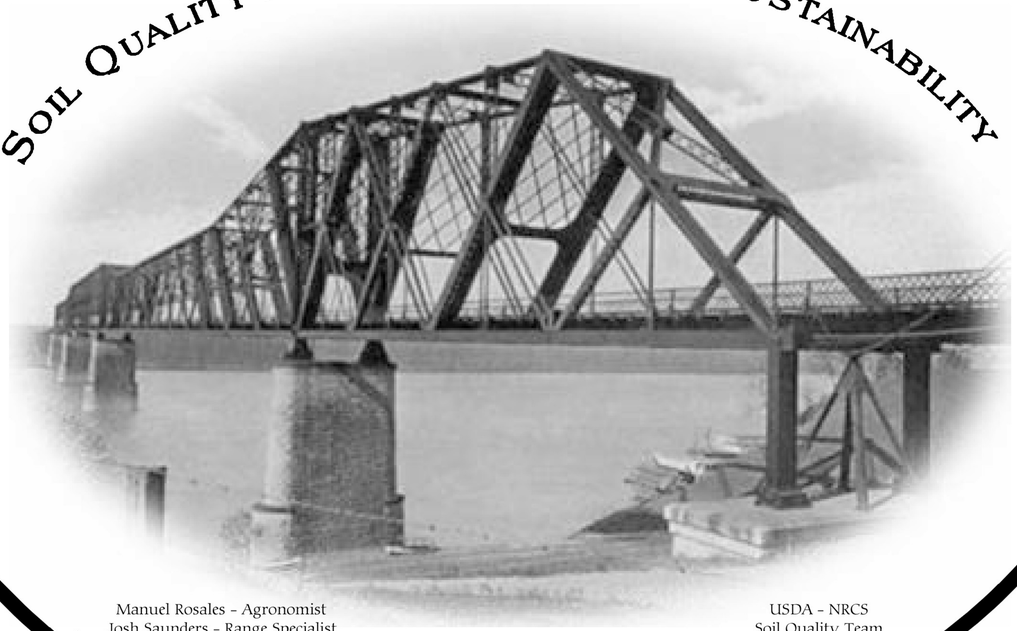
Soil Quality as an Indicator of Sustainability



Manuel Rosales - Agronomist
Josh Saunders - Range Specialist
Mike Sucik - Soil Quality Specialist

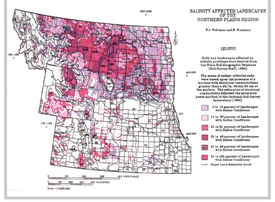
USDA - NRCS
Soil Quality Team
Akron, Colorado

Soil Degradation

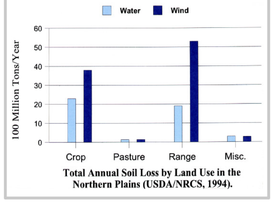
Long-term soil degradation has been and continues to be costly in terms of agricultural productivity and environmental impact. Deterioration of soil quality diminishes soil productivity by reducing the soil's ability to supply plant-available nutrients and water, and by creating poor plant growth conditions. Soil degradation fosters sedimentation through accelerated erosion and surface and groundwater contamination due to increased need for chemical fertilizers and pesticides.

Loss of organic matter by erosion and decomposition, decline in nutrient supplying capacity, destruction of aggregation and porosity, acidification, and salinization are some examples of soil degradation.

Improper water management is a main cause of salinization.



Soil quality can be degraded by wind and water erosion.



Total Annual Soil Loss by Land Use in the Northern Plains (USDA/NRCS, 1994).

Effect of Cultivation Length on Soil Properties

Cultivation Length*	Soil Organic Matter	Total N	Sand Content
Year		%	
0	2.00	0.18	63
3	1.20	0.12	71
20	1.10	0.11	71
60	0.75	0.08	79

*Ascalon sandy loam, 0-15 cm
Data from R.A. Bowman et al., USDA/ARS, Central Great Plains Research Station, Akron, Colorado.

Organic matter reduction due to cultivation is significant when compared to native condition.

Soil Quality

- Soil quality has been defined as "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."
- Soils impact global climate and air and water quality by providing functions such as filtering, buffering, decomposition of organic and inorganic materials, and the exchange of gases with the atmosphere.
- The quality of a soil is determined by assessing its physical, chemical, and biological properties and comparing them to the soil's inherent capacity to function.

Assessment

- Assessment of soil quality is essential in determining the sustainability of land management systems.
- It takes about 100 to 400 years to form 1 cm of topsoil through the interaction of climate, topography, living organisms, and mineral parent material.
- Soil quality alone is not of much value unless it is used to evaluate land management and the assessment leads to practices that will support a sustainable system.
- Assessment is done by measuring several indicators such as organic matter, soil nitrate levels, soil reaction (pH), infiltration, compaction, etc.

Interpretation

- Interpretation of soil quality assessment should be evaluated from a holistic standpoint.
- Evaluation of change in one indicator is interrelated to changes in other indicators: the loss of organic matter reduces soil fertility and degrades soil structure.
- On-site baseline data set is needed to complete any interpretation and monitoring of soil quality.
- Once soil condition is identified, soil improvement practices can be applied.
- An agroecosystem is sustainable when soil quality trends are steadily maintained or improved and is economically viable.

Soil Improvement

Understanding properties and processes that affect soil quality can guide producers in management decisions and practices that will maintain or improve the soil resource.

As soil quality is improved, a better quality of life can be recognized through cleaner air and water, a reduced dependence on fossil fuels, and the comfort of recognizing that the soil resource is being sustained for future generations.

Diverse crop rotations reduce dependence on fossil fuels.

Reduced tillage improves biological, chemical, and physical soil properties.

Improved soil translates to higher production and increased profits.

Sound livestock management improves pasture, soil, air, and water quality.

Soils are the foundation of a healthy community.

Air and water are enhanced when soil quality is improved.

Quality soil produces quality food.

USDA NRCS Natural Resources Conservation Service

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