



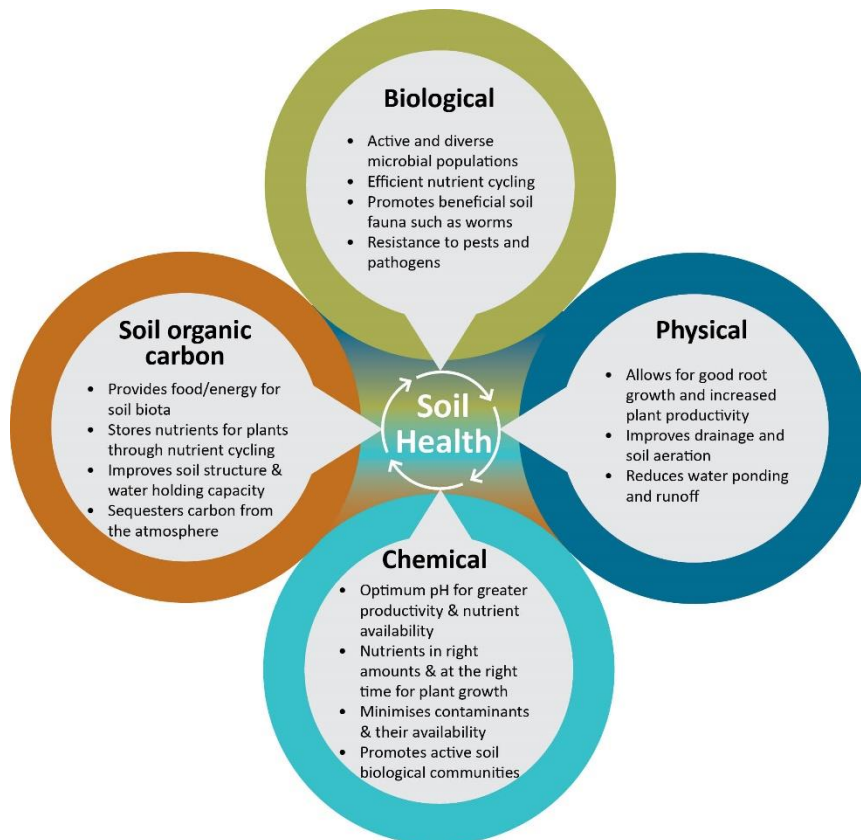
# SOIL HEALTH FACTSHEET

## What is Soil Health?

This factsheet is part of a series on Soil Health that provide summarised information on a wide range of soil related topics. The characteristics, benefits and management practices necessary for a healthy soil are summarised in this factsheet along with social and Te Ao Māori perspectives on soil health.

### Healthy soil characteristics and best practice guidelines

Soil health is defined as "*the continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans*" (Doran & Zeiss 2000). Soil health seeks to maintain or improve the different functions that soils perform. These functions can include retention and cycling of nutrients, climate regulation, and supporting biodiversity as well as production of food and forage (which also benefit from maintaining the other soil functions).



Maintaining soil health involves addressing the biological, physical and chemical components of the soil (Fig. 1). Soil organic carbon (SOC) has often been considered in conjunction with the biological component, but its prominence has grown and so we now consider SOC as a separate component of soil health.

### Characteristics of a 'healthy' soil

- Cycles nutrients effectively
- Provides good aeration to promote root growth
- Regulates the flow of water and rainfall in the water cycle
- Reduces runoff and erosion
- Resilient to drought, heavy rainfall events, and temperature extremes
- Resilient to disease and pest problems
- Contains a well-rounded microbial community

### Best management practices for a healthy soil

Soil properties vary depending on the complexity and site-specificity of the soil, prior land use, and trade-offs between the services they provide for humans, plants and animals. Soils are dynamic systems that can change over time but there are a range of best management practices that can be implemented to improve the chemical, physical, biological and soil organic carbon components of soil (Table 1). These are the most recommended best management practices, but others (including regenerative agriculture) are being investigated.

