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Soil Quality: As an Indicator of Soil Health

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Abstract

The ability of soil to function as a vital living system within constraints of land use is the definition of soil health and soil quality. The biological productivity of soil is maintained via this function, which also preserves the quality of the immediate environment and public health. Soil quality and soil health are sometimes used interchangeably, but it's vital to understand that one refers to soil function while the other describes the soil as a limited, non-renewable, and dynamic living resource. In this, we discuss the idea of soil health, which encompasses how plant inputs and soil interact to provide a healthy environment. Nutrient imbalance in the soil, excessive fertilization, soil pollution, and processes that lead to soil loss are all factors that have a negative impact on the health and quality of the soil. In order to lessen adverse effects on agricultural productivity and long-term sustainability, this will look at the evolution of soil health approaches as well as the informational content of soil health and soil quality. Minimum data sets as an indicator of soil health and quality.

Key words: Soil health, Soil quality, MDS, Indicator

Soil health

Capacity of a soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality and promote plant and animal health.

or

A healthy soil would ensure proper retention and release of water and nutrients, promote and sustain root growth, maintain soil biotic habitat, respond to management and resist degradation (Laishram *et al.*, 2012).

Soil health is defined as the continued capacity of soil to function as a vital living system, by recognizing that it contains biological elements that are key to ecosystem function within land-use boundaries (Doran and Zeiss, 2000; Karlen *et al*., 1997).

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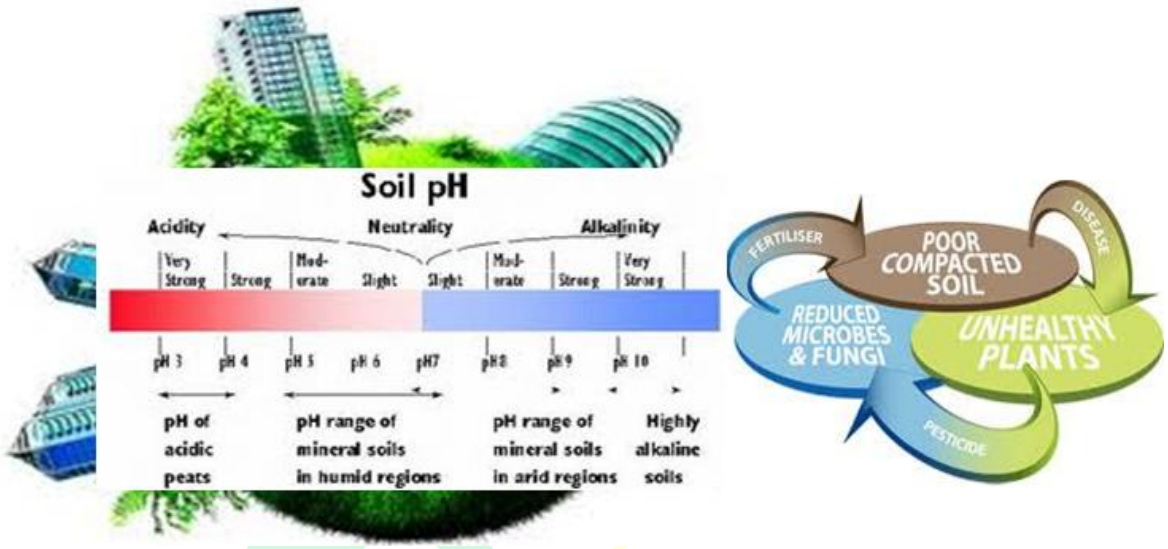

Soil quality

The capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality and support human health and habitation.

- The ability of a soil to function within ecosystem boundaries to support healthy plants and animals, maintain or enhance air and water quality, and support human health and habitation.
- Soil quality integrates the physical, chemical and biological condition of the soil.

Constituents of soil quality

The two main elements of soil quality corresponds to

1. Identification of existing potential to perform functions
2. Identification of sensitivity/reaction to external influences

What are indicators?

