African Organic Agriculture Manual Booklet Series

No. 2 | Soil fertility management

HOW DO I BEST MANAGE THE FERTILITY OF MY SOIL?

FiBL

What do I need to know about soils?

Soil can be living or dead. Living soil continuously requires enough air, water and soil organic matter in order to provide a good growing environment for plants and soil organisms. By providing these, even dead soil can manage to live again.

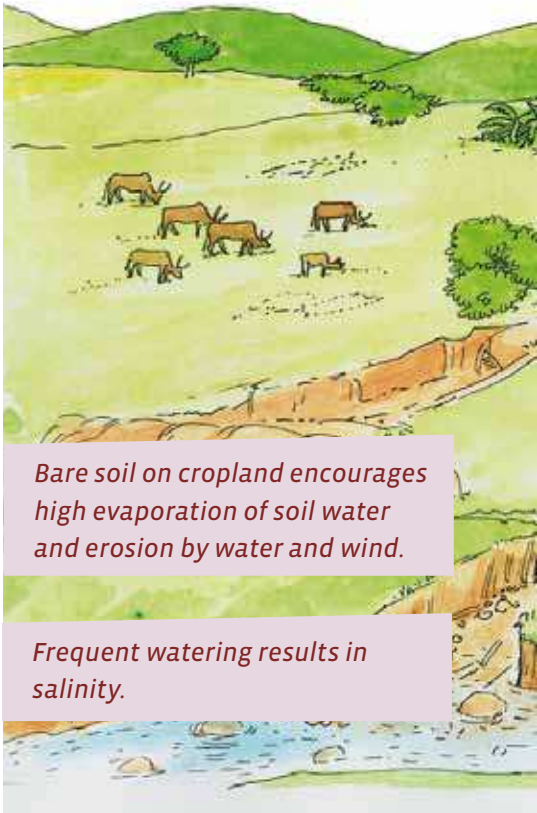
You can tell whether your soil is living or dead by the amount of farm products that can be obtained from it under average management conditions. A living soil can support consistent and sufficient production of farm products while a degraded and dead soil cannot.

What causes soils 'to die'?
Generally, the productivity of soil has been decreasing in most regions of Africa. This implies that most soil is either 'dying' or 'simply dead'. There are different causes, that contribute to the death of soils. Some of them are indicated on the right.

'Living soil' is what most farmers will term as a 'fertile soil'. Is your soil living, dying or dead? What are you doing to improve the health or fertility of your soil?

Some reasons why soils die:

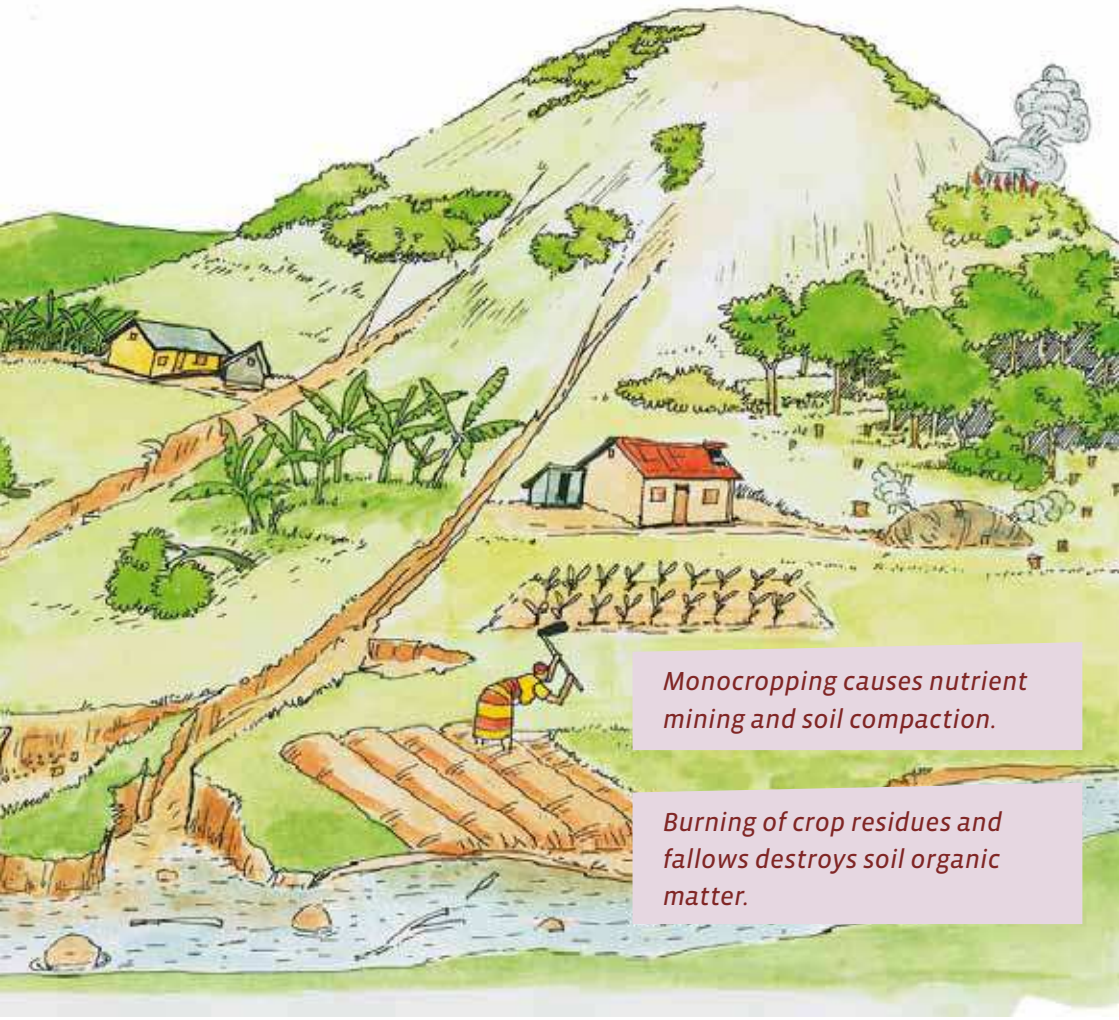
Overgrazing leads to loss of vegetation and valuable species



