SECTION 3

Identifying and Prioritizing Local Indicators of Soil Quality

Section 3. Identifying and Prioritizing Local Indicators of Soil Quality

3.1 Introduction

Farmers traditional knowledge comes from an intuitive integration of the response of the agricultural systems through time, to factors affecting agricultural production like management, fertility, climate, pests, etc. (Barrios et al., 1994; Barrios 1995). Farmers' knowledge on soils is a valuable resource that is being lost with time. The aim is to combine the best soil science with the best local knowledge on the part of the farmers. The word best is used here to make reference to the methods used to solve problems and the basic knowledge, on the one hand, and to specific technological advances, on the other hand. The objective is to use both knowledge systems to prevent and solve local soil management problems in order to improve efficiency of each individual system.

From the above, it is clear that the integration of farmers' experience with technical-scientific knowledge allows both groups of stakeholders to have a better understanding of the soil and therefore it will be possible to make better management decisions. There are many management practices that farmers' know, experiment with, and can adopt to improve and maintain crop yields. Understanding the importance of such practices and their adoption will be improved, if effective communication is achieved through a common language between the farmer and the technician.

In Section 3 we will present a methodological approach to work with farmers in order to identify their local indicators of soil quality and then show how these indicators can be grouped according to soil property and prioritized in order of importance.

3.1.1 Local Indicators

Local indicators correspond to a language traditionally adopted by a community of farmers, to describe soil characteristics by using words they easily understand. The agreement between technical and local indicators is one of the objectives of the methodology contained in this Guide. The goal is to make the technical and scientific language compatible with the local language so that researchers and extensionists, on one hand, and the farmers on the other hand, share a common language about the soil and its management.

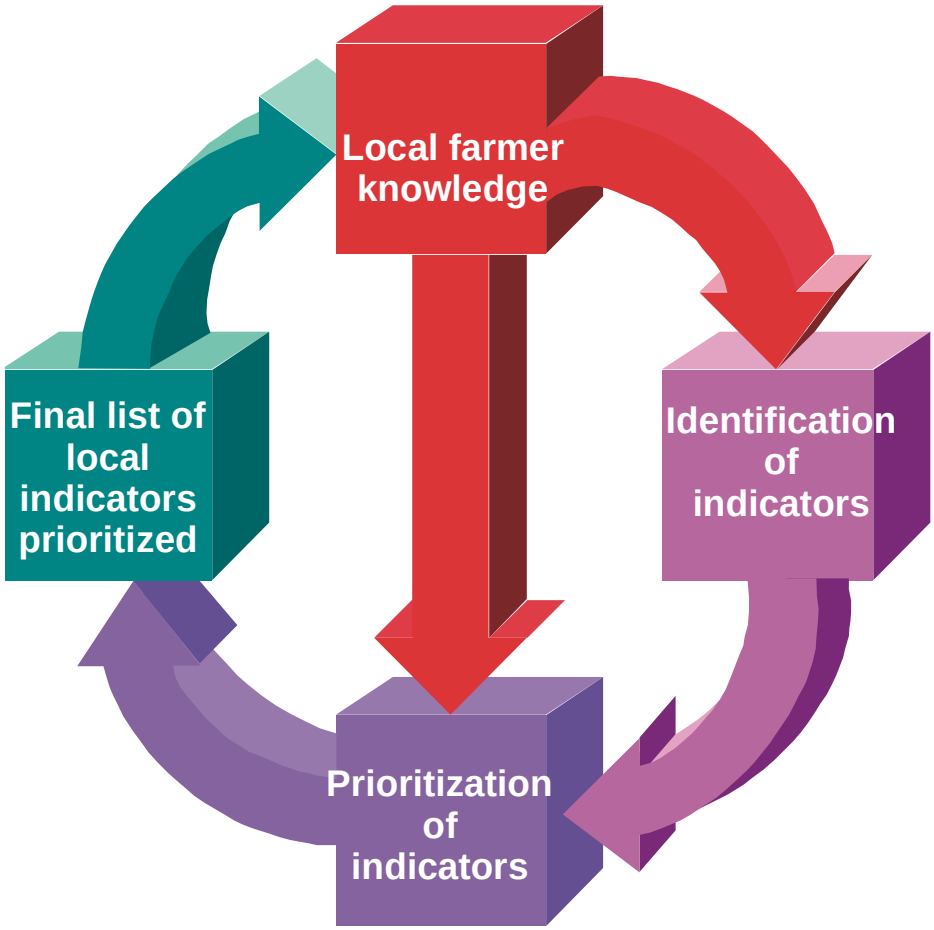
3.1.2 Objectives

At the end of this section the trainees will be able to,

- obtain the local indicators of soil quality.
- group local indicators according to soil properties.
- prioritize local indicators of soil quality.
- describe the methodology used to obtain the local indicators of soil quality.

3.1.3 Section Structure

This section consists of an introduction on the importance of local farmer knowledge about soils and local indicators of soil quality for sound soil management. This is followed by identification of local indicators of soil quality. The farmers assisted by technicians then prioritize and group the indicators according to soil properties and produce a prioritized list. At the end of the exercise the trainees will be able to describe the methodology used to obtain and prioritize local indicators of soil quality.



3.1.4 Opening Questions

1. What are the differences between a good and a bad soil?

2. How do you know if a soil is excellent, fairly good or bad for production?

3. Do you think that there are different types of soils on your farm?

4. Can you indicate the limits of the soil types on your farm?

3.2 Methodology to Identify and Prioritize Local Indicators

This methodology facilitates the identification and prioritization of local indicators commonly used by farmers in their smallholdings to evaluate soil quality. Through this process, the criteria used to identify and judge the soils, and determine which factors or indicators are more important, are also identified.

A methodological process developed by Burpee and Turcios (1997) is described below. In summary, there are two steps: group analysis (a brainstorming session) where farmers have the opportunity to judge their soils, in order to determine the differences between a good and a bad soil, and secondly prioritize the identified local indicators.

3.2.1 Group Analysis

The farmers attending the group meeting (brainstorming session) are requested to mention the indicators or characteristics they know to determine if a soil is good, fairly good or bad, for the various landuse practices. The farmers should be grouped according to gender/stakeholders. Then, all those indicators expressed with different words (local indicator) but with similar meanings, are

grouped as descriptors of the same characteristic. Every indicator is written down on cardboard cards.

