# A RAPID FARMER-FRIENDLY METHOD TO ESTIMATE SOIL HEALTH


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# FOREWORD

How to assess soil health in field condition is an important challenge for many farmers and researchers. There are lists of indicators to estimate the soil health. But, there are methodologies existing which farmers may use as simple indicators to rapidly observe the status of their land. Such tools would help them to make management decisions by improving upon the attributes performing poorly. The methodology presented in this technical brochure will help farmers to measure the sustainability in a *comparative or relative* way, either by comparing the evalution on time of the same agroecosystem, or by comparing two or more agroecosystems under different management practices or transitional stages.

The comparison of various systems will allow to identify the *healthier* systems, where farmers and researchers can together identify the processes and ecological interactions that explain better performance. This information can afterwards be translated into specific practices that optimize the desired agroecological processes in the region that exhibit indicator values below the threshold level. The brochure would be highly useful to the field functionaries, farmers, NGOs and extension scientists.

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## INTRODUCTION

- One of the challenges that farmers, as well as extentionists face, is to know when an agroecosystem is healthy.
- A set of sustainability indicators have been designed to assess the condition of particular agroecosystem.
- A practical methodology has been given through important indicators in this hand out to rapidly assess the soil quality of a particular place. Although the indicators are specific to lower hills or valley region but with some modifications this methodology is applicable to a broad range in various regions.

## WHY THESE INDICATORS?

### The rationale for selecting the indicators:

The indicators described herein were selected because they are :

- Easy to use by farmers
- Relatively precise and easy to interpret
- Of practical use for making new management decisions
- Sensitive enough to reflect environmental changes and the effects of management practices on the soil and the crop
- Most of them possess the capability of integrating physical, chemical and biological properties of the soil.

## METHODOLOGY

- Qualitative indicators of soil, which are relevant to farmers and the biophysical conditions of the region, are selected.
- Once the indicators are applied, each farmer can visualize the conditions of his/her Farm, noticing which of the soil attributes are doing. When the methodology is applied in various Farms simultaneously, then it becomes possible to visualize which Farms exhibit low or high values of sustainability.
- It allows farmers to understand why some Farms perform ecologically better than other sustainability indicators.



- Each indicator is valued separately and assigned with a value between 1 and 10 (1 being the least desirable value, 5 moderate or threshold value and 10 the most preferred value) accordingly to the characteristics presented by the soil depending on attributes observed for each indicator (Table 1).

**Table 1: Soil health indicators with corresponding characteristics and values (values between 1-10 can be assigned to each indicator)**

| Established value | Characteristics | Estimated value |
|---|---|---|
| **1. Soil structure** | | |
| 1 | Loose, powdery soil without visible aggregates | |
| 5 | Few aggregates that break with little pressure | |
| 10 | Well formed aggregates difficult to break | |
| **2. Soil compaction** | | |
| 1 | Compacted soil, flag bends readily | |
| 5 | Thin compacted layer, some restriction to a penetrating wire | |
| 10 | No compaction, flag can penetrate all the way into the soil | |
| **3. Soil depth** | | |
| 1 | Exposed sub-soil (soil depth <25 cm) | |
| 5 | Moderately Shallow soil (25-50 cm) | |
| 10 | Deep soil with soil depth at least >50 cm | |
| **4. Status of residue** | | |
| 1 | No visible sign of residue, soil colour appears pale or light | |
| 5 | Presence of decomposing residues or mulch material, soil colour appears to be brownish | |
| 10 | Residue in various stages of decomposition, most of the residues well decomposed, soil colour appears to be dark or blackish | |
| **5. Soil colour, odour and organic matter** | | |
| 1 | Pale, no presence of humus, no smell of decomposing residue or rotten residues | |
| 5 | Light brown, odourless, some presence of humus or slight smell of rotten materials | |
| 10 | Dark brown or blackish appearance, fresh odour and abundant humus | |
| **6. Soil water retention (moisture level after irrigation or rain)** | | |
| 1 | Dry soil, does not hold water | |
| 5 | Limited moisture level available for short time | |
| 10 | Reasonable moisture level available for a reasonable period of time | |

