Productive soils in the grazing enterprise

Presenter: Bruce Alchin

Outline

1. Soils in the livestock enterprise
2. Soil properties
3. Soils in the grazing ecosystem
4. Management of soils in the grazing ecosystem
5. Examining soils in the paddock

1. Soils in the livestock enterprise

Property management – profitable and sustainable grazing

Profit? = return on managed assets

Profit is a function of	→	gross margin (=variable return – variable costs)	
Gross margin	→	production (reproduction/growth rate/quality	
Production	→	nutrition	
Nutrition	→	forage (quality, quantity)]	[Soils]
Forage	→	land management]	[Soils]
Land management	→	grazing management]	[Soils]
		fire (management burning)]	
		weeds/reclamation/plant introduction]	

Three ways to improve profit

1. Increase gross margin per animal
    - Animal genetics
    - Livestock husbandry
    - Land management – grazing management / fire [Soils]
2. Increase size of enterprise (animal units/production)
    - More land
    - Use existing land resource more productively – land management
      – grazing management / fire [Soils]
3. Reduce overhead costs
    - Labour: increase efficiency of input
    - Land: reduce land units per animal – land management
      – grazing management / fire [Soils]

Soils – the 'unseen engine' which has a major influence on the grazing ecosystem and livestock enterprise profits

2. Soil properties

There are two very important aspects of the properties of soils:

- The properties vary horizontally across the landscape and vertically from the surface down the profile
- The properties influence the outcome of grazing management strategies.

Soil morphology

'Soil morphology' refers to the appearance of the soil. It relates to characteristics that can be seen or felt.

A soil profile is used to examine the morphological properties. The first property to consider is the horizons (natural layers) present.

Horizons

Horizons are visible in the soil profile – refer to Figure 1.

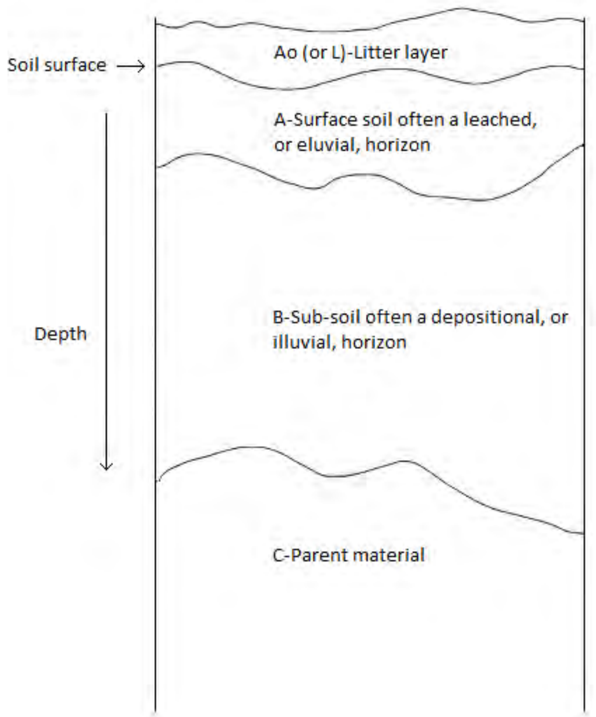


Figure 1: A generalized soil profile illustrating common horizons

The main profile forms that occur are:

- Uniform: there is little change in soil texture down the profile.
- Gradational: there is a gradual change in soil texture down the profile and only a gradual change between horizons.
- Duplex: there is a clear and sharp change in soil texture from the A to B horizon.
- Organic: these profiles are dominated by organic matter. They occur mainly in environments where organic matter breakdown is very slow (e.g. very cold climates).

The profile form affects the influence of all soil properties on plant growth.

Soil colour

Soil colour is a common descriptive term for all soils. Soils have a wide range of colours. These colours may vary significantly between soil types and even within the same soil type.

The colour of the soil is determined by a number of factors, including:

- quantity/type of organic matter
- nature/abundance of iron oxides
- parent material/accumulations
- water content

Soil texture

Soil texture refers to the relative proportions of sand, silt and clay present. Table 1 shows the main characteristics of several soil textures grades.

Table 1: Characteristics of soil texture

Field texture	Coherence	Feel	Ribbon length	Clay content
Sand	Nil-slight	Very sandy	0-15 mm	**<10%**
Sandy loam	Coherent	Very sandy	1-25 mm	**10-20%**
Loam	Coherent	Spongy/smooth/no sandiness	25 mm	**25%**
Clay loam	Coherent/plastic	Plastic	40-50 mm	**30-35%**
Light clay	Plastic	Smooth	50-75 mm	**35-40%**
Medium-heavy clay	Plastic	Smooth/stiff plasticine/resists shear	>75 mm	**>40%**

The range of sizes for the three mineral components of soil is shown in Table 2.

Table 2: Size of individual mineral particles in the soil

Sand	Silt	Clay
>0.02 - <2.0	>0.002 - <0.02	>0.0002 - <0.002

Structure

Structure refers to the arrangement of mineral particles within the soil. This property has an important influence on soil porosity (i.e. the amount and configuration of space for air and water).

The natural building blocks which characterize soil structure are termed aggregates or peds. They are comprised of mineral particles and organic matter. Electrical charges are involved in the bonding of the soil particles within the peds.

Peds are classified by their shape – refer to Figure 2.

