COTTON MADE IN AFRICA

Understanding agricultural soils and their needs

A simple practical guide to assess conditions, health & fertility of your soil

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Version 02.1

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1 Introduction

This simple practical guide to assess conditions, health and fertility of soil was developed by sustainable AG in cooperation with the consortium partners of the CAR-iSMa project.

CAR-iSMa stands for "Climate Adaption and Resilience: a Pan-African Learning and Knowledge Exchange Project on Improved Soil Management". Created at the initiative of the Aid by Trade Foundation, the project is supported by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) with funding from the German Federal Ministry for Economic Cooperation and Development (BMZ); it is being implemented in collaboration with the agricultural company LDC Suisse and three CmiA-verified cotton companies: CIDT in Côte d'Ivoire, SAN-JFS in Mozambique, and LDC in Zambia.

This document is a practical guide for assessing the condition and health of soil and crops (especially cotton) on smallholder farms in sub-Saharan Africa, where access to professional laboratory results can be difficult.

The aim of this practical guide is to enable farmers to monitor their soils and crops to identify problems and nutrient deficiencies with little investment. Only with this knowledge can they take timely countermeasures and avoid crop losses and failures.

2 Soil Health

What is soil health, and why is it essential?

Like human beings, soils have several needs to produce healthy crops. Like us, soils need food (plant and animal remains), water, air (via their structure) and protection from extreme weather like heat, storms and strong rains or floods. But if they are healthy, they can also provide food, water, air and protection to their surroundings, as a human being in his or her full strength can support his or her community while being also sustained by others. Plants protect and feed the soil with their root and leaf residues, while the soil feeds them along with millions of small animals, fungi, algae and bacteria which all live beneath our feet. How healthy a soil is can be determined by the extent to which it has these capabilities, i.e. storing water, nutrients and air, providing spaces for roots and small organisms, and withstands physical stresses, diseases or pollutants.

This guidance is designed to help you better understand the condition of your soil without using a laboratory. It will not give you the same precise results, but it will help you observe and learn how to listen to your soils to provide for them and eventually build them up to improve their health and productivity.

2.1 Why doing Soil Assessments?

Soils must be healthy and fertile if they are to be used for agricultural production. Neither of these conditions can be measured directly. Therefore, various soil parameters can be used as indicators to draw conclusions about the health, fertility and thus the condition of the soil (1). These indicators can be determined by visual, physical and chemical assessment. Soil assessments are generally carried out to gain a deeper understanding of soil condition.

Continuous monitoring of the soil in several places is helpful to detect nutrient deficiencies or poor soil condition and to counteract negative consequences such as soil degradation and crop failures through sustainable soil management practices.

2.2 Visible and sensual Parameters

Soil properties that you can either see, feel or smell include parameters such as texture, structure, density, aggregate stability, temperature, smell, and color. These properties affect processes such as water and air infiltration, susceptibility to wind and water erosion, nutrient cycling, and the activity of living organisms in the soil.

Visual and sensual assessments should be carried out when soils are moist and suitable for cultivation.

2.2.1 Soil texture

“Soil texture is fundamental to soil properties and their impact on plant growth and overall farm productivity.” (1) Soil texture is basically the way that soil feels and can therefore be well evaluated by different assessments performed with the fingers (e.g. the ribbon method).

The soil texture defines the size of the dominating soil particles and the respective portion of sand, silt, and clay within soil. The texture of soil cannot be changed through management practices. But it is essential to several essential soil functions and properties such as water and nutrient retention, the probability to suffer from wind and water erosion or the levels of fertile soil organic matter (see Table 1).

S/N	Property/Behavior	Rating associated with soil particles		
		Sand	Silt	Clay
1	Water holding capacity	Low	Medium	High
2	Aeration	Good	Medium	Poor
3	Drainage/infiltration rate	High	Medium	Very slow
4	Decomposition rate of Soil Organic matter	Rapid	Medium	Slow
5	Compactibility	Low	Medium	High
6	Susceptibility to wind erosion	Moderate	High	Low
7	Susceptibility to water erosion	Low	High	Low
8	Swell –shrink potential	Very low	Low	Moderate to very high
9	Sealing of ponds, dams, landfills	Poor	Poor	Good
10	Suitability for tillage after rain	Good	Medium	Poor
11	Pollutant leaching potential	High	Medium	Low
12	Ability to store plant nutrients	Poor	Medium	High
13	Resistance to pH change	Low	Medium	High
14	Warm up in winter	Rapid	moderate	Slow
15	Soil organic matter level	Low	Medium	High

Table 1: Soil properties associated with soil texture (FAO 2020:4)

Learn how to measure soil texture with your fingers in chapter **3.1.2 Soil texture analysis – the ribbon method**.