3.2.2 Prioritizing indicators

At this stage, two procedures can be used: The first one is the 2-entry matrix (Geilfus, 1997), as shown below;

Indicator	Water retaining soil	Black soil	Deep soil	Indicator $_n$
Water retaining soil				
Black soil				
Deep soil				
Indicator $_n$				

The following is the procedure to fill in the matrix:

- Explain to the farmers that what you want is to determine, from all the indicators identified, which are the most important, and get a list of prioritized indicators.

- Prepare a 2-entry matrix, with the same number or rows and columns as the identified indicators. Write on the first row and first column one indicator per cell, always following the same order.

    - Begin with the cell corresponding to indicator number 1 (second column) and indicator number 2 (third row). Ask the trainees which indicator (number 1 or number 2) they deem the most important. Or which of them is to be taken into consideration at the moment of

judging the soil. After reaching an agreement, the most important indicator is written down in the cell. For instance:

Indicator	Water retaining soil	Black soil	Deep soil	Indicator $_n$
Water retaining soil		Black soil	Deep soil	
Black soil			Black soil	
Deep soil				
Indicator $_n$				

- Repeat the exercise by comparing the indicators with one another. At the end, half of the matrix must be filled in.

- For every indicator, attention must be paid to how many times it appears in the matrix, so that they can be ordered by frequency. The indicator most frequently appearing is the most important. This comparison by pairs is less subjective than other prioritizing methods. An example of frequency analyses based on the previous chart, could be:

Indicator	**Frequency**	**Priority Order**
Water retaining soil	0	3
Deep soil	1	2
Black soil	2	1

This method is recommended to be used with groups or farmers having a low level of schooling, since, as seen further on, the alternative methodology requires a better mastering of reading and writing skills.

The second method is classification by cards.

Classification by cards

1. The farmers are divided in 3 to 5-member groups, depending on the audience.

2. As in the previous methodology, farmers' indicators are obtained and written down on cards.

3. Every farmer is to separate the cards in three groups, according to the importance assigned to each indicator (high, medium, and low) (Figure 3.1).

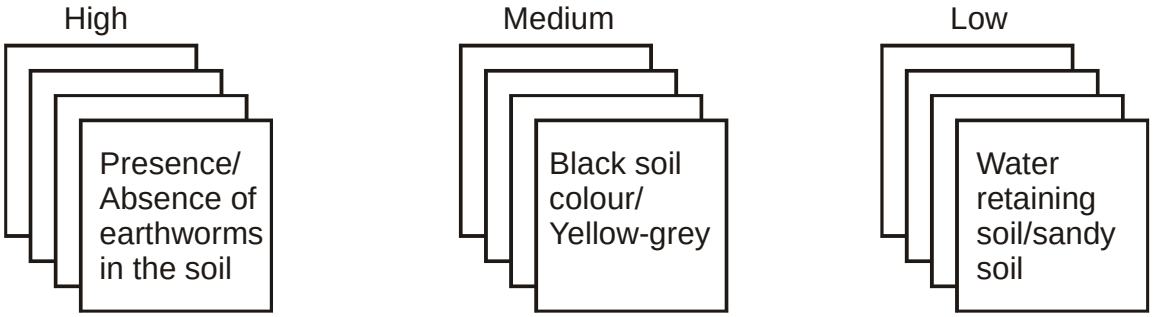


Figure 3.1 Farmer's card classification

- Then, every farmer is to individually assess each indicator in the group of cards, and is to give it a high or low importance, placing the most important one on top, followed by the others, in order of the importance (Figure 3.2).

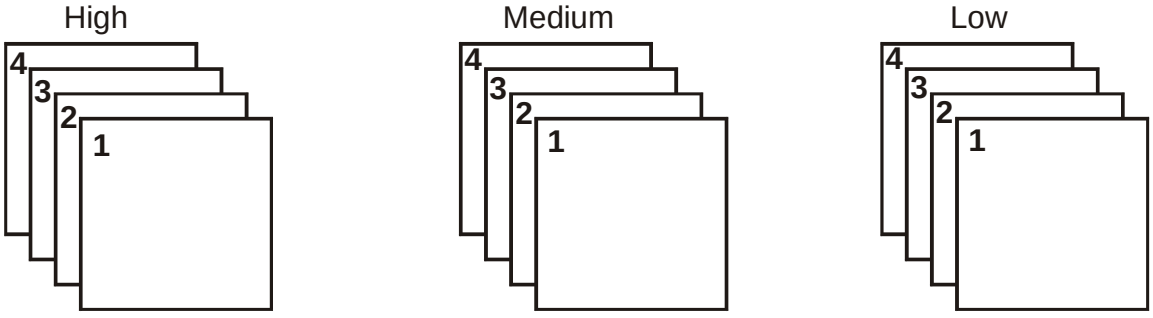


Figure 3.2 Assessing each card and assigning importance order, according to farmer's concept.

- Then, the narrator is to assign a numeric order to each indicator, according to the importance order assigned by the producer. The information generated by each farmer is recorded in the matrix shown in Table 3.1.

Table 3.1 Priority indicators matrix by farmers within each group.

Group:_____ **Farmers' name**

Narrator:_____ **1.**_____
2._____
3._____

Indicator (number and title)	Farmers			Total	Priority (see average value*)
	1	2	3		
1					
2					
3					
X_n					

- Average value = Total score divided by the number of farmers in each row.

Example:

If the group of high importance cards contains eight indicators, obviously the last indicator prioritized shall have the eighth place. When taking middle importance cards, already prioritized, the indicator assigned number 1 is to have the ninth priority place. If the total number of cards in this group is five, then the last card is to be located in the thirteenth place. For the last group of cards the same criteria are applied.

Every table is to contain specific information for each indicator. Based on this, the average score arising from the sum of the scores in each row, divided by the number of scores is established.

Finally, the matrix with all the indicators is submitted for its validation in a plenary session with all producers. The aim is to find out if all participants agree with the priorities established for the indicators in order to reach a group consensus that is fed back to the farmer community.

An example of several farmers answers is shown on table 3.2, for three indicators. If Farmer 1 thinks that "muddy/too much sand/ loamy soil" indicator is the third most important one, the narrator writes '3' in the appropriate cell, under Farmer 1, right in front of "muddy/too much sand/loamy soil" indicator. Likewise, if the farmer thinks that the "deep or thick soil/ thin soil" indicator is the seventh in importance, and that "gentle slopes/slope" indicator is number 1, the narrator writes 7 and 1 in the cells corresponding to these two indicators.

Table 3.2 Example of priority Matrix for three indicators and three farmers.

