SECTION 6

Soil Fair : Integration in Practice

Section 6: Soils Fair : Integration in Practice

6.1 Introduction

The Soils Fair demonstrates practically the integration (Section 4) of the technical knowledge gained on local indicators of soil quality (Section 2) with the technical knowledge of soil quality (Section 3), see Fig. 6.1.

This section develops the trainees understanding of soil physical, chemical and biological properties through the use of simple practical exercises. These exercises do not aim to go intoa detailed study of soil characteristics, instead, they aim to introduce some concepts and ideas to the trainees, so that they can relate technical and local indicators of soil quality with their permanent and modifiable characteristics. The soil characteristics that will be investigated during the Soils Fair are outlined in Table 6.1.

Table 6.1 Soil properties and methodologies used to determine those soil properties.

Properties	**Table number**	**Method**
Texture Consistency	**1**	Hand evaluation Hand evaluation
Organic matter Colour	**2**	Addition of hydrogen peroxide Munsell colour chart
pH Carbonates Indicator species	**3**	pH paper Addition of hydrochloric acid Participatory determination
Structure Macro/micro fauna	**4**	Visual examination Observation and counting

6.1.1 Objectives

At the end of the Soils Fair the trainees will,

- ✓ have developed their skills to be able to determine by using simple and easy methods, soil physical, chemical and biological properties.

- ✓ be able to relate these technical indicators to local indicators of soil quality

- ✓ be able to explain the relationship between technical and local indicators of soil quality to others

6.2 Organization of the Soils Fair

The outline of the preparation and organization of the Soils Fair is given in Fig. 6.2, the Soils Fair takes one day and occurs on the last day of the training workshop.

6.2.1 Before the Soils Fair

At the planning stage of the training workshop a coordinator needs to be appointed who is responsible for preparation and purchase of all materials required and for organizing the logistics to successfully run the Soils Fair.

Before the Soils Fair the order of planning is:

1. Conduct field day with local farmer community to collect LISQ.

2. Ensure that all materials required for the Soils Fair are purchased before the start of the training workshop.

3. During the training workshop agree on who (two trainers per table) is to demonstrate the soil property at each table

4. The appointed people are to prepare wallcharts for each Group to record the Soils Fair results as outlined in Appendix 6.1. These wallcharts

are to be displayed on the wall behind the tables and filled in by the people leading the demonstration.

Produce sufficient photocopies of the Farmer Worksheet (Appendix 6.2).

6.2.2 During the Soil Fair

During the Soils Fair the order of planning is:

The trainees are assigned to a starting Group, this starting group also contains at least two farmers who were involved in the identification of LISQ before the start of the training exercise. The farmers are given their Farmer Worksheet.

The opening questions are used to introduce the subject being demonstrated at that table. It is important for the audience to understand that this is not an examination but a method to know the starting point, in order to optimize the training event and at the end to be able to evaluate the benefit obtained by the trainees during the practice. Sample answers are given in Appendix 6.3.

Note: The questions are written to allow selection of the most convenient method of introduction and presentation to the trainees. For instance, give them the questions to be answered in groups (remember that they have these questions in the working material) and afterwards organize a plenary discussion to discuss the groups answers.

5. The practical should be developed according to the level of knowledge of the trainees.

Note: If chemical reagents are used in the practical, warn the trainees of the danger

6. The trainers demonstrating the topic should record on the wallchart the individual results for each farmer and the farmer should record their result on the Farmers Worksheet

7. After completing the practicals for that Group, the trainees are to pass to the next Group until all four Groups have been completed (Fig. 6.3).

6.2.3 After the Soil Fair

After the Soils Fair the order of planning is:

1. After the trainees and Farmers have completed all four Groups the wallcharts for each Group are correlated and transcribed into a table so that they can be discussed with the trainees and farmers during the following plenary session.

2. Hold the plenary session and explore the impact produced by the practicals on the trainees and farmers way of thinking (take as reference the responses to the questions at the end of the practice). Identify the strengths and weaknesses in the knowledge acquired.

3. In this plenary session the following key concepts should be addressed:

- ✓ why were the practicals grouped as they were
- ✓ what did you learn
- ✓ how can this knowledge be used in the field

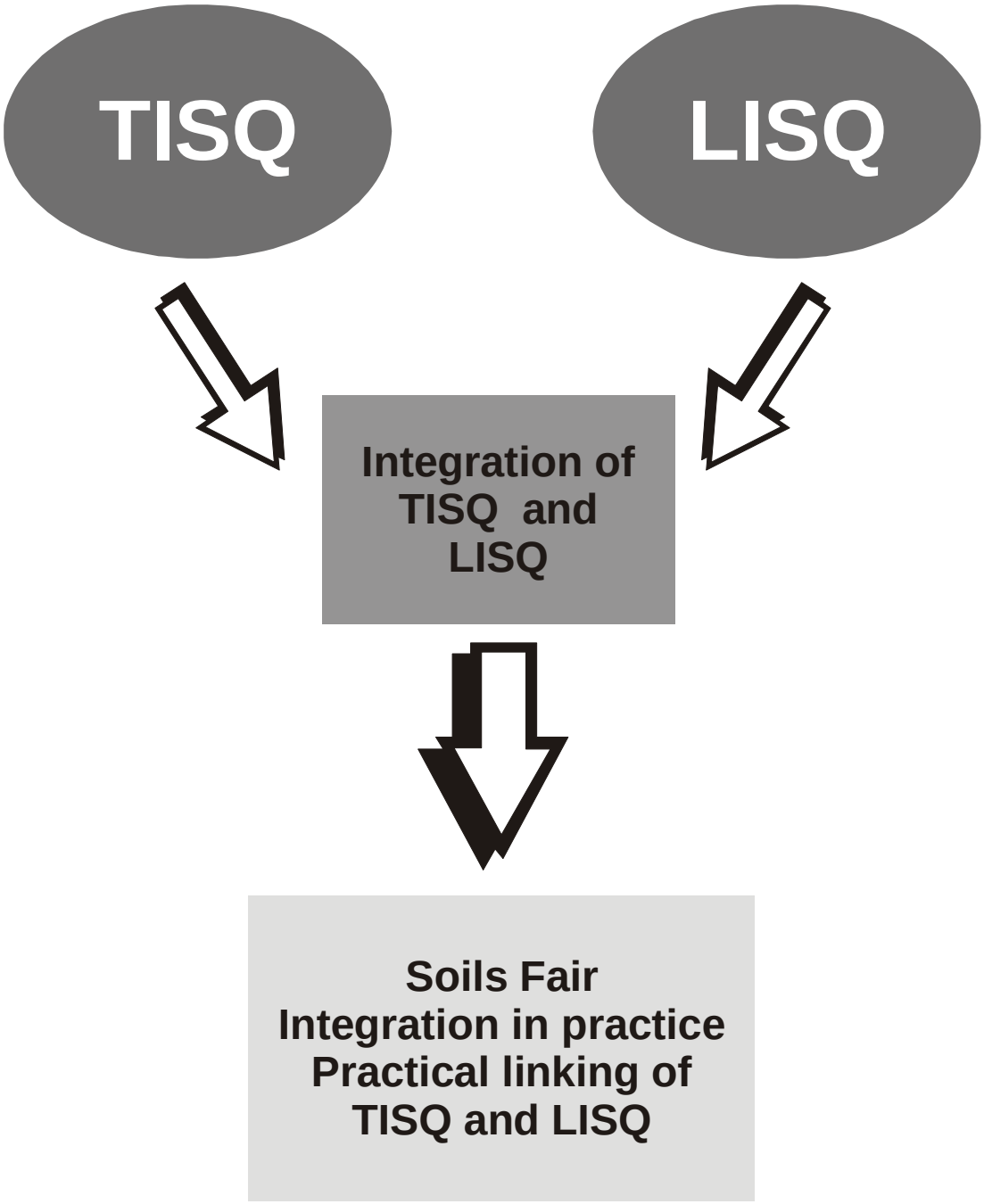


Fig. 6.1 How the Soils fair integrates technical knowledge with practical determination of soil quality

