

DEFINITIONS OF SOIL HEALTH: THE IMPORTANCE OF LANGUAGE

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Healthy soil is that which allows plants to grow to their maximum productivity without disease or pests and without a need for off-farm supplements. Healthy soil is teeming with bacteria, fungi, algae, protozoa, nematodes, and other tiny creatures. Those organisms play an important role in plant health.¹³

"Healthy soils" means soils that enhance their continuing capacity to function as a biological system, increase soil organic matter, improve soil structure and water- and nutrient-holding capacity, and result in net long-term greenhouse gas benefits.¹⁵

Soil health is an assessment of the ability of a soil to meet its range of ecosystem functions as appropriate to its environment. Also refers to the condition of the soil, including its ecosystems (minerals, nutrients, and microbial activity), pH, and structure.⁸

Producers prefer "soil health", which portrays soil as a living, dynamic organism that functions holistically rather than an inanimate mixture of sand, silt and clay" and that "Soil scientists prefer "soil quality", which describes quantifiable physical, chemical and biological characteristics.¹⁰

Healthy, fully functioning soil provides an environment that sustains and nourishes plants, soil microbes and beneficial insects.²

SOIL HEALTH, also referred to as soil quality, is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.¹

"Soil health" means the overall composition of the soil, including the amount of organic matter stored in the soil, and the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.¹⁶

Soil physical, biological and chemical properties work together to influence the health of a soil and its ability to function as a living productive ecosystem that sustains plants, animals and humans.⁵

Soil health, or quality, is the soil's fitness to support crop growth without resulting in soil degradation or otherwise harming the environment.⁹

Soil health is defined as the suite of biological, chemical, and physical properties and which enable soils to function as a vital living ecosystem that sustains all life above and underneath the soil surface.⁴

Soil health is the capacity of soil to function as a living system, with ecosystem and land use boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and promote plant and animal health. Healthy soils maintain a diverse community of soil organisms that help to control plant disease, insect and weed pests, form beneficial symbiotic associations with plant roots; recycle essential plant nutrients; improve soil structure with positive repercussions for soil water and nutrient holding capacity, and ultimately improve crop production.³

Another definition that is embraced by many is the improved function in terms of crop yield response to inputs, such as fertilizer efficiency.¹¹

Besides being the main medium for crop growth, soil functions to sustain crop productivity, maintain environmental quality, and provide for plant, animal, and human health. The terms *soil quality* and *soil health* describe the soil's ability to perform these critical functions. Soil quality or health is generally seen as the foundation of successful organic vegetable crop production systems.⁶

In its broadest sense, soil health can be defined as the ability of soil to perform or function according to its potential, and changes over time due to human use and management or to natural events.¹⁴

Soil health is established through the interactions of soil's physical, chemical, and biological, properties.⁷

Soil quality can be conceptualized as a three-legged stool, the function and balance of which requires an integration of three major components — sustained biological productivity, environmental quality, and plant and animal health. The concept attempts to balance multiple soil uses (e.g., for agricultural production, remediation of wastes, urban development, forest, range, or recreation) with goals for environmental quality.¹²