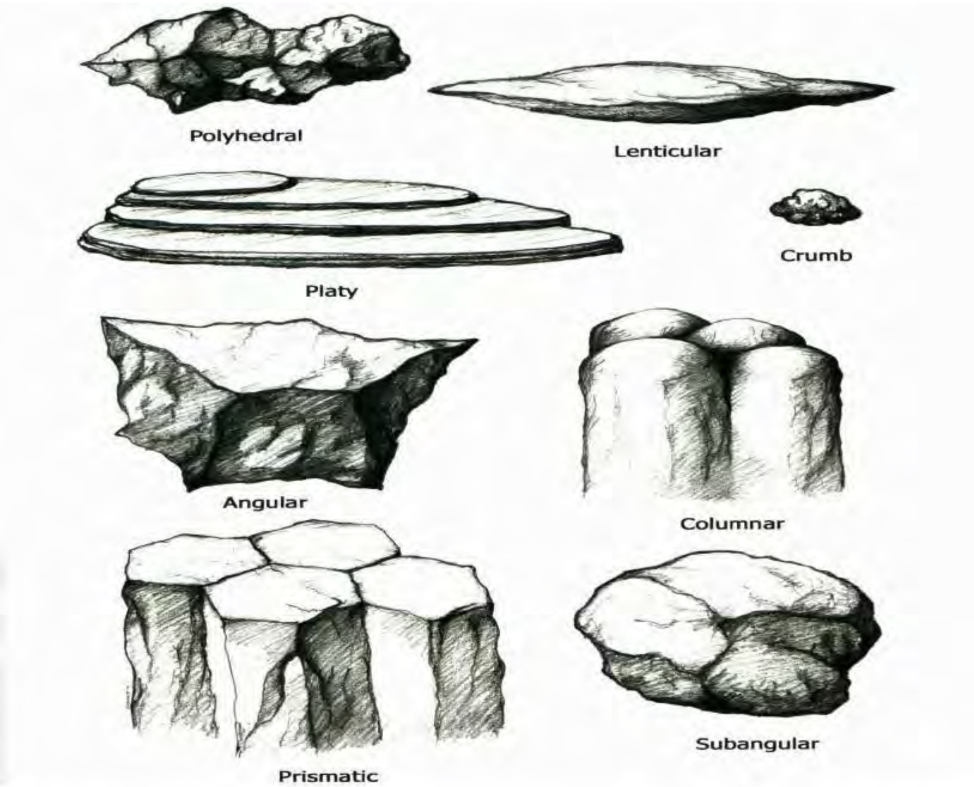


Figure 2: Main shapes that characterize soil peds

Figure 3 illustrates the **electrical charges** which assist in bonding the particles within a ped.

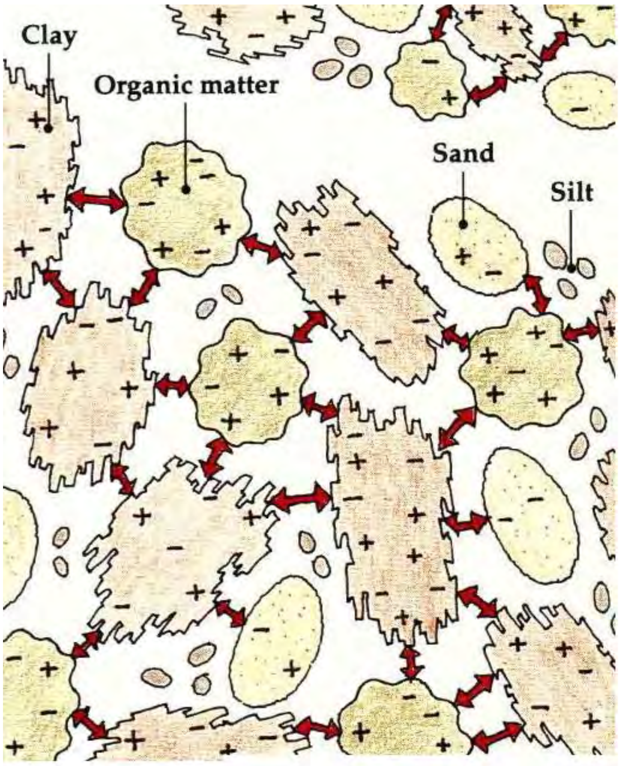


Figure 3: Electrical charges bonding particles with a soil ped

Mineralogy

The sand, silt and clay components of soil result from the weathering of parent material (rocks). This weathering is the result of physical, chemical and biological actions on the rock material. Sand and silt are the direct result of weathering of quartz (silica) material. Clay is also weathered from parent material but is then subject to further complex processes. As a consequence, clay has very different properties to sand and silt.

Clay

Individual clay particles are comprised of microscopic charged layers. These layers hold the nutrients essential for plants – refer to Figure 4. The capacity to hold nutrients varies between clay types.

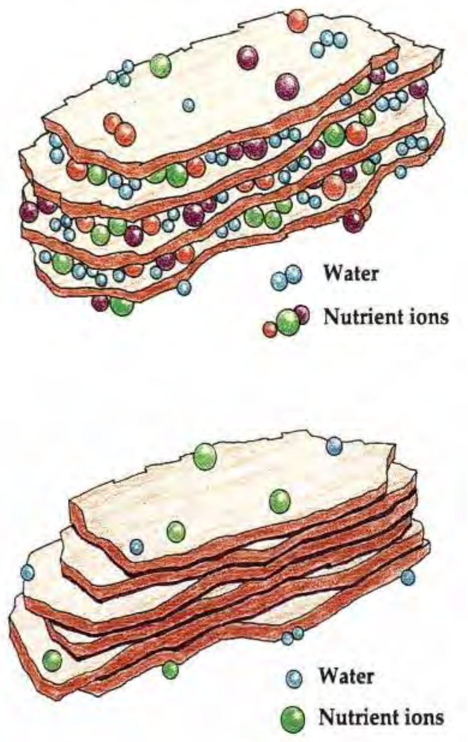


Figure 4: Microscopic charged layers of clays: nutrients are held as 'ions' (i.e. charged atoms)

The properties of clays are determined by their parent material. Dark/fertile clays (e.g. montmorillonite) have a surface area of 800 sq m per gram. In contrast, light coloured/infertile clays (kaolinite) have a surface area of only 10 sq m per gram.

Silt

In contrast to clay particles, silt has only a small surface area – approximately 1.0 sq m per gram. This contributes to silt providing little structure to soils as a result of limited bonding into aggregates. Silt dominant soils are easily eroded by overland flow of water.

Sand

Sand has a very small surface area - 0.01-0.1 sq m per gram. This results in poor structure and limited available nutrients for plant uptake. Sand dominant soils are easily eroded. However, they are both well-aerated and well-drained.

Chemical properties

Soil water

Water is essential for plants and soil organisms, particularly in its role as a carrier of nutrients. The uptake of water and nutrients by plants results in gradient of nutrient concentration, resulting in a diffusion of nutrients towards the plant root.

The solution of soil water is characterised by a particular level of acidity/alkalinity (measured as pH).

Water enters the soil surface through macropores or cracks. It is stored in micropores – refer to Figure 5.

