



African Organic Agriculture Manual Booklet Series
No. 3 | Soil and water conservation

HOW DO I PROTECT THE SOIL NUTRIENTS AND WATER FROM LOSS?

What do I need to know about soil and water?

Plants and animals need water available all times in order to grow well. Lack of water reduces the ability of the soil to supply nutrients to growing plants, however fertile it may be.

As a farmer you probably depend on rainfall to grow crops and raise animals. However, rainfall is increasingly becoming unreliable leading to reduced or no yields at all. Heavy rains can wash away the soil and reduce the productivity of the land.

To minimize lack of water and loss of soil fertility, organic farmers put a lot of emphasis on soil and water conservation. Proper soil and water conservation build the foundation for sustainable farming. Organic farmers:

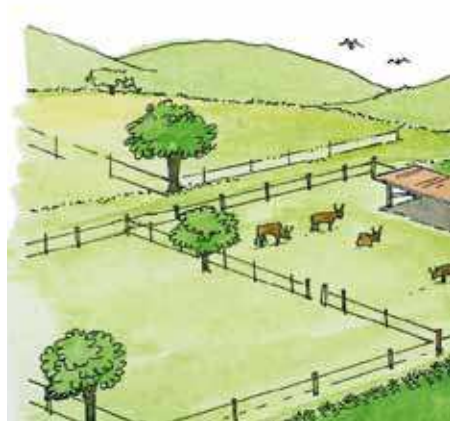
- › Keep the soil covered as much as possible.
- › Minimize the movement of water and encourage water infiltration and storage in the soil.

Do you often experience droughts or water shortages, and how have you managed to deal with them?

No soil and water conservation



Improved soil and water conservation





How do I conserve nutrients and water?

Nutrients and water are best conserved in soil covered by vegetation or dry mulch, water retaining structures on slopes, and reduced soil cultivation.

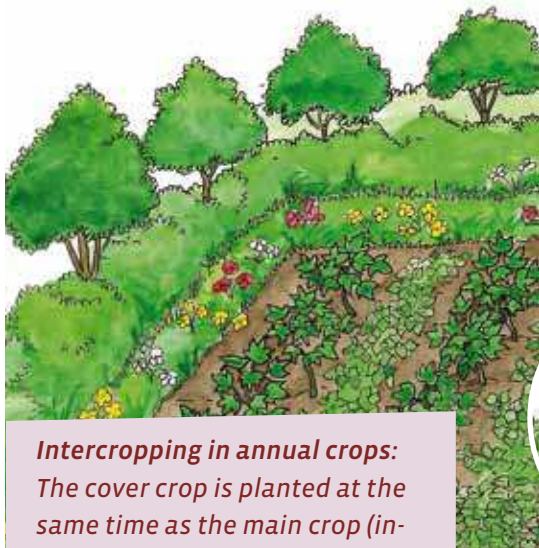
Overgrazing of rangelands, intensive soil cultivation, continued destruction of forests and utilisation of steep areas accelerate loss of soil. Loss of topsoil involves removal of soil organic matter and results in decline of soil structure, nutrients and water-holding capacity.

Eroded land can be rehabilitated, but it takes much more time and effort than avoiding its destruction. Therefore, organic farmers apply all possible practices to control erosion and prevent loss topsoil.

The easiest way to protect the soil from being eroded by water or wind is to keep it covered with living plants (called cover crops) or dead plant material (called mulch).

