3

Rows of vetiver grass reduce nutrient losses by 50-90%

Healthy and productive soils

17 • Introduction

The soil is one of our most important resources. It is the base for food production and for plant growth. Plants again are essential for the existence of animal life.
However, the soil is not often looked after:

- Crop residues are burned instead of used as fertilizer.
- Soil is depleted by the continuous growth of the same crop.
- The felling of trees causes soil erosion, which leads to desertification.

How to build healthy soil

The material which today is commonly regarded as 'soil' is usually only a compacted residue of rock minerals. Healthy topsoil consists of minerals and air, in addition to water and living organisms, such as plant roots, microorganisms, insects and worms and the organic materials they produce. It is by reintroducing the missing components that new topsoil is formed.
There are six essential ingredients for soil formation:
1. Minerals
2. Air

Gully resulting from erosion

3. Water
4. Living things IN the soil (plants and animals) and their by-products
5. Living things ON the soil (plants and animals) and their by-products
6. Regular and patchy disturbances

For soil to form, it needs to be living (4). To be living, the soil needs to be covered (5). To be covered with healthy plants and decomposing plant litter, soil needs to be managed with appropriate disturbance systems (6).

Cover the soil to keep it alive

Many people believe that new topsoil cannot be formed. But then - how did all the topsoil get here in the first place? We know how quickly we lose it when we ignore the fundamental importance of components 5 and 6. To turn things around, we need to encourage soil building processes every day in our land management.

Rules for building topsoil:

- No bare soil. The soil must always be covered with plants or plant litter.
- Produce organic matter - for example by giving the land a rest from grazing, or by growing green cover crops with minimum tillage.
- Graze or slash the groundcover periodically. Use high stock densities for short periods to place organic matter both in and on the soil (This prunes the roots and tramples the litter).

High levels of biological activity are required to form topsoil. Soil conditions must be such that soil organisms can flourish. The more organic material there is on and in the soil and the faster it decomposes, the faster new topsoil will form.
A smell of compost indicates high levels of biological activity, particularly fungi. The activities of beneficial soil microbes are important for the formation of soil aggregates (lumps of soil particles) which give soil its structure, improve porosity and water-holding capacity.
The soil should feel light and springy under your feet. Can you easily push a screwdriver in up to the handle?

Adapted from "How to build new topsoil" by Christine Jones on the website: www.managingwholes.com

In this chapter the following will be described:

- Systems for testing the soil (18)
- Systems that improve fertility and soil life production of compost, minimum tillage system and agroforestry systems (17-19)
- Systems for soil conservation and to reduce erosion (20-21)

18 • Soil Examination

Introduction

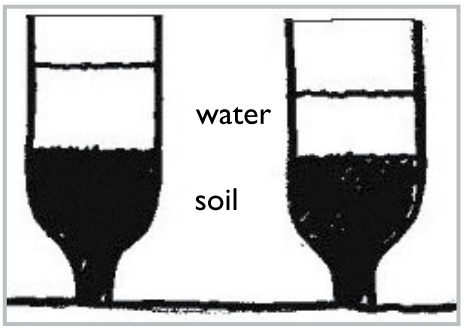
It is very useful to analyze soil quality in several parts of the field in order to better determine its use.
The best way is to run chemical analysis/ tests on soil samples, but that is seldom possible in rural areas of Africa.
In many places, however, there is local knowledge that can provide information on what kind of crops can be grown. This can be seen from what kind of weeds grow on the fields.
It is useful to spread such knowledge on to communities where it does not exist.
There are also simple systems for analyzing soil structure - especially to determine the amount of sand in relation to clay. This is important information because a soil without clay and organic material - like a sandy soil - cannot hold water or nutrients.
These are therefore leached from the soil.
Fertile soil should have at least 3% organic material and 5-30% clay. If there is more clay, the soil is more difficult to cultivate.