Indicator	Farmer			Total	Priority (average value*)
	1	2	3		
Loamy/muddy, too much sand	3	1	2	6	2
deep or thick soil/ thin soil	7	10	4	21	7
gentle slope/ foothill	1	2	6	9	3

* Average value = Total divided by the number of farmers in each row.

- Then, the narrator writes in the matrix the priority number corresponding to each indicator, per farmer consulted; these values are added to the "Total" column. The number in this column is divided among the number of farmers in

the group (in this case, the number is "three") to find out the average priority value for this indicator and for this group.

The last column, to the right, in Table 3.2 shows that for these three farmers, the "muddy, too much sand/loamy" indicator is the first one in importance when judging if the soil is good or bad. The "gentle slope/foothill" indicator is the second one, and the "deep or thick soil/thin soil" is the third.

Finally, the individual value assigned by each group to each indicator is added, and the total is divided by the number of groups, which is the final indicator of priority (Table 3.3).

Table 3.3 Final Matrix of Indicators Priority by group, with average figures calculated for each indicator.

Indicator	Groups Average						Total	Final Priority (Average Value*)
	1	2	3	4	5	6		
Loamy/ muddy, too much sand	2	3	5	1	9	5	25	5.0
Deep or thick soil/ thin soil	7	10	8	4	7	11	47	9.4
Gentle slope/ foothill	3	4	1	6	5	2	21	4.2
Burns/ does not burn								
Presence/ absence of earth worms in the soil								
X_n								

* Average value = Total divided by the number of groups.

As in the previous example, the conclusion can be drawn, as per Table 3.3, the most important indicator, according to the "average value" column, is: "gentle slope/foothill", followed by " loamy/muddy,too much sand" indicator, and by "deep or thick soil/thin soil" indicator.

3.2.3 Case studies

The methodology to study cases was designed to understand local soil quality indicators and the context in which they are used by farmers.

Once activities 3.2.1 and 3.2.2 are completed, choose farmers who are interested, and who have the knowledge and capacity to serve as key informers to conduct more detailed studies through a checklist for study cases on local soil knowledge and their management (Barrios et al., 1998). This checklist has been designed to be used during a field day in each farmer's farm. Through a series of informal conversations, the information mentioned in the checklist is gathered (Gracia, 1989). It is important to check the checklist carefully before visiting the farmer in order to incorporate the checklist topics in the conversation.

The checklist comprises the following issues:

1. Information about the farm: The length of time in use, land holding, area, etc.

2. Farmer participatory mapping: Preparation of a farmer/ interviewer-designed map, emphasising the types of soils and their limits, past and current use with regard to slope, etc. This information is confirmed during the next steps, when using the recently-made map to locate the identified soils and their past and current use.

3. Soils knowledge: The aim is to identify the descriptive properties of each soil type.

4. Soil management practices: The aim is to identify the distribution of crops, land preparation, fertilization, conservation practices, etc.

5. Soil organisms: The aim is to identify beneficial and harmful organisms in the soil.

6. Factors guiding management and the decision making process: the aim is to identify local integrative indicators (e.g.: soil colour, indigenous plants) providing important information on management and the decision making processes.

7. General issues: In this section, some examples are introduced, which simultaneously incorporate various aspects mentioned in the previous items, as they occur in nature. Through this section, gathered data can be corroborated.

8. Soils sample related to each study case: representative soil samples described by the farmer are collected (geo-reference, if possible).

It is worth mentioning that the participatory mapping at farm level, which allows for the definition of past and current uses of the soil, according to their position on the slope, is very important in studying watersheds. This activity is complemented by the information generated by guides 2 (Land use tendencies by Photo analysis) and 3 (Participatory mapping). The impact of soil uses, position with regard to the slope and the micro-watershed, has not been broadly studied. This methodological proposal pursues a systematic focus to allow the evaluation of the impact of new options and spatial/temporal arrangements, in the management of natural resources at the watershed scale.

3.2.3.1 Checklist to case studies on soils, local knowledge and their management.

Name of the farmer:_____

Ethnic origin :_____
Name of District/ Division:_____
Village:_____
Name of interviewer:_____
Date of the interview:_____

Information about the farm:

a. How long have you cultivated this farm? _____
Is it all cultivated? You cultivate_____% Fallow _____%
History of the use of the various plots, as long as you can recall.
_____
_____
_____

b. Land tenure : Owner_____ Rented_____
Inherited_____ Purchased _____
Cultivates permanently_____
Cultivates occasionally_____
Other _____ (specify)

c. Head of the household: Name_____ Age_____

d. Wife / wives name (s):_____Age_____
_____
_____

e. Number of children:_____ Age_____
Boys _____ _____ _____ _____
_____
_____
Girls _____ _____ _____ _____

f. Is there enough labour for the whole family or do you need to hire labor ?
_____
_____
_____

g. What are the task of each of the family members of the farm:
Father:_____
Mother:_____

Child 1:_____

Child 2:_____

Child 3:_____

Child 4:_____

Child 5:_____

Other family members:_____

h. Do you depend on charcoal to cook your meals? Yes__ No__ Heating? _____

What amount do you use per week?_____

Where do you get the charcoal from and how far it is from your farm?_____

_____

What type of charcoal do you use?_____

Which one do you prefer and why?_____

_____

_____

Farm participatory mapping

Prepare a map with the farmer showing the various types of soils (good - intermediate-poor), indicating slope, soils which dry fast or slowly, past and current use with regard to their location on the slope, location of cropping or fallow areas (geo-reference the uses, if possible), presence of weeds, soil organisms (e.g.: ants, earthworms, etc.). Use this map to conduct the rest of the interview while observing and sampling the various soils types.

Knowledge of the soils

a. Are there various soil types in the region and on your farm?

b. How can you distinguish one soil from another soil ?. Repeat these comparisons covering all possible combinations, as well as the contrasting features and identification criteria.

c. Descriptive properties of each identified soil type.

- What colour is the soil when dry or wet?
- Does the soil need little or a lot of fertilizer and can you plant without fertilizer?
- How deep is the fertile soil layer?
- Is the soil hard or dusty in the dry season and does it have large lumps or stones?
- Is it sandy or sticky (clayey)? In case of rain, does the water accumulate on the surface, does it run on the surface or does it quickly penetrate? Does the soil dry quickly or slowly after the rains? Is it easy to plough?
- How steep is the plot? Rolling plain <10%, moderate 10-30%, steep >30%. When it rains, is the water brown, yellowish or transparent (e.g.: too much erosion)?
- Which plants grow in the soil (i.e. fertility indicating plants), a great variety of plants or a common or prevalent type? (define the plants and their relationship with the soil type). Age of natural vegetation in the soil.