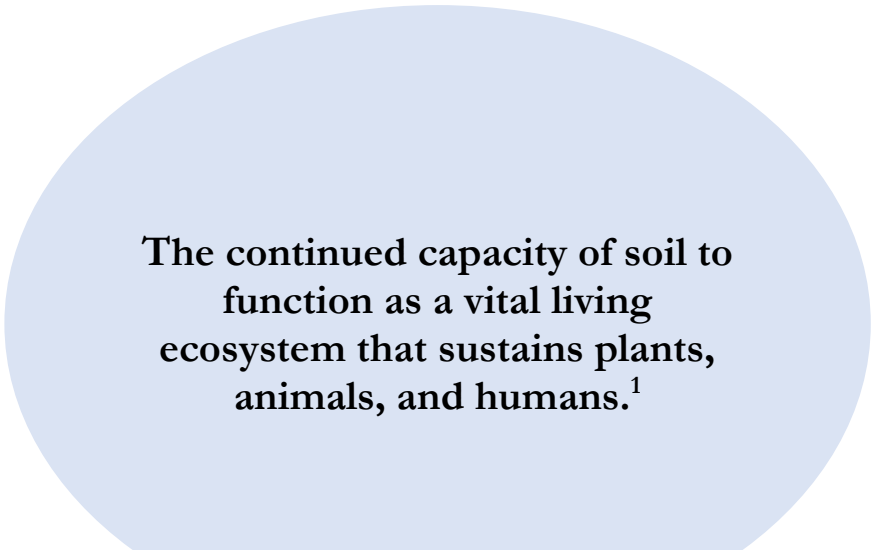
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1. National Resources Conservation Service (NRCS): “Soil Health.” The sources that reference this exact definition are: University of Minnesota "Optimizing soil health using Kernza during organic transition period", and Michigan State University "What is your definition for soil health?". There are other variations of this definition that change a few words or phrases. For example, White Buffalo Land Trust uses the definition, but excludes the phrase, “also referred to as soil quality”.
2. NRCS: “Unlock the Basics of Soil Health” flyer. This is another definition by the NRCS that is also referenced by The Washington State Soil Health Committee: “About Soil Health” web page.
3. Food and Agriculture Organization of the United Nations (FAO): “What is a healthy soil?” page. FAO references a definition by Pankhurst et al. (1997) which is similar to the NRCS definition referenced [1]. This present definition is their remodeling of the cited definition, after building on it at a workshop in 2008: “An international technical workshop Investing in sustainable crop intensification The case for improving soil health.”
4. North Central Region Soil Health Nexus: “Soil Health 101.” This definition contains similar phrases as the NRCS [1] definition but is reorganized.
5. North Central Region Soil Health Nexus on a different web page than [4]: “Soil Health Nexus Toolbox Grows with Additional Resources.” This definition also takes pieces from the NRCS [1] one.
6. UC Davis Agricultural Sustainability Institute: “Soil Management and Soil Quality for Organic Crops” page.
7. UC Santa Cruz Center for Agroecology & Sustainable Food Systems: “Managing Soil Health.” Provides reference to NRCS and gives a link to this definition and cites the authors Doran and Parkin (1994) for a definition that is similar to the NRCS [1] one.
8. The Ohio State University College of Food, Agricultural, and Environmental Sciences “Soil Terminology and Definitions” list. Following this definition is a reference to how the Soil Science Society defines soil health that is similar to the NRCS definition [1]. This list also includes “soil quality” separately but says the two can be used interchangeably and gives a definition for soil quality that is similar to the NRCS definition [1] of soil health as well.
9. Agriculture and Agri-food Canada: “Soil Health: A Definition.” This definition is mentioned in this comparison between the United States and Canada. It comes from a book in 1995 called “The health of our soils – Toward sustainable agriculture in Canada.” And is noted by Agriculture and Agri-food Canada in the section titled “Canadian History.” This section also notes that the book states that the terms “Soil health” and “soil quality” are used interchangeably.
10. Agriculture and Agri-food Canada – “Soil Health: A Definition.” This definition is also mentioned in a comparison between the United States and Canada on the “Soil Quality vs Soil Health” page. They specify what people prefer which term and give definitions for both. They continue to provide reference to Doran and Parkin (1994) and their definition that is similar to the NRCS [1] one.
11. Michigan State University "What is your definition for soil health?" referenced the exact NRCS [1] definition above and then added this definition that they claim is referenced a lot.
12. D.L. Karlen, et al., Soil Quality: A Concept, Definition, and Framework for Evaluation (A Guest Editorial), Soil Science Society of America Journal (1997). This definition is for “soil quality.”
13. Rodale Institute. This is a different and more specific definition than most of the other sources and with no outside references to the larger organizations.
14. Pankhurst et al., Biological Indicators of Soil Health (1997). This provides a general definition from the authors who are referenced [3] and have provided another definition that is similar to the NRCS definition. This similar definition will be discussed in the paragraphs following.
15. Hawaii State Policy: HB 1578 Relating to Climate Change. This climate change legislation in Hawaii gives a good look at how soil health may be defined in policy and how these definitions may factor into the requirements of the policy.
16. Illinois State Policy: HB 2737 Amends the Soil and Water Conservation District. This is another example of a soil health definition used in legislation, and this one actually is very similar to the NRCS [1] definition.