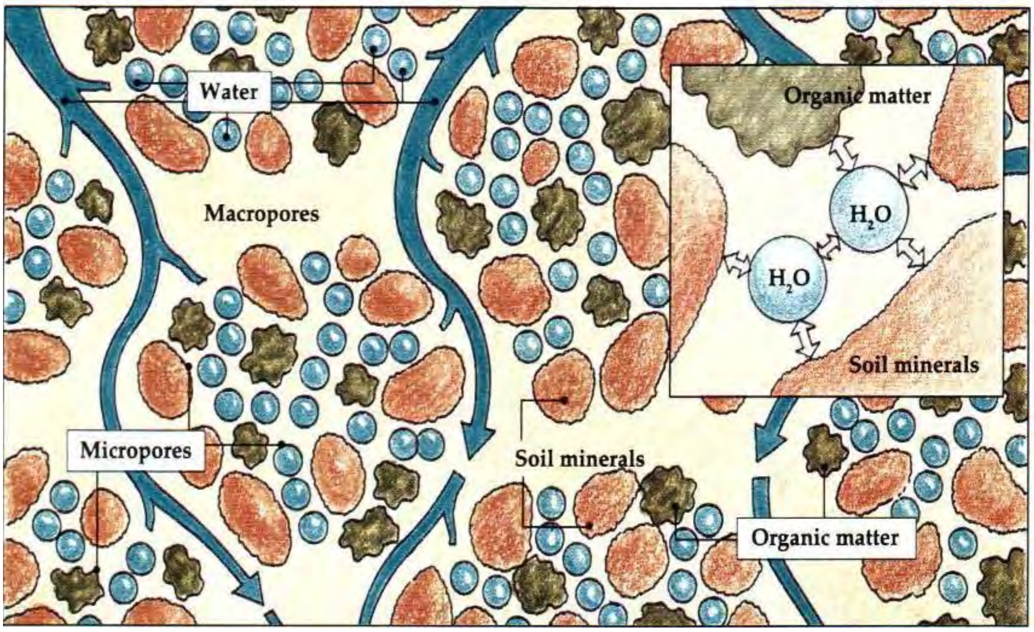
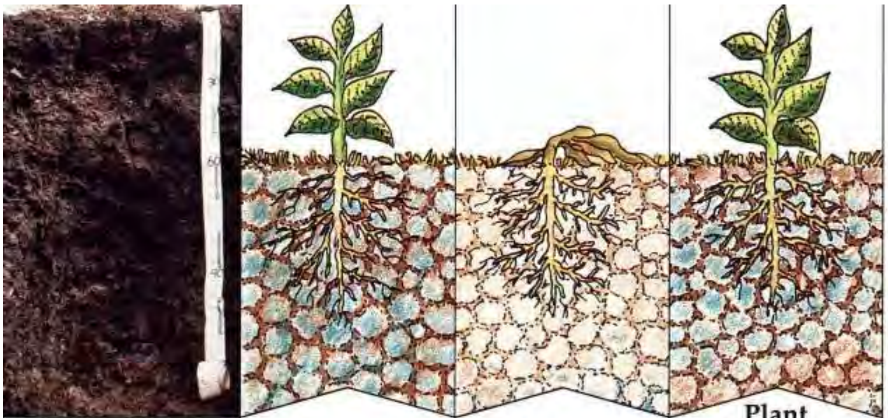


Figure 5: Macropores and micropores in relation to water movement and storage in the soil

The level of water storage that a particular soil can hold is determined mainly by the texture – refer to Figure 6.



Soil texture	Field Capacity	Permanent Wilting Point	Plant Available Water Content
Well-structured clay	50	30	20
Clay	38	24	14
Loam	34	12	22
Sandy loam	23	9	14
Sand	9	2	7

Figure 6: Approximate water storage capacity (cm per metre depth) for different soil textures

Once water has infiltrated into the soil, there are several pathways it can follow – refer to Figure 7.

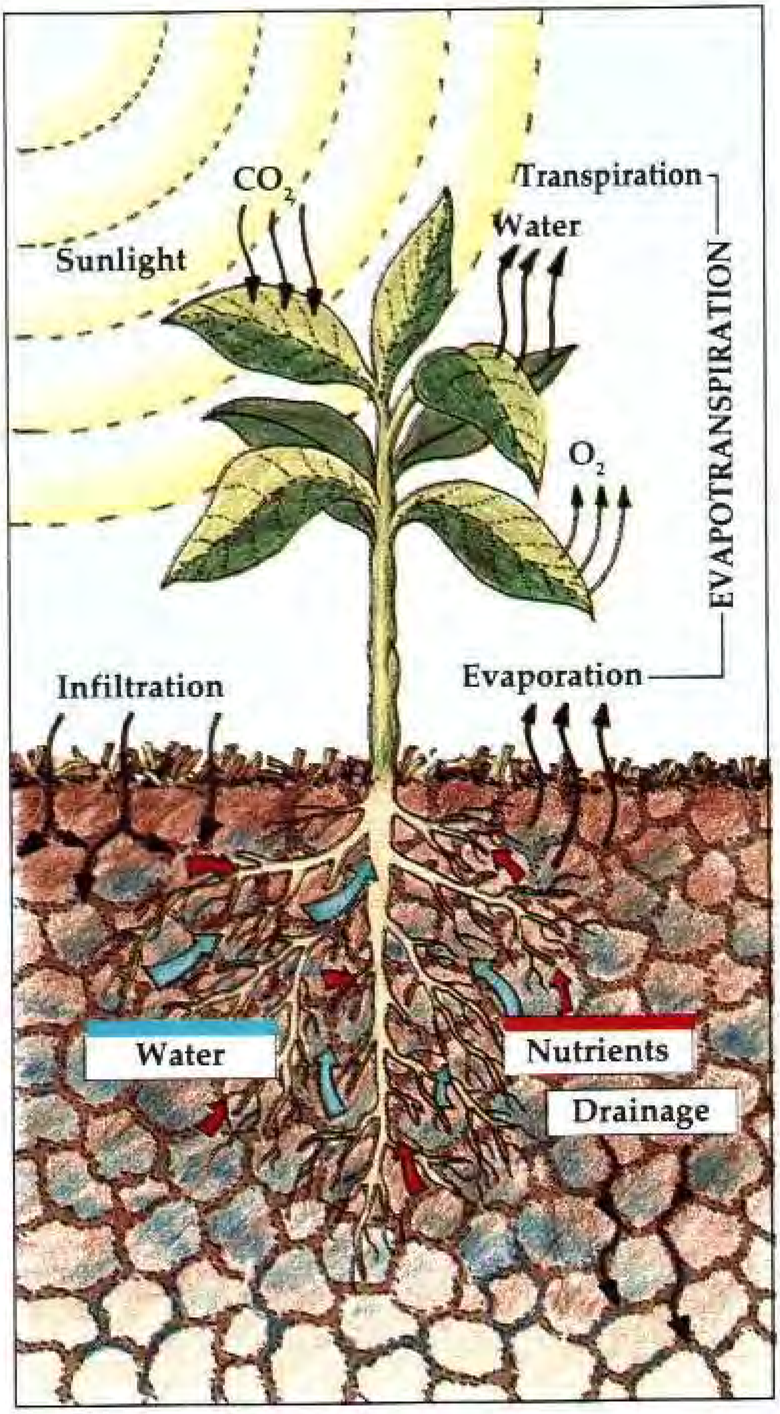


Figure 7: Water movement through the soil

pH

pH is a measure of the acidity/alkalinity of the soil water solution. This is a very important soil chemical property that affects many other properties, particularly the availability of nutrients to plants. Figure 8 illustrates the range of pH values in soils.

pH exerts a strong influence on the soil chemical environment, particularly in relation to **weathering** and **availability of nutrients**.