Presence of earthworms, ants, termites, etc ?
Crops yield is : Low_____ Medium_____ High _____ ?
Are crop yields decreasing_____, pasture yields _____, animals weight gain_____,milk production per animal_____, taste_____?

d. Which are the best soils to cultivate?_____
Has it always been good? Yes___ No___ Was it better before?_____
What happened?_____
And the worst?_____

Where they worse before? Yes_____ No_____

e. Is the soil # better for a particular crop? (Repeat for every soil mentioned)

f. Can soil #, be cultivated for a longer period than soil #? Yes _____ No _____

(Repeat for every pair of soils) Do you think that soil # resists a longer cropping

period ? One year ____ 5 year _____, 10 years_____, 20 years_____, more>20 years_____

Soils management practices

Crop distribution

When choosing the farm area to be planted during the next season, how do you decide where to assign each crop and how much of the farm area do you use? Do you sow all the above mentioned soils in the same way? Give details.

Land preparation

How is the land prepared: not prepared ____, with oxen ____, hand/hoe ploughed ____, with a tractor ____.

If you do not prepare the land, do you use a traditional hoe to plant? What is the sowing depth?

If the land is prepared, in what direction do you prepare the land? Downward (along the slope?) _____ or across (perpendicular to the slope _____) Why?

Slash and burn
Yes ____ No ____

When do you slash and burn, who does it, and indicate the various methods?
_____
_____

_____
_____
_____

Which is the best method and why?

_____
_____
_____

Manure

Yes ____ No ____

a) What type of manure do you use? Chicken manure ____?, sheep manure__ __goat manure ___ pig manure ____, other manure ____ (specify ___) Where do your animals graze? Do you transport manure to some places in your farm?
Other organic fertilizers used _____?
For what crops or plots do you use the various kinds of manure? Why?
How do you apply the manure? Broadcasted? _____, in the crop furrows _____, to each plant? ____, depending on the crop?_____
Amount of manure applied by crop or plot?
How do you decide the necessary amount of manure?
What do manures do to the soil?

Chemical fertilizers

Yes ____ No_____
If not, Why?

_____
_____
_____

You do not have knowledge on fertilizers ____, the cost is to high_____ (if the cost was low would you use them? Not available in the market _____, the results are not good ____ (based on your personal experience _____, or the experience and information from other farmers _____?

If you use fertilizers, why?, On which crops or plots are chemical fertilizers used? Why? What type of fertilizers do you use? (Urea ___, Super-phosphate ___, NPKs _____? Do you know the meaning of NPK grades (e.g. 20-20-20) fertilizers? How do you choose the grade or type of fertilizer to be used? Do you use various types or grades of fertilizers for the various crops or plots? How do you apply the fertilizer? Broadcasted _____,in the crops furrows _____, to each plant _____, depending on the type of crop or type of fertilizer?

Amount of fertilizer applied (bags per plot _____)? Kg _____?

How do you decide the necessary amount? What do fertilizers do to the soil?

Who tells you about the use of fertilizers? (type, amount, and how to apply)? Dealer ____. Extension agency (government) ____ Other farmers _____?

Green manure

YES ____ NO _____

Which plants help to enrich the soil? One type____ Several types_____

Which crops do you use them
with?_____
_____
_____

Why?

_____
_____
_____

How much labour or time do you spend?_____
_____
_____

Who performs this activity?_____
_____
_____

How long is the land under the green manure?

_____
_____
_____

Residues Management

Yes_____ No_____

Do you leave the residues on the soil and for how long? Yes ____ No_____

Are residues fed to livestock and what do you do to the manure?_____
_____
_____

Are the animals allowed to graze on the residues?

_____
_____
_____

Do you incorporate fresh or dried
residues?_____
_____
_____

When do you incorporate crop
residues?_____
_____
_____

Before the first rains?

_____
_____
_____

After the first rains?

_____
_____
_____

Composting:

Yes ____ No _____

Types of compost? How do you prepare it and which ingredients do you use in your compost?
Do you apply compost selectively or just to some crops? Which crops?

Soil erosion control

Do you control erosion? YES _____ NO _____

Do you use barriers: YES _____ NO_____

Types of barriers: live, trash, terraces?
_____
_____
_____

Amount of labour required for each activity?
_____
_____
_____

Soils and plots you use the barriers, on what slopes and what is the distance between barriers?
_____
_____
_____

For which crops do you use the barriers?_____
_____
_____

Which plants do you use as barriers and are they fed to livestock as feed supplement and who is in charge of these activities?_____

How important is the quality of the feed supplement?

_____

_____

_____

Do you construct terraces and what type of terraces? YES____ NO_____

Crops grown between the terraces, amount of labour required and who is in charge of these activities? _____

_____

Weed control

Yes____ No ____

How do you control weeds and how often? Herbicides ____,handpulling?___

Panga/machete?____ , hoe/shovel?____

Which herbicide and at what rate?_____

_____

_____

How long does it take to weed and who does the weeding?

_____

____

Which crops do you weed more frequently and what do you do with the weeds?_____
_____
_____

Which are the most common pests or diseases affecting each crop.
_____
_____
_____

Pesticides
Yes__ NO __
If yes, indicate the types of pesticides:
herbicides _____, insecticides _____? What amounts, number of back pumps (20lts)/ ha _____ ? How much pesticide do you use per back pump _____? How often do you use the pesticide? One or more times per harvest? Do you apply it at the beginning, at midday or at the end of the day? What tells you that is the moment to apply a pesticide? Who applies the pesticide? What does the pesticide do to the soil? Does it crack it? Does it harden it?

Soil organisms

a. There are good soil organism and these must be preserved. Are there some soil organisms helping to enrich the soil?
b. Can you increase the number of organisms in the soil? How?

Factors guiding management and the decision making processes

a. In plot #, when do you decide to rotate the crops? Which? And in what order? What changes do you observe in the soil? For how long do you rotate?

b. When do you decide that a plot must be left fallow? Less fertility, less money, less time? Indicators: weeds (which, how much), soil structure, colour? How long do you let it rest? What tells you that the soil has rested and can be sown again? How do you estimate the age of the vegetation or the rest time?

c. What types of plants can be mutually associated within a plot? Why? Plant # and plant # would have mutual positive effects? Replicate, to try to define some probable competitive (allelopathy) or mutually beneficial relationships

d. Do you have natural forests on your farm? How much of the land is under forest? How useful is the forest? Did you plant the forest? Why did you plant the forest (trees)?

e. Are there some periods during the year when lack of water affects the crops? When? Is there anything that can be done to reduce the effects of lack of water?

f. Which crops are sensitive to the lack of rains?
Which crops have deep roots, and which crops have superficial roots? Which indigenous plants have deep roots or superficial roots? How dependent are

animals on animal feed supplements during dry season? What is the importance of drought-tolerant cultivars?

g. How do you know when the rains will start, and the best moments to burn, plant, etc.? Are there some constellations, plants, or animals that serve as indicators of this year's weather?

