Soil Quality Concepts

Overview

Soil quality is how well soil does what we want it to do. More specifically, 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. Soil Organic Matter and Soil Biology play a major role in soil quality.

People have different ideas of what a quality soil is. For example:

- 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 present and future generations;
- 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 Soil Does

Healthy soil gives us clean air and water, bountiful crops and forests, productive rangeland, diverse wildlife, and beautiful landscapes. Soil does all this by performing five essential functions:

- 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.

The Inherent and Dynamic Qualities of Soil

Soil has both inherent and dynamic qualities. Inherent soil quality is a soil's natural ability to function. For example, sandy soil drains faster than clayey soil. Deep soil has more room for roots than soils with bedrock near the surface. These characteristics do not change easily.

Dynamic soil quality is how soil changes depending on how it is managed. Management choices affect the amount of soil organic matter, soil structure, soil depth, water and nutrient holding capacity. One goal of soil quality research is to learn how to manage soil in a way that improves soil function. Soils respond differently to management depending on the inherent properties of the soil and the surrounding landscape.

Soil Quality Link 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 is sustainable.

Assessing Soil Quality

Soil quality assessment is the process of measuring the management induced changes in soil as we attempt to get soil to do what we want it to do. The ultimate purpose of assessing soil quality is to provide the information necessary to protect and improve long-term agricultural productivity, water quality, and habitats of all organisms including people.

Managing for Soil Quality

Managing soil to improve soil quality entails the use of conservation practices that improve soil function. In general, practices that reduce disturbance, increase crop diversity, and efficiently cycle nutrients, water and energy will accomplish this.

Research Potential

Most soil quality research is motivated by one of two goals:

1. improving land management on farms and watersheds, or
2. monitoring soil at a national or regional scale.

The first goal involves site-specific assessment and decision-making, so the link between researchers and farmers is important to the success of the research.

Most research attempts to identify the links among management practices, observable soil characteristics (i.e. soil quality indicators), soil processes (e.g. nutrient cycling), and the performance of soil functions (e.g. productivity and environmental quality). A single study may examine only one or two of these links.

Some important directions for future research include:

- measuring the spatial and temporal variability of soil characteristics, and using patterns of variability as an indicator of soil quality,
- further defining the characteristics of a healthy soil biological community, and approaches to managing soil biology,
- describing and managing changes during the transition time when farmers switch from one set of practices to another,
- improving nutrient cycling by managing soil biology, and
- identifying low-cost remote techniques for monitoring soil quality regionally.

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 agricultural 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.