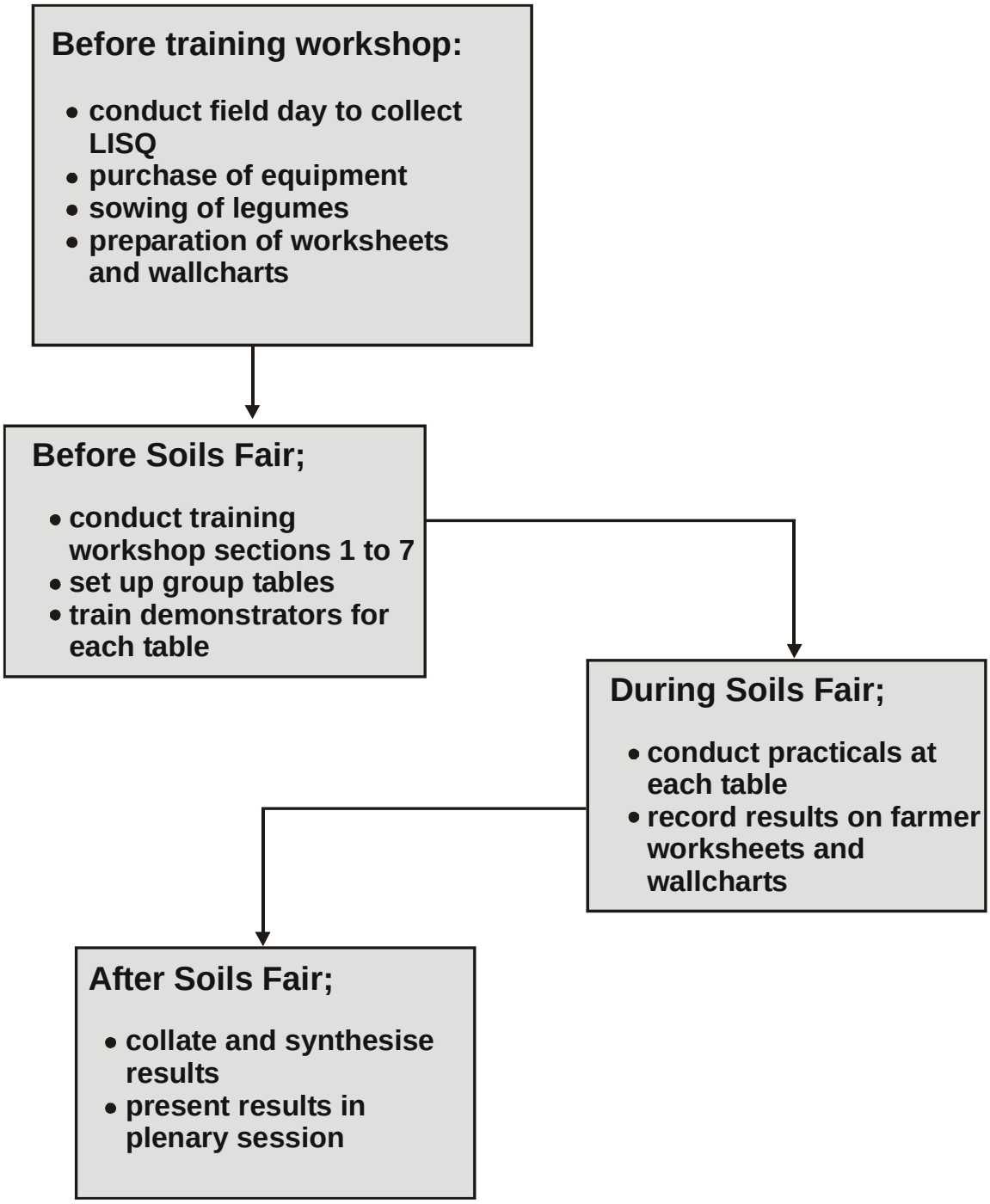


Fig. 6.2 Schematic diagram for the preparation and running of the Soils Fair

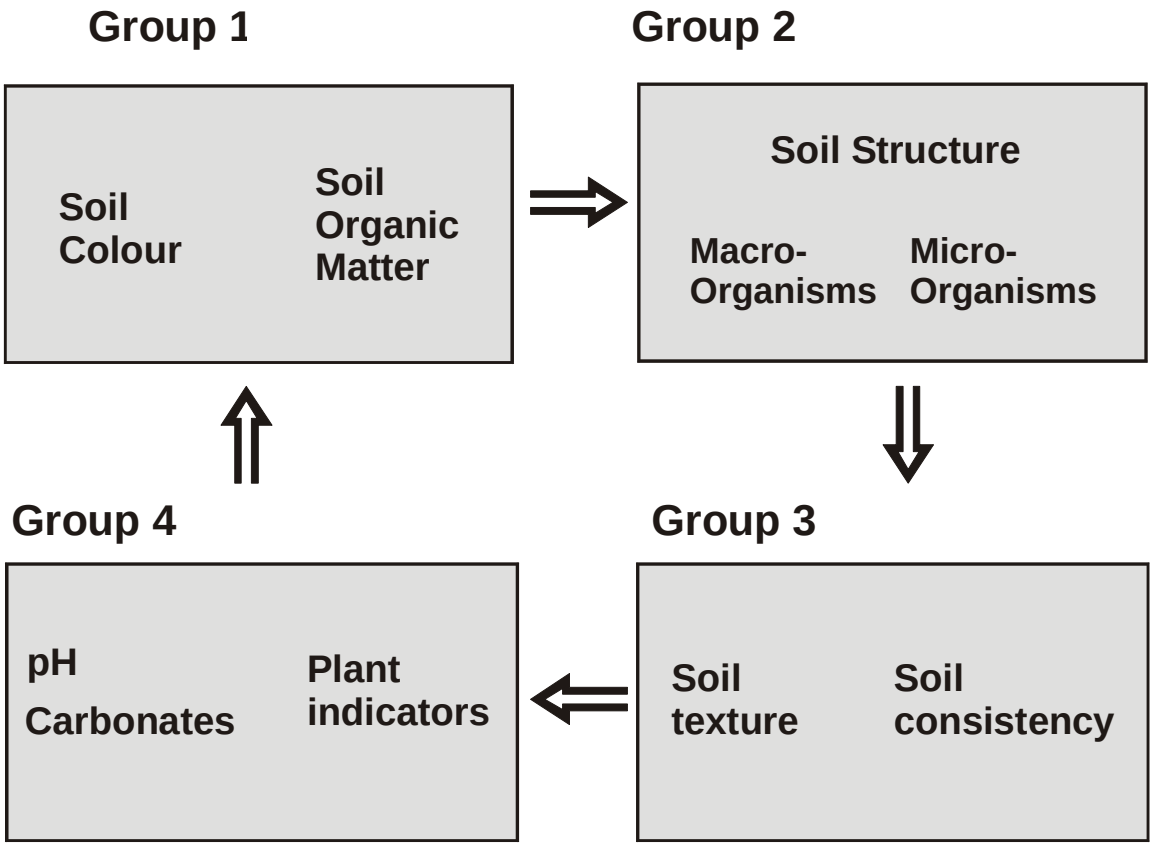


Fig. 6.3 Outline of the tables for the Soils Fair

Soils Fair exercises

6.3.1 Group 1: Practicals 1 and 2 - Determining Soil Texture and Consistency

Objectives

- ✓ To evaluate soil texture in different soil types
- ✓ To recognize the consistency of a soil as a physical characteristic related to its quality.