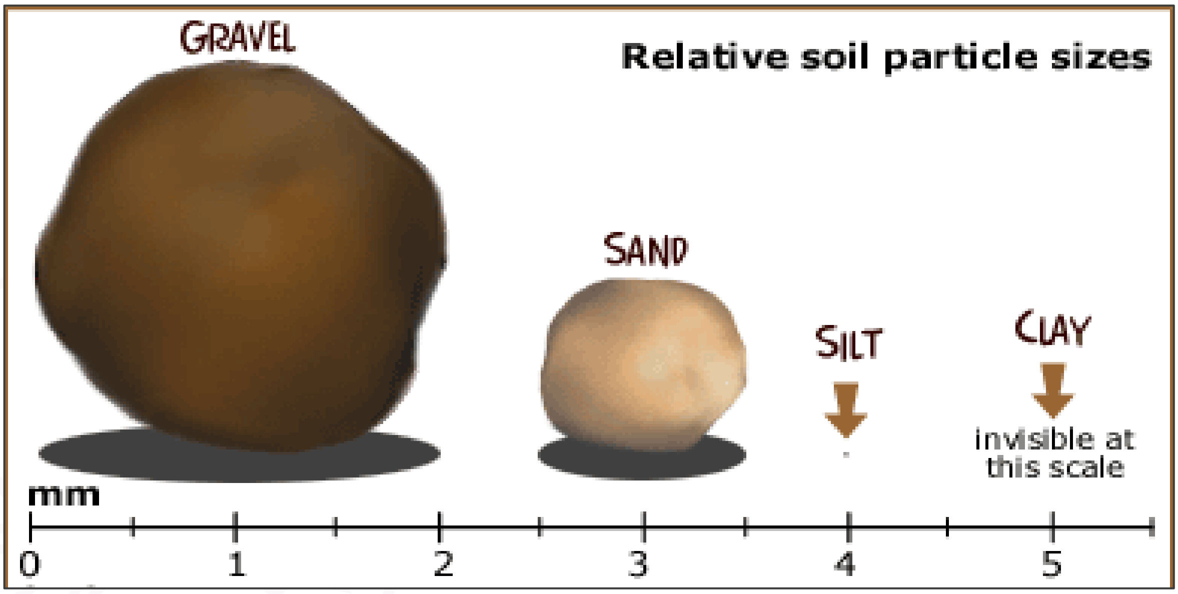

Image 1: Soil particle sizes (Discovery Education 2023)

2.2.2 Soil structure

The soil structure describes the size, density, and aggregation of soil particles. The structure of soil significantly influences the water and air balance, the availability of nutrients, the root growth of plants and therefore also the plant growth. The soil structure is influenced by the soil texture, especially by the amount and type of clay. In comparison to the soil texture, which is described in the previous chapter (**Fehler! Verweisquelle konnte nicht gefunden werden.**), the soil structure can be altered by human activity. Cultivation, removal of vegetation and excessive tillage or chemical fertilization of the soil can destroy aggregates. This has a negative effect on soil structure, which in turn can lead to soil compaction and consequences such as poor water and air infiltration and problems with root growth. The consequences are slower plant growth and lower harvests (2).

Learn how to assess soil structure in chapter **3.1.1 The spade test.**

2.2.3 Soil organic matter content

Soil organic matter consists of plant or animal residues in various stages of decomposition. Along with very small clay particles and bigger and smaller organisms like earthworms, fungi, and bacteria, it is the most important component for the formation of black humus, which is valuable for our soils in many ways. Soils which are rich in organic matter usually have a dark color. They store water, air, and nutrients more easily; they have a better structure with particles being glued together as mottles, and they can host more small organisms which help our crops to grow well and be healthier.

You can enhance the organic matter content of your soil by using organic fertilizers like manure or compost, by frequently growing cover crops, using mulch and leaving crop residues and roots on the field. Agricultural soils usually have an organic matter content of 1-5%.

For guidance on estimating the organic matter content of your soil, see chapter **3.3.1 Soil organic matter content**.

2.3 Chemical Soil Parameters

Soil chemistry can be explained as the interaction of different substances, like minerals, within the soil. The chemical interactions within a soil are extremely complex. But understanding and assessing certain essential parameters, such as the soil pH, will help you to better manage your soil and avoid nutrient deficiencies as well as pests and diseases for your soil and plants.

2.3.1 Chemical parameters: Nutrient Availability

If certain nutrients are lacking or present in excess, changes in the plant can be noted. For example, the leaves will change in color, growth and fruiting may stop, or diseases and other disturbances may arise.

Observing your crops can be helpful in assessing soil quality, as soil conditions (physical, chemical, and biological) directly influence the crop's appearance, growth, and overall well-being. Along with the results of a pH test, you can learn to observe and try to identify which main nutrient is most likely lacking. Frequently occurring and easily recognizable nutrient deficiencies are, for example, Nitrogen, Phosphorus, Potassium and Magnesium.

How you can interpret and understand the signs and symptoms that your cotton plant is showing, is explained in chapter **3.4. Visual assessment for plant symptoms**.