**Table 1. Management practices for improving the biological, soil organic carbon (SOC), physical and chemical components of soil (adapted from BBRO & AHDB<sup>1</sup> 2021)**

Component	Management practices for a healthy soil
Chemical	<ul style="list-style-type: none"> <li>• Maintain optimum pH by liming (or otherwise adjusting pH) when necessary</li> <li>• Apply the right amount of nutrients in the right place at the right time</li> <li>• Know soil textures and minerals (impacts inherent soil characteristics as described later in the document)</li> </ul>
Physical	<ul style="list-style-type: none"> <li>• Know soil textures and understand limits to workability and trafficability</li> <li>• Optimise water balance</li> <li>• Minimise compaction and pugging</li> <li>• Reduce erosion</li> <li>• Improve soil structure by maintaining soil carbon levels, root activity and soil biota activity such as worms</li> </ul>
Biological & Soil organic carbon	<ul style="list-style-type: none"> <li>• Maintain plant cover (and active root growth) that supplies carbon below ground and feeds soil biota</li> <li>• Diversify plants in space and time</li> <li>• Disturb or till soil only when necessary</li> <li>• Maintaining good soil chemical and physical conditions also helps to support soil biology and carbon cycling</li> </ul>

<sup>1</sup> British Beet Research Organisation (BBRO) & Agriculture and Horticulture Development Board (AHDB), (2021). Great Soils: Principles of soil management.  
<https://projectblue.blob.core.windows.net/media/Default/Imported%20Publication%20Docs/AHDB/GREATsoils/Principles%20of%20soil%20management.pdf>

Regardless of the land use, there are three basic soil health practices that are generally recommended (see Fig.2):

- 1) **Minimise disturbance and tillage of the soil**
- 2) **Increase soil cover to minimise bare ground**
- 3) **Increase plant diversity through diversifying rotations and/or species planted (which in turn increases soil fauna and microbe biodiversity)**

Minimising soil disturbance and protecting the soil surface from erosion helps to increase soil stable aggregates and organic matter which will increase water infiltration, storage, drainage and the nutrient holding capacity of the soil. Increasing soil health and plant biodiversity encourages the diversification of soil fauna and microbes which can lead to more nutrient cycling, an increase in organic matter and less likelihood of pests and diseases needing to be managed.

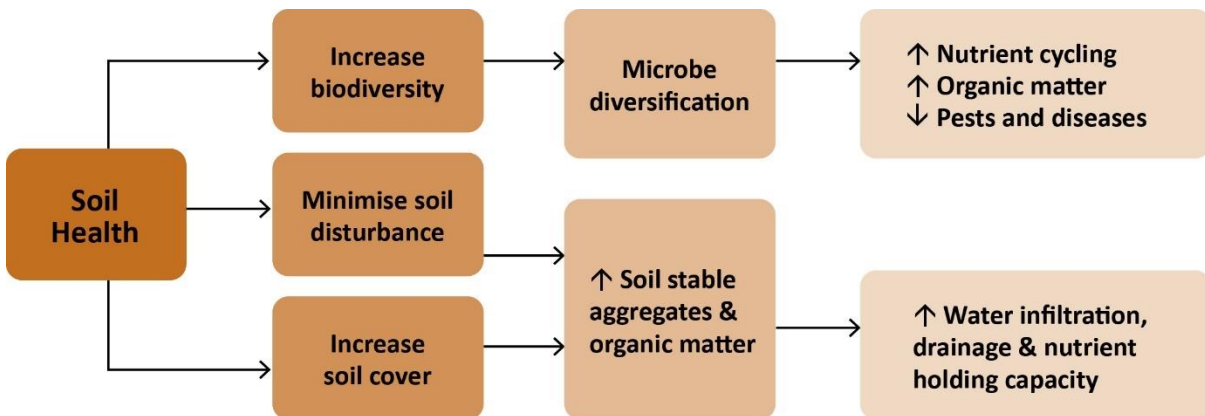


Figure 1 The effects of different soil functions on three basic soil health practices

### Inherent and dynamic soil properties

Certain properties of soil that undergo little or no change in response to land use are referred to as **inherent properties** e.g., soil texture, type of clay, depth to bedrock. Some inherent properties (for example slowly draining soils) make some soils less desirable for certain activities, though these soils are not necessarily less healthy than other soils. Alternatively, properties that are affected by land management practices over time are referred to as **dynamic properties**. The dynamic properties of soil include the amount of soil organic matter, the biological activity, and the nutrient content of the soil. Dynamic properties can also modify the soil structure, and the soil's ability to hold water and nutrients. Changes in dynamic properties (resulting from land management practices) are the primary reason for soil health being enhanced, maintained or degraded (Fig 3.).