Resources Necessary

- Water dispenser
- Soil sample
- Measuring spoon
- Paper towels
- Worktable
- Chair
- Waste basket
- Waste bag
- Water container for hand washing

Suggested time: 40 minutes per group

Practice 1 - Determining Soil Texture - Worksheet

Opening questions to begin the practical

1. What do you understand by the term soil texture?

_____
_____
_____
_____
_____
_____

2. What do you understand by the term sand?

_____
_____
_____
_____
_____
_____

3. What do you understand by the term silt?

_____
_____
_____
_____
_____
_____

4. What do you understand by the term clay? What are its characteristics?

_____
_____

_____

_____

_____

_____

Guidelines for the Trainee

1. Take a sample of the soil, about a spoonful.

2. Put it on your left hand.

3. With the aid of the water dispenser, gradually add some water (drop by drop) and with your right hand manipulate it to the point where a sticky consistency is reached and then make a 2- 5 cm ball (1 to 2 inches) diameter.

4. The point at which the wet soil becomes malleable is an indicator of its texture (Fig. 6.4).

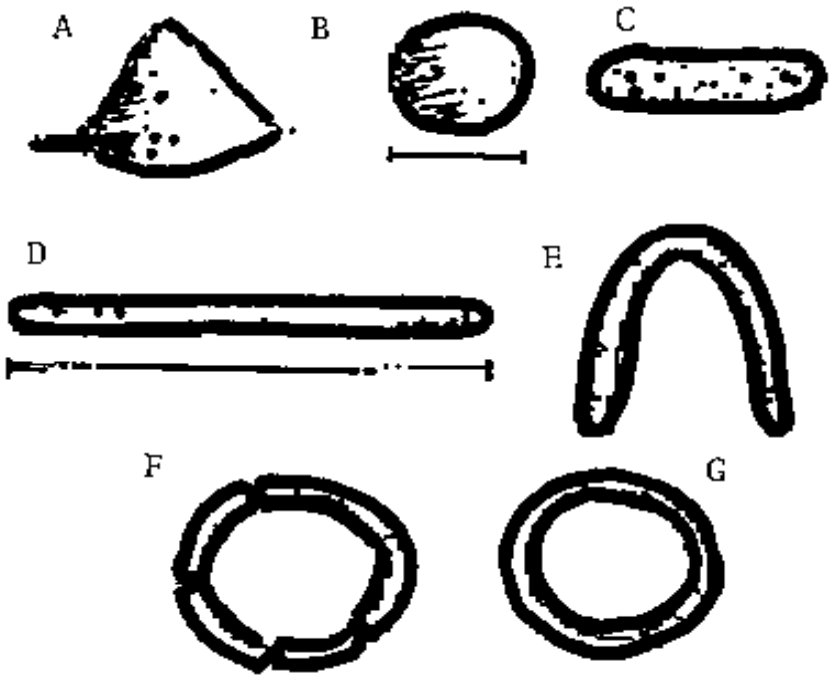


Fig. 6.4 Point at which the soil becomes malleable and can be hand-shaped, indicates its texture. (Source: Agricultural Compendium for Rural Development in the Tropics and Subtropics)

5. In order for you to identify the textural class the soil belongs to, compare it to the table and figures shown below:

Sandy	The soil stays loose and separated, and can be accumulated only in the form of a pyramid	**Figure A**
Sandy Loam	The soil contains enough silt and clay to become sticky, and can be given the shape of an easy - to - take - apart ball.	**Figure B**
Silty Loam	Similar to the sandy loam, but the soil can be shaped rolling it with a small and short cylinder.	**Figure C**
Loam	Contains almost the same amount of sand, silt and clay. Can be rolled with a 6" long (approximately) cylinder that breaks when bends.	**Figure D**
Clayey Loamy	Similar to the loamy, although this one can be bent and be given a U shape (without forcing it) and does not break.	**Figure E**
Fine Clay	The soil can be given the shape of a circle, but shows some cracks.	**Figure F**
Heavy Clay	The soil can be shaped as a circle, without showing any crack.	**Figure G**

Source: Agricultural Compendium for Rural Development in the Tropics and Subtropics.

6. Mark on the wallchart and the farmer's worksheet, the category corresponding to the soil analyzed.

Practice 2 - Determining Soil Consistency - Worksheet

Opening questions to begin the practical

1. What is soil consistency?

_____
_____
_____
_____
_____
_____

2. What is soil adherence?

_____
_____
_____
_____
_____
_____

3. What is soil plasticity?

_____
_____
_____
_____
_____
_____

4. What is soil friability?

_____

_____

_____

_____

_____

_____

Instructions for the trainee

Measuring the consistency of dry soil.

- Take a lump of soil and try to break it between thumb and index finger
- Write the result on the wallchart and the Farmers Worksheet

Soft	The lump is weak, brittle and breaks into powder or granules.
Slightly Hard	The lump is weakly resistant to pressure, and easy to break between thumb and index fingers.
Hard or very Hard	The lump is very resistant to pressure, can be hardly broken by hand, but can not be broken by applying pressure with thumb and index fingers.

2. Measuring the consistency of a moist soil.

If your sample is dry:

- To achieve the recommended moisture, add water (drop by drop). Allow the moisture to evaporate from the sample surface and then proceed to determine its consistency.
- Take a lump from the moist soil and try to break it by hand.
- Write the result on the wallchart and the Farmers Worksheet

-
-

Friable	The lump is easy to break into pieces under a slight pressure of thumb and index fingers.
Firm	The lump breaks into pieces under a moderate finger pressure; it is weakly resistant to pressure, and is easy to break between thumb and index fingers, but resistance is
Very firm	The lump is very resistant to pressure, and difficult to break into pieces.

B.If the sample is moist, proceed as in the previous case, beginning with No. 2

3.Measuring the consistency of a wet soil

- To reach the recommended moisture, add water (drop by drop) to the soil.
- Take the wet soil lump and repeatedly rub it between your index finger and thumb.
- By doing this you are measuring two parameters, adherence and soil plasticity.
- Write the result on the wallchart and the Farmers Worksheet

Non-adherent	The soil does not adhere to thumb and index fingers.
Adherent	When manipulated, the soil sticks to your fingers.
Very adherent	When manipulated, the soil easily sticks to your fingers
Non-plastic	The soil does not take any shape when manipulated
Plastic	The soil forms a strand that breaks when a moderate pressure is applied by your fingers.
Very Plastic	When manipulated, a strand is formed and requires great pressure to deform the soil mass.

6.3.2 Group 2: Practices 3, 4 and 5 - Determining Soil Structure and the Presence and Activity of Soil Macro and Micro Fauna

Objectives

- ✓ To recognize and classify soil structure
- ✓ To recognize the presence and activity of soil fauna

Resources necessary

- Water dispenser
- Soil sample (lump)
- Paper Towel
- Work Table
- Chair
- Waste basket
- Waste bag
- Water container for hand washing

Suggested time: 40 minutes per group

Practice 3 - Determining Soil Structure - Worksheet

Opening questions to begin the practical

1. What do you understand by "soil structure"?

_____
_____
_____
_____
_____
_____

2. What is an aggregate?

_____
_____
_____
_____
_____
_____

3. What does "prismatic structure" mean?

_____
_____
_____
_____
_____
_____

Guidelines for the trainee

1. Take in your hands a lump of soil, trying to preserve the original shape

2. Add slight pressure at first and then, little by little, add more pressure until the soil lump breaks apart and reveals the shape of the aggregates.

3. Once the soil has broken apart, use the chart to identify the soil structure by:

- The shape it has taken
- The size and the shape obtained
- The hardness
- Write the result on the wallchart and the Farmers Worksheet

Without structure

Structured

Grade
Without Structure There is no visible aggregation or there is no ordering or natural fissure lines. If the material is coherent, an agglomerate is formed; if not, it is formed as a free grain.
Weak Poorly-formed or indistinct aggregates, very difficult to observe in the field.
Moderate Differentiated and well formed aggregates, moderately durable and visible.
Strong Durable and evident aggregates in non-altered soils. Mutual weak adherence, admit displacements and are easily separated in altered soils.