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

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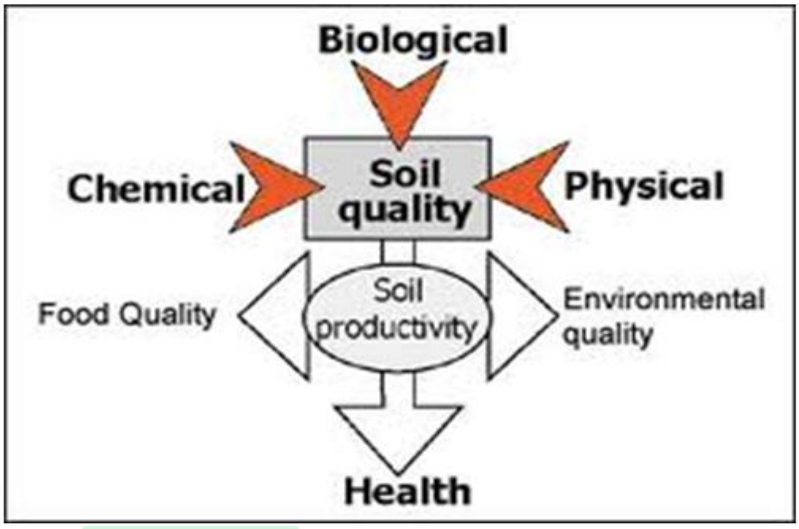

Soil quality indicators are important to?

- Focus conservation efforts on maintaining and improving the condition of the soil
- Evaluate soil management practices and techniques
- Relate soil quality to that of other resources
- Collect the necessary information to determine trends
- Determine trends in the health of the Nation's soils
- Guide land manager decisions

Indicators selection based on land use

- The relationship between an indicator and the soil function being assessed
- The ease and reliability of the measurement
- Variation between sampling times and variation across the sampling area
- The sensitivity of the measurement to changes in soil management
- Compatibility with routine sampling and monitoring
- The skills required for use and interpretation

Indicators

Four general groups: Visual, physical, chemical, and biological

Visual indicators: Observation or photographic interpretation.

Physical indicators: Arrangement of solid particles and pores.

Chemical indicators: pH, salinity, OM, P, CEC, nutrient cycling, and concentrations of elements.

Biological indicators: Micro and macro-organisms, their activity

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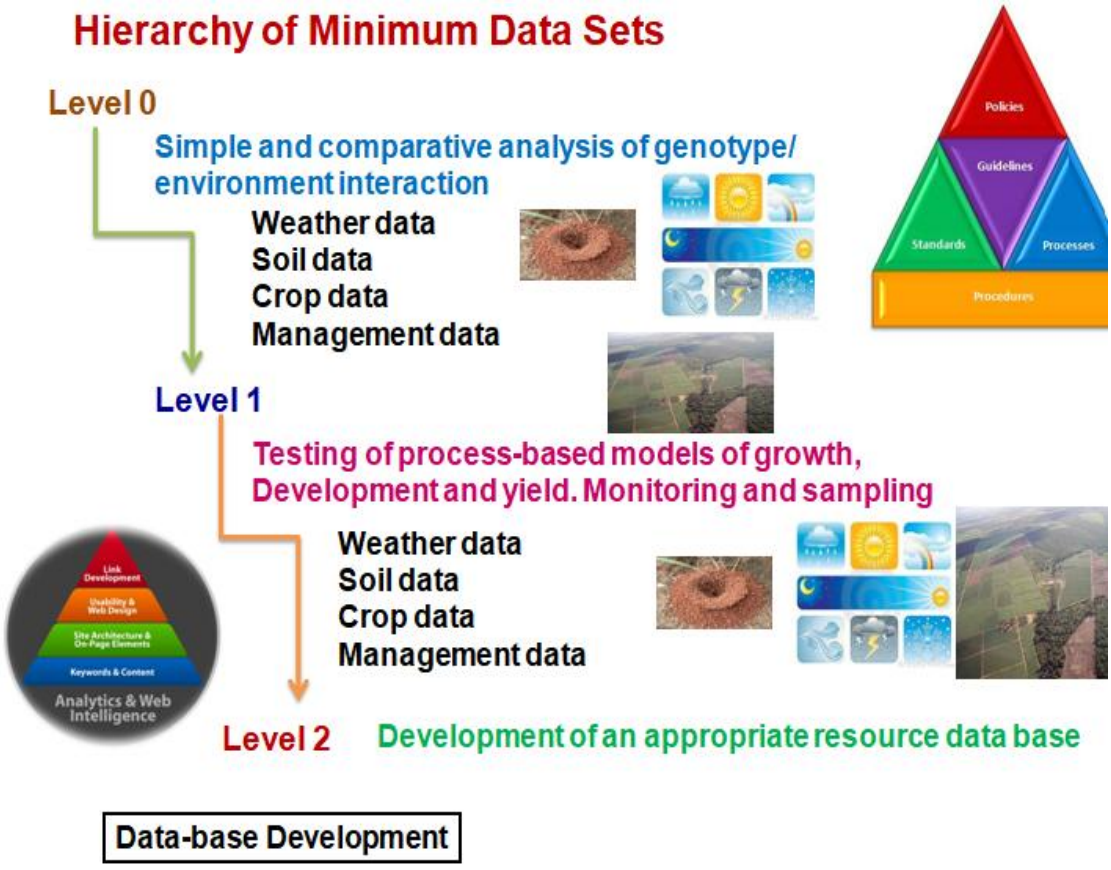
Potential indicators in MDS