General

a. In a year with no weather problems (rain and temperature) out of every 100 seeds you plant in the soil, how many germinate? (do not germinate, uneven germination, all germinate). Is the crop or tree growth fast or slow? Vigorous? Do you observe any yellowing, stripes or spots on the crop or tree leaves? How about resistance to drought, pest and diseases and crop yield?

b. Which are the poorest soils on your farm, and also among the ones you know in your area, and where are they located? Do they require fertilizer, or they do not respond to fertilizer?

c. Which are the fertile soils on your farm, in your area, and where are they located? Indicate the soils that can be sown without fertilizer.

d. Can you identify two people that use little or no fertilizer, and they still have good yields?

e. Can you identify two people that use fertilizer and have good yields?

Sampling of soils associated to each case study:

Preparation of a composite sample: Locate a central region in each type of soil described by the farmer. Draw on the soil a 5-m line. Draw another 5 m line, perpendicular to the one above, so that an X is formed. Take samples from the end of the X, and at the intersection point (a total of 5 samples for each required depth). Finally, mix well the 5 samples corresponding to each depth, to give one compound sample for every soil depth (should you be able to geo-reference this sampling, use the intersection point of two lines to take a GPS reading).

1. Take a composite sample (0-5, 5-10, 10-20, 20-40 cm) from the soil types identified by the farmer as representative of the region.

2. Take a composite sample (0-5, 5-10, 10-20, 20-40 cm) from the soils identified by the farmer as the poorest one in his/her farm and in the region.

3. Take a composite sample (0-5, 5-10, 10-20, 20-40 cm) from the soil types identified by the farmer as the most fertile in his/her farm and in the region.

3.2.4 Results from a study case exercise: Local weeds as indicators of soil quality

The composition and abundance of weed species growing on agricultural soils is a useful indicator of the soil condition frequently used by farmers (Barrios et al., 1994).Studies conducted in South America (de Kool, 1996; Barrios and Escobar, 1998) and Central America (Trejo et al., 1999) also indicate the importance of native plants as indicators of soil quality. Biological indicators have the potential to capture changes in the soil quality because of their integrative nature; that is, they simultaneously reflect changes in the physical, chemical and biological characteristics of the soil.

In fig. 3.3 the process of local knowledge generation about native plants as indicators of soil quality is summarized. Certain plants mainly predominate in poor soils and ubiquitous plants develop with difficulty. On the other hand, certain plants mainly predominate in fertile soils and ubiquitous plants grown vigorously. Farmer observation of this phenomenon in several soils and farms through time constitutes his/her direct experience and constitutes the basis of their knowledge on this topic.

It is now important to introduce the ecological concept of natural succession. Natural and agricultural ecosystems respond similarly to degradation and regeneration processes through natural succession. During these processes, best adapted plants and soil organisms gradually replace those least adapted through a selection exerted by changes in soil characteristics (i.e. during soil fertility decrease or increase). Local knowledge collects observations about changes in plant populations generated by changes in soil quality.

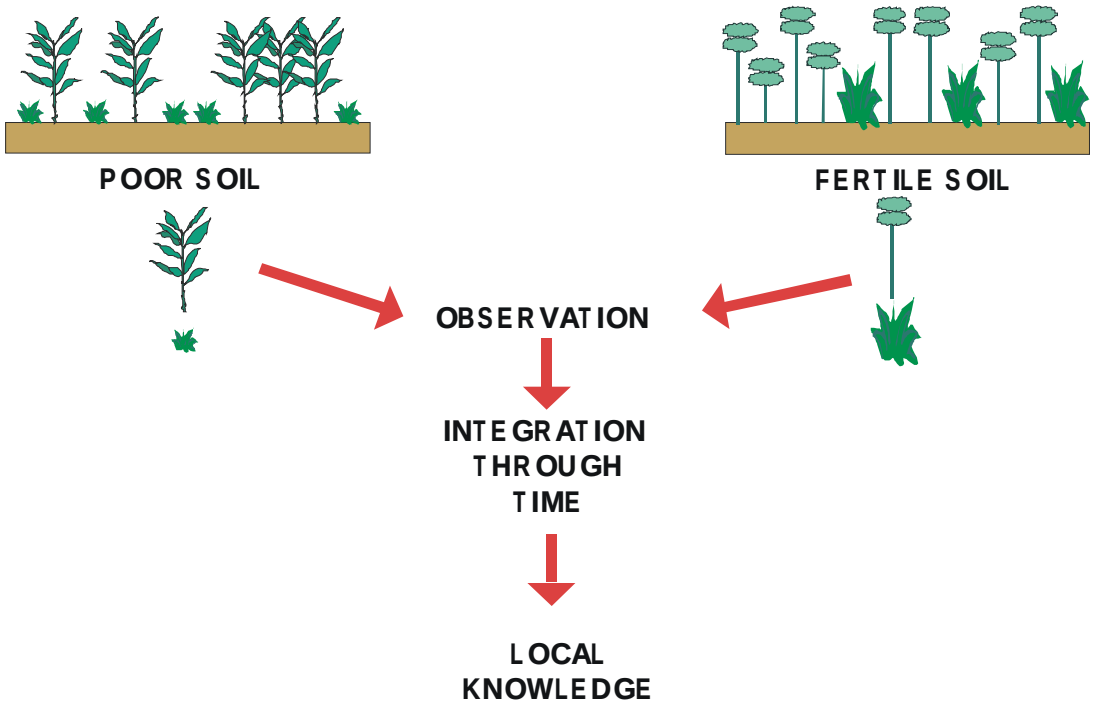


Fig. 3.3 Development of local knowledge about native plants as indicators of soil quality.

The study case approach allows exploration in more detail of certain aspects showing high importance. Ethnobotanical information related to the use of native plants as indicators of soil quality can thus be systematically collected. Results using this methodology in Colombian hillsides are presented as a list of indicator plants in Table 3.4 .

Table 3.4 Common plants as indicators of soil quality used by farmers in the Cabuyal Micro-watershed, Cauca, Colombia (Barrios and Escobar, 1998).