Bare soil on cropland encourages high evaporation of soil water and erosion by water and wind.

Frequent watering results in salinity.

Deforestation removes valuable species and exposes the soil to erosion



Monocropping causes nutrient mining and soil compaction.

Burning of crop residues and fallows destroys soil organic matter.

What is fertile soil?

Fertile soil is able to hold enough water and nutrients to supply to plants, as required, even when no additional nutrients are applied.

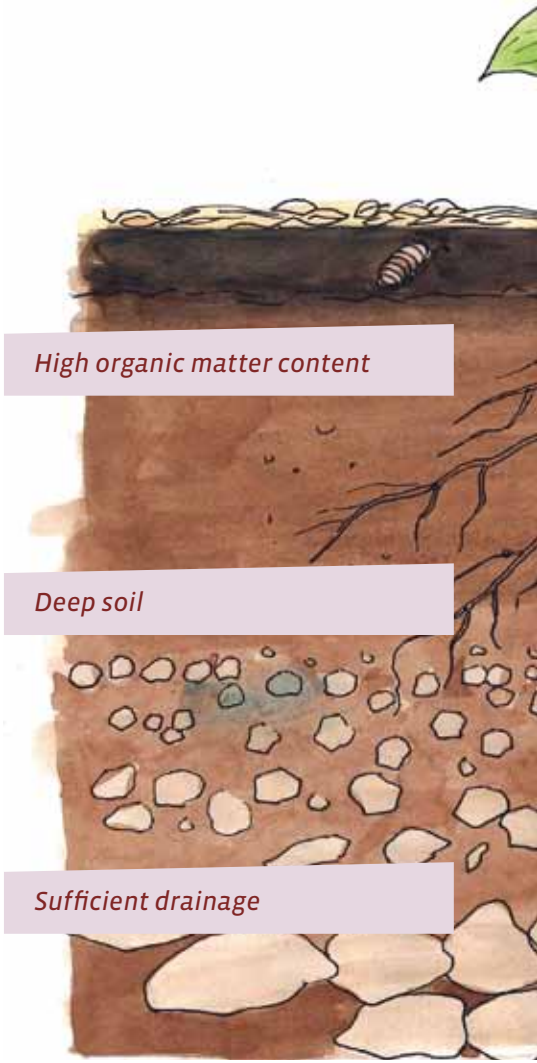
Naturally the availability of nutrients in soil strongly depends on the presence of soil organisms. Soil organisms contribute to the building of soil organic matter (also called humus), which is an important nutrient reservoir.