Source : Haluk, Y (1981)

Practice 4 Investigating the presence of Soil Macro-organisms Activity

Opening questions to begin the practice

1. What are soil macro-organisms?

_____
_____
_____
_____
_____

2. What do soil macro-organisms do?

_____
_____
_____
_____
_____

3. What is the importance of soil macro-organisms?

_____
_____
_____
_____
_____

Instructions for the trainee:

Identify a tilled soil, adjacent to a forest or pasture soil and use them as examples of disturbed and non-disturbed soils, respectively.

a) Activity 1

The activity and presence of earthworms may be associated with the number of casts left on the soil surface. It is worth me
ntioning that this measure can vary considerably, according to the type of earthworms present. For instance, some earthworms do not deposit casts on the soil surface but in the soil, others deposit casts on the surface every time they are active. Thus, the counting of casts per area unit gives a first idea about the size of earthworms population and their activity in that soil.

1. Place a 50 x 50 cm grid at random on the soil, and count the number of earthworms casts within the area. Do this five times in each of the disturbed soil and undisturbed soil.

(Photo: A.F. Rangel)

b) Activity 2

Removing a soil monolith (lump) careful allows the macro-organisms and the structures produced by their action in the soil to be observed (Lavelle, 1988; Anderson & Ingram, 1989).

1. Remove a monolith (30 cm x 30cm x 30cm) from the soil.

2. Place the monolith on a plastic sheet on the table.

3. Using a knife, cut three 10-cm deep layers and place them in plastic bags labelled as 0-10 cm, 10-20 cm and 20-30 cm.

4. Empty the content of the corresponding bags into a plastic basin and label as 0-10 cm, 10-20 cm and 20-30 cm.

5. Break apart each layer.

6.Pick out carefully all macro-organisms and put them into glass jars with 5% formaldehyde for earthworms and 70% alcohol for other organisms.

7. Count the organisms and record the level of incidence on the wallchart and the Farmers Worksheet

—	**Null**	No organism is observed (only in exceptional cases)
+	**Low**	1 - 20 organism are observed
++	**Moderate**	21 - 60 organisms are observed
+++	**High**	More than 60 organisms are observed

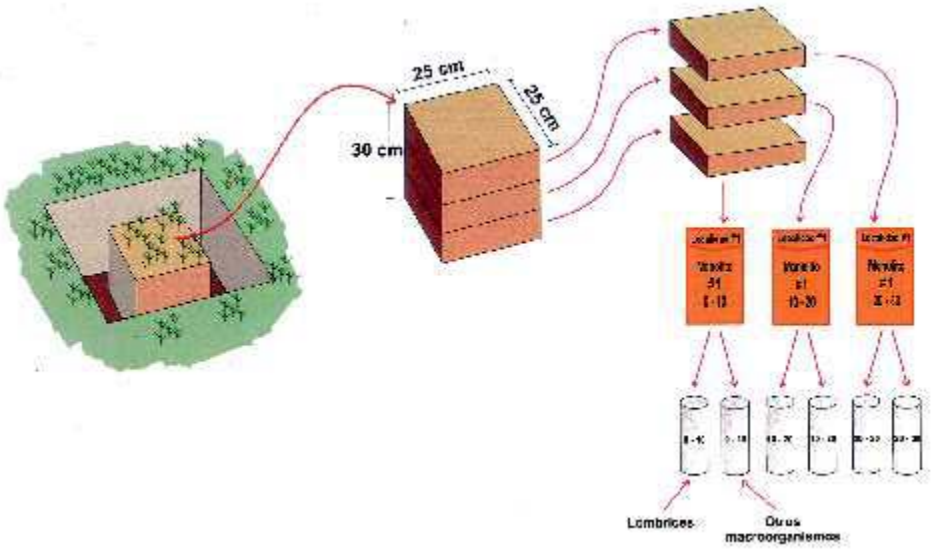


Figure 9.1 Estimating soil macro-organisms activity (Activity 2)

Practice 5 - Estimating Soil Micro-organisms Activity

Opening questions to begin the practice

1. What are soil micro-organisms?

_____
_____
_____
_____
_____

2. What do soil micro-organisms do?

_____
_____
_____
_____
_____

3. What is a symbiotic relationship?

_____
_____
_____
_____
_____

Instructions for the trainee

Identify a bean-sown area, where preferably little or no inorganic N fertilizers has been applied.

1. Select 10 plants at random and mark them with a white string to facilitate their identification.

2. Use a hoe to remove a monolith (30 x 30 cm and 30 cm) from the soil, including each of the 10 plants marked in step 1.

3. Place the monolith in a plastic container with water, and leave it there for 10 minutes. Carefully remove with water the remaining soil on the roots.

4.Identify the main root, the secondary roots and check the presence of nodules (small cylindrical formations adhered to the roots)

5. Count the number of roots in the nodules, and the total number of nodules in the entire root.

6. Separate10 nodules at random for each plant and cut them in half with a knife.

7. Check the internal colour of the nodules: whitish or beige (inactive), brown or reddish (active).

8. Record your result on the wallchart and Farmers Worksheet.

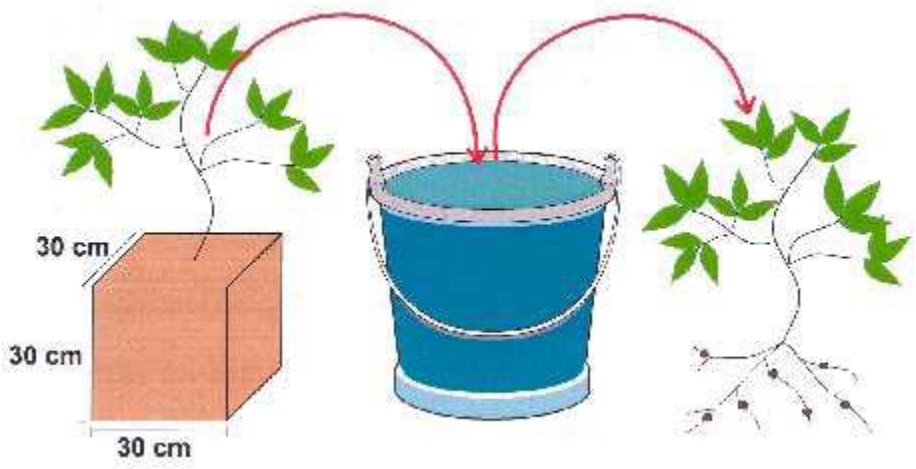


Fig. 6.8 Estimating soil micro-organisms activity (Rhizobia)

6.3.3 Group 3: Practice 6 and 7 - Determining Soil Colour and Organic Matter Content

Objectives

1. To identify the colour of soils

2. To identify variations in the content organic matter in soil

Resources necessary

- Water Dispenser
- Distilled water dispenser
- Soil sample
- Munsell Table to determine colours
- 35% hydrogen peroxide solution
- Droppers
- Paper Towel
- Work Table
- Chairs
- Waste basket
- Waste bag
- Water container for hand washing

Suggested time: 40 minutes per group

Practice 6 - Determining Soils Colour - Worksheet

Opening questions to begin the practice

1. What is soil colour?

_____
_____
_____
_____
_____
_____

2. What do black, red and yellow colours indicate?

_____
_____
_____
_____
_____
_____

Instructions for the Trainee

1. Measurement of dry soil colour

- Take a 5 cm (2 inches) soil sample; if it is part of a lump determine the colour in the part that was adhered to the lump (the part that has been exposed to air might be affected and have changed colour).
- Determine the soil colour by using a Munsell's colour chart.
- Record the colour on the Wallchart and the Farmers Worksheet

2. Measurement of the colour in moist soil

A. When your sample is dry:

- You may continue to use the previous sample
- To reach the recommended moisture, add water (drop by drop), allow the moisture to evaporate from the sample surface.
- Determine the soil colour by using a Munsell's colour chart.
- Record the colour on the Wallchart and the Farmers Worksheet

B. When your sample is moist:

- Take a 5 cm (2 inches) soil sample; if it is part of a lump determine the colour in the part that was adhered to the lump (the part that has been exposed to air might be affected and have changed colour).
- Determine the soil colour by using a Munsell's colour chart.
- Record the colour on the Wallchart and the Farmers Worksheet

Practice 7 - Determining Soil Organic Matter - Worksheet

Opening questions to begin the practice

1. What is soil organic matter?

_____
_____
_____
_____
_____

2. What is organic matter decomposition?

_____
_____
_____
_____
_____
_____

3. What role does soil organic matter play?

_____
_____
_____
_____
_____
_____

Instructions for the Trainee:

Warning:

These reagents are dangerous and might cause skin burning; therefore, they are to be used with precaution and always in the presence of the instructor.