2.3.2 Soil pH

The soil pH is probably the most important soil chemical parameter as it affects nutrient availability and the activity of soil microorganisms. It assesses the proportion of acidity or alkalinity within the soil. Soil pH values lay between 0 and 14, with a level

- below 7 being rather acidic, with the extreme < 5.5;
- above 7 being rather alkaline, with the extreme > 8.5;
- of 7 being considered as neutral.

The soil pH level determines, which nutrients are bound to the soil particles, and which ones are rather freely available for plants. If the pH level in your soil is extremely acidic or extremely alkaline, you may be fertilizing as much as you want, but particular nutrients may not be available for plant roots. A good nutrient uptake by plants can be reached with a pH in the range between 5.5 and 7.5. The most favorable pH range for cotton is 6 to 6.5, with 6.5 being the optimum (3). A pH outside this range can be a sign of disease or pest infection within the soil, which will affect crop growth (1) (4).

Soil pH can be affected by climatic conditions (e.g. heavy rainfall) as well as though human activity (e.g. fertilization with ammonium or sulfur) (5). Generally, changes in pH occur rather slowly. The pH in soils with a high sand content can change more quickly than pH in clayey soils.

Lime or dolomite is usually used to improve acidic soils. Lime contains mainly calcium carbonate, while dolomite contains calcium carbonate and magnesium carbonate. Addition of composts usually helps to neutralize the pH.

In the practical section in chapter **3.2.1 pH value: Test strip method** you will learn how to measure the pH value easily.

2.3.3 Soil salinity

Soil salinity is the salt content within the soil. Salts are occurring naturally within soils and water. The salt content in the soil can increase through natural weathering or also through human activities such as using salt-containing irrigation water. Soil salinity can affect the soil structure, water movement and the diversity of microorganisms and plants in soils.

Too high a salt content in the soil impairs plant growth and yields, can affect groundwater quality, and makes the soil more susceptible to soil erosion.

You will learn how to observe soil salinity in chapter **3.2.3 Field Symptoms of Soil Salinity**.

2.4 Biological Soil Properties

The biological (life) activity in the soil can be an important sign of the quality and health of the soil and plants. Like each of us has got a digestion supported by 2 kg of microorganisms in the guts, millions of microbes in the soil act as the digestive system of the plants. They live in close cooperation and often in a trading relationship with plant roots and are essential for the nutrition of your crops, especially when organic fertilizers are used. The more diverse this micro-universe is, the better, because then organisms that may cause diseases cannot dominate. To learn more about soil biology assessment, see chapter **3.3.2 Observing and sampling soil**.

3 Soil Assessment in Practice

Here you can find examples for simple methods to assess soil parameters which are critical to soil health and fertility. They can be performed directly and cost-efficiently in the field and kitchen lab. Remember, all assessment methods should be carried out on moist soil, that is suitable for cultivation.

Sampling soils in a representative way

To get useful information about the condition of your soils, it makes a difference where you take the samples. Like when you ask your family if they are doing well, and two out of five children answer that they are doing well, but you haven't asked the other three and your spouse, who may not be doing so well. Following on from this example, it is important to take several samples from areas that give a representative overview of the condition of the soil and the problems that are occurring. This means that you should consider separately the soils that are typical for your farm (such as the "normal" situation) and the areas that are particularly problematic (unhappy) or very productive (happy).

To do this, select the fields you are interested in and collect the soil in several places, moving through your field in a "zigzag" course. This way you avoid that one point is very different from the other and gives you a false idea. Later, you can mix the samples from similar points or, as with the spade test, simply perform several tests in different places.