Acid soils occur naturally in relatively high rainfall areas and where there is significant organic matter decomposition.

The pH scale is in multiples of 10 (a logarithmic scale) and is a measure of hydrogen ion concentration:

- 1 pH unit difference represents a 10X difference in hydrogen concentration
- 2 pH unit difference represents a 100X difference in hydrogen concentration

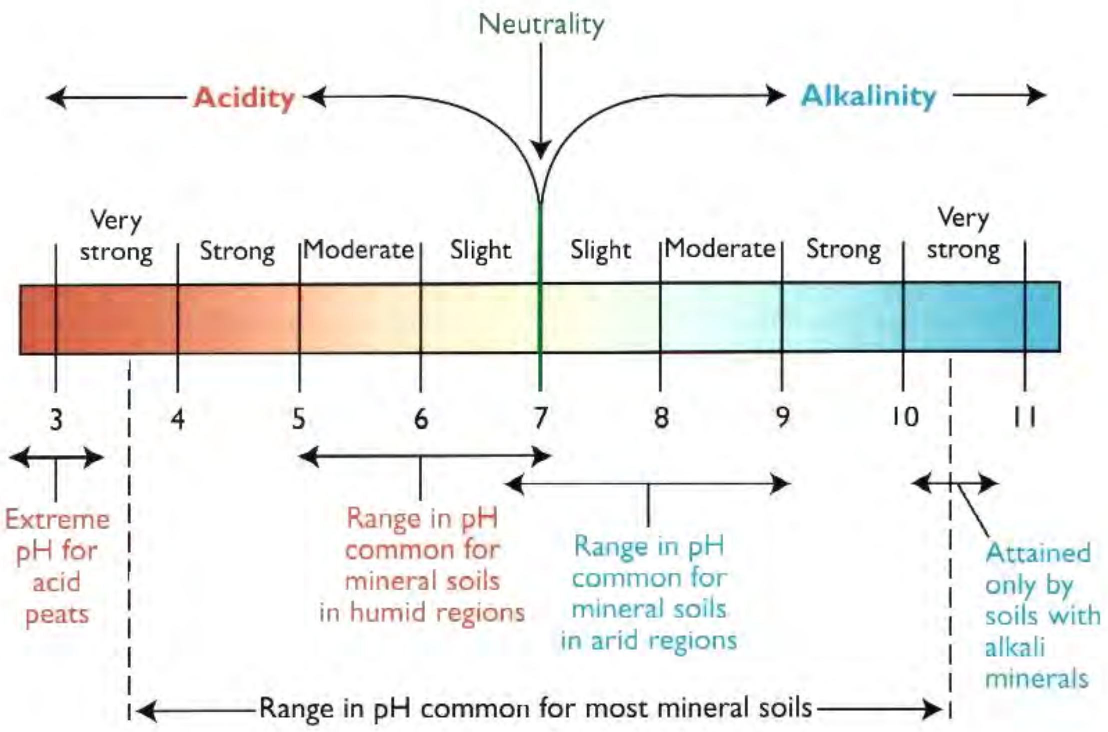


Figure 8: Range of pH values in soils

Plant nutrients

There are 15 elements required by plants which are taken up by their roots. These elements are also required by micro-organisms. Six of these nutrients are required in relatively large amounts (**macronutrients**) and nine which are required in relatively small amounts (**micronutrients**). The elements are:

- **macronutrients:**
    - nitrogen
    - phosphorus
    - potassium
    - calcium
    - magnesium
    - sulphur

- **micro-nutrients:**
    - boron
    - chlorine
    - cobalt
    - copper
    - iron
    - manganese
    - molybdenum
    - zinc
    - sodium

Excessive amounts of some elements may be toxic to plants.

Deficiencies of elements are common in highly leached sands and where pH values are very high (alkaline). (Note that deficiencies in any soil relate to the plant species that are growing. Unless degraded, most soils have adequate nutrients for the native species).

The nutrients are taken up from the soil solution where they occur as 'ions' (i.e. atoms or molecules with a positive or negative charge). Most of the nutrients exist as **'cations'** (positive charge); the remainder are **'anions'** (negative charge). It is these charges which provide the bonding to clay and organic matter – refer Figure 9.

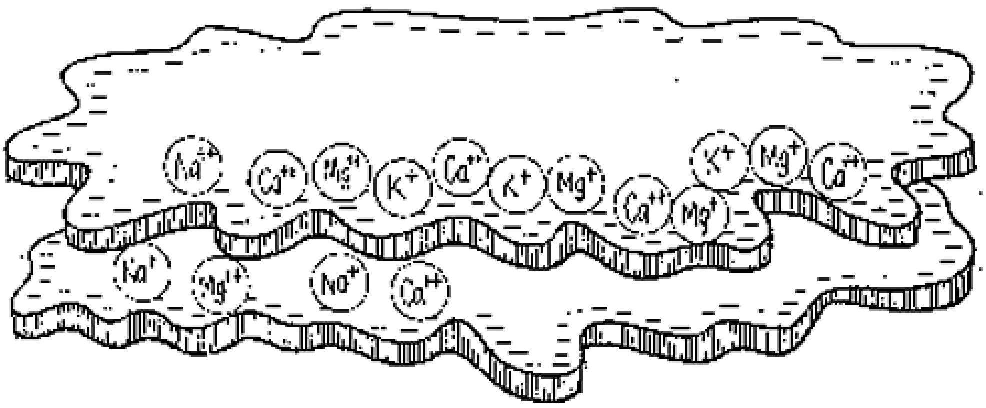


Figure 9: Cations held on the plates of clay particles by their positive charges

Soil chemical fertility is measured in relation to its capacity to retain cations – this is termed the soil's **cation exchange capacity** (CEC).