Impact of Definition Inconsistency

As displayed by the various definitions in the chart above, there are many potential ways to interpret “soil health.” The definition may vary by project, organization, or the context in which it is used. While it may serve organizations well to alter a definition to better fit their goals or purposes, it may also cause some communication and comprehension issues. When it comes to creating a healthier environment, language can serve as an important tool for scientists and policymakers to establish plans of action. However, if there are inconsistencies within definitions for certain terms it may cause confusion and miscommunication. Understanding language is crucial for enacting environmental programs and change heading forward.

Resembling Definitions



The continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.¹

The capacity of a 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 quality is analogous to soil health.³

The capacity of soil to function as a vital living system, within ecosystem and land use boundaries, to sustain biological productivity, promote the quality of air and water environments, and maintain plant, animal, and human health.²

1. NRCS
2. FAO
3. The Ohio State University College of Food, Agricultural, and Environmental Sciences

Based on this research, many definitions have overlapping phrases and terminology but are not exactly the same. Others are even identical except for a few words, yet even these small changes can lead to confusion. One of the most referenced definitions was found on the NRCS website and is also found on other sources, referencing different authors, and with slight changes in the wording. These three definitions in the above figure are all very similar in word use and upon reading them, one would think that they are saying the exact same thing. However, these all three come from different sources that provide different interpretations and contexts.

Definition 1

The first definition is from the NRCS website, which is also included in the chart above. The NRCS definition is referenced by many other sources included in the chart above, but while they reference the organization, they don't always use this exact definition that appears on the site. Some will use one of the other two definitions below.

Definition 2

Unlike the first and third definitions, the second definition in this chart does not use the terms "soil health" and "soil quality" as synonyms. This definition comes from the Food and Agriculture Organization of the United Nations. This definition was used by this organization to build on and add their own variations after a workshop. They referenced the authors Pankhurst et al. (1997) and credited them with this definition. While this definition is very similar to the NRCS one, and may be the basis of the NRCS one, the FAO points out parts of the definition to say that these aspects differentiate "soil health" from "soil quality" with this present definition representing "soil health." They state that the "continued capacity" aspect and the "as a vital living system" aspects, acknowledging a time component and significance of soil biota are what differentiate "soil health" from "soil quality." It is interesting that FAO specifically states that this definition highlights a distinction between "soil health" and "soil quality". NRCS, on the other hand, has a very similar definition, but states that the two terms are synonymous.

Definition 3

The third definition above also states that "soil health" and "soil quality" are analogous. Not only are there different versions of very similar definitions, but some organizations have conflicting opinions on the terminology used, as shown with these three examples. The debate about whether "soil health" and "soil quality" are synonymous is not unique to these few organizations and examples. Many other sources established their specific view on if the two phrases are synonymous or not. Pankhurst et al. (1997) sheds some light on the why some people prefer one term over the other: "Some prefer the term soil health because it portrays soil as a living, dynamic organism that functions holistically rather than as an inanimate mixture of sand, silt, and clay. Others prefer the term soil quality and descriptors of its innate quantifiable physical, chemical and biological characteristics."²

CONCLUSION

Establishing a concrete definition for a concept that may be subjective and constantly evolving can pose a challenge. The definitions may depend on the type of organization and what its goals are, for example, which is why when cross-searching definitions one may find conflicting results. Even within organizations there can be conflicting definitions, or more than one statement provided, as shown in the first figure with North Health Regional Soil Nexus having web pages with different definitions and the NRCS having one definition on their "Soil Health" web page and a slightly different definition in an educational flyer that they created. While these definitions may seem like they mean the same thing, this research has shown how very similar definitions or terms can be interpreted differently. Ultimately, the variety of interpretations offers as much opportunity as it does confusion. Certainly, it may lead to confusion when a concrete definition provides the clarity that would best serve scientific and legislative needs. However, having multiple definitions may also provide opportunities for growing and expanding the interpretations, as well as potentially considering contributing factors to soil health that have not been expressed in prior definitions. If there was just one established universal definition, it may limit further research into soil health factors, but the complexity of having a variety of definitions illuminates the pathway towards deeper understanding of soil health. As the natural world changes and evolves, the terms and ways that we define it must evolve as well to provide the most accurate understanding that ultimately leads to better science and policy.

² Pankhurst et al., "Biological Indicators of Soil Health," 1997, https://www.isprambiente.gov.it/files/biodiversita/Pankhurst_1997_Biological_indicators.pdf.