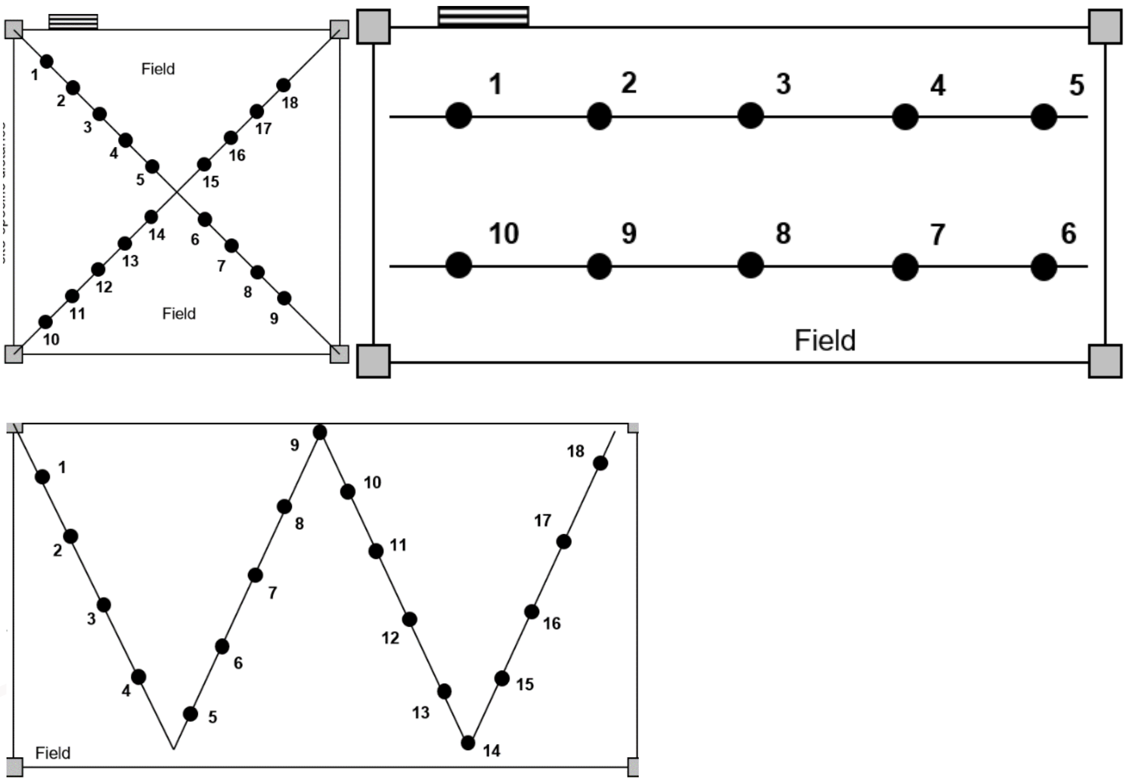

Image 2: Schematic examples on sampling one field with rather uniform growing conditions (SMI)

3.1 Assessing Soil Physical Parameters

3.1.1 The spade test

The spade diagnosis gives a good overview of the general condition of the soil. The spade test checks indicators such as soil structure, color, and smell in order to assess the level of aeration / compaction of the soil as well as its air content.

The spade sample can be used before tillage to assess moisture, but also for longer term soil monitoring to assess changes in the soil as a result of adapted management. This soil sampling method is often carried out in an area of the field where the plants are not growing well and compared with a spade sample from a field area where crops are growing well. The longer and narrower the spade, the better (1).

Soil sampling for the spade test: (see photo documentation below)

1. Choose a square of soil (ca. 25x25 cm)
2. Extract some topsoil to make room for taking the actual spade sample.
3. Stick the spade into the soil in a square, go as deep as the shovel is, and take out one continuous soil block (if necessary, secure it with your hand to make sure it does not break).
4. Keep the chunk of soil on the spade and find a good place to look at it.
5. Loosen those spots where the spade has created a smooth surface on the soil with a knife, so that natural fractures in the chunk of soil are visible.

Image 3: The spade test (Organic Farm Knowledge 2021)

Analysis using the spade test:

Analyze the structure, color, and odor of the sample according to the conditions / statements below:

- If the structure is rather crumbly, forming small aggregates with roots, that is good.
- If there are soil blocks and clods rather than crumbs, it is not so good.
- If there are no crumbs nor clods, but just single grains, the soil structure is pretty bad.

No structure - just single grains

Few structure - blocks, clods

Good structure - crumbly

Image 3: Soil structural differences (SMI)

- If the colors of the soil are yellow, brown, or red, the soil is well aerated. That is good.
- If the color of the soil is blue gray or greenish, this is not good. It is a sign for poor drainage and possibly waterlogging. The soil then runs the risk of losing nitrogen, growth is stunted, and plants can potentially die from the lack of air.
- If color of the top layer of the soil is dark, the fertile soil organic matter content is high. That is good. A high content of organic matter leads to a higher water storage capacity as well as better aeration and rooting of the soil, which in turn reduces the risk of soil compaction and erosion.
- If the soil smells unpleasant and musty, it is not good. The air content in the soil is probably too low which can damage roots, inhibiting their function to supply the plant with nutrients. The death of the plant can be a consequence.

Image 4: Different soil colors (SMI)

Check the rooting depth and roots of the soil and analyze it for defects.

- If the main and fine roots are evenly distributed, that is a good sign.
- If roots are unevenly distributed and bent, the soil might be compacted which leads to poor plant condition.
- If roots are rotten or dry, it is likely that the nutrient uptake by the plant is disturbed, and growth is likely to slow down or stop.

The soil taken for the spade test can also serve as the basis for samples for further analysis.

3.1.2 Soil texture analysis – the ribbon method

The ribbon method has the goal of determining the texture of the soil with your fingers, e.g. if sand, loam or clay are dominating. Loamy soils can store water and nutrients more easily than sandy soils, which dry out quickly. Heavy clay soils are easily compacted or waterlogged.

Recognizing the soil texture with your hands takes some practice, and the ribbon method is a good way to start.

