

# **What is Soil Quality?**

**Soil Quality -- Managing soil for today and tomorrow**

## **SOIL QUALITY IS LINKED TO SUSTAINABILITY –**

**Understanding soil quality means assessing and managing soil so that it functions optimally now and is not degraded for future use.**

**By monitoring changes in soil quality, a land manager can determine if a set of practices are sustainable.**

**SOIL QUALITY is how well soil does what we want it to do**

**Soil quality is ...**

**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.**

**People have different ideas of what a quality soil is...**

**For people active in production agriculture –  
it may mean highly productive land,  
sustaining or enhancing productivity,  
maximizing profits, or  
maintaining the soil resource for future generations;**

**For consumers,  
it may mean plentiful, healthful, and inexpensive food;**

**For naturalists,  
it may mean soil in harmony with the landscape and its surroundings;**

**For the environmentalist,  
it may mean soil functioning at its potential in an ecosystem with  
respect to maintenance or enhancement of biodiversity, water quality,  
nutrient cycling, and biomass production.**

## WHAT DOES SOIL DO?

Regulating water. Soil helps control where rain, snowmelt, and irrigation water goes. Water and dissolved solutes flow over the land or into and through the soil.

Sustaining plant and animal life. The diversity and productivity of living things depends on soil.

Filtering potential pollutants. The minerals and microbes in soil are responsible for filtering, buffering, degrading, immobilizing, and detoxifying organic and inorganic materials, including industrial and municipal by-products and atmospheric deposits.

Cycling nutrients. Carbon, nitrogen, phosphorus, and many other nutrients are stored, transformed, and cycled through soil.

Supporting structures. Buildings need stable soil for support, and archeological treasures associated with human habitation are protected in soils.

# **SOIL HAS BOTH INHERENT AND DYNAMIC QUALITY**

**Inherent soil quality is a soil's natural ability to function.**

**sandy soil drains faster than clayey soil**

**deep soil has more room for roots than shallow soils**

**These characteristics do not change easily**

**Dynamic soil quality is dependent on how a soil is managed.**

**amount of soil organic matter**

**soil structure**

**soil depth**

**water and nutrient holding capacity**

**Soils respond differently to management depending on the inherent properties of the soil and the surrounding landscape**

# ASSESSING SOIL QUALITY

Soil quality is an assessment of how well soil performs all of its functions.

**It cannot be determined by measuring only crop yield, water quality, or any other single outcome**

**The quality of a soil is an assessment of how it performs all of its functions now and how those functions are being preserved for future use**

**Soil quality cannot be measured directly, so we evaluate indicators.**

**Indicators are measurable properties of soil or plants that provide clues about how well the soil can function. Indicators can be physical, chemical, and biological characteristics.**

**Useful indicators :**

- are easy to measure
- measure changes in soil functions
- encompass chemical, biological, and physical properties
- are accessible to many users and applicable to field conditions
- are sensitive to variations in climate and management

**Indicators can be assessed by qualitative or quantitative techniques. After measurements are collected, they can be evaluated by looking for patterns and comparing results to measurements taken at a different time or field.**

# Indicator

## PHYSICAL

Soil structure

Depth of soil

Infiltration and bulk density

Water holding capacity

## Relationship to Soil Health

Retention and transport of water and nutrients

Habitat for microbes

Estimate of crop productivity potential

Compaction, plow pan, water movement

Porosity

Workability



# Indicator

## CHEMICAL

pH

Electrical conductivity

Extractable N-P-K

## Relationship to Soil Health

Biological and chemical activity thresholds

Plant and microbial activity thresholds

Plant available nutrients and potential for N and P loss.

# Indicator

## BIOLOGICAL

Microbial biomass C and N  
Potentially mineralizable N  
Soil respiration.

## Relationship to Soil Health

Microbial catalytic potential and repository for C and N  
Soil productivity and N supplying potential  
Microbial activity measure

# Indicator

## **Soil Organic Matter (SOM)**

### Relationship to Soil Health

Soil fertility  
Structure  
Stability  
Nutrient retention  
Soil erosion.

# **SOIL QUALITY IS NOT AN END IN ITSELF**

The ultimate purpose of researching and assessing soil quality is not to achieve high aggregate stability, biological activity, or some other soil property.

**The purpose is to protect and improve long-term productivity, water quality, and habitats of all organisms including people.**

We use soil characteristics as indicators of soil quality, but in the end, soil quality must be identified by how it performs its functions.

## **MANAGING FOR SOIL QUALITY**

Each combination of soil type and land use calls for a different set of practices to enhance soil quality. Yet, several principles apply in most situations.

# MANAGING FOR SOIL QUALITY

## 1. Add organic matter.

Regular additions of organic matter are linked to many aspects of soil quality.