| Established value | Characteristics | Estimated value |
|---|---|---|
| **7. Soil cover** | | |
| 1 | Bare soil fallow with sparse vegetation | |
| 5 | Less than 50% soil covered by residue or live cover at least for 6 months | |
| 10 | More than 50% soil covered by residue or live cover at least for 9 months | |
| **8. Erosion** | | |
| 1 | Severe erosion, presence of small gullies | |
| 5 | Evident but low erosion signs | |
| 10 | No visible signs of erosion | |
| **9. Presence of invertebrates and insects** | | |
| 1 | No signs of earthworms or insect's presence or activity | |
| 5 | A few earthworms and arthropods present | |
| 10 | Abundant presence of invertebrate organisms | |
| **10. Microbiological activity** | | |
| 1 | Very little effervescence after application of hydrogen peroxide ($H_2O_2$) | |
| 5 | Light to medium effervescence | |
| 10 | Abundant effervescence | |

- For instance, in the case of the soil structure, a value of 1 is given to a dusty soil, without visible aggregates; a value of 5 to a soil with some granular structure whose aggregates are easily broken under soft finger pressure; and a value of 10 to a well structured soil whose aggregates maintain a fixed shape even after exerting soft pressure. Values between 1 to 5 and 5 to 10 can also be assigned, accordingly.
- Once the values are assigned to the indicators, they are added and divided by the number of measured indicators. A mean value for soil quality and another for crop health is then achieved.

## RATING

- Farms with an overall value lower than 5 in soil quality are considered below the sustainability threshold, and rectifying measures should be taken to improve the low indicators on these farms.
- The indicators are more easily observed by using an *amoeba* type graph as it allows to visualize the general status of soil health, considering that the closer the amoeba approaches the full diameter length of the circle, the more sustainable the system is (a 10 value). The amoeba showing weak indicators (below 5) may allow farmers to prioritize the agroecological interventions necessary to correct soil, crop or system deficiencies.
- At times it may be possible to correct a set of deficiencies just by intervening on one specific attribute (increasing the species diversity or the soil organic matter) which in turn affects others.
- For example by adding organic matter, in addition to increasing the soil's water carrying capacity, it is also possible to augment soil biological activity, and improve soil structure. The average values of various farms can be plotted, allowing researchers and farmers to visualize how each farm performs in relation to the threshold level (5) of soil health (Fig. 1).

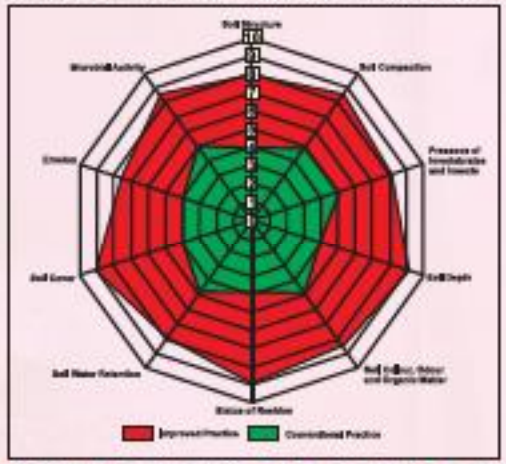

Fig. 1: Spider web representing the soil quality status of two agro-eco systems (conventional and improved practices)

## CONCLUSION

Assessment of agro ecosystem sustainability is an important challenge for many farmers and researchers. The methodology presented here suggest farmers to measure the sustainability in a comparative or relative way, either by comparing the evolution on time of the same agroecosystem, or by comparing two or more agroecosystems under different management practices or transitional stages. The comparison of various systems allows a farmer to identify the healthier systems. Such tool would permit them to make management decisions directed at improving the attributes performing poorly and thus improve agroecosystem functions.