Procedure:

a) Take a handful of soil, around 25 grams, add a small portion of water to it and start mixing the two until the soil feels moldable (if the soil is too wet, add some more dry soil and if too dry, add some more water).

b) Try to form a ball with the soil. If you cannot form a ball, it is probably sand.

c) Try to form a ribbon by placing the soil between your thumb and index finger and squeezing the soil upwards to form a ribbon. Can the soil form a ribbon? If yes, continue to d). If not, it is probably loamy sand.

d) The soil can form ribbons, but how long can they get? If the ribbon breaks at 2.5 centimeters or below, the soil is a type of loam. If the ribbon is between 2.5 and 5 centimeters, it is a type of clay loam, and if it reaches over 5 centimeters, it is a type of clay.

e) To determine the textural class more in depth, take some of the soil, wet it, handle at the palm of your hand, and determine whether the soil feels gritty, smooth or neither gritty nor smooth. This will help you determine the textural class of your soil.

Image 4: The ribbon method (FAO 2020: 10f)

Further specification of e) textural classes (1):

- Types of loam
  - Does the soil feel gritty? > Sandy loam
  - Does the soil feel smooth? > Silt loam
  - Neither gritty nor smooth? > Loam
- Type of clay loam
  - Does the soil feel gritty? > Sandy clay loam
  - Does the soil feel smooth? > Silty clay loam
  - Neither gritty nor smooth? > Clay loam
- Type of clay
  - Does the soil feel gritty? > Sandy clay
  - Does the soil feel smooth? > Silty clay
  - Neither gritty nor smooth? > Clay

Note the soil textural type and compare with other samples. Which type gives the best crop growth results?

3.1.3 The shaking test

The shaking test is used to differentiate clay from silt as it can be hard to know their differences, but their properties are different (1). How? See Table 1.

Procedure:

Take a soil sample and add some water to it (similar as in the ribbon method)
Form a patty out of the soil sample which is about 8 cm in diameter and 1.5 cm thick / high (
Image 5 below)
Place the patty on the palm of your hand and shake it from side to side, focusing on its surface.

- If the surface becomes shiny, the soil is mostly composed of silt.
- If the surface does not change, remaining dull, the soil is probably clayey.

Confirm by bending the soil sample using your fingers, if it becomes dull again, it is silt.
Let the patty dry completely.

- If it is brittle and dust comes out when rubbing your fingers on it, it is silt.
- If it is firm with no dust coming out when rubbing your fingers on it, it is clay.

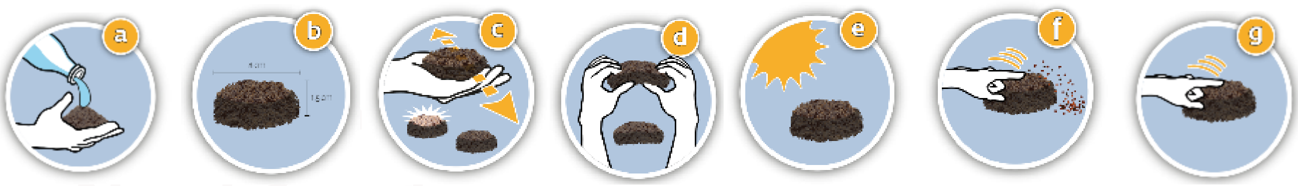

Image 5: The shaking test (FAO 2020: 12ff)

3.2 Assessing Soil Chemical Parameters

Since it is not always possible and practical to sample your soils and send them to a laboratory, there are some rather simple methods to get an idea of whether the nutrient content of your soil is good.

3.2.1 pH value: Test strip method

For this test, you need a pH test strip from a pharmacy, laboratory, or your agricultural extension officer. Please also ask them for distilled water. This is extra clean water with a neutral pH, which will not disturb the outcome of the test with it's on pH value. Make sure to have clean hands, clean equipment and to no touch the end of the pH strips which you dip into the water, as your skin has also got its own (acidic) pH.

Soil Sample:

- Choose a small area on your field where you want to take the sample
- Clear that area of vegetation as well as root and leaf debris
- Use a shovel or spoon to remove a soil sample from a depth of about 10 centimeters
- Remove any gravel, roots or debris with clean hands and fill the soil into a clean container or plastic bag
- Dry the soil before assessing its pH value

Materials:

- pH paper strips and color charts with a range of at least 5 to 10 (urine pH test stripes can be used and are usually found at a drug store or pharmacy)
- a clean transparent (glass or plastic) container
- 500 mL of water (ideally distilled)
- Teaspoon

Procedure:

- Pour 2 teaspoons of air-dried soil into the transparent container
- Pour the water into the container
- Shake or stir the mixture with a clean spoon for 5 minutes
- Wait for another 5 minutes for the solution to settle
- Dip the paper strip into the settled solution and observe the color change
- Compare the color on the strip with the color chart and determine the pH value of the soil

For an interpretation of the result, see chapter **2.3.2 Soil pH. Fehler! Verweisquelle konnte nicht gefunden w erden.**

3.2.2 pH value: Vinegar and Baking Soda Test

Image 1: pH strips (SMI)

This test is less precise than using a pH strip but can be done with simple ingredients from a grocery store. It tells you whether your soil has a near neutral pH (no reaction), an acidic pH (bubbles) or an alkaline pH (bubbling and fizzing). The more extreme the reaction, the more extremely acidic or alkaline is your soil.