1. Take a soil sample (5 cm lump).

2. Use a dropper to apply a couple of drops of hydrogen peroxide

3. Observe the degree of effervescence (bubbling).

4. Classify the soil sample by following the table below

5. Record your result on the wallchart and Farmers Worksheet

Degree of effervescence	**Interpretation**	**Record as**
The soil does not show any effervescence	Very low OM content	Very low OM
The soil shows very little effervescence	Low OM content	Low OM
The soil shows moderate effervescence (many bubbles)	Moderate content of OM	Moderate OM
The soil shows great effervescence (lots of bubbles)	High OM content	High OM

6.3.4 Group 4: Practices 8, 9 and 10 - Determining Soil pH, Presence of Carbonates and Indicator Plant Species

Objectives

- ✓ To quantify the soil pH
- ✓ To identify the content of free carbonates in the soil.

Resources necessary

- pH measuring tape
- Colour pH comparative table
- Plastic cups (50 cc)
- Glass rods to stir the samples
- Plastic spoons
- Distilled water dispenser
- 10% hydrochloric acid jar and a dropper
- Soil Sample
- Paper towels
- Work table
- Chair
- Waste basket
- Waste bag
- Water container for hands washing

Suggested time: 40 minutes per group

Practice 8 - Determining Soil pH - Worksheet

Opening questions to begin the practice

1. What is soil pH?

_____
_____
_____
_____
_____

2. What is soil acidity?

_____
_____
_____
_____
_____

3. What is soil alkalinity?

_____
_____
_____
_____
_____

Instructions for the Trainee

- Put one spoonful of soil in a plastic cup
- Add 25 ml of water
- Stir the solution for 2 minutes with the glass rod.
- Dip the pH paper into the solution for a few seconds.
- Remove the pH paper and compare the colour to the standard pH colours provided with the pH paper.
- Record your result on the wallchart and Farmers Worksheet

Practice 9 - Determining the Presence of Carbonates - Worksheet

Opening questions to begin the practice

1. What is limestone?

_____
_____
_____
_____
_____

2. What are carbonates?

_____
_____
_____
_____
____

3. What is the soil liming?

_____
_____
_____
_____
____

Instructions for the trainee

Warning:
Reagents are dangerous and might cause skin burning; therefore they are to be used with precaution and always in the presence of the instructor.

1. Take a piece of soil approximately 5 cm in size

2. Use your dropper to apply a couple of drops of 10% hydrochloric acid drops.

3. Observe the degree of effervescence (bubbling) and determine the presence of carbonates, according to the following table.

Observation	Interpretation	Record as
The soil does not show any effervescence	No carbonate present	No carbonate

4. Record the colour on the Wallchart and the Farmers Worksheet

Practice 10 Use of Indicator Species to Identify Soil pH

Bracken fern (inside circle) is usually associated with acid soils

6.4 Summary

In The Soils Fair we developed our understanding of some of the soils physical, chemical and biological properties through the use of simple practical exercises. The intention was not to go into detail with these practical exercises, rather to give you the concepts and ideas so that you will be able to explain these different soil properties to other people during your work.

6.5 Bibliography

Anderson J.M. and Ingram J.S.I. 1989. Tropical Soil Biology and Fertility: A Handbook of Methods. 1ed.

Lavelle P. 1988. Assessing the abundance and role of invertebrate communities in tropical soils: Aims and methods. J.Afr.Zool.102: 275-283.

Munsell 1990. Munsell soil colour charts. Edition revised.