Use of cover crops

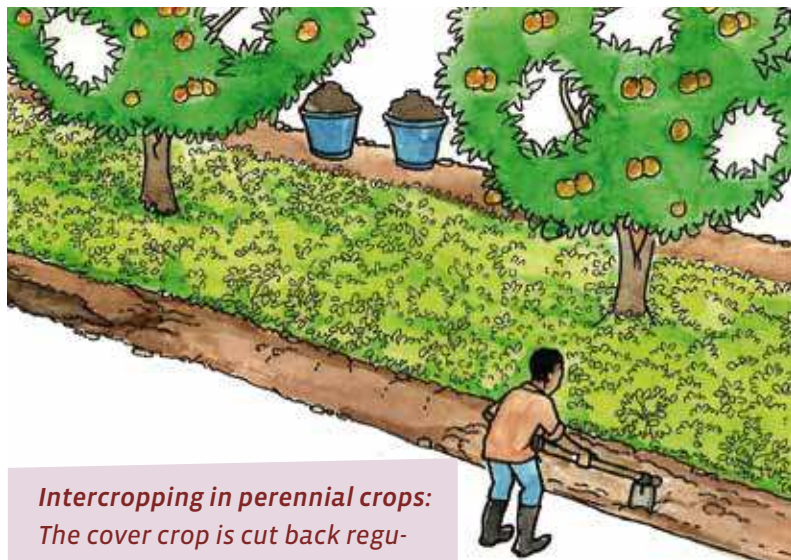
Cover crops are planted as intercrops, especially within perennial crops. Ideally they cover the soil rapidly and densely without competing too much with the main crop.



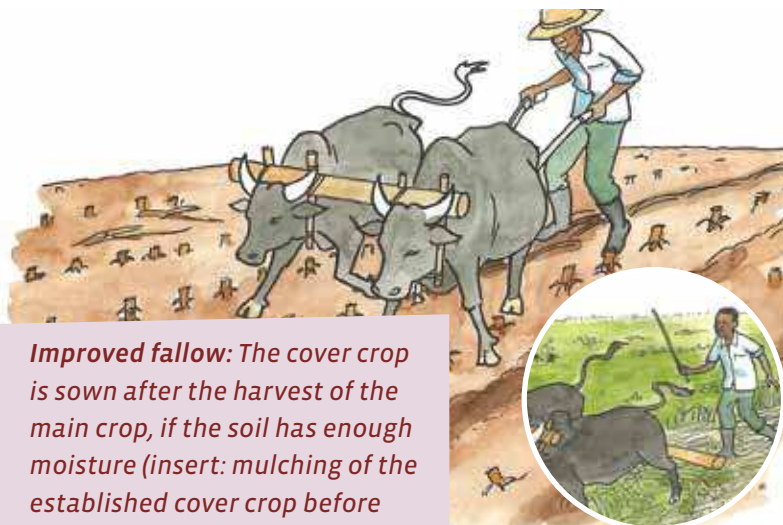
Intercropping in annual crops:
The cover crop is planted at the same time as the main crop (insert: established cover crop).



Relay cropping in annual crops:
The cover crop is sown when the main crop has established (insert: cover crop after harvest of maize).



Intercropping in perennial crops:
The cover crop is cut back regularly or grazed by animals.



Improved fallow: The cover crop is sown after the harvest of the main crop, if the soil has enough moisture (insert: mulching of the established cover crop before sowing the next crop).



Mulching

Instead of growing cover crops to cover the soil surface, you can use dry plant materials such as pruning material from trees, cuttings from hedges, weeds, crop residues such as straw, and wastes from agricultural and forestry processing to cover the soil.

Dry mulch not only prevents the soil from being washed away by rain, it also protects it from sun and reduces loss of water through evaporation. Mulching keeps the soil humid and thus also enhances its biological activity.

Tough and woody materials such as straw or stalks decompose slowly and, therefore, cover the soil for a longer time than fresh and green materials. However, a mixture of woody and fresh materials may minimize possible nitrogen deficiencies in the crop.

Some crop pests such as stalk borers may survive in the stalks of crops such as cotton, maize and sugarcane. Plant material infected with viral and fungal diseases should not be used, where there is a risk that the disease might spread to the next crop.