Water infiltration

Try an experiment to show how water moves through sandy and clayish soils:

1. Cut out the bottom of two plastic bottles.
2. Stick their necks in to the ground.
3. Fill half of the bottle with sandy soil and half of the other bottle with clay soil.
4. Fill both bottles with water and observe how long it will take for the water to drain from each bottle.

Then try the same thing to compare sandy soil and soil mixed with compost (In the absence of compost, use animal manure).

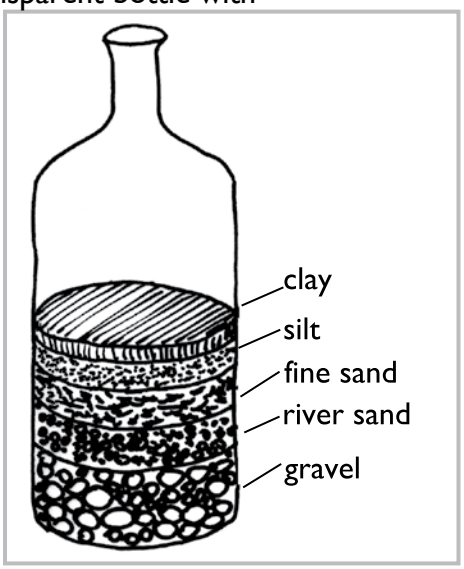


Infiltration measurement

Soil structure

Make an experiment to quantify the amount of clay, silt, fine sand, coarse (river) sand, and gravel:

1. Take a sample of soil.
2. Fill a clean and transparent bottle with 10-20 cm of soil.
3. Add a spoonful of salt and fill the bottle with water.
4. Shake it for a couple minutes and then let it rest.
5. Measure and calculate the percentage of each layer.



System used to determine soil structure

Amount of organic material and water

If you have access to a scale that registers small quantities, you will be able to calculate the amount of water and organic material in the soil:

1. Take a sample of soil and note its weight (W1). Keep it in a closed container or plastic bag until you can weigh it.
2. Dry it well by spreading it out in the sun on a piece of plastic to make it easier for water to evaporate.
3. Register the weight of the sample after some hours in the sun (W2). The differ-

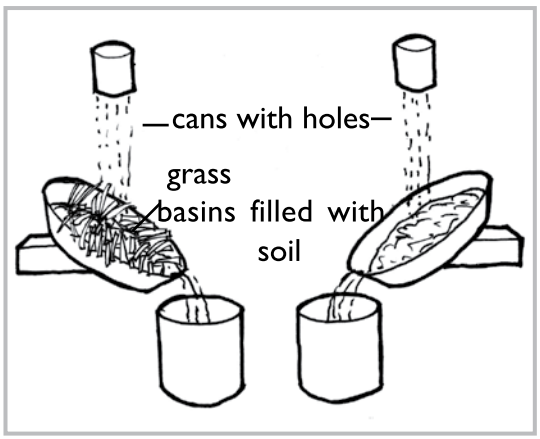
ence is the weight of evaporated water: W(evaporated) =W1-W2

4. Put the dry sample on top of a piece of sheet metal and leave it over a really hot fire for 10-15 minutes.
5. Let the sample cool and register its weight (W3). The difference is the weight of organic material that has been burned: W(organic material)=W2-W3

The effect of mulching

The following experiment shows the difference between water movement in two situations: (a) when the field is covered by mulch (dead plant material); and (b) when the field is left uncovered.

1. Fill two basins with the same kind of soil.
2. Place them so that they lean sideways, by placing a brick under one side.
3. Cover the soil in one of the basins with grass cut into small pieces.
4. Use a nail to make many holes on the bottom of one (or two) aluminium cans.
5. Place a glass (or transparent plastic bottle with the neck cut off) at each basin to catch the run-off.
6. Fill the cans with water to simulate rain falling over the two basins. Make sure both basins receive the same amount of "rain".
7. Compare the amount of water and soil in the two glasses (bottles).



Demonstrating the effect of mulching