How?

Organic matter may come from crop residues at the surface, roots of cover crops, animal manure, green manure, compost, and other sources.

Organic matter, and the organisms that eat it, can improve water holding capacity, nutrient availability, and can help protect against erosion.

## MANAGING FOR SOIL QUALITY

### 2. Avoid excessive tillage.

Tillage has positive effects, but it also triggers excessive organic matter degradation, disrupts soil structure, and can cause compaction.

## MANAGING FOR SOIL QUALITY

### 3. Carefully manage fertilizer and pesticide use.

Fertilizer can increase plant growth and the amount of organic matter returned to the soil

They can harm non-target organisms and pollute water and air if they are mismanaged

Manure and other organic matter also can become pollutants when misapplied or over-applied

## MANAGING FOR SOIL QUALITY

### 4. Increase ground cover

Bare soil is susceptible to wind and water erosion, and to drying and crusting

Ground cover protects soil, provides habitats for larger soil organisms, such as insects and earthworms, and can improve water availability

Cover crops, perennials, and surface residue increase the amount of time that the soil surface is covered each year



## MANAGING FOR SOIL QUALITY

### 5. Increase plant diversity

Each crop contributes a unique root structure and type of residue to the soil.

A diversity of soil organisms can help control pest populations, and a diversity of cultural practices can reduce weed and disease pressures.

How?

Diversity across the landscape and over time can be increased by using buffer strips, small fields, contour strip cropping, crop rotations, and by varying tillage practices.

Changing vegetation across the landscape or over time increases plant diversity, and the types of insects, microorganisms, and wildlife that live on your farm.



Erosion

Sediment Deposition on Cropland



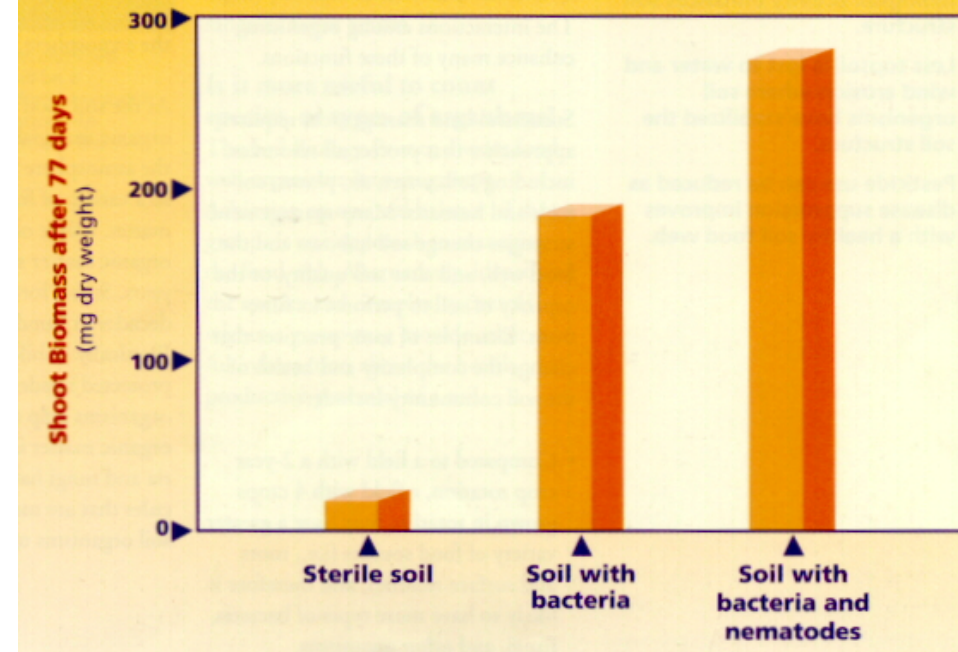
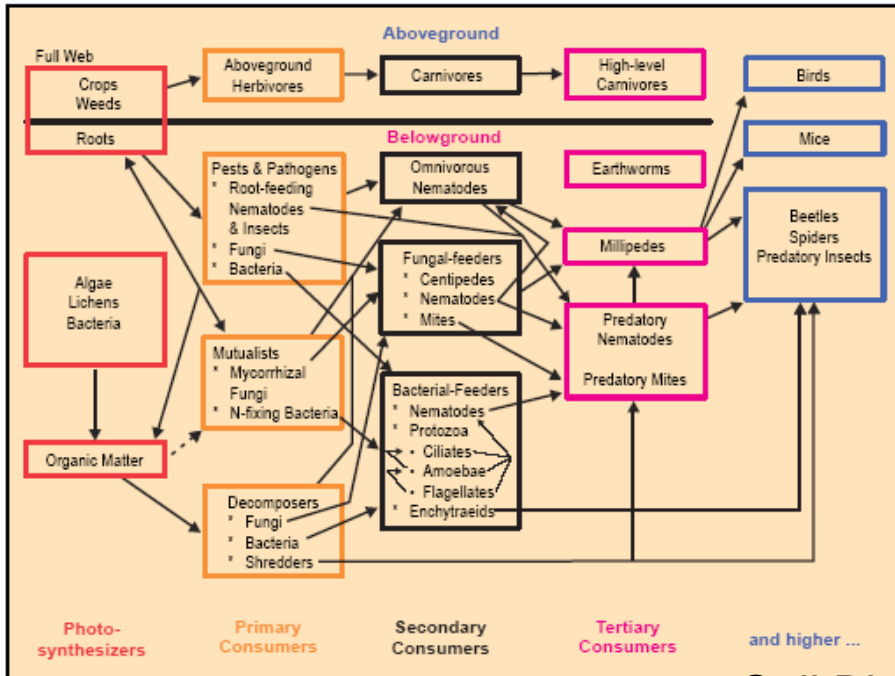