Nutrient availability, total organiccarbon, labile organic carbon, texture, plant-available water capacity, soil structure, soil strength, maximum rooting depth, pH, electrical conductivity

The indicators should be useful across a range of ecological and socio-economic situations

- ✓ Correlate well with natural processes in the ecosystem (modelling)
- ✓ Integrate soil properties and processes, and serve as basic inputs needed for estimation which are more difficult to measure directly
- ✓ Be relatively easy to use under field conditions, for specialists and producers
- ✓ Be sensitive to variations in management and climate and sensitive for short-term weather patterns
- ✓ Be the components of existing soil databases where possible



Data-base Development

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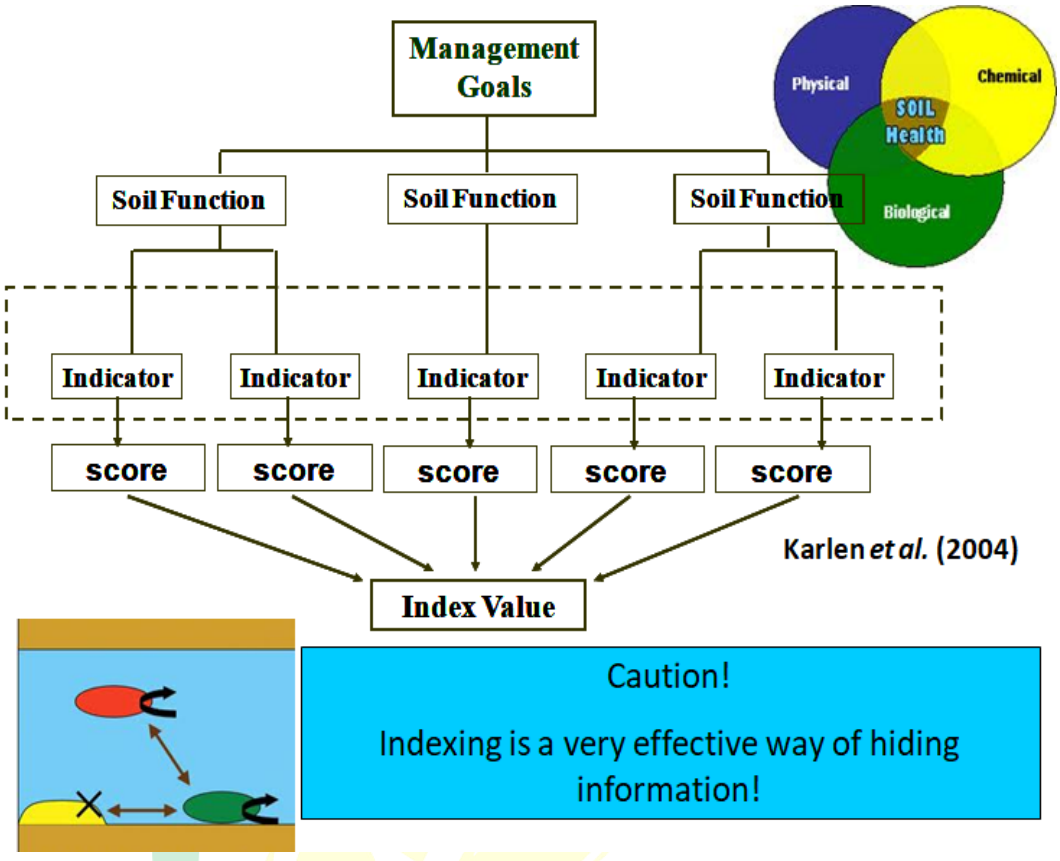
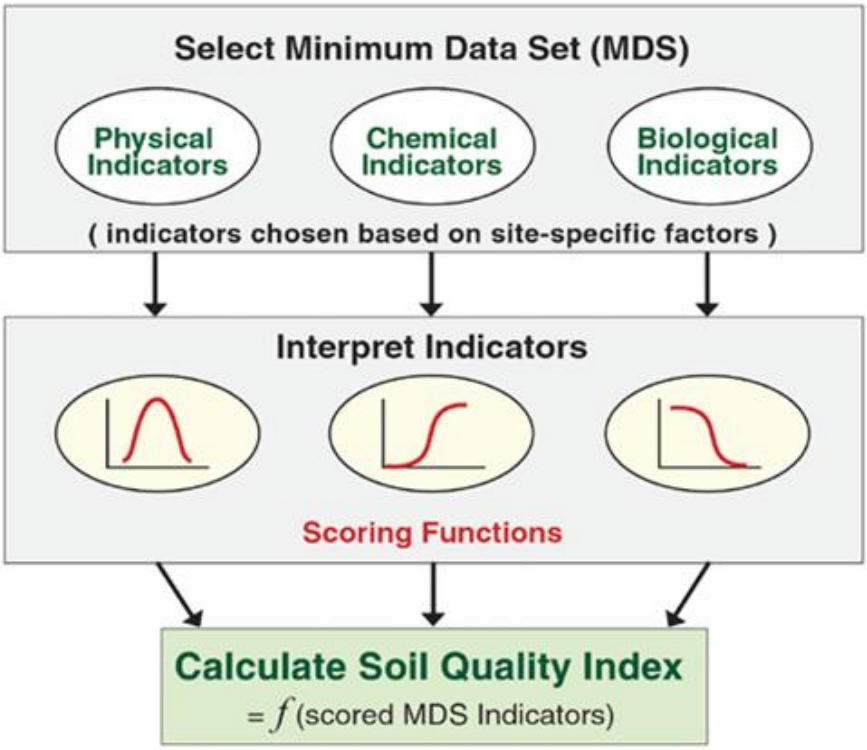