Common name	Scientific name	Botanical family	Soil type
Helecho marranero	*Pteridium aquilinum*	Pteridiaceae	Poor
Mangaguasca	*Braccharis trinervis*	Compositae	Poor
Escoba Lanosa	*Andropogon bicornis*	Gramineae	Poor
Siempre Viva	*Commelina difusa*	Commelinaceae	Fertile
Papunga	*Bidens pilosa*	Compositae	Fertile
Hierba de chivo	*Ageratum conyzoides*	Compositae	Fertile
Escoba Blanca	*Sida rhombifolia*	Malvaceae	Any soil
Caracola	*Koheleria lanata*	Gesneriaceae	Any soil
Margarita	*Chaptalia nutans*	Compositae	Any soil

The use of plant (weeds) dynamics as an integrative measure of changes in soil quality is based on the concept of natural selection mentioned above. Weeds are usually pioneer plants that grow on soils of different qualities and predominant weed populations often associate with a set of soil physical, chemical and biological characteristics. As soil characteristics change through time, for good or for bad, weed composition and abundance also changes. As mentioned before, local knowledge about native plants as indicators of soil quality is the result of cumulative farmer experiences. Therefore, a systematic

monitoring of the changes in diversity and abundance of weeds while simultaneously monitoring changes in soil properties would permit the establishment of a practical relationship between local and technical indicators (i.e. pH, total C, etc.) of soil quality.

Exercise 3.1 Identifying and Prioritizing Local Indicators of Soil Quality

Objective

In a simulation situation, the trainees will identify and prioritize local soil quality indicators in farms belonging to a group of farmers.

Orientations for the Instructor

1. Select the group of trainees who are to play the role of "technicians", and another one that is to play the role of "farmers", in a proportion of one technician per five farmers.

2. Give the group of farmers the corresponding work agenda. The technicians must not know the farmers' agenda.

3. Provide the technicians with instructions to accomplish the following assignment:

- Conducting group analysis ("brainstorming session"), as described in the text.
- Grouping the indicators with the same meaning, according to the soil properties previously described.
- Preparing the cards with the indicators, and selecting the method of prioritization.

Prioritizing.

- Getting the averages for each group and for the group total.
- Validating, in a plenary session with the farmers, the indicators and the corresponding priority.
- Explaining the relationships between local indicators and soil properties.

Resources required

- cardboard cards.
- Thick tip markers (various colours)
- Paper for the flip chart
- A roll of masking tape
- Work sheets:

Indicators priority matrix by farmers in each group (Worksheet No. 1)

Final indicators priority matrix by the group (Worksheet No. 2)

List of trainees

Suggested time: 60 minutes

Exercise 3.1 Identifying and Prioritizing Local Indicators of Soil Quality

Orientations for the trainee

Agenda for the "Farmers"

You have been selected to play the role of a farmer during this exercise. Follow the instructions below:

1. You are a member of a 5-member farmer group who know how to read and write.

2. During the group analysis ("brainstorming session"), mention at least three soil quality indicators belonging to a local language; e.g.: washed land, cracked soil, weeping land, the land becomes waterlogged, the soil breaks, the soil is brittle; mild slope, mildly porous, sandy, lumpy, etc.

3. For the rest of the exercise follow the instructions given by the "technician" who will work with this group.

During the validation of the indicators and the corresponding priority, accept or reject the outcomes, depending on how you think they match or do not match with your opinion.

Exercise 3.1 Identifying and Prioritizing Local Indicators of Soil Quality - Worksheet No. 1

Group:_____Narrator:_____

Farmers names':

_____

Local Indicator (Number and title)	Farmers			Total	Priority (average value *)
	1	2	3		

Exercise 3.1 Identifying and Prioritizing Local Indicators of Soil Quality - Worksheet No. 2

Local Indicator	Groups Average						Total	Final Priority (average value*)
	1	2	3	4	5	6		
1								
2								
3								
X_n								

- Average value = Total mean among the number of groups

Exercise 3.1 Identifying and Prioritizing Local Indicators of Soil Quality Feedback Information

The instructor, as part of the feedback information, is to show the trainees a case where indicators were identified as in the case of trainees in the stakeholder/soil quality indicator tool analysis workshop held in March 2000 in eastern Africa (Uganda). In this exercise, trainees in 3 groups were asked to play the role of farmers. Each group of "farmers" wrote down on cards 5-10 indicators of good soil and 5-10 indicators of poor soil and stuck these on a flip chart. The "farmers" presented and explained their indicators in a plenary session as shown below(The letters in brackets show indicators that are specific to the various countries: E = Ethiopia; K = Kenya; M = Madagascar; T= Tanzania and U = Uganda).

GROUP 1

GOOD	BAD
Gives good yield (T/K/E)	Sloppy shallow soils
Well drained	Rocky (water - logged) (E)
Udongo tifutifu (workable)	Lunyu (salty) (U)
Rhotuba (high fertility) (K/T)	Digitaria (indicator plant) (E)
Deep soils	Cracking soils (vertisols) (E)
Virgin soils	Kichanga (sandy soils) (T)
Valley bottoms alluvial soils	Tincha (story) (E)
Kossie (E) (High Organic Matter)	Striga infested
Sama (E) (indicator plant)	Fern (indicator plant for acidity) (T)
Serdo (E) (indicator plant)	Tindiga (swampy) (T/K)
Amaranthus (indicator plant) (T/K/U)	Litosi (clay for pottery) (K)
Soil with worms	

GROUP 2

GOOD	BAD
Colour of the crop green - good	Yellow/light grey soils
Deep soils	Poorly drained soils
Presence of certain weeds e.g. commelina, galinsoga	Presence of certain weeds e.g. striga/ferns
Black colour	Shallow soils
Growth vigour of the crop / vegetation	Stoniness
Anti hills	Limited worms
Water retaining	Excessive run off/ gullies, erosion
Easiness to cultivate	Poor growth/ stunted
Smell of rotting materials	Colour of the crop yellowish/purplish
Sedimentary Rock “Musimbi” W/Uganda	Difficult to cultivate hard pan
Presence of worms	
Well drained soils	

GROUP 3

GOOD	BAD
Wet/ retains water in dry season	Reddish/ brownish steep slops
Presence of earth worms	Bracken fern
Presence of Tithonia plants	Presence of striga
Can support many crops	Water logging
Workability	Stunted Plant growth
Vigour crops	Sick soils
Presence of obengele	Murram soils
Cool soils	Presence of couch grass
Black/ Dark	Sticky clay soil
Valley/ flat/ gentle plots	Thin/ shallow soil
Many diverse weeds	Ebeija
Deep soils	

Making compatible similar indicators

List of indicators, grouped around the same meaning.