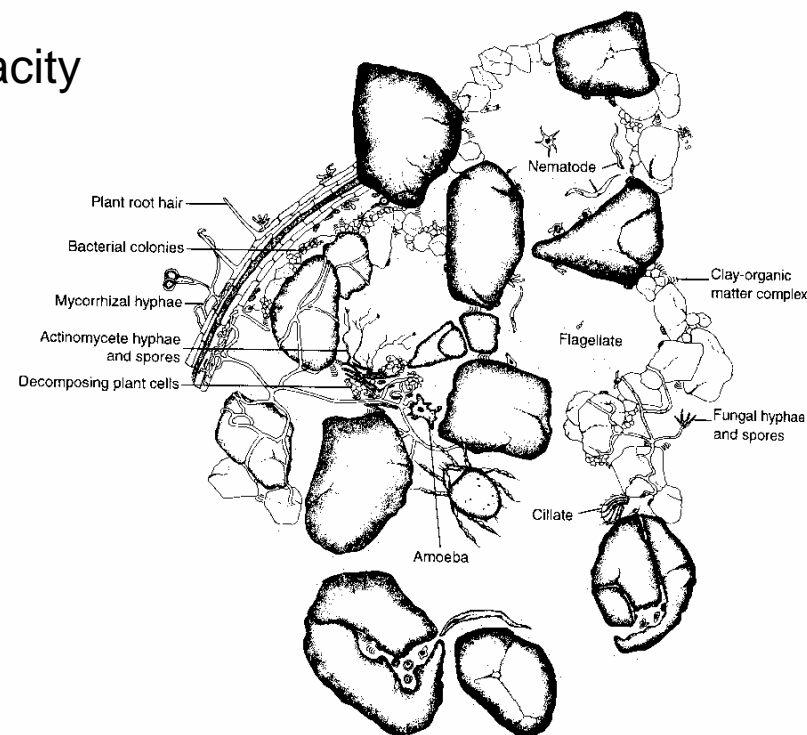
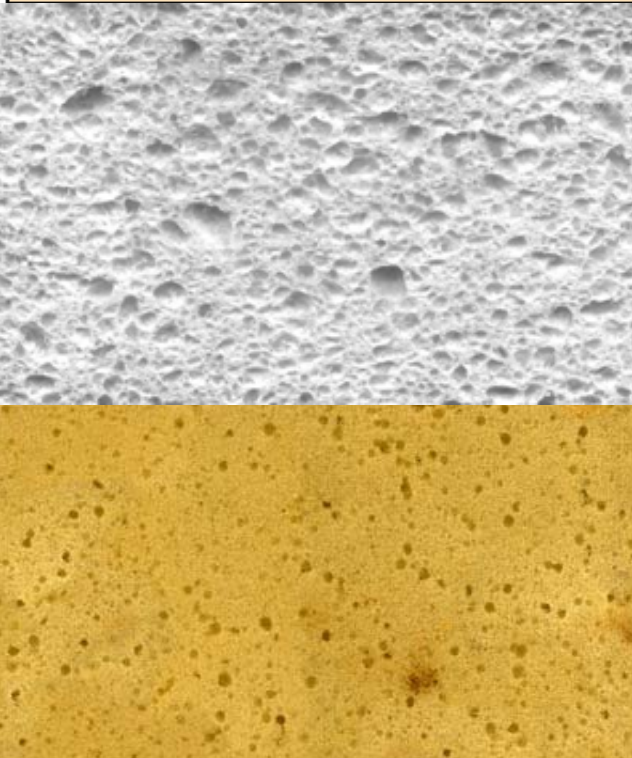
## Compaction Salinization







## Soil Biodiversity Available Water Capacity





Pesticides

Hydrophobicity



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