Without mulch cover





Many weeds

High evaporation

Strong erosion

Poor soil structure

Low activity of soil

Overheating of soil

With mulch cover

Few weeds

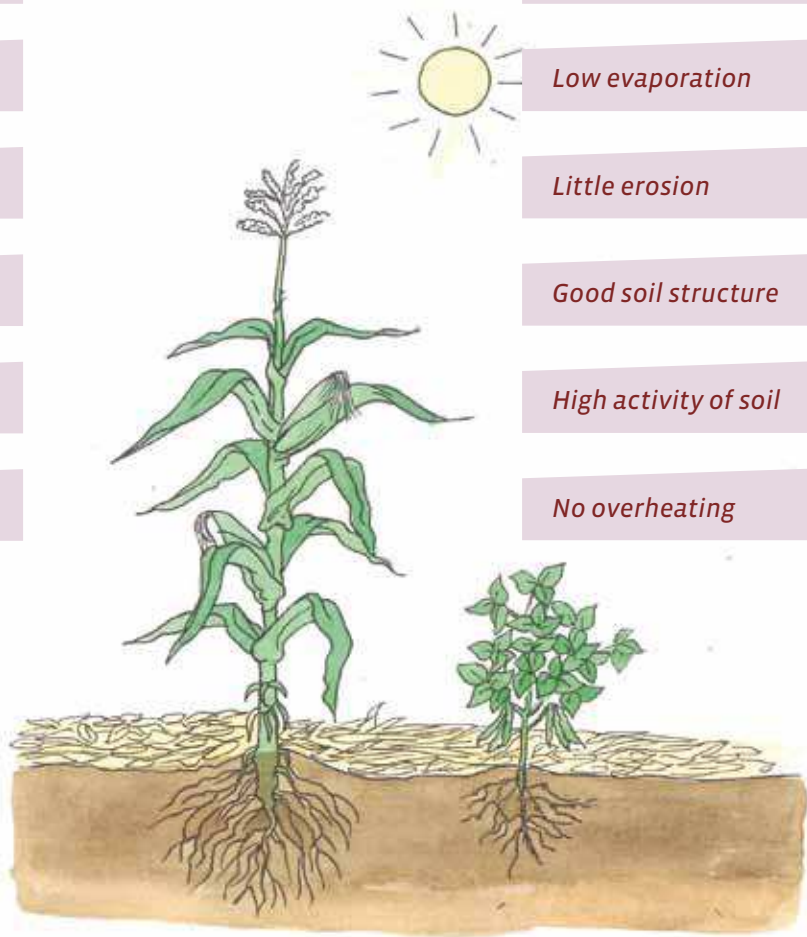
Low evaporation

Little erosion

Good soil structure

High activity of soil

No overheating



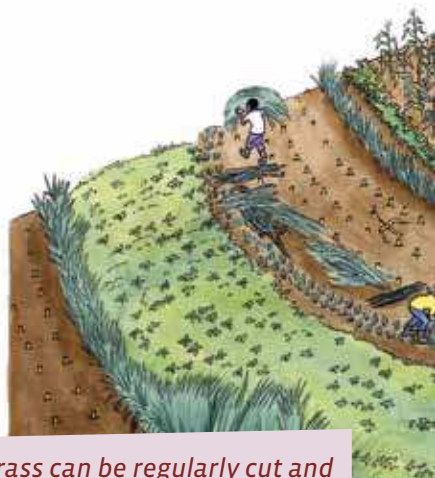
Reducing the movement of water

Organic farmers build structures to either stop the moving water or reduce its speed to allow it to soak into the soil, but also to intercept any moving soil. Such structures include:

- › **Grass strips:** Strips of grass are planted along the contours.
- › **Trash lines:** Crop residues and other bulky plant materials are aligned along the contours.
- › **Stone lines:** Stones are collected and aligned along the contours.
- › **Contour ridges:** Trenches are dug along the contours and the soil is thrown uphill or downhill along the trenches to build ridges.
- › **Terracing:** On steep slopes the long slope is broken into a series of short ones, building terraces.