This method requires a small amount of soil, vinegar, and baking soda. The vinegar must be mixed with the selected soil. If the soil is alkaline, a carbon dioxide reaction will occur - the sample will fizzle and bubble. If there was no reaction during the experiment, you need to thoroughly mix a new soil sample with water and cover it with baking soda. Bubbles and hiss will appear on acidic soil. If both experiments did not result in a chemical reaction, the soil at this site is most likely neutral (4).

3.2.3 Field Symptoms of Soil Salinity

Image 6: Extremely saline, alkaline soil in China (SMI)

Saline soils contain very high proportions of soluble salts in both the soil solution and on clay particles, and most plants fail to grow in saline soils, or their growth is altered significantly. In this method, the symptoms are observed whether a soil is affected by salts or not (1).
Visual indicators of soil salinity can include the following (1):

- Patchy crop growth
- Bare soil
- Salt crystals on the soil surface
- Puffy dry soils
- The presence of salt tolerant species and weeds*
- Light gray or white colors on the soil surface
- Some areas within a field can take longer to grow

*The species of salt-tolerant plants and saline soils will differ by region, climate etc. (1)

3.3 Assessing Soil Health

As mentioned earlier, a healthy soil is defined by many different parameters such as a good and un-compacted granular structure, dark color, presence of earthworms and small organisms, and its abilities to foster healthy plant growth. Below we emphasize on the biological ("living") indicators to understand the quality of your soil.

3.3.1 Soil organic matter content

The higher the organic matter in our soils is, the better for our crops and for us.

- How can you tell if your soil is rich in organic matter?
- The color. Organic matter is always dark. When your soil is black or dark brown, it might be humus. If it is rather red or yellow, there is less organic matter.
- The smell. A healthy soil rich in organic matter smells like forest soil.
- Observing small organisms. Humus-rich soils often contain more small insects and living roots than "poor" soil.
- Water holding capacity. Carefully pour one cup of water over a humus-rich soil which you hold in your two hands. If it is rich in organic matter, it will maintain more of this amount of water than a soil with less organic matter. Careful to choose soils for this comparison, which are both not completely dry or wet.

Image 7: Compost smells like humus-rich soil with half decayed organic matter (SMI)

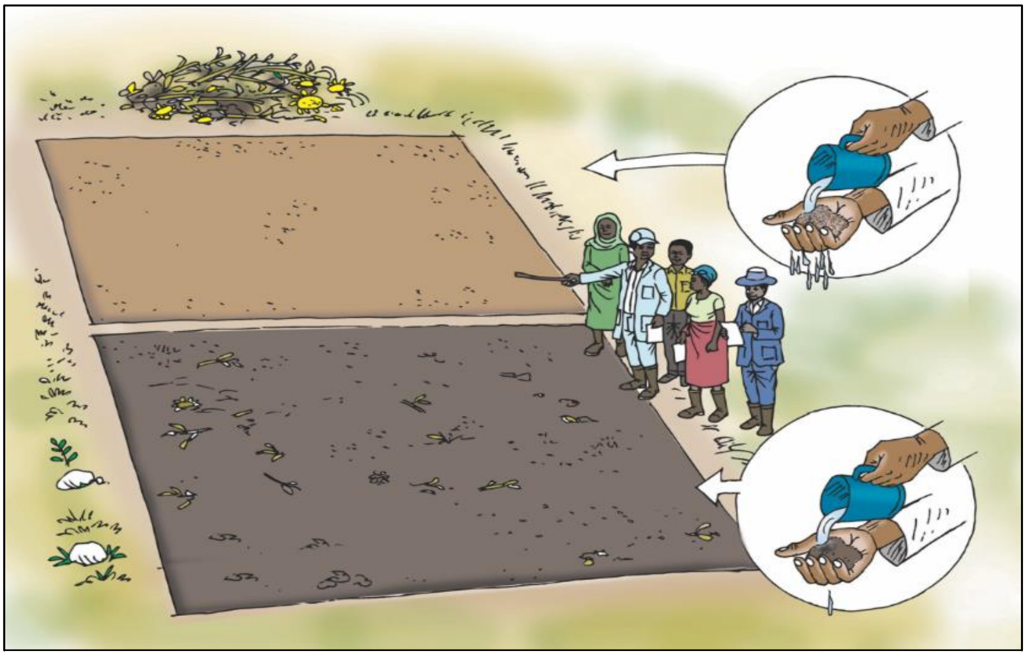

Image 8: Practical training to illustrate physical differences between soil with good humus levels (consequence of composting) and degraded sandy soil (James Kazembe)

3.3.2 Observing and sampling soil life

As mentioned earlier, healthy soils are teeming with life. Earthworms, fungi, and smaller organisms are also responsible for a good, crumbly soil structure, and for making nutrients available to plant roots. We cannot see micro-fungi, bacteria, or archaea with our own eyes. But we can see the bigger organisms who feed on or with the help of those microorganisms. If you can see centipedes, earthworms, or termites in the soil, you can be sure that there are also plenty of smaller organisms, as they feed on each other.