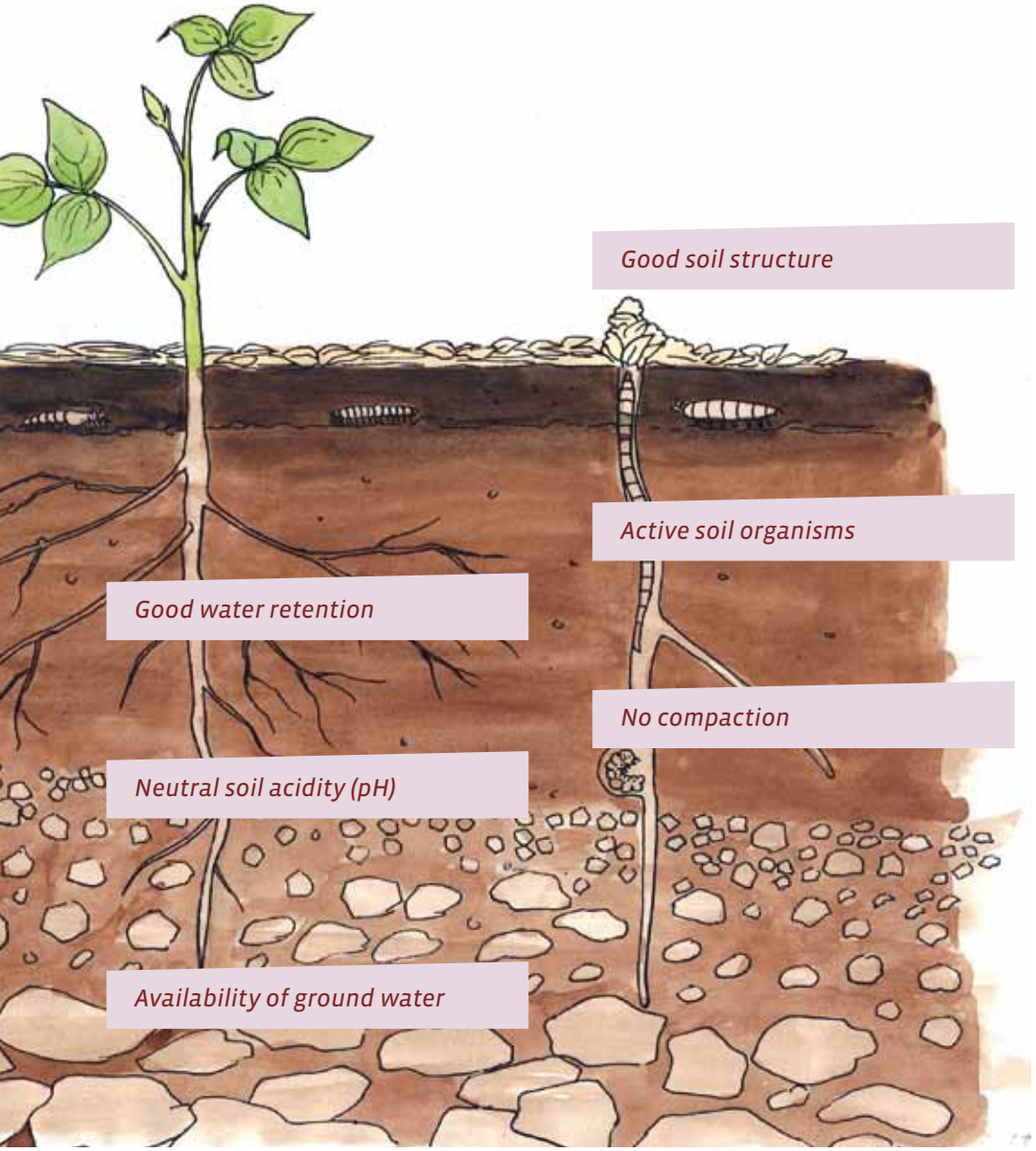
Organic matter content

Soil organic matter improves the structure of soil by binding soil particles together. It also increases the activity of soil organisms and the availability of nutrients while improving the capacity of the soil to hold water. Organic matter also regulates the acidity or alkalinity of the soil, which strongly determines the ability of nutrients to become soluble and available to plants.

Soil organisms

Beetles, mites, earthworms, fungi and bacteria, and other organisms transform crop residues and other organic materials into soil organic matter.




Good soil structure
Active soil organisms
Good water retention
No compaction
Neutral soil acidity (pH)
Availability of ground water

How can I assess the fertility of soil?

Relevance of soil analysis is often limited for organic farming. A close look at the growth of the plants and the inside of the soil can provide valuable information as well.

To assess the fertility of your soil you can use indicator plants and the type of vegetation on a given land. Presence of a diversity of weeds of full colour, and specifically species such as *Commelina* spp, *Amaranthus* spp., is indicative of fertile soils. On the other hand, the prevalence of certain weed species such as Striga, *Digitaria* spp., is an indicator of poor soils. On crop land, crop yields are good indicators of the fertility of the soil.