Originals for Overheads

Section 6
Soils Fair: Integration in Practice

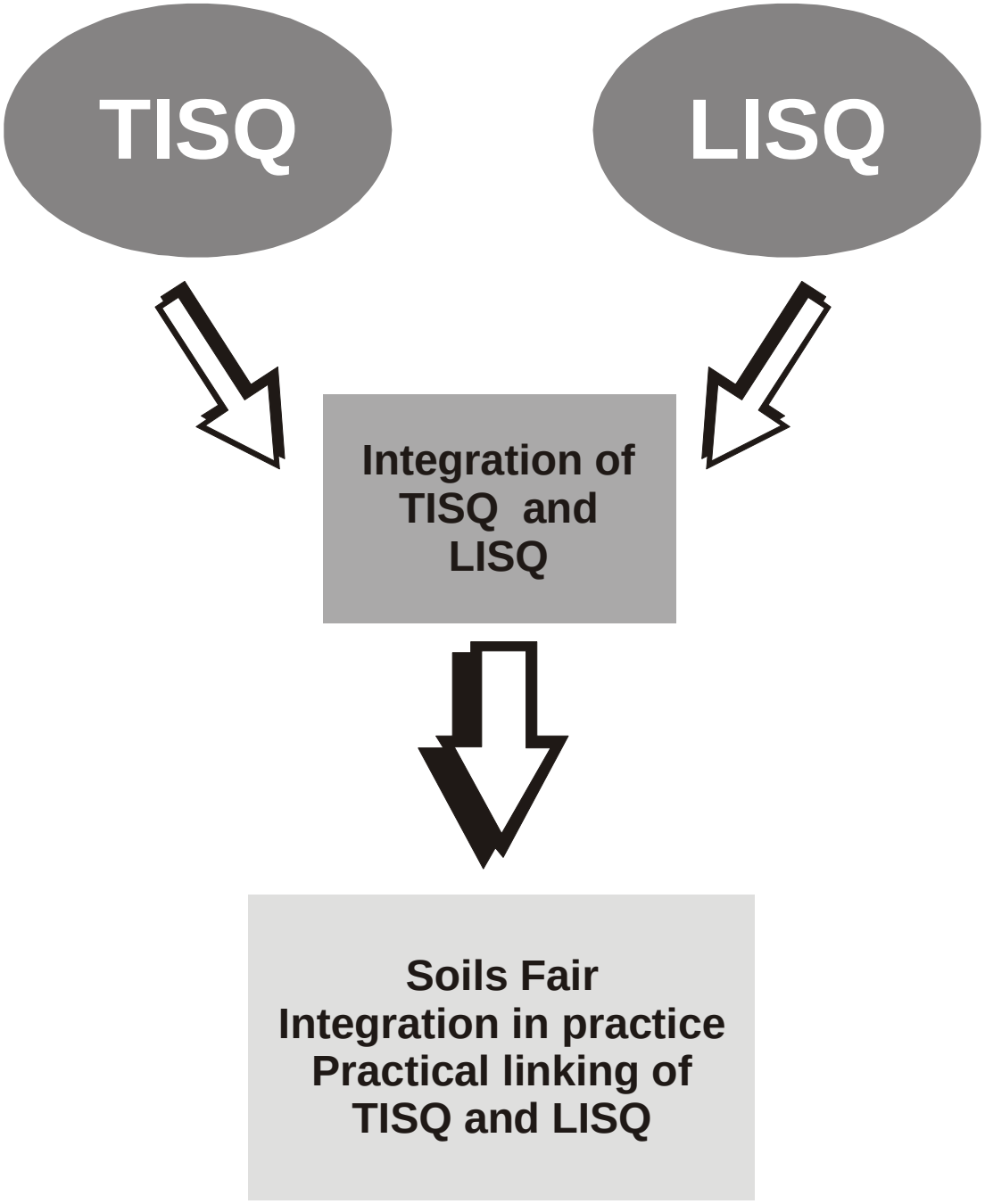
Objectives

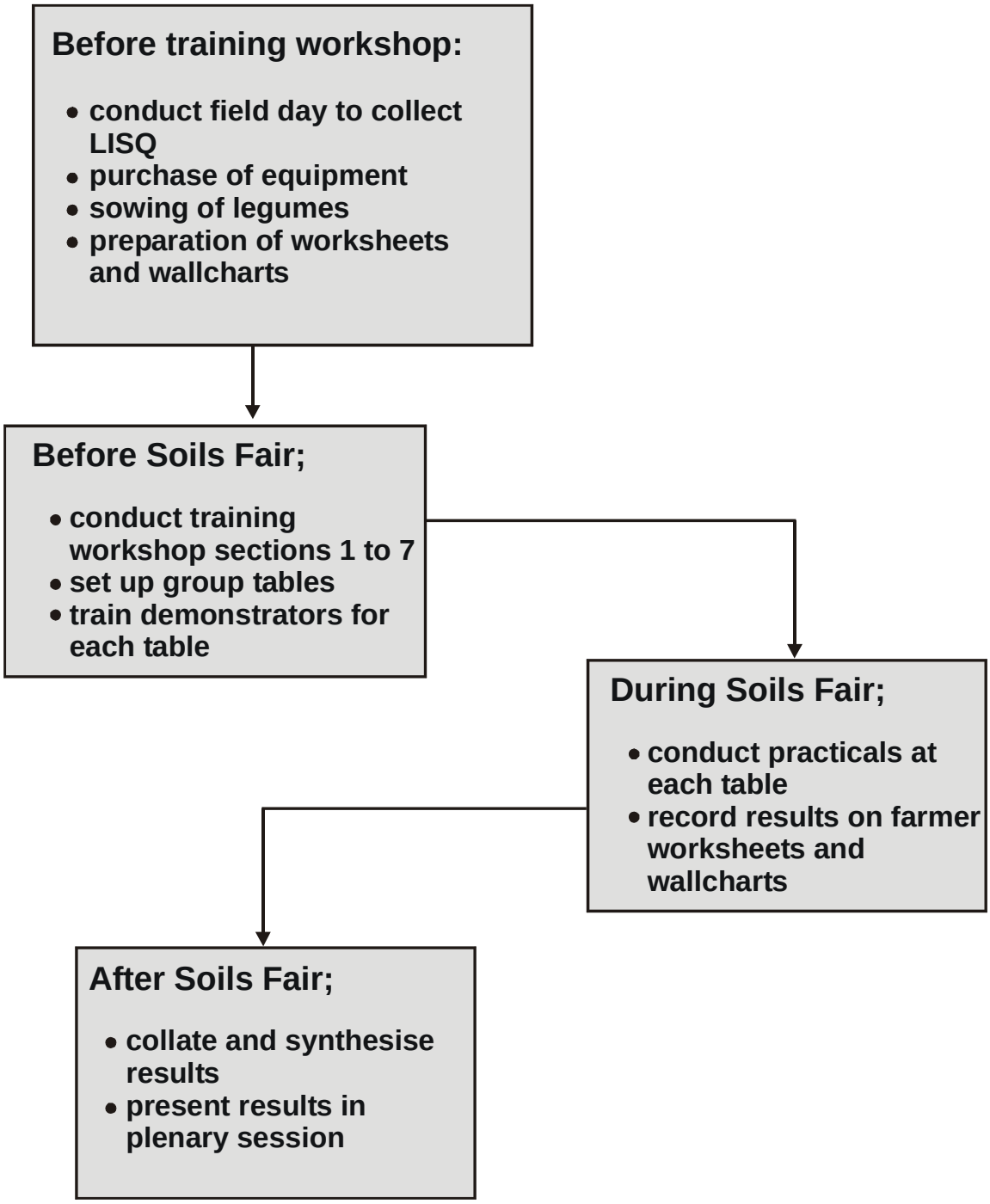
At the end of the Soils Fair the trainees will,

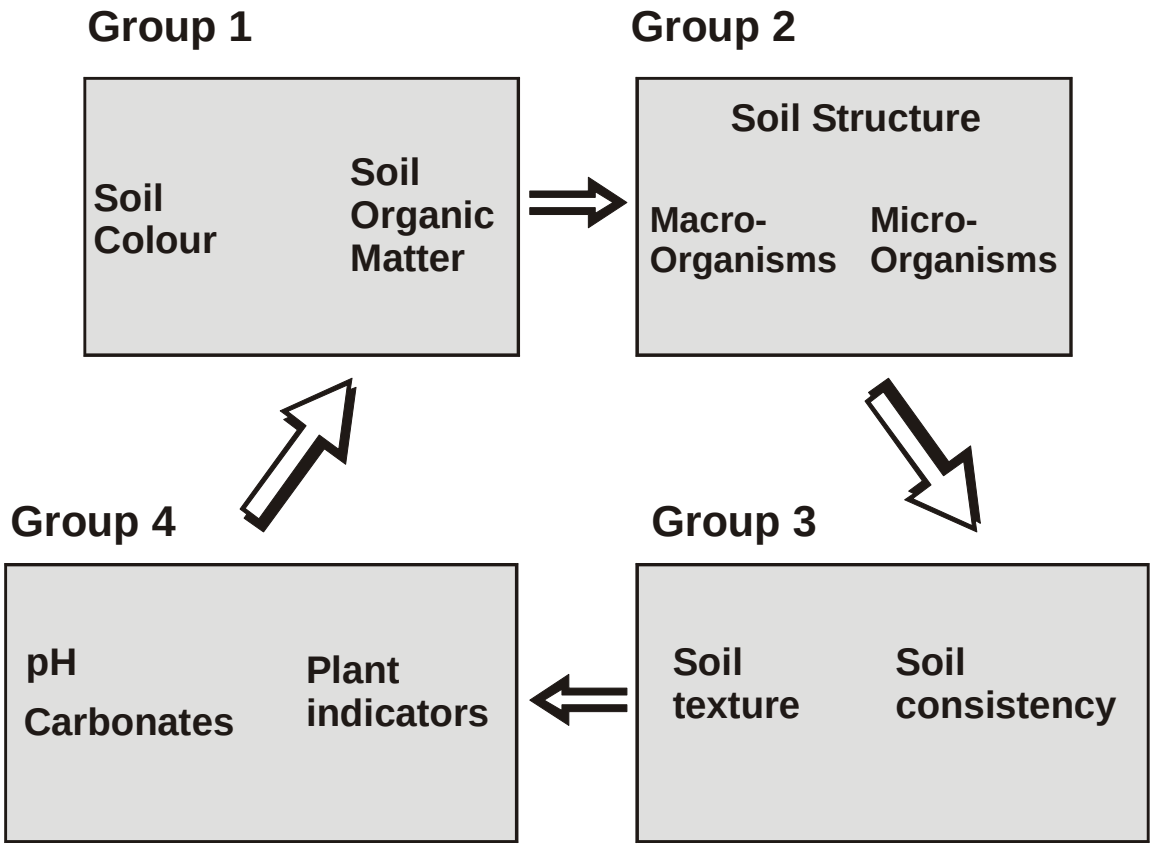
- have developed their skills to be able to determine by using simple and easy methods, soil physical, chemical and biological properties.