The clay type present influences the level of CEC:

- dark coloured clays high in montmorillonite – high CEC
- red clays with kaolinite – low CEC

Increasing organic matter increases the CEC in soils.

It is the **root hairs** on plants that take in the required nutrients – refer to Figure 10.

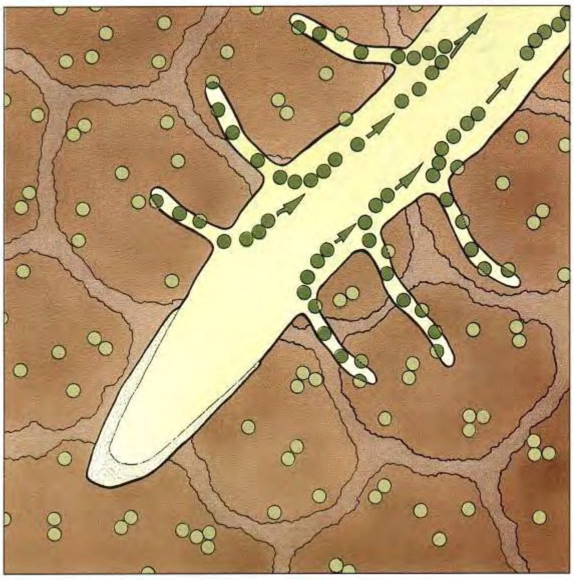


Figure 10: Uptake of nutrients by root hairs

pH has a strong influence on nutrient availability to plants and microorganism activity – refer to Figure 11.

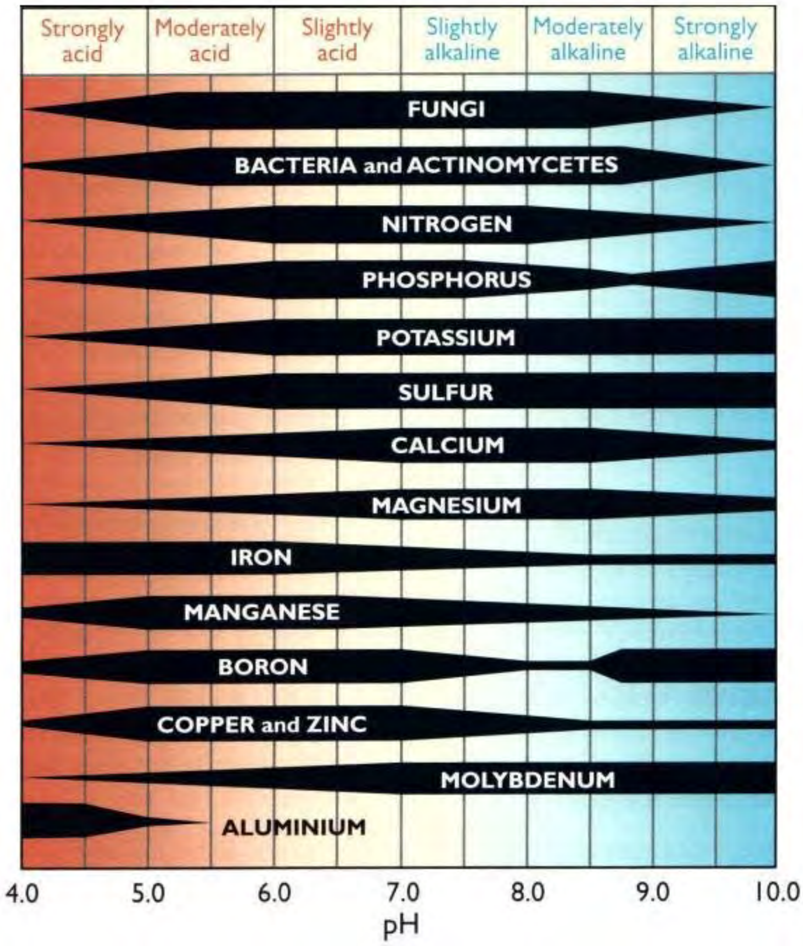


Figure 11: Relationship of nutrient availability and micro-organism activity to soil pH

Nitrogen and phosphorus

Nitrogen and phosphorus are two critical elements in livestock production.

Nitrogen has a major control over plant growth. There is a significant relationship between the level of carbon and the level of nitrogen (The carbon to nitrogen ratio: C:N).

Most nitrogen is immobilized in organic matter (humus) and this needs to be broken down to release it:

nitrifying bacteria

immobilized nitrogen in humus ⟶ ammonium and nitrate compounds (<2% of total nitrogen)

Nitrogen is also made available through biological fixation by legumes, bacteria within the soil and cyanobacteria on the soil surface. A small quantity of nitrogen may also result from lightning during storms.

Nitrogen may also be lost by the activity of denitrifying bacteria:

denitrifying bacteria

nitrates (waterlogged soils) ⟶ nitrogen gases (lost to atmosphere)

Phosphorus is essential for plants and animals. An understanding of phosphorus levels is important for cattle production in northern Australia where deficiencies may occur.

Phosphorus is a relatively complex plant nutrient. It occurs in organic and inorganic forms as a phosphate compound:

- in solution: readily available
- labile: slowly available
- non-labile: very slowly available

Inorganic phosphorus availability is strongly controlled by pH (refer Figure 11). Micro-organisms have a high demand for phosphorus.

Mycorrhiza (‘friendly fungi on plant roots’) enhance phosphorus uptake by plants.

Organic matter

Organic matter (OM) consists of un-decayed plant/animal material. It is broken down by biological, chemical and physical processes to dark coloured humus and ultimately to plant nutrients. Organic matter makes up only a small proportion of the soil material (1 - 2%):

- low OM: <1%
- medium OM: 1-2%
- high OM: >2% of soil

Organic matter has a strong influence on soil physical, chemical and biological properties. It is similar in structure to clay (i.e. plates with electrical charges) and holds plant nutrients. It can contribute **up to 50% of the soils cation exchange capacity**.

Organic matter is also very important in stabilizing soil aggregates. Soils with high organic matter content form strongly bonded peds – refer to Figure 12.