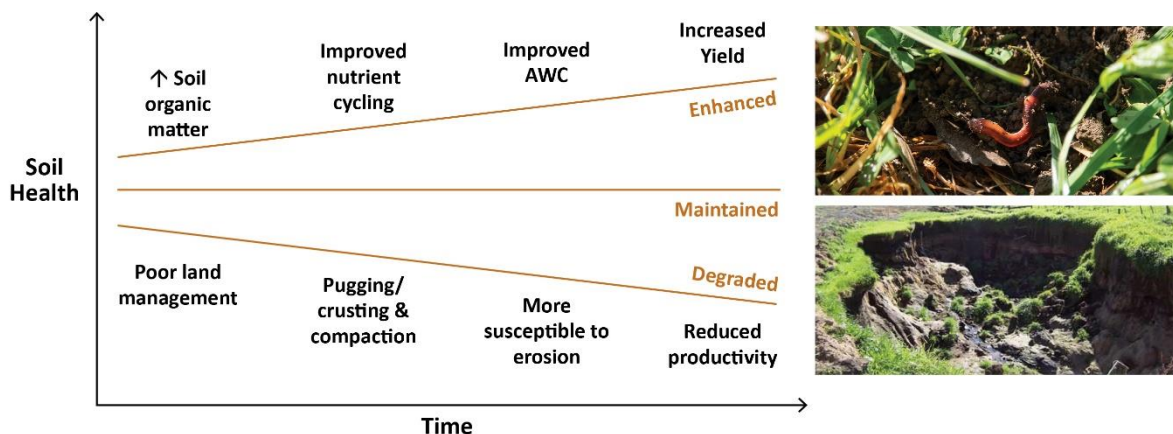


Figure 3. Dynamic properties that change soil health over time [AWC = Available water capacity]

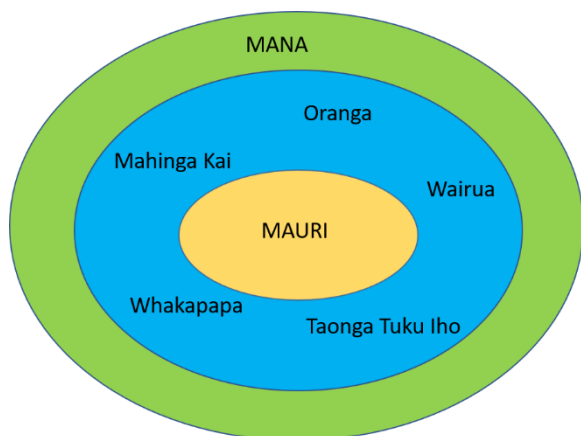


## Social perspectives on soil health

Soil is fundamental to human and societal well-being and globally there is increasing demand being placed on soil as a resource and for farmers to grow more food more sustainably. To sustainably manage soils, a more holistic well-being approach to soil policy is needed, one that goes beyond the instrumental values of soils which is currently the predominant western-centric, ecosystem services' perspective. Many indigenous cultures, including Te Ao Māori take a more integrated, holistic approach to soil health where people, soil and the environment are interconnected.

In Aotearoa-New Zealand (A-NZ), the connection between soil health and human wellbeing does not generally have a high profile. People see and value soil(s) in different ways so if we understand the multiple knowledges and the diverse ways people value soils, soil ecosystems and the environment, New Zealand's soils are more likely to be better managed, protected, sustained and enhanced for future generations. Soil health and wellbeing policies that include social indicators of soil, for example, the uptake of composting or the establishment of community gardens in urban environments, could lead to improved management and decision-making of land resources and soils in A-NZ (Stronge et al. 2020).