Local Indicator	
Good crop vigour / Stunted growth Easy to cultivate / hard to cultivate Deep soils / Shallow soils Dark green plant colour / yellow purple e.g. ebeija Black soil colour / Yellow - grey, red - brown Weed species e.g. *Commelina* / Weed species e.g. Bracken fern, *Striga, Digitaria* Water retaining, well drained / water logged, sandy soils Presence of earth worms / Absence of earth worms salty e.g. visible at surface / Not salty Smell of rotting material / no smell	

Indicators priority matrix by "farmers" in each group.

Trainees as "farmers" in their groups prioritized the local indicators they had identified (1=highest priority and 10=lowest priority).

Local indicator	Group 1[a]	Group 2[a]	Group 3[a]	Total [b]	Average [c]
Good Crop / Stunted growth	3	2	4	9	3.0
Easy to cultivate / hard to cultivate e.g. hard pan	9	6	9	24	8.0
Deep soils/ shallow soils, erosion	2	5	5	12	4.0
Dark green plant colour	4	4	3	11	3.7
Black soil colour / Yellow purple e.g. ebeija	6	9	6	21	7.0
Weed species e.g. commelina / weed species e.g. Bracken fern , Striga, Digitaria	8	9	8	25	8.3
Water retaining, well drained / water logged, sandy soils	10	8	10	28	9.3
Presence of earth worms / Absence of earthworms	1	1	1	3	1.0
Salty e.g. visible at surface / Not salty	5	6	2	13	4.3
Smell of rotting / no smell	7	2	7	16	5.3

a The score in each cell is the result of the previous exercise to classify the cards into low, medium and high importance, individually by each "farmer", and writing it down on Table 1 Matrix.
b Is the sum of the rows, corresponding to each indicator.
c Is the average of the scores obtained for each indicator

A list of prioritized local indicators of soil quality.

Order of importance	Local indicator

3.3 Summary

In this section we saw how to work with farmers in order to identify their indigenous knowledge of local indicators of soil quality. Following the classification and ordering of local indicators farmers used a card classification system and a 2-way matrix table to prioritize these local indicators of soil quality.

In the next section these local indicators of soil quality will be integrated with the technical indicators of soil quality that were derived during the exercises in Section 2. This integration will allow the development of a common language between farmers and researchers which will be essential to allow information exchange and sharing of knowledge.

3.4 Bibliography

Barrios E. (1995) Agroforestry on tropical floodplains: Indigenous know-how from Venezuela. Agroforestry Today 7(1): 13-15.

Barrios E., Herrera R., Valles J.L. 1994. Tropical Floodplain Agroforestry Systems in mid-Orinoco River basin. Venezuela. Agroforestry Systems 28: 143-157.

Barrios E. and Escobar E. 1998.Plantas indicadoras de calidad del suelo en la Cuenca del Río Cabuyal (Plants as indicators of soil quality in the Cabuyal river watershed). CIAT internal working document.

Barrios E., Thomas R., Amézquita E. y Rao I. 1998 Guía de estudio de caso sobre el conocimiento local de los suelos y su manejo. (Case study on local knowledge about soils and their management). CIAT Internal work ing document.pp.9

Burpee C. y Turcios W. 1997. Indicadores locales de la calidad de suelo: Resultados iniciales de Honduras. (Local soil quality indicators: Initcial Outcomes in Honduras). International Center of Tropical Agriculture (CIAT). Tegucigalpa, Honduras. Internal Work Document. p. 8-11.

De Kool, S.1996 Exploring soil health through local indicators and scientific parameters. Msc. Thesis. Wageningen Agricultural University.

Geilfus F. 1997. 80 herramientas para el desarrollo participativo: diagnóstico, planificación monitoreo, evaluación. (80 tools for participatory development. Diagnosis, monitoring, planning, evaluation)
Prochalatei - IICA,San Salvador, El Salvador, 208 p.

Gracia T. 1989. Planeación de la entrevista semi-estructurada. (Planning semi-structured interviews). CIAT Internal working document. Investigación Participativa en Agricultura (IPRA), CIAT, pp 69.

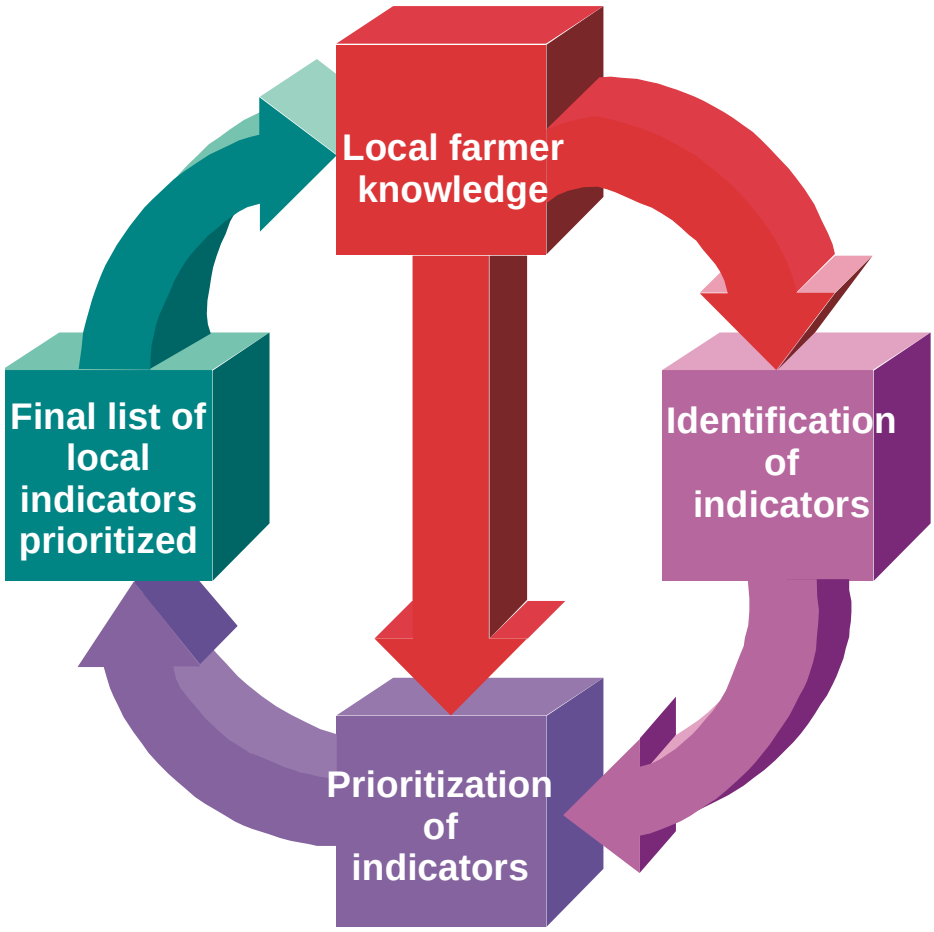
Trejo M. T., Barrios E. , Turcios W.y Barreto H. 1999. Método participativo para identificar y clasificar indicadores locales de calidad del suelo a nivel de microcuenca. Guía No.1 Nueve Instrumentos de Apoyo a la toma de decisiones para el Manejo sostenible de los Recursos Naturales (Participatory method for identifying and classifying local soil indicators at microwatershed level. Guide 1. In: Decision making for sustainable natural resources management: Nine tools that help). 255p.