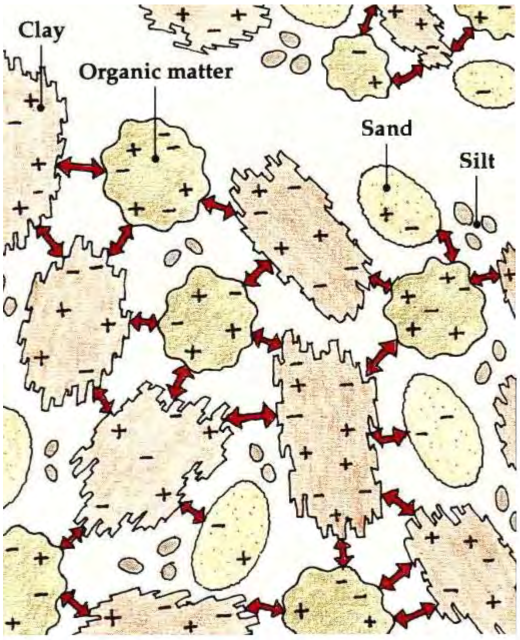


Figure 12: Contribution of organic matter to soil aggregate stability

Humus has a **high water holding capacity**.

Organic matter provides energy/nutrients for micro-organisms.

Organic matter plays a very important role in minimizing large changes in soil acidity/alkalinity (pH) – this is referred to as its **'buffering' capacity** – refer to Figure 13. This ensures optimum plant nutrient uptake (refer to Figure 11).

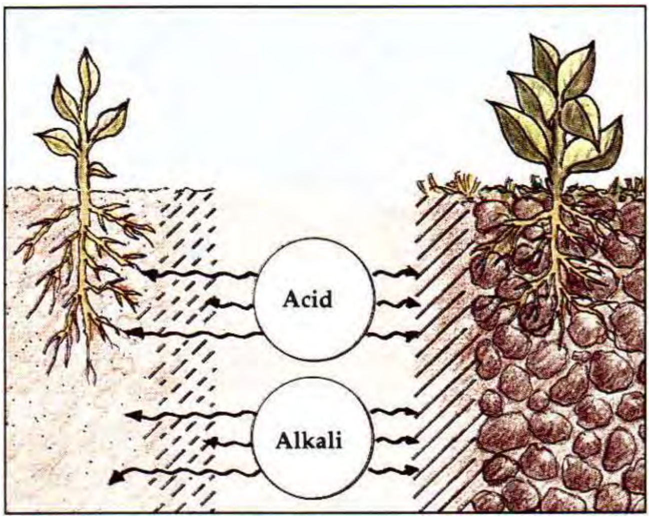


Figure 13: Increasing organic matter reduces significant changes in pH

Salinity and sodicity

'Salinity' refers to the soluble salt content present in the soil. There is a natural accumulation of soluble salts in some Australian soils – this is referred to as **primary or natural salinity**. The level of salt accumulation depends on leaching.

Salinity is measured by electrical conductivity. For a soil to be classified as saline it will contain >0.1-0.2% of soluble salts in the surface soil or >0.3% in the sub-soil.

'Secondary salinity' occurs where land use/management results in increases in soluble salts. In areas that are vulnerable to secondary salinity, tree clearing or irrigation may result in the water table rising and bringing with it salts. This can be exacerbated by geological constrictions which accentuate the rising water table.

'Sodicity' refers to the situation where the soluble salts are dominated by sodium chloride (common salt). Sodic soils are defined by their **exchangeable sodium percentage**, i.e. their exchangeable sodium concentration expressed as a percentage of the cation exchange capacity.

Increasing clay content reduces the effect of salinity – refer to Table 3.

Table 3: Effect of clay content on plant response to salinity

Salinity rating	Electrical conductivity (dS/m^3)			Plant response
	Clay content (%)			
	10-20	20-40	40-60	
Low	0.07-0.15	0.09-0.19	0.12-0.24	Moderately sensitive
Moderate	0.15-0.34	0.19-0.45	0.24-0.56	Moderately tolerant
High	0.34-0.63	0.45-0.76	0.56-0.96	Tolerant

Physical soil properties

The main physical soil properties are:

- Particle size distribution
- Bulk density and porosity
- Air and water storage
- Permeability
- Physical impediments to root growth

… and these are all important components of soil fertility.

Particle size distribution

Particle size distribution is another term for soil texture – this was covered in section 2.1.3.

Bulk density and porosity

The bulk density of soil refers to the ratio of its weight to volume (expressed by grams per cubic centimetre) – refer to Figure 14.

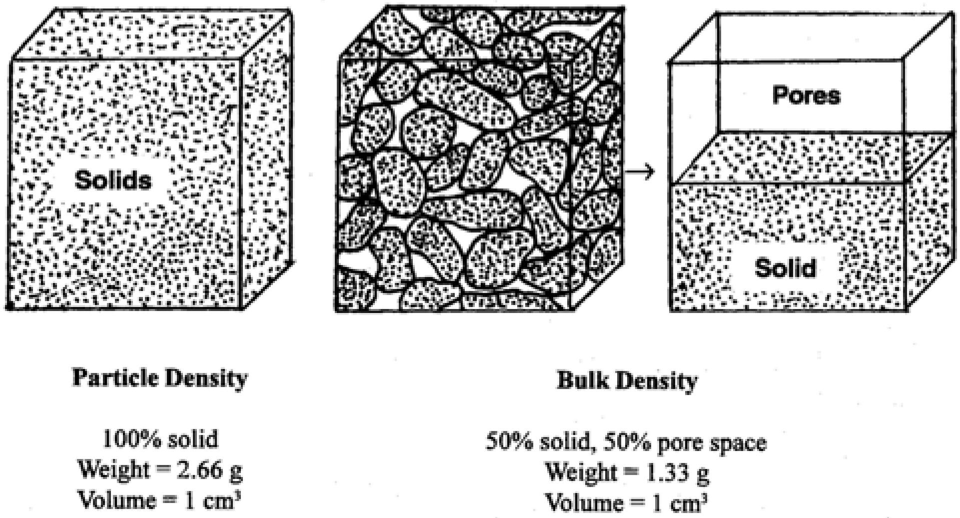


Figure 14: Particle density and bulk density of soils

Bulk density varies from 1.1 – 1.8 grams per cubic centimetre. It has a major effect on root growth and permeability – bulk densities greater than 1.6 grams per cubic centimetre root growth.

Porosity refers to the volume of space per volume of soil (expressed as a %). Increasing bulk density results in decreasing porosity – refer to Table 4.

Table 4: Relationship of porosity to bulk density

Bulk density (g/cm^3)	Porosity (%)
1.1	58
1.8	32

Air and water storage

Maximising **infiltration** is critical to ensuring water use efficiency in pasture growth – refer to Table 5.