## Soil health from a Te Ao Māori perspective



For Māori, soil has mana and mauri, and people are strongly connected to soil through their whakapapa (ancestry). While there are many emerging definitions of what a healthy soil means for Māori, core values principles were found to include: Whakapapa, Mana, Mauri, Wairua, Taonga tuku iho, Māra kai/Mahinga kai, Oranga, Kaitikaitanga<sup>2</sup> (see Fig. 4 and Table 2).

**Figure 4. Māori core values and principles associated with sustaining a healthy soil**

Incorporating Māori knowledge, values, and perspectives alongside conventional science and other knowledge forms, helps to:

- Empower and inform tangata whenua/iwi/hapū/whānau about soil health, strengthening Māori knowledge (mātauranga Māori) and building capacity
- Inform non-indigenous groups (e.g., stakeholders, councils, Govt) about Māori knowledge, concepts, values, and aspirations for soil health
- Raise awareness of different knowledges, values, perspectives for understanding soil health and the importance of soils
- Show connections and linkages between soil ecosystems and human wellbeing
- Identify, understand, and address a range of soil-related issues
- Inform and guide effective policy and planning
- Enable inclusive land management decisions and actions that achieve desired societal outcomes and promote soil health and wellbeing.

<sup>2</sup> Taken from the Soil health and resilience website <https://www.landcareresearch.co.nz/discover-our-research/land/soil-and-ecosystem-health/soil-health-and-resilience/kaupapa-maori/key-maori-principles/>

**Table 2 Core values/principles integral for understanding soil health from a Te Ao Māori perspective**

<b>Māori core values/principles</b>	<b>Description</b>
Whakapapa	Recognising the ancestral links or lineage of the soil originating from the Māori belief system (Papatūānuku and Ranginui, Te Ao Marama, and Atua (gods, deities, domains)) and links to tangata whenua (e.g., whānau/hapū/iwi). Strengthens understanding of inter-dependencies and inter-connections between ecosystems, plants, animals and humans,
Mana	Power, prestige, and authority of the soil, elevating the importance and prestige of the soil resource, and the mana, authority and responsibilities of human beings to govern, protect and manage the soil resource in accordance with local tikanga and kawa (customs and values). Recognises the Treaty of Waitangi – Te Tiriti o Waitangi as an over-arching framework to reinforce this mana.
Mauri	Life force or energy, vitality and continued capacity of a soil to sustain/support healthy living ecosystems, along with human wellbeing e.g., a well-functioning soil ecosystem has the capacity to maintain inter-connections between the physical, chemical, biological components of soil, plants, animals, microbes, and people and restore balance to the system.
Wairua	The spiritual dimension/connection – helps to provide the glue to maintain and strengthen mana and mauri and achieve a healthy soil and human wellbeing, particularly spiritual.
Taonga tuku iho	Soil is a treasure passed down through the generations and has an ancestral lineage and connection. Soil health can be maintained by building inter-generational capacity to care for the soil resource through kaitiakitanga (e.g., values driven guardianship to give wise-land use options that sustain soil health and wellbeing.
Māra kai/ Māhinga kai	Ability of soil to provide healthy food (kai) for sustenance and wellbeing.
Oranga, ora, toiora	Ability of a soil to provide and ensure health and wellbeing of whenua (land), plants, animals and humans A well-functioning soil free of harmful pollutants, contaminants, pathogens, and toxicity.
Kaitiakitanga	Cultural and environmental guardianship, as a responsibility, to protect and manage the environment embracing all the values above.



*Healthy pasture soil in Waimate (MWLR photo archives)*

### References and further reading

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- Stronge DC, Stevenson BA, Harmsworth GR, Kannemeyer RL. (2020). [A Well-being approach to soil health – Insights from Aotearoa New Zealand](#). *Sustainability* 12 (18) 7719. DOI: 10.3390/su12187719

### Contacts

Bryan Stevenson: [Stevensonb@landcareresearch.co.nz](mailto:Stevensonb@landcareresearch.co.nz);  
John Drewry: [Drewryj@landcareresearch.co.nz](mailto:Drewryj@landcareresearch.co.nz)

### Website

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