Originals for Overheads

Section Objectives

- ✓ The trainers will be able to obtain the local indicators of soil quality.
- ✓ The trainees will be able to group local indicators according to soil properties.
- ✓ The trainees will be able to prioritize local indicators of soil quality.
- ✓ The trainees will be able to describe the methodology used to obtain the local indicators of soil quality.

Section Structure



Opening Questions

1. What are the differences between a good and a bad soil?

2. How do you know if a soil is good, fairly good or bad for production?

3. Do you think that there are different types of soils on your farm?

4. Can you indicate the limits of the soil types on your farm?

What is the meaning of an "Indicator"?

Technical

Soil quality indicators are physical, chemical, and biological properties, processes, and characteristics that can be measured to monitor changes in the soil.

For example:

- **Slope**
- **pH**
- **Texture**
- **Organic matter**

What is the meaning of an "Indicator"?

Local

This describes soil quality using the language of farmers in a given community. It is the traditional, local terminology for soil characteristics.

For example:

- **Water retaining soil**
- **Black soil**
- **Deep soil**

Why do we need to incorporate farmers knowledge about soils?

- **It is the result of hundreds of years of trial and error and accumulated experiences**
- **It is valuable knowledge that tends to fade away with time**
- **It facilitates both actors (farmer and technician) to have a shared understanding of soils**
- **It is the farmer who knows and experiments with soils**

Methodology

Group analysis (brainstorming) to identify indicators

Prioritization of indicators

a.Two way matrix

b. Classification using cards

Case studies

Steps

Group analysis (Brainstorming session)

Farmers are asked to mention the characteristics they use to determine whether a soil is good, fair or bad

Local indicators are grouped with the list of characteristics

Prioritizing indicators

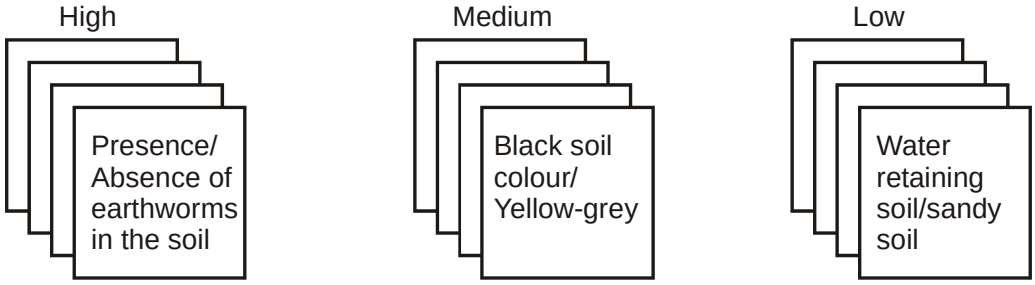
a. Two way matrix

Indicator	Water retaining soil	Black soil	Deep soil	Indicator $_n$
Water retaining soil				
Black soil				
Deep soil				
Indicator $_n$				

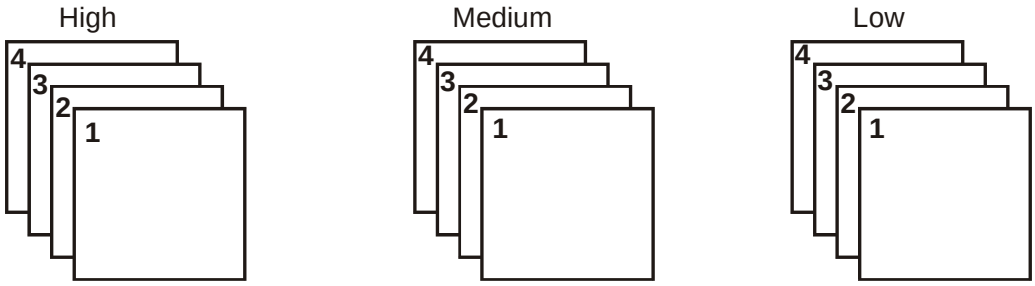
Indicator	Frequency	Priority Order
Water retaining soil		
Black soil		
Deep soil		

Classification using cards: Importance of indicators

Importance assigned by farmers



Value of each card



Indicators Prioritization Matrix for each Farmer within each Group

Group:_____ **Farmers' name**

Narrator:_____ **1.**_____
2._____
3._____

Indicator (number and title)	Farmers			Total	Priority (see average value*)
	1	2	3		
1					
2					
3					
X_n					

*** Mean value = Total score divided by the number of farmers in each row.**

Example of a Prioritization Matrix for three indicators and three Farmers

Indicator	Farmer			Total	Priority (average value*)
	1	2	3		
Loamy/muddy, too much sand	3	1	2	6	2
deep or thick soil/ thin soil	7	10	4	21	7
gentle slope/ foothill	1	2	6	9	3

*** Mean value = Total divided by the number of observed scores.**

Final Indicator prioritization Matrix, Group Means Calculated for each indicator

Indicator	Groups Average						Total	Final Priority (Average Value*)
	1	2	3	4	5	6		
Loamy/ muddy/ too much sand	2	3	5	1	9	5	25	5.0
Deep or thick soil/ thin soil	7	10	8	4	7	11	47	9.4
Gentle slope/ foothill	3	4	1	6	5	2	21	4.2
Burns/ does not burn								
Presence/ absence of earth worms in the soil								
X_n								

- **Mean value = Total divided by number of observed scores.**

Final List of Prioritized Indicators

Order of Importance	Indicator
1	Gentle slope/Foothill
2	Loamy/ Muddy, too much sand
3	Deep or thick soil/ Thin soil