Table 5: Range of infiltration rates

Infiltration	Very low	Low	Moderate	High
Rate (mm/hr)	<2.5	2.5-12.5	12.5-25	25

The supply of air and water in the soil relates to its porosity and ability to retain water.

Water storage in soils is usually referred to as the plant available water capacity – refer to Figure 15.

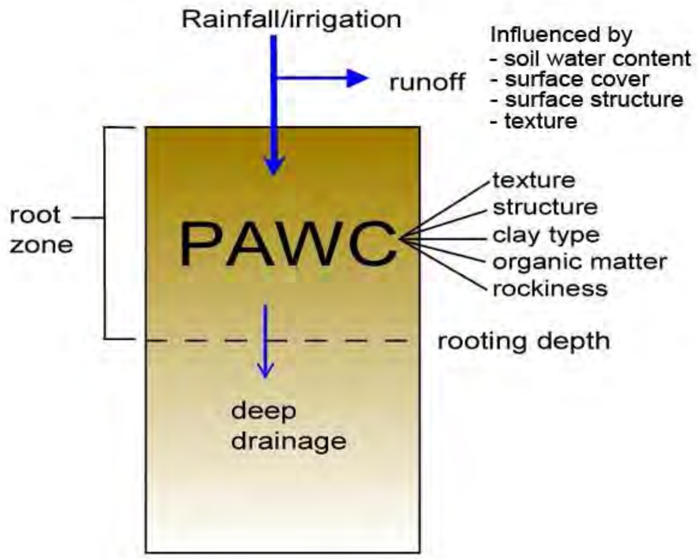


Figure 15: Factors influencing plant available water capacity

The water available to plants varies with soil texture – refer to Figure 16.

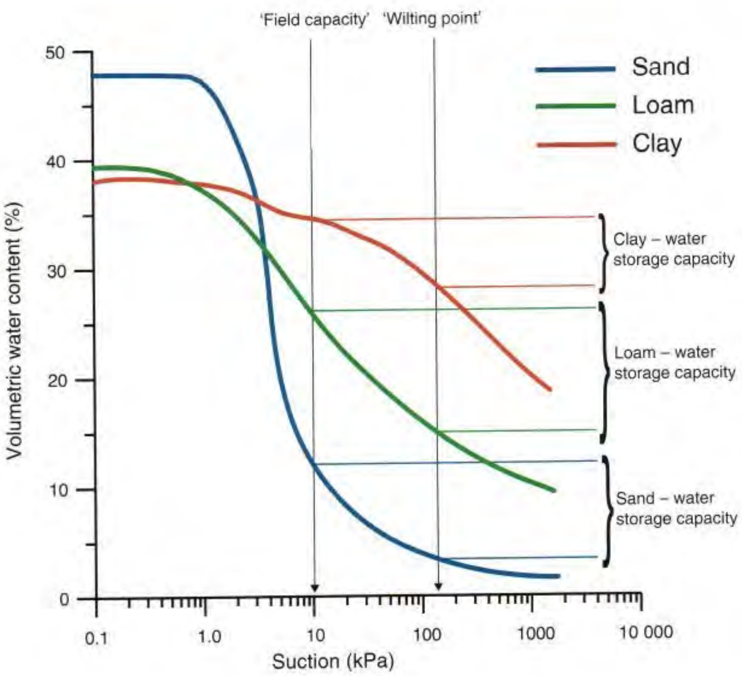


Figure 16: Relationship of plant available water to soil texture

Permeability

Permeability refers to the ease of air and water movement in soil. The importance of this can be illustrated as:

• **permeability**]	]	
]	**soil water regime**]	**control of ecosystem processes**
• **water storage**]	]	

Hydraulic conductivity is the measure of permeability (mm/hour).

Soil air

Oxygen in soil air is required by plant roots and organisms for respiration (carbon dioxide is a product of respiration). Aerobic conditions in soil allow air circulation.

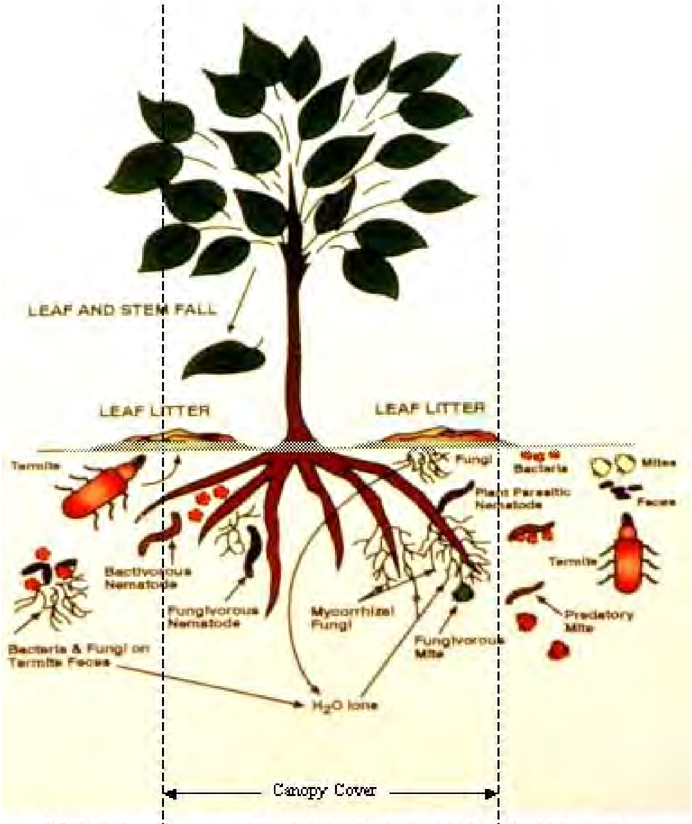
Where anaerobic conditions exist in the soil, plant growth and organism activity is limited. These conditions also result in increased losses of nitrogen as a gas

Impediments to root growth

Impediments to root growth may occur where the soil is too compact. Soil strength increases as it dries. Root growth may also be impeded where there are insufficient cracks or pores.

Biological properties

Biological life is an essential component of soil fertility – refer to Figure 17.



Measuring the canopy cover of trees and shrubs to assess the below-ground contribution to the overall functioning of the landscape. Diagram: W. G. Whitford

Figure 17: Biological life in the soil

The importance of biological life in the soil can be illustrated as:

Biological	]		]	**morphological**	
	]	**control**	]	**chemical**	
processes	]		]	**physical**	**… properties**

These biological processes are largely the result of microorganisms and soil fauna.

