

## **Soil organic matter: catalyst of soil health**

**Henry Janzen, Ed Gregorich, Ben Ellert, and Bobbi Helgason**

Agriculture and Agri-Food Canada

Soils are the universal medium for capturing, by photosynthesis, the solar energy that fuels all terrestrial ecosystems and human societies. Sustaining their productivity – this continuing stream of solar energy – has therefore been a longstanding goal of land stewardship, an aim implicit in the emerging concept of ‘soil health’. Our objective is to define ‘soil health’, by reviewing the origins of this metaphorical concept, and then to explore the prominent role of soil organic matter (SOM) in fostering ‘soil health’ as here defined.

Drawing on the literature, we define ‘soil health’ as the vitality of a soil to sustain the social and ecological functions of its enfolding land (ecosystem). Thus, health of a soil is determined not by specific attributes, but by performance: its capacity to promote multiple functions, including societal services as well as underlying ecological processes. The functions considered, further, are those of the ecosystem as a whole, not of the soil in isolation, which means that the health of a soil can only be assessed within its ecological and social setting. And, inevitably, ‘health’ explicitly invokes the dimension of time – a ‘sustained’ capacity to perform functions, despite inevitable disturbances, conferring resilience.

Soil organic matter has long been recognized as crucial to soil health and its ancestral concepts, largely because of its link to productivity and agricultural yield. Now, however, the number of land functions considered has expanded, encompassing also other services such as preserving biodiversity, filtering air and water, and regulating climate. These and other functions, we hypothesize, are affiliated closely with soils’ capacity to direct the flow of carbon (solar energy) into and through the land or ecosystem. If so, the health of a soil can be equated to its capacity to promote capture of solar energy via photosynthesis, dispense the flow of this energy efficiently through the ecosystem, and hold a store of energy in reserve for resilience. Preserving health, then, means ensuring the proper balance of SOM turnover (energy flow) and SOM stocks (energy storage) to support the desired functions of a given ecosystem, now and into the future. This perspective may offer unifying insights that help advance SOM science by elevating its integrative role in identifying and resolving stresses in the biosphere.