- be able to relate these technical indicators to local indicators of soil quality

- be able to explain the relationship between technical and local indicators of soil quality to others


TISQ
LISQ
Integration of TISQ and LISQ
Soils Fair
Integration in practice
Practical linking of TISQ and LISQ


Before training workshop:
• conduct field day to collect LISQ
• purchase of equipment
• sowing of legumes
• preparation of worksheets and wallcharts
Before Soils Fair;
• conduct training workshop sections 1 to 7
• set up group tables
• train demonstrators for each table
During Soils Fair;
• conduct practicals at each table
• record results on farmer worksheets and wallcharts
After Soils Fair;
• collate and synthesise results
• present results in plenary session


Group 1
Soil Colour
Soil Organic Matter
Group 2
Soil Structure
Macro-Organisms
Micro-Organisms
Group 3
Soil texture
Soil consistency
Group 4
pH
Carbonates
Plant indicators

6.7 Appendices for Section 6

Appendix 6.7.1 - Wallcharts for the Soils Fair

Group 1: Texture Assessment

Farmer	Local soil name	Sandy	Silty	Loamy	Clayey

Group 2: Consistency Assessment (1)

Farmer	Local soil name	Dry soil			Wet soil		
		Soft	Slightly hard	Hard v. Hard	Friable	Firm V.	Firm

Group 2: Consistency Assessment (2)

Farmer	Local soil name	Non adherent	Adherent	Very adherent	Non plastic	Plastic	Very plastic

Group 3: pH Assessment

Farmers name	Soil name (local) description	pH		
		Acid	Neutral	Alkaline

Group 4: Biological Properties

	Macro-Organisms			
Farmersname	**Earthworms**	**Ants**	**Beetles**	**Other insects**

Appendix 6.7.2 - Farmer's Worksheet

Farmer's name: _____

Village: _____

1. Information about the property or smallholding

Slope of land (%)	0-15	15-30	30-50	> 50
Soil depth (cm)	0-20	20- 50	50 100	> 100

2. Physical Properties

Property	1	2	3	4
Colour	Black	Brown	Red	Light
Texture	Loamy	Clayey	Silty	Sandy
Structure	Without	Weak	Moderate	Strong
Consistency: Dry	Soft	Hard	Very Hard	
Humid	Friable	Firm	Very firm	
Wet	Non-adherent	Adherent	Very Adherent	
	Non-plastic	Plastic	Very Plastic	
Infiltration	< 0.5 cm	0.5-1 cm	1-2 cm	> 2 cm

3. Chemical Properties

Property	-	+	++	+++
Organic Matter	None	Low	Moderate	High
Reaction to HCl	None	Low	Moderate	High
pH	------	Acid	Neutral	Alkaline

4. Biological Properties

4.1 Presence of soil macro-organisms

Property	-	+	++	+++
Earthworms	None	Low	Moderate	High
Ants	None	Low	Moderate	High
Beetles	None	Low	Moderate	High
Others	------	------	------	------

4.2 Presence of Soil micro-organisms

Rhizobia	None	Low	Moderate	High

Appendix 6.8 - Answers to introductory questions for the Soil Fair

Below is a list of possible answers to the questions posed to evaluate the trainees previous knowledge of each topic in the Soils Fair.

Practice 1 - Determining soil texture

To question 1

It is the physical characteristic of the soils, determined by the amount of each mineral component: clay, silt and sand.

To question 2

The coarsest fraction of soil mineral components; very coarse sands (not greater than 2.00 mm) up to very fine sands (not less than 0.02 mm) according to the ISSS (International Society of Soil Science) scale, can be found.

To question 3

Intermediate fraction of soil mineral components (less than 0.02 mm, but greater than or equal to 0.002 mm diameter)

To question 4

The finest fraction of soil mineral components with a diameter less than 0.002 mm. This is the fraction with the biggest responsibility in regard with the response to soil physical, chemical and biological processes.

Practice 2 - Determining soil consistency

To question 1

Consistency is defined as the resistance to the deformation offered by a soil mass, under specific moisture conditions.

To question 2

It is the consistency characteristic determined in a humid soil, and is identified by the capacity of the soil to adhere or stick to other surfaces.

To question 3

The characteristic of the soils, consisting of the possibility to take various shapes when moulded under humid conditions.

To question 4

Perturbation facility present in a dry condition soil**.**

Practice 3 - Determining soil structure

To question 1

This is how the various groups of soil components are called; it is influenced by the decomposition of organic matters, iron oxides and hydroxides, and clayey fractions.

To question 2

This is the minimum fraction determining the structure of a soil.

To question 3

This is the elongated soil structure, where most faces are flat.

Practicace 4 Investigating the presence of soil macro-organisms

To question 1

These are the organisms observable with a naked eye, such as earthworms, beetles and ants, who live in the soil.

To question 2

Macro-organisms fragment organic residues into finer pieces which, in their turn, are swallowed by these or other organisms that, further on, excrete them. The resulting excrete can, in its turn, be fragmented again, swallowed and excreted by other organisms; thus, the chain of events is replicated many times.

To question 3

The fragmenting capacity many of these organisms have, reduces the size of organic residues, and enables a faster decomposition. Earthworms' activity might reduce soils susceptibility to erosion and, moreover, their movement in the soil profile promotes an increased aeration and water infiltration into the soil.

Practicace 5 Investigating the presence of soil micro-organisms

To question 1

These are the micro-organisms that can not be observed with the naked eye, such as bacteria and most fungi.

To question 2

There are both beneficial and harmful micro-organisms for agricultural production. Some beneficial micro-organisms are bacteria, responsible for converting organic nutrients derived from the organic matter, into inorganic nutrients useful for crops.

There are also fungi and bacteria causing diseases and crops losses. The Biological management of soil fertility aims at increasing the impact of beneficial micro-organisms, and reducing the action of the harmful.

To question 3

This is a mutually beneficial relationship, where both the plant and the micro-organism live better together than separated. This is the case of rhizobia (bacterium) and mycorrhizae (fungi), which are able to supply additional nutrients to the crops, in exchange of being hosted in the plant roots.

Practice 6 - Determining soil colour

To question 1

The colour is a soil characteristic with a direct relationship with temperature, moisture, climate and organisms; it is commonly used as an indicator of soil fertility. The most common colours are black, reddish and yellowish.

To question 2

The black colour suggests the presence of organic matter; the reddish colour suggests the prevalence of iron oxides, and the yellowish colour suggests the prevalence of aluminium oxides.

Practice 7 - Determining soil organic matter

Answers

To question 1

These are all products derived from the disintegration of vegetal material and animal remains, being part of the soil.

To question 2

The action animal or vegetal compounds are subjected to by soil macro and micro-organisms.

To question 3

The organic matter influences soil structuring, nutrients release, cationic exchange and soil water retention processes.

Practice 8 - Determining soil pH

Answers

To question 1

It is the 0 to 14 scale, that serves to measure acidity or alkalinity levels. Soils with a pH 7 are neutral. Soils pH value, in most cases, ranges between 4 and 8; in general terms, crops show a better development in soils whose pH range between 6 and 7.

To question 2

All soils having a pH below 7 are considered acid.

To question 3

All soils with a pH above 7.0 are considered alkaline.

Practice 9 - Determining the amount of carbonates present

Answers

To question 1

Limestone is a rock lime can be obtained from, and is mainly made up of calcium carbonates.

To question 2

Carbonates are the chemical combination of carbonic acid and calcium or magnesium.

To question 3

Incorporating lime to the soil to raise pH level, and improve nutrients availability for the plants.

Practice 10 Use of indicator species to identify soil pH

7. Evaluation Forms

Appendix 7.1 Workshop Evaluation

Place:_____

Date: _____

Dear Participant:

The worshop (course) organizers would like to know your opinions on the activities that have been carried out during this training event. You do not have to sign this form. We would like you to be very honest in your responses for the improvement of this activity depends heavily on your answers.

The evaluation includes two components:

a. You assign a value, chosen from a scale of 0 to 3, to each aspect being evaluated:

0 = Very poor, inadequate
1 = Deficient, just acceptable
2 = Good, needs little improvement
3 = Very good, highly satisfactory

b. We have left space after each question for you to write the comments you may have on the assigned score. Refer to positive and negative aspects. Leave blank those aspects you feel you don't have a clear opinion about.