Do you apply any measures in the field to stop soil from washing away down the slope?

Grass strips



The grass can be regularly cut and used as animal feed or mulch.

Contour ridges



The ridges are usually planted with fodder grasses like vetiver or napier grass and, if appropriate, with leguminous shrubs or trees to stabilize them.

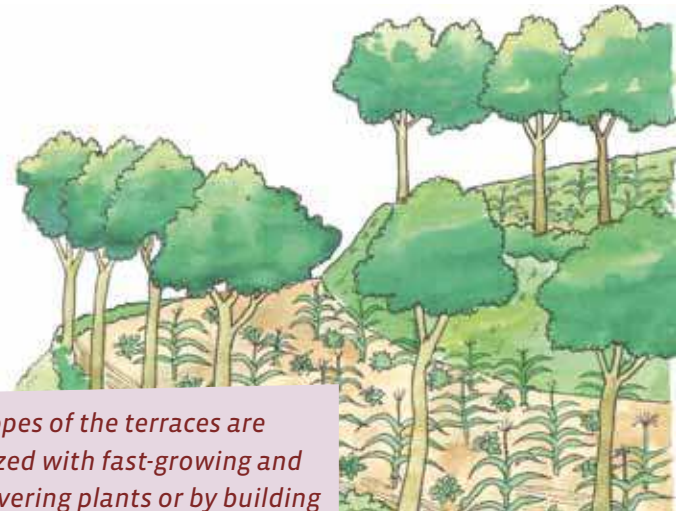


Trash lines



For most effective erosion control trash lines are combined with contour ridges, ditches and crop strips.

Terraces



The slopes of the terraces are stabilized with fast-growing and soil-covering plants or by building stone walls.

Conservation of vegetation

Plant roots hold soil particles together and protect it from being carried away by water or wind. This is why land that is covered with vegetation is less susceptible to erosion than bare land. This fact is of special relevance on steep slopes.

On steep slopes vegetation should be conserved or, where it was removed earlier, should be reestablished with trees or tree crops instead of cultivating the slopes with annual crops.

Establishing of a diverse cropping system

Cropping systems that consist of plants of different heights create a micro-climate, which reduces evaporation and protects the soil and the annual crops from the drying effects of sun and wind.

Therefore, organic farmers grow trees in rows (called alley cropping) and hedges in or around their fields. Depending on the local climate, the types of plants and the way they are planted, good management is needed to minimise competition for water and light between trees and annual crops. Leguminous trees have the advantage in that they can fix nitrogen from the air.



At the beginning of the rainy season, when annual crops are sown, the trees are pruned to avoid competition for light.





In the dry season the trees can be left to grow to form a dense shade cover. Ideally underneath a green manure crop is grown.



During the growing season the trees are periodically lopped. The leaves can be used as a mulch, the branches for firewood. it.

How do I ensure best use of rainwater?

As water is the limiting factor for crop yields, every drop of rain or irrigation water should be retained in the field, especially in semi-arid and arid regions.

Water harvesting

To ensure sufficient water in the soil, organic farmers ensure proper water harvesting of the available rainfall. This includes minimizing water runoff, increasing infiltration into the soil, improving the soil's water holding capacity and decreasing evaporation. Application of irrigation water is kept to an absolute minimum in order to avoid problems of salinity and over-exploitation of water resources (especially ground water).