Soil micro-organisms

Most soils have a very large population of organisms. **Bacteria dominate the micro-organisms**. They are the main group of organisms involved in organic matter decomposition. Rhizobia species of bacteria in legumes are important for nitrogen fixation.

Fungi are involved in decomposition of organic matter.

One group of the fungi are the **mycorrhiza** (‘friendly fungi’). There are symbiotic relationships between many plant species and mycorrhiza. These are very important in assisting nutrient uptake. Mycorrhizal hyphae act as rootlets for uptake of nutrients (particularly phosphorus and nitrogen) – refer to Figure 18.

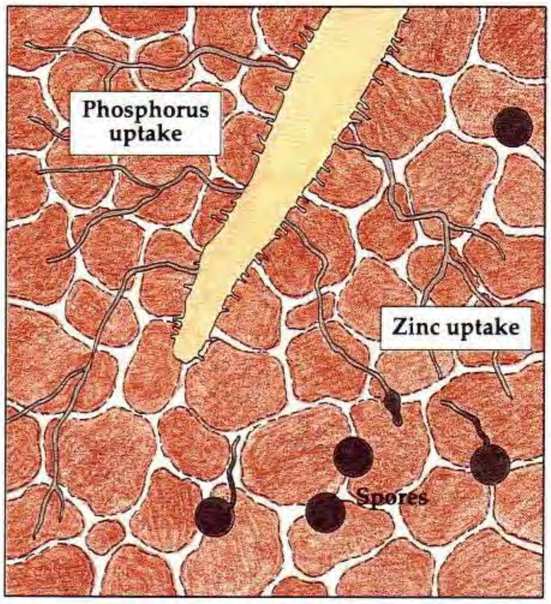


Figure 18: Mycorrhizal hyphae assist in nutrient uptake

Mycorrhiza spend part of their life as spores; the spores germinate and enter plant roots – refer to Figures 19 and 20.

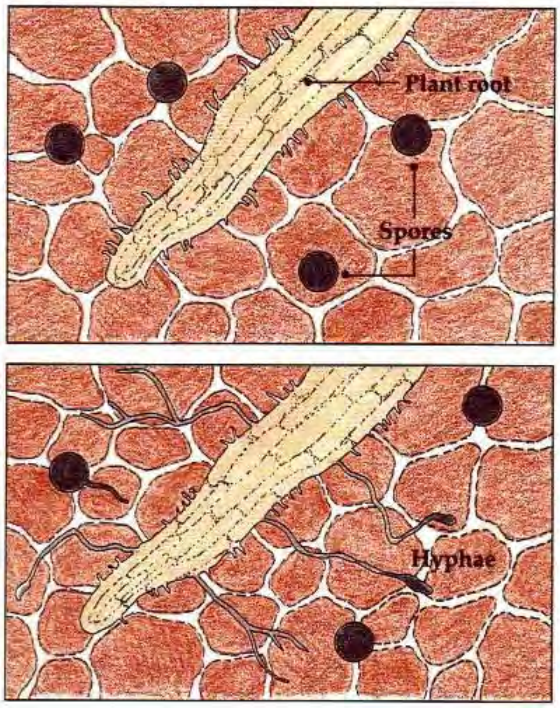


Figure 19: Mycorrhizal spores germinating and forming hyphae on plant root

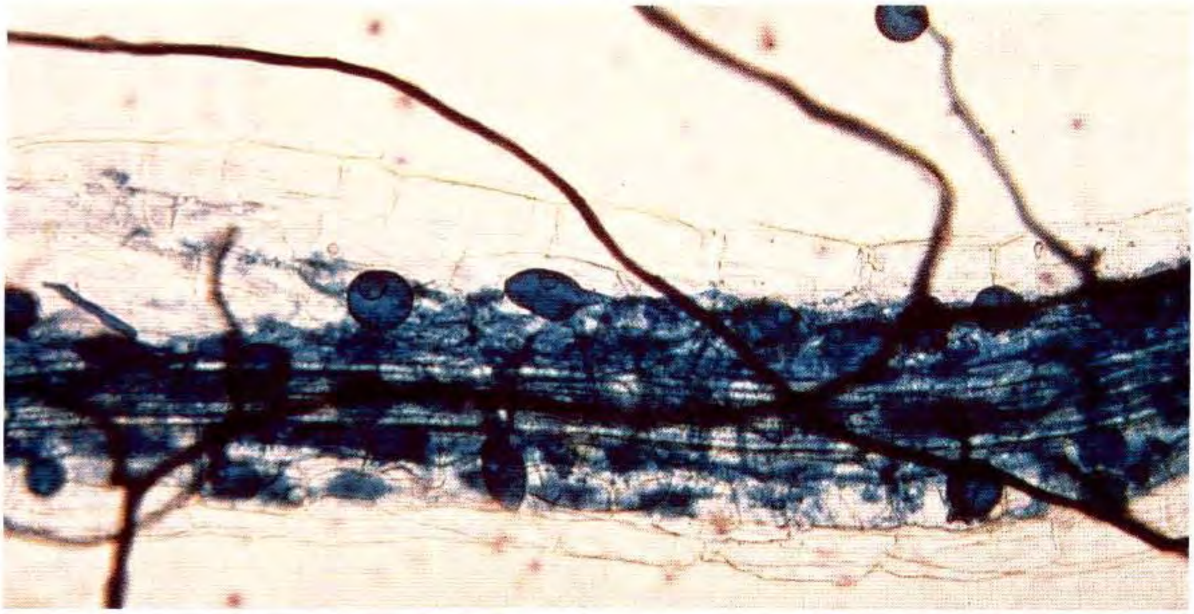


Figure 20: Microscopic view of mycorrhiza on plant root

Biological soil crusts are the organisms which occur on the soil surface. They are comprised of one or a combination of:

- **cyanobacteria**
- **algae**
- **fungi**
- **lichens**
- **mosses**
- **liverworts**

These organisms play an important role in **soil cover and nutrient cycling**.

Cyanobacteria (previously called 'blue-green algae') contribute to enhance soil stability, through soil cover (refer to Figure 21) and exudation of a sticky mucilage.

Cryptogam Cover. The query zone being assessed is the line between the arrows. ***Class 4.***

Figure 21: Cyanobacterial soil crust protecting the soil surface from erosion

Many species fix nitrogen from the atmosphere – refer to Figure 22.

