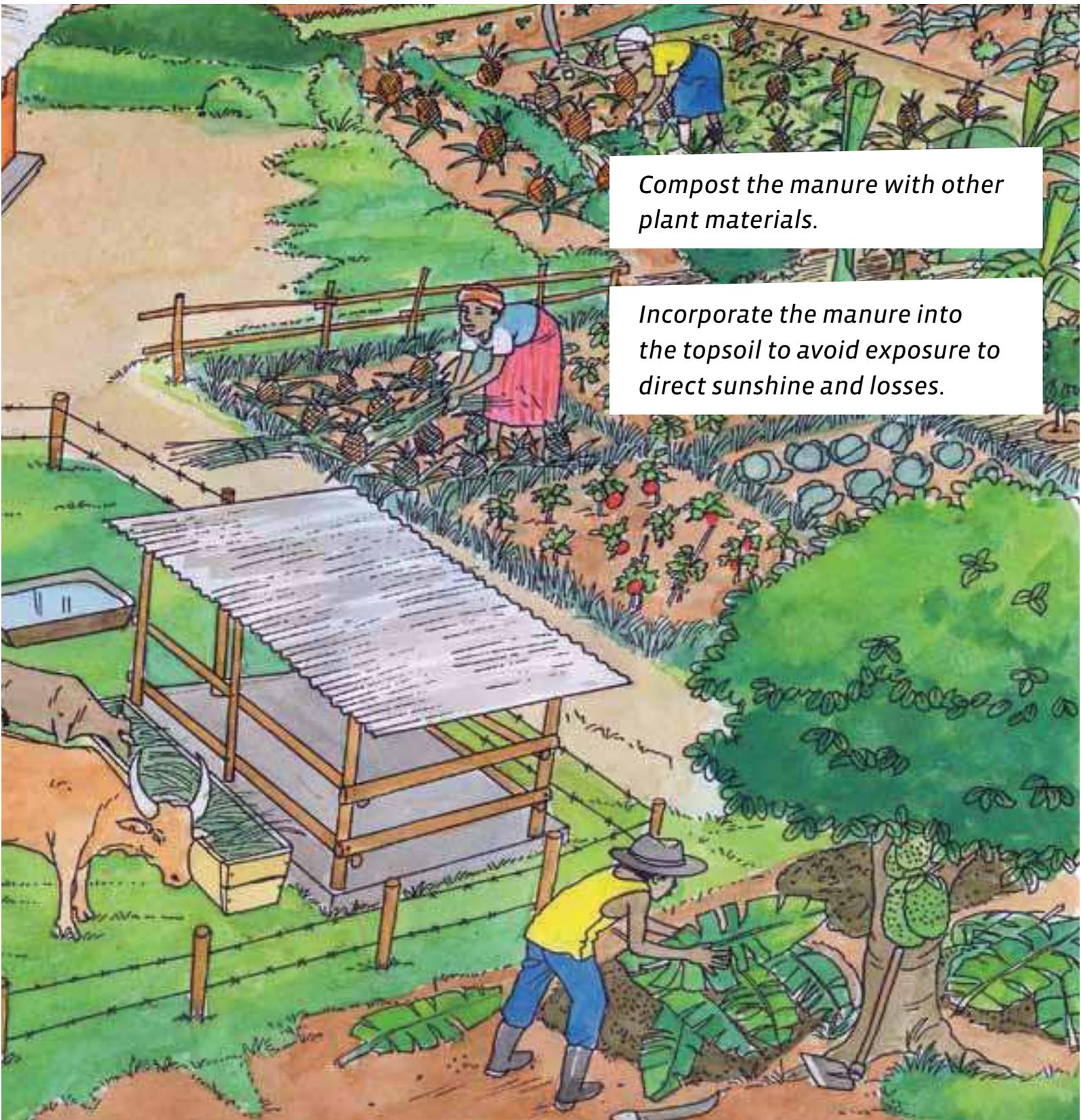
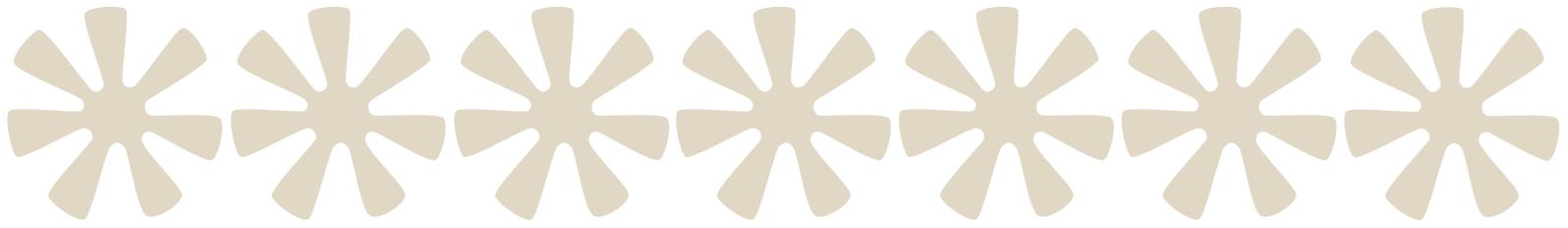
Avoid the use of seeded weeds as bedding materials to prevent propagation of weeds.



Collect all run off and drainage water from the animal house.



Cover the manure from rain water during storage to minimise losses and to keep off flies.



Compost the manure with other plant materials.

Incorporate the manure into the topsoil to avoid exposure to direct sunshine and losses.

This booklet is an outcome of the African Organic Agriculture Training Manual project and was conceived as a handout for farmers.

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