Conceptual model for converting minimum data set indicators to index values



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Summary of soil health indicators used to asses soil function

Indicator	Soil function
SOM	Soil structure, stability, nutrient retention; soil erosion
Physical: Soil aggregate stability, infiltration and BD	Retention and mobility of water and nutrients; habitat for macro and micro fauna
Chemical: pH, extractable soil nutrients, NPK and base cations Ca & Mg	Soil biological and chemical activity thresholds; plant available nutrients and potential for N and P as well as loss of Ca, Mg & K
Biological: Microbial biomass C & N; potentially mineralizable N	Microbial catalytic potential and repository for C and N; soil productivity and N supplying potential

Proposed minimum data set (MDS) of physical, chemical, and biological indicators for assessing soil quality

Indicator	Rationale for assessment
Biological	
Microbial biomass, C and N	Describes microbial catalytic potential and repository for C and N. Provides an early warning of management effects on organic matter.
Potentially mineralizable N	Describes soil productivity and nitrogen supplying potential. Provides an estimate of biomass.
Soil respiration	Defines a level of microbial activity. Provides an estimate of biomass activity.
Chemical	
SOM	As a proxy for soil fertility and nutrient availability.
pH	Biological and chemical activity thresholds
EC	Plant and microbial activity thresholds.
Extractable N, P,and K	Describes plant-available nutrients and potential for N loss. Indicates productivity and environmental quality.

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Physical	
Soil texture	Indicates how well water and chemicals are retained and transported. Provides an estimate of soil erosion and variability.
Soil depth and rooting	Indicates productivity potential. Evens out landscape and geographic variability.
Infiltration and BD	Describes the potential for leaching, productivity, and erosion. BD is used to correct soil analyses to volumetric basis.
WHC	Describes water retention, transport, and erosion. Available water is used to calculate soil BD and OM.

Conclusion

- Soil quality can be assessed using a MDS comprising soil attributes such as texture, OM, pH, BD, and rooting depth.
- MDS is expected to work well for studies of soil dynamics in other agro-ecosystems.
- MDSs can be utilized for soil quality assessment with respect to the management goals of soil productivity and stability.

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