



SUSTAINABLE SOILS IN NORTH QUEENSLAND

SOIL HEALTH FOR GRAZING

WHAT IS SOIL HEALTH?

People are the most important asset in any grazing business—but soil is a close second. Soil underpins the growth of all plants, including pastures and woodlands, but if it's in poor condition then pasture growth, quality and health will be impacted. Therefore as a grazier it is important that you maintain your soil like any other valuable farm asset.

Soil health is a term used to describe the condition of soil and its capacity to support a profitable and sustainable farming enterprise.

Healthy soil is in good condition, with key physical, chemical and biological properties in reasonable balance for the soil type. These key properties include groundcover, soil structure and level

of organic matter. Healthy soil cycles nutrients effectively, maintains its structure, and is important for healthy landscapes and catchments.

Soil health is not the same as soil fertility, which refers to the level of available nutrients in soil. A paddock may have a high level of nutrient fertility due to the land type, however, if the soil is unhealthy then pastures won't be able to use these nutrients effectively.

There are two key aspects to soil management: managing your soil's health and managing its nutrients. The two are interconnected but you need to manage soil health or you will not be able to optimise the fertility potential of your various land types.



Fungus plays a critical role in organic matter decay and nutrient cycling



Grazing expert Judi Earl demonstrates the relationship between soil structure and root development



Soil tests can help you understand your soil



Well structured soil allows root growth as well as air and water movement



Planned grazing practices involve pasture monitoring

WHY IS SOIL HEALTH IMPORTANT?

Soil health is important because your soil asset is the foundation of a productive and profitable grazing enterprise. When your soil is healthy and performing well, you will achieve a number of positive outcomes for your grazing business.

Improves soil water dynamics

Groundcover, plant roots, soil organic matter and soil organisms contribute to soil structure in grazing landscapes. Well structured soil has good porosity, assisting the flow of both air and water. Soil with good structure will have higher water infiltration during rain events compared to compacted soil. *Research shows infiltration can*

be over five times higher in healthy soils¹. Well-structured soil also stores a greater volume of plant-available water compared to compacted soil, and keeps pastures green for longer after rain.

Stores and cycles nutrients efficiently

Research indicates that good soil health is necessary for nutrients to cycle effectively in grazing landscapes. This applies to both high and low fertility land types. Healthy soil with adequate levels of organic matter, biological activity and root biomass, cycles nutrients readily. Pasture plants are more likely to use available nutrients and this may lead to better quality feed.

Provides optimal conditions for plant growth and health

Perennial grasses growing in healthy soil have more chance of reaching their annual growth potential. They will have vigorous root systems that can take up nutrients in a balanced way in partnership with beneficial soil microbes. Research indicates that periodic wet season spelling every third or fourth year is needed to allow pasture plants to recover and rebuild root systems. Overstocking and lack of rest periods can lead to poor soil health, compaction, low levels of organic matter and low ground cover. This can reduce land condition and affect long term carrying capacity.



Soil organic matter is critical for healthy soils and pastures

KEY SOIL HEALTH PROPERTIES

Soil is a complex system that has chemical, biological and physical characteristics. Some important key soil health properties are outlined in the table below:

Physical Properties	
Structure	Structure is the way that the physical soil particles are arranged together into aggregates or crumbs. Ideally, these aggregates will be in a range of sizes. Between them are air spaces also known as soil pores. Healthy soil is porous and aerated, which means that rainfall infiltrates well, beneficial soil organisms thrive, and plant roots grow effectively.
Bulk Density	Bulk density measures the weight of soil against its volume. Dense, compacted soil impacts rainfall infiltration, pasture root growth and air movement.
Chemical properties	
pH	pH indicates the overall balance of acidity or alkalinity in the soil. When pH is too high or too low, nutrients may not cycle effectively and some trace elements may become available at toxic levels.
Soil Salinity	Soil salinity measures the amount of water soluble salts present in the soil. These salts may be from the natural soil chemistry, from fertiliser applications or from irrigation water. When soil is too saline it impacts the yield of pasture plants.
Exchangeable Sodium	This measures the amount of sodium that is exchangeable on the soil's active surface area. High levels of exchangeable sodium result in a sodic soil that usually has poor plant growth and poor structure.
Exchangeable Aluminium	This measures the amount of aluminium that is exchangeable on the soil's active surface area. High levels of exchangeable aluminium can be toxic and inhibit pasture growth.
Biological Properties	
Groundcover	Groundcover is the plant litter and living plant biomass on the soil's surface. It helps prevent erosion and soil capping by providing a protective cover against rainsplash and runoff. At a minimum, an end of dry season pasture cover of 70% is recommended to protect against erosion, however higher levels will help maintain soil structure and reduce moisture loss due to evaporation.
Organic Matter	Organic matter is the energy source that sustains the soil's biological community. It contains carbon, and includes all the plant and root residues in the soil, along with the humus. Soil needs adequate organic matter to hold and cycle nutrients, improve water retention and maintain its structure. Humus also acts as a buffer against salinity and pH.
Carbon To Nitrogen Ratio	The C:N ratio provides an estimate of the overall quality of the soil's organic matter. Organic matter will take longer to break down if it doesn't contain enough nitrogen, because nutrients will not cycle adequately.
Root Activity	Good root depth and root volume are an essential part of a pasture soil. Roots help build soil structure, and contribute large amounts of carbon to the soil.
Soil Microbes	Soil should contain trillions of bacteria, along with fungi and protozoa. All of these play an important role in nutrient cycling, soil structure formation, and plant health.
Soil Organisms	Healthy soil contains a range of insects and other organisms such as earthworms, ants, termites, mites and springtails. These play an important role in nutrient cycling, soil structure formation and plant health.

MANAGING FOR SOIL HEALTH IN GRAZING LANDSCAPES

Improving soil health may require making adjustments to your current grazing practices. Research in Queensland and other parts of Australia has demonstrated a number of approaches that can improve soil health in grazing landscapes². The most important is to use a planned or rotational approach to your grazing management.

The important aspects of planned grazing include:

- maintaining groundcover;
- promoting pasture species diversity and a balance between trees and grasses;
- grazing to a sustainable utilisation rate of available forage;
- moving stock between areas to allow adequate time for pasture recovery, including wet season spelling; and
- using management options that promote evenness of grazing and trigger improvements to land condition.

The first step in managing your soil's health is to assess its key health properties, both in the paddock and using a lab soil test. Based on this you can develop a plan to address any soil issues in a systematic way, to avoid wasting time and money.



Earthworms cycle nutrients and open soil to plant roots, air and water

FURTHER INFORMATION AND RESOURCES ABOUT SOIL HEALTH AND SUSTAINABLE AGRICULTURE:

Soil health projects, events, grants, case studies, grazing BMP:

NQ Dry Tropics www.nqdrytropics.com.au

Terrain NRM www.terrain.org.au

Soils for Life www.soilsforlife.org.au

Dept Agriculture and Fisheries www.daf.qld.gov.au

Courses, technical advice and consultation:

Meat and Livestock Australia www.mla.com.au

Future Beef www.futurebeef.com.au

Resource Consulting Services
www.rcsaustralia.com.au

Soil Land Food www.soilandfood.com.au

Inside Outside Management
www.insideoutsidemgt.com.au

Agricultural Information Monitoring Services
Consulting www.aimsag.com.au

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REFERENCES AND FURTHER READING:

¹DPI Qld (2005) Grazing Land Management - Technical Manual, DPI & MLA.

²Nicholls et al.(2007): Planned Grazing Management Fact Sheet, Land & Water Australia.

Stirling et al. (2016): Soil Health, Soil Biology, Soil Borne Diseases & Sustainable Agriculture: A guide. CSIRO Press.



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