Questions

1.0 Evaluate the objectives that we were to achieve according to items 1.1 and 1.2:

1.1 How well did the objectives correspond to the institutional and personal needs you brought to the workshop?

	0	1	2	3

Comments:

_____

_____

_____

_____

1) To the instructor: This form can be used on a daily basis throughout a workshop lasting one or more weeks.

How well do you consider the proposed objectives were achieved?

0	1	2	3

Comments:

_____

_____

_____

_____

2.0 What did you think of the following methodological strategies used?

2.1 Instructor's presentations	0	1	2	3
2.2 Group work sessions	0	1	2	3
2.3 Quantity and quality of materials delivered	0	1	2	3
2.4 Exercises carried out at the training site	0	1	2	3
2.5 Field practices with farmers	0	1	2	3
2.6 The time dedicated to the different activities	0	1	2	3

Comments:

_____

_____

_____

_____

3.0 How do you rate the coordination of activities?

3.1 Preliminary information received by participants	0	1	2	3
3.2 Fulfillment of the training agenda	0	1	2	3
3.3 Daily coordination of activities	0	1	2	3
3.4 Logistic support provided (space, equipment, etc.)	0	1	2	3
3.5 Lodging (if applicable)	0	1	2	3
3.6 Board (if applicable)	0	1	2	3

Comments:

_____

_____

_____

_____

5. Evaluate the applicability (usefulness) of what you have learned for the work you do now or may do in the future.

0	1	2	3

Comments:

_____
_____
_____
_____

6.What activities will your institution carry out in the short term to which you could apply or transfer what you have learned ?

_____
_____
_____
_____
_____

7. Would you be interested in this training course being held at your institution? How could this be done?

_____
_____
_____
_____
_____

Thank you for your answers and comments!

Appendix 7.2 Assessing the Instructor's Performance

Date: _____

Name of instructor: _____

Topic or topics addressed by this instructor_____

Dear Participant:

Described below you will find a series of descriptors of sound training practices. These have been drawn from educational literature on characteristics of a good instructor or of a good facilitator.

Four dimensions of the trainer's performance will be analysed: (1) organization and clarity, (2) knowledge of subject matter, (3) interaction abilities , and (4) direction of practical activities and exercises. Descriptors are included for each dimension.

Mark X in the YES column if you are sure that this behavior was a part of the trainer's performance, regardless of how other participants may have evaluated it.

Mark X in the NO column if you are sure that such behavior was not a part of the trainer's performance.

The instructor is the main beneficiary of this self-evaluation test. It aims to help him improve his performance in future training activities.

The instructor will collect the completed forms and tabulate the answers, using the tabulation sheet on page A-14.

1. Organization and clarity

The instructor ...

	Yes	No
1.1 Presented and discussed with us the learning objectives	☐	☐
1.2 Explained the methodology needed to carry out each activity	☐	☐
1.3 Managed the activities within the established time limits	☐	☐
1.4 Handed out written material on his presentation	☐	☐
1.5 Followed an orderly sequence while presenting content	☐	☐
1.6 Used visual aids that improved understanding	☐	☐
1.7 Kept the participants' interventions relevant to the topic	☐	☐

2.	Subject matter knowledge	☐	☐
2.8	Am sure that he knows well what he is talking about	☐	☐
2.9	He/she answered the participants' questions correctly	☐	☐
2.10	He/she connected theory with practice	☐	☐
2.11	Provided examples illustrating the topic discussed	☐	☐
2.12	Focused the participants' attention on the most relevant aspects	☐	☐
3.	Interaction abilities	☐	☐
3.13	Spoke according to the participants' level of understanding	☐	☐
3.14	Acknowledged the participants' contributions	☐	☐
3.15	Made sure that the participants understood	☐	☐
3.16	Kept eye contact with the participants	☐	☐
3.17	Asked the participants questions	☐	☐
3.18	Invited the participants to ask me questions	☐	☐
3.19	Provided immediate feedback to the participants' responses	☐	☐
3.20	Maintained good interaction with fellow facilitators	☐	☐

4. Direction of practice (i.e., in the field, laboratory, and classroom) ☐ ☐

As the person in charge of coordinating practical activities, he/she ... ☐ ☐

4.21 Made clear to course participants the objectives and procedures ☐ ☐

4.22 Showed how to carry out the practical activities ☐ ☐

4.23 Selected the appropriate site and equipment for practice ☐ ☐

4.24 Organized the audience so all could participate ☐ ☐

4.25 Had all the equipment and materials necessary for practice ☐ ☐

4.26 Provided immediate feedback to participants once the practice was ended ☐ ☐

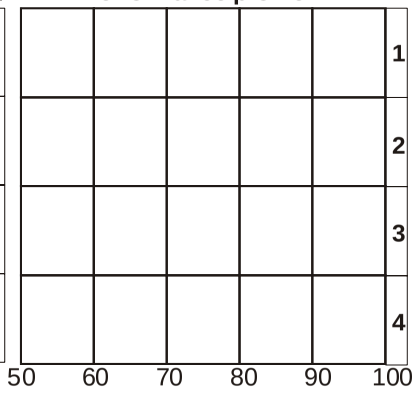
Tabulation Sheet for Assessing the Instructor's Performance

1. The instructor hands out copies to 10 or more of the course participants before the activity starts so that they can observe and assess the instructor's performance during the activity.

2. At the activity's end, the instructor will pick up the forms and tabulate the results according to the tabulation sheet given below. Then he or she will transfer the scores to the performance profile to establish the difference between the score obtained and the ideal score.

	Areas to assess	*Affirmative answers tabulated*								Score obtained	100% ideal
1	Organization and clarity	1.10	1.20	1.30	1.40	1.50	1.60	1.70			
2	Command of topic	2.80	2.90	2.10	2.11	2.12					
3	Ability to interact	3.13	3.14	3.15	3.16	3.17	3.18	3.19	3.20		
4	Direction of practice	4.21	4.22	4.23	4.24	4.25	4.26				

A. Scores are based on a scale of 0 to 5



To establish the scores and the profile, the instructor should proceed as follows:

1. Add up the tabulations in every box and write the sum in the column 'Score obtained'.
2. Establish the "ideal" score corresponding to 100%; this will depend on the number of evaluators. For example, 10 evaluators scored for row 1, 'Organization and clarity'. The score obtained was 45, then the score corresponding to 100% is 70. In this case, the score obtained (45) is 64% of the ideal score. The instructor writes this score in the appropriate box of the 'Performance profile'.
3. For the 'Performance profile' graph, the points of each component (1, 2, 3, and 4) are joined .

Appendix 7.3. Evaluating the Training Materials

Training materials can be evaluated with the participation of:

Subject matter experts (scientists, researchers)

Communication experts

Technicians, facilitators, professors, etc.

Producers, farmers, members of community organizations, etc.

ASPECTS TO EVALUATE	Draw an X in the appropriate box	
Quality of content	**Yes**	**No**
The information presented is technically valid in the context in which it is used.		
The content is divided into segments that follow a clear and ordered sequence.		
The content is presented objectively, in other words, it respects accepted principles and methods.		
The content is appropriate for the level of understanding of the audience.		
The content is up-to-date from the scientific and technical viewpoints.		
Quality of presentation	**Yes**	**No**
The printing quality is excellent.		
The images (drawings, graphs, tables) are clear.		
The illustrations supported written messages.		
The icons are well selected (according to the meaning of the text).		
The distribution of information (diagramming) on each page is adequate.		
A good correspondence exists between images and text.		
Quality of instruction	**Yes**	**No**
The objectives are clearly established.		
The material facilitates audience participation.		
The relationship between objectives and content is excellent (the content reflects what is proposed in the objectives).		
The material facilitates both teaching and learning.		
The exercises and practices are innovative.		
The exercises and practices help the participants understand the topic.		