2 A healthy soil

Background

Many farmers in intensive production areas have experienced lately that the yields of their crops are plateauing or even decreasing, although they use the same amount or more chemical fertilizer as they did before. How is this possible? In most cases, this decline of productivity is caused by a decline of soil fertility. Yield increases achieved over the past decades through the cultivation of high yielding varieties have depleted nutrient reserves in the soil that have not been fully replenished by applications of chemical fertilizers. Consequently, the soil is no longer capable of supporting the high yield levels, which is experienced by farmers as stagnant or declining productivity.

Objectives

The objective of this activity is to enhance:

- The participants' awareness on the importance of a healthy soil.
- Their knowledge on the composition, formation and maintenance of soils.

Materials

- Newsprint paper.
- Felt-tip markers.
- Small plastic bags.
- KCl and TSP fertilizers (if needed)*.
- Manure*.
- Hoe (each participant should bring a hoe).

* provided by the owner of the FFS field, if that has been the agreement at the beginning

Activity steps

A *What is the difference?*

A.1 Participants are divided into four small groups.

A.2 Each group observes the soil in two different locations: (1) in the field and (2) on a dirt road. Two of the groups observe the soil of a field that often receives organic manure, while the two other groups observe the soil of a field that is usually only given chemical fertilizer. All groups observe the soil of a dirt road in the field area. The following characteristics of the two soil types should be observed by all participants using all their senses:

→ Color.
→ Texture.
→ Humidity.
→ Smell.
→ Structure of soil layers.
→ Thickness of the upper, fertile soil layer.
→ Animals.
→ Other interesting features.

The findings are written on a sheet of newsprint paper. A handful of soil from each location is put into a plastic bag and taken to the meeting place as a sample.

A.3 The groups present their findings in a plenary session.

A.4 the facilitators leads a discussion in which the three soil types are compared. The following questions could be asked:

→ What is the most obvious difference between the three types of soil?
→ Why have the soils become different?
→ Which of the soils provides the best living place for the crop?
→ What are the characteristics of a good soil and a bad soil?

A.5 Draw conclusions relating to the relationship between cultivation and fertilization practices, and soil characteristics.

B *What is a healthy soil?*

Lead a discussion about the composition and characteristics of a healthy soil:

B.1 The participants are requested to mention all elements contained by soil. Write the answers on a sheet of newsprint paper. Let the participants make up their list first, and add only if necessary:
→ Mineral material: sand, loam, clay.
→ Nutrients.
→ Water.
→ Air.
→ Humus/organic matter.
→ Remainders of plants and animals, compost, manure.
→ Living organisms: animals (insects, earthworms, etc.), fungi, bacteria.

B.2 Draw a table of three columns in a sheet of newsprint paper, with the just mentioned soil elements in the first column. Ask the participants, and write their answers in the two other columns of the table:
→ How did each element get into the soil?
→ Is the element favorable (+) or unfavorable (-) to soil health?

B.3 Discuss together if and how an unhealthy soil can be made healthy again. Draw conclusions.

C *Fertilizers and nutrients*

C.1 The participants are requested to list all the types of fertilizer they know. Add to this list if there is no more answers from them:

→ Organic manure.
→ Compost.
→ Green manure.
→ Urea.
→ TSP.
→ KCl.
→ NPK.
→ Other locally specific fertilizers.

C.2 Explain that NPK fertilizer contains the nutrients "N" (15%), "P" (15%) and "K" (15%). All of these nutrients are important food elements in the total menu for plants, just like rice or potatoes, vegetables, and meat or fish for humans.

C.3 List together the contents of N, P and K in the other fertilizers mentioned before. Extract from the participants' knowledge and add if they do not know. Emphasize that organic fertilizers, such as manure and compost, also contain other elements that are needed for plant development. Explain that all elements are also available in nature, i.e. in the air, water and soil, albeit in very small concentrations.

C.4 Invite one of the participants in front of the group to draw a flowchart (in pictures or words) of what happens to urea from the moment it is bought in the shop. This picture is used to further discuss:

→ The behavior of fertilizers and nutrients in the soil.
→ The loss of nutrients from the soil (through uptake by plants, evaporation, leaching and run-off.

C.5 Discussion:

→ Why do fertilizers have to be applied every season?
→ What are the strengths and weaknesses of organic fertilizers and chemical fertilizers?
→ Why do manure, KCl and TSP have to be applied as a basal fertilizer for sweetpotato?

D *Application of basal fertilizer to the ICM FFS field*

Explain to the participants how basal fertilizer is applied to the sweetpotato field, divide tasks, and fertilize the field as follows:

D.1 Manure:

Ripened manure (at least 400 kg per 1,000 m^2) is applied evenly over the FFS field.

D.2 Chemical fertilizer:

The participants determine together the amount of chemical fertilizer needed by considering the following guidelines:

→ 1) if 400 kg of cow manure per 1,000 m^2 is applied, and

→ 2) the field received TSP during the previous season, and

→ 3) a yield of 40 t/ha is expected, then:

- it is not necessary to apply TSP;
- 5 kg of KCl per 1,000 m^2 should be applied as a basal application (or 50% of the total dose).

AND:

→ If chicken manure was applied, there is normally no need for additional chemical fertilizer at the expected yield of 40 t/ha.

→ If more than 400 kg of cow manure per 1,000 m^2 was applied, the amount of KCl fertilizer can be reduced.

→ If no TSP was applied to the field during the previous seasons, 3-5 kg of TSP per 1,000 m^2 could be applied as a basal application.

→ If the expected yield is more or less than 40 t/ha, the doses of chemical fertilizer should be adjusted accordingly. In the case of an application of basal chicken manure at 400 kg per 1,000 m^2, additional chemical fertilizers only will have to be given when the expected yield is more than 45 t/ha.

D.3 The fertilizer is weighed and broadcast evenly over the field, or applied evenly over the ridges before they are finalized for planting. The fertilizer should preferably be covered with soil to prevent losses from evaporation and run-off.

D.4 Manure trial:

If the participants are interested to observe the effects of manure only on crop development, a simple trial could be set up. In a corner of the field, preferably the place where the organic manure was previously stored and left to ripen, a small ridge of 1-2 m is prepared and applied with a relatively large amount of organic manure which is mixed with the subsoil. No chemical fertilizers are added to this ridge throughout the season. The ridge is marked with a stick. Soil composition (texture, remainders of the manure, living organisms) and plant growth is observed during the season and compared with the rest of the field.

Preparation

Prior to this FFS session the following preparations need to be made:

- Select three locations for soil observation which are close to the meeting place, with the following characteristics: (1) a field with a relatively high organic matter content that is often given organic manure; (2) a field with low organic matter content that is normally only given chemical fertilizer; and (3) a compacted soil on a dirt road or field bund.
- Measure and calculate (in m^2) the exact area of the FFS field.
- Confirm the availability of ripened organic manure for the FFS field at a rate of 400 kg/1,000 m^2.
- Confirm the availability of chemical fertilizers (KCl and TSP, if needed) at a rate according to the guidelines given above. The amount needed for the field school field can be calculated as follows:

$\Rightarrow$ *amount of fertilizer (kg) = dose (kg/1,000 m^2) * field area (m^2) / 1,000*

For more information see:

- A healthy soil (Part III, Section 2.2).

Notes