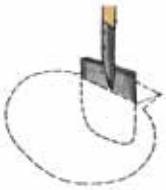
You can also assess the fertility of the soil by digging up and observing a slice of the soil profile using a spade for the following indicators:

a. **Soil structure and texture.** Soil with a crumby structure, like well-made bread, and soft texture is well-aerated and the plant roots are able to penetrate it easily.
b. **Soil depth.** Deep soil allows the plant roots to grow both wide and deep, and access more nutrients to support good growth.
c. **Soil colour.** Soils rich in organic matter are darker in colour and more fertile than similar soils which are low in organic matter.
d. **Soil water.** Plant nutrients are taken up along with water from the soil. Therefore soils with enough water can easily supply nutrients to plants.

Chemical soil analysis can be useful to analyse the level of acidity in soil (pH) or for detecting deficiencies or toxicities of nutrients such as Phosphorus (P), Potassium (K) or Zinc (Zn). Organic farmers may especially be interested in knowing and monitoring the content of soil organic matter (Corg). For soil that has presented problems such as low yields during several consecutive years, doing the traditional analyses of P, pH and Corg can give an indication as to what should be done to improve soil fertility.

Do you have fertile soil on your farm?

Digging a soil sample for examination:



1. Choose an area in a future field.

2. Carefully cut out a block of soil.

3. Remove the soil block carefully.

4. Present it for easy inspection.

Examination of the soil sample:

Is it humid, or is it wet or dry?

Does it have dark colour? How does it break?

How does it smell?

Does it have stains?

How is the root growth?

Are there signs of active soil organisms?

Organic soil fertility management

Soil fertility management is neither limited to addition of fertilisers nor to achieving high crop yields alone. It is about building up a rich, stable and living soil.

A three-step approach

Organic soil fertility management can be seen as a three-step approach, whereby each step builds the foundation for the next one. The aim is to encourage natural rejuvenation of the soil and to minimize application of foreign fertilisers, soil amendments and irrigation water.

Step 1 - Conserving the soil, organic matter and water from loss.

Step 2 - Improving the organic matter content of the soil.

Step 3 - Supplementing the nutrient requirements as well as improving the growing conditions by applying some soil amendments.

Organic farmers give a lot of attention to proper and efficient application of steps 1 and 2 in order to save on costs of fertilisers and other supplements and to prevent possible negative impacts on the farm ecosystem.

Three steps of organic soil fertility management

3rd step : Application of supplements
Enhancing and balancing plant nutrition t
fertilizers, soil amendments and irrigation

2rd step : Soil organic matter management
Enhancing soil organic matter content thr
material

1rd step : Soil and water conservation
Stabilizing and protecting the soil and har

How do you manage the fertility of your soil? Are you a step-1, step-2 or step-3 farmer?

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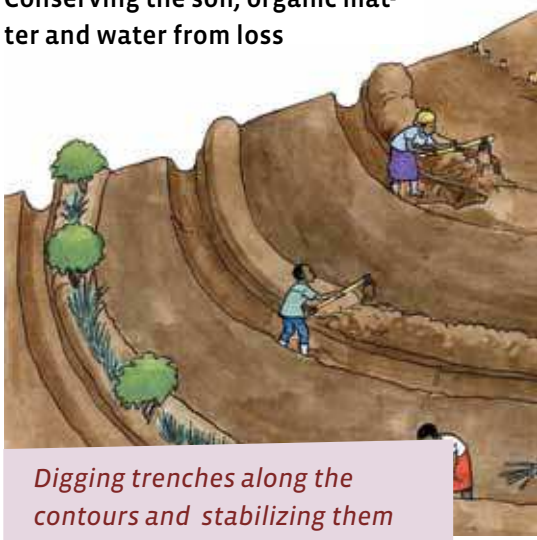
1st step: Soil and water conservation

In the first step, organic farmers aim to establish a stable and less vulnerable soil as the foundation to managing fertile soil. They do this by:

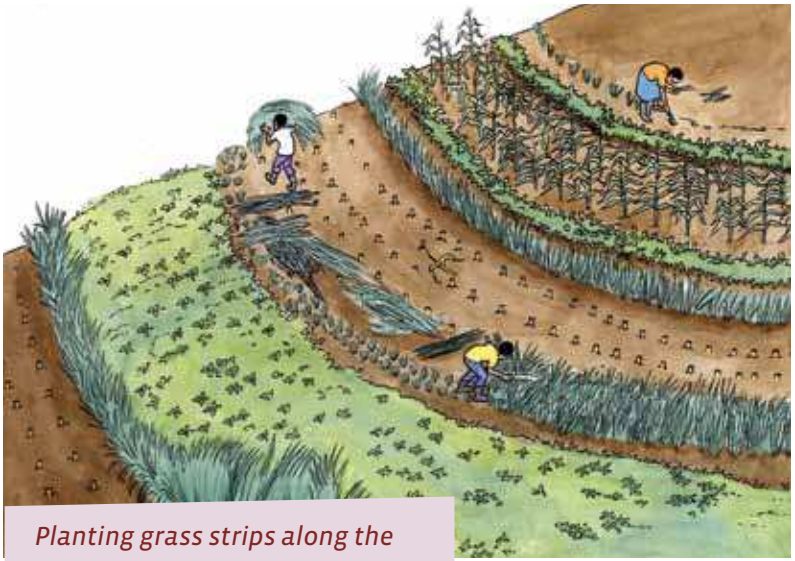
- **Preventing the soil from being eroded by rainwater or winds by keeping it covered as much as possible.** They cover the soil with living plants (called cover crops) especially within perennial crops or with dead plant material (called mulching). They also dig and construct barriers across the slope to reduce the speed of movement of rainwater down the slope.
- **Minimising soil disturbance.** Organic farmers practise redu-ced or no tillage, maintain a protective cover on the soil surface, and allow early land preparation before heavy rains. These practices conserve the soil structure, reduce the risk of soil compaction, increase water infiltration, reducing runoff and evaporation and thus improving water storage.

Conserving the soil, organic matter and water from loss



Digging trenches along the contours and stabilizing them with grass and trees.

Covering the soil surface with dry mulch and digging small planting holes.



Planting grass strips along the contours.

Ripping the land instead of ploughing it.

2nd step: Improving soil organic matter

In the second step, the aim is to build an active soil with good structure, which can hold water and supply plant nutrients. Organic farmers achieve this by applying practices, which improve the organic matter content of the soil and enhance the activity of soil organisms. Such practices include:

- **Growing green manures**, mostly legumes, for the large quantities of fresh plant material they produce. They then cut and mix them into the soil to feed the soil organisms and provide nutrients to the crops that follow.
- **Intercropping cover crops** such as velvet bean, tithonia, lablab and others as living mulch. They regularly slash the cover crop before it competes too much with the main crop.
- **Mulching** with especially hard-to-compost or woody materials, which break down slowly. These contribute to an increase in soil organic matter with time.
- **Growing trees and shrubs** for agroforestry in the fields with crops, on the edges of crop fields or on fallow plots, where they are regularly pruned and the branches used as mulch.
- **Returning crop residues** from harvested crops in the form of husks, leaves, roots, peelings, branches and twigs either as compost, mulching materials, or for incorporation into the soil.
- **Adding organic materials** from primary agro processing, for example, wood shavings, or coffee or rice husks.
- **Introducing livestock on the farm** for regular supply of manure and bedding for recycling.

Burning crop residues or any dead biomass (such as plant materials left after land clearing) is a crime to the environment! All the benefits derived from mulching or incorporating these materials are lost, the atmosphere is polluted, and beneficial insects and worms are killed.

Adding organic materials to the soil

Mulching

Tree cuttings

Crop residues

Animal manures

Cover crops

Compost

Balanced rotation

Green manures

3rd step: Soil fertility supplements

In situations of heavy nutrient depletion or unfavourable growing conditions organic farmers apply supplementary measures that are necessary to speed up the improvement of growing conditions for plants, such as:

- **Using liquid manures** to overcome temporary nutrient shortages and to stimulate plant growth. Liquid manures are made from animal manure, compost or nitrogen-rich green plant material.
- **Using commercial organic fertilisers** that do not contain chemical residues, if accessible and affordable. Examples include seed oil cakes, pelleted chicken manure, brewery by-products, fruit peels, coffee husks, wood shavings and dust, rice husks, plant ashes, etc.
- **Using soil amendments** such as lime to correct soil pH and microbial fertilisers, for example rhizobium and mycorrhizal fungi inoculations, to enhance mineralisation and nitrogen fixation into the soil.
- **Using irrigation** to supplement soil water requirements.

How to make plant tea

1. Collect and chop sappy leaves.

How to make manure tea

1. Fill a bag with manure.

2. Immerse the plant material into fresh water and cover the drum. Stir every three days.

4. Apply to the plants in the early morning.

3. After 15 days sieve the mixture and dilute it with two parts water.

2. Immerse the bag into a drum with fresh water and cover it. Stir the mixture every 3 to 5 days.

4. Apply to the base of the plants.

3. After 2 to 3 weeks dilute the mixture with 2 to 3 parts of water.

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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