Therefore, organic farmers put emphasis on field water harvesting using measures such as:

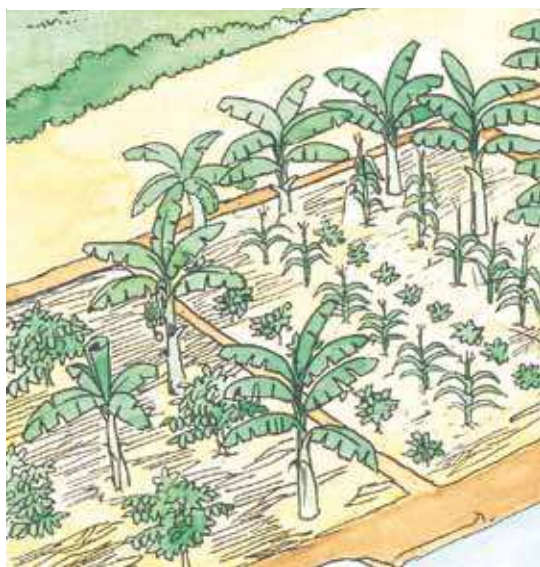
- › Planting into water-retaining pits.
- › Catching water from roads.

Planting pits



1. Instead of ploughing, small holes are dug along a rope.

Contour ridges

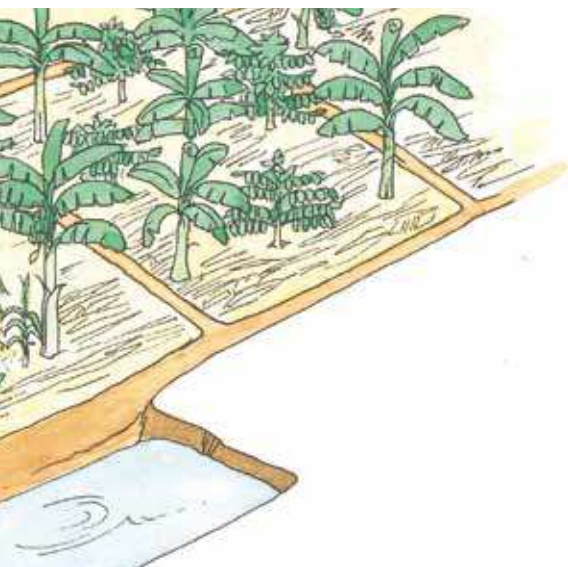




2. A bit of compost or manure can be added and mixed with the soil.



3. Then seeds are placed into the refilled holes.



The run-off water from roads and can be directed though channels into a small pond.

Every time land is tilled, it is exposed to erosion, water is lost through evaporation and decomposition of organic matter is accelerated.

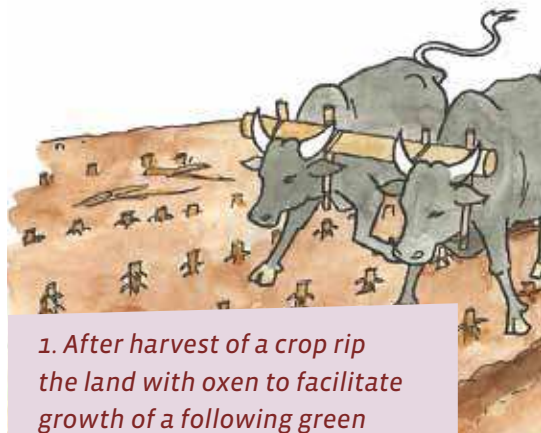
Minimising soil disturbance

Traditional organic farming practices involve deep tilling or ploughing with inversion of the soil to allow incorporation of plant materials, weeds and animal manures, and prepare a seedbed.

Increased awareness of the negative impacts of such practices on soil organic matter, nutrient losses, soil organisms, climate, use of energy and costs, organic farmers are increasingly adopting systems that minimise soil disturbance, maintain a protective cover on the soil surface and allow early land preparation before the strong rains. This involves two alternative approaches:

- › **Zero-tillage or No-tillage:** Here, the crop seeds are planted or drilled directly into the soil without any seedbed preparation.
- › **Reduced or minimum tillage:** Here, the soil is ripped only leaving most of the soil untouched.

Application of reduced soil cultivation



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



3. Flatten the green manure stems with a beam.



2. Sow the leguminous green manure and let it grow until flowering. In case of improved fallow leave it longer.



4. Rip the land through the mulch cover to prepare for sowing of the next regular crop.

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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