Image 9: Soil organisms (JFS; SMI)

One simple method for understanding the abundance of life in your soils is to take a sample of soil, and count and recognize the animals you find.

Image 10: Demonstrating soil health by sampling life in the soil – Arthropod sampling (James Kazembe)

Counting the number of earth worms and arthropods per unit area in the field

- Identify and measure sampling area (1 m2) → clear of surface vegetation
- Dig into the ground up to 20-30 cm
- Sort through the earth worms and arthropods and count them

Do this with a good, fertile soil, preferable under a mulch cover, and with a sandy, poor, uncovered soil and note the difference!

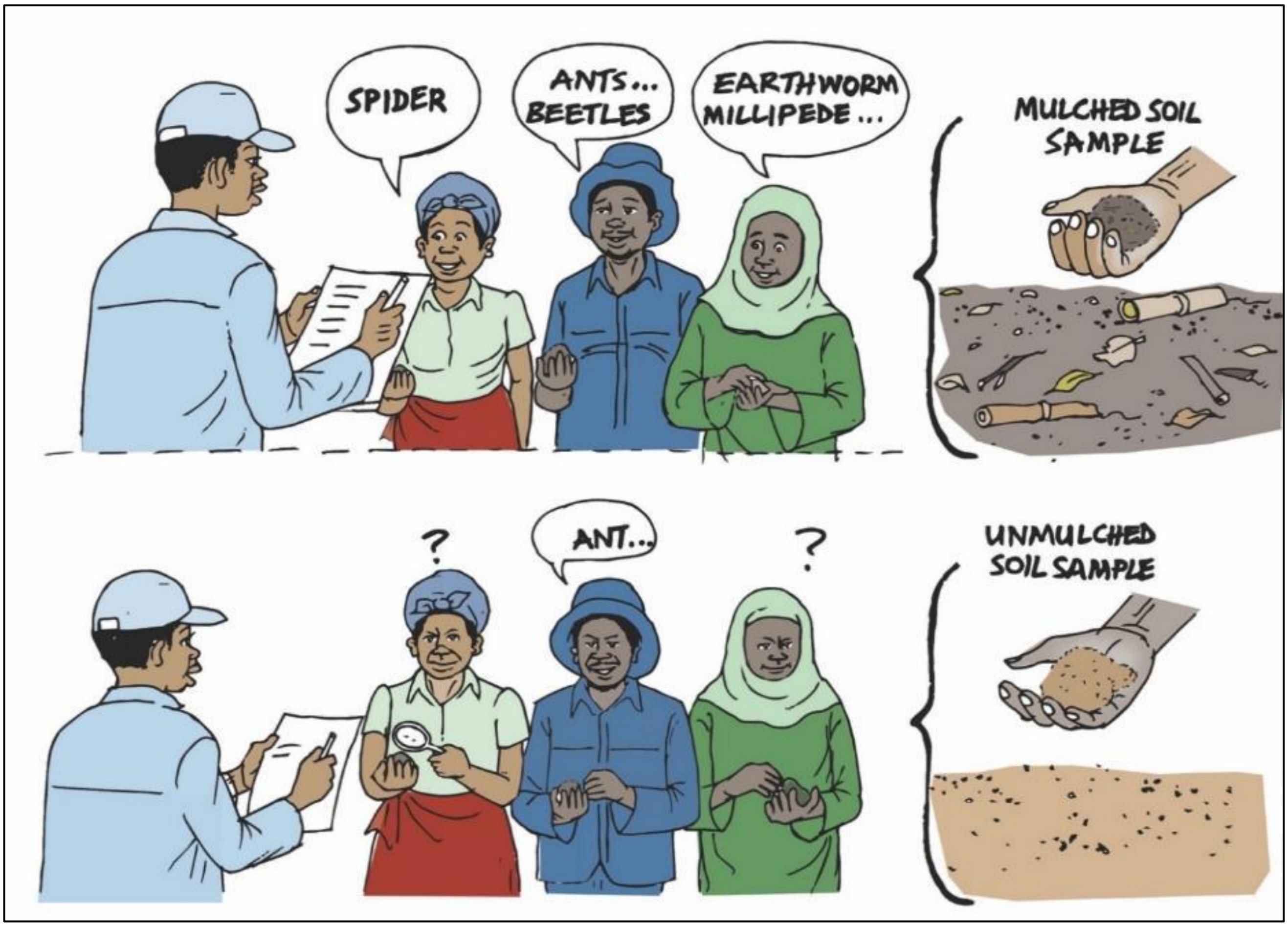

Image 11: Participatory farmer sampling and naming soil arthropods- comparing sandy mismanaged soils with good soils (CmiA – James Kazembe)

3.4 Visual assessment for plant symptoms

Nutrient deficiencies are best identified when plants show respective symptoms. However, it always helps to know the soil type and soil pH, because some problems can be improved by influencing the pH of the soil.

3.4.1 Chemical parameters: Nutrient Availability (visual)

Depending on the nutrient deficiency, symptoms appear first on older or on younger leaves (6). These signs on the leaves of your plant tell you, what minerals, and nutrients your plant is most probably lacking.

One word of caution: a visual plant assessment can only be an educated guess. Only a laboratory soil and leaf analysis will bring certainty.

Lack of Nitrogen (N) N deficiency symptoms first appear on the older, lower leaves. N is rapidly translocated to the young developing plant parts (4) (7). Early season deficiency results in plants with pale green yellowish leaves and stunted growth. Late season deficiency leads to reduced boll retention. Plants suffering from N deficiency mature earlier, leaves are smaller, stem is thin. Yellowing of leaves begins with the veins and around them, until no green veins are left.	N is an essential growth nutrient contained in urea, poultry manure, beans/peas, or manures. Too much N will make the plant weak against pests and diseases.	 Image 12: Lack of Nitrogen (SMI)
Lack of Phosphorus (P) P deficiency symptoms are reflected in the lower/older leaves. Drought during boll formation will particularly affect P availability (4) (7). Symptoms: Dark green, bluish/purplish color of the leaves. Growth slows down, leaf death increases. Flowering and ripening are delayed. With strong starvation, brown or red-brown spots appear, turning into holes.	P is an essential nutrient. It is contained in urines, poultry manure, phosphate fertilizers, bone meal, and manures. P availability is limited at pH < 6.5 or > 8.0.	 Image 13: Lack of Phosphorous (Plantix 2023)
Lack of Potassium (K) K is a mobile element in the plant and deficiency symptoms appear on the older, lower leaves (4) (7). Symptoms: At first the veins remain green, while the leaf starts yellowing. Tips become brown and leaves dry from the outside, brown spots appear, curling of the edges to the bottom. K becomes plant-unavailable in acidic soils (pH < 5.5) or after heavy rainfalls in sandy soils.	K is an essential nutrient for good yield, fibre maturity and length. It is contained in poultry manure, wood ashes, sulfate of potassium magnesia, seaweed.	 Image 14: Lack of Potassium (Adotey et al. 2020)
Lack of Magnesium (Mg) Mg is a mobile element and symptoms appear first in older leaves. The spaces between the leaf veins become light green, yellow or even reddish. Without Mg, the plant cannot produce green leaves and has no option to produce sufficient energy for growth. In sandy, acidic soils (pH <5.5), Mg becomes fixed and is not available to the plants.	Mg is an essential nutrient for making leaves green and healthy. It is contained in poultry manure, dolomitic limestone, and magnesium sulfate.	 Image 15: Lack of Magnesium (Adotey et al. 2020)

3.4.2 Weed Growth Indicators

Weeds can be strong competitors to the crop regarding light, water, and nutrients. Weeds must be managed, and their growth must be controlled.

But they are also able to efficiently procure water and nutrients and make them available to the crops during their life cycle. Funnily enough, they often draw the very nutrients from the depths that the soil lacks. A leguminous plant, for example, grows well where the soil lacks nitrogen, and it fixes nitrogen from the air, which other plants cannot.

Weeds with strong tab roots often grow where the soil is compacted, as they also have the ability to loosen it. Weeds as wild cover crops act in favor for the soil, protecting it from sun and wind wherever we do not cover it.

It therefore makes sense to observe what kind of weeds grow on a field, because they will reveal information on the soil's problems. Certain weeds will become less dominant once the status of the soil improves. Ask elderly farmers about the name, uses and properties of certain weeds in the field.

Image 13: Leguminous "weed" bush in Mozambique (SMI)

There are also mobile applications to identify types of weeds, for example https://identify.plantnet.org/pt.

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AID BY TRADE FOUNDATION

The Aid by Trade Foundation (AbTF) was founded in 2005 by Prof. Dr Michael Otto, an entrepreneur from Hamburg, Germany. The aim of the foundation, which operates independently of the Otto Group, is to help people to help themselves through trade, thereby preserving vital natural resources and securing the livelihoods of future generations.

Cotton made in Africa is an internationally recognised standard for sustainably produced cotton from Africa, connecting African small-scale farmers with trading companies and fashion brands throughout the global textile value chain. The initiative's objective is to employ trade rather than donations to offer help for self-help in order to improve the living conditions of around one million cotton farmers and their families in Sub-Saharan Africa while protecting the environment. The small-scale farmers benefit from training and better working conditions, and additional social projects enable their children to attend school. Female small-scale farmers are supported in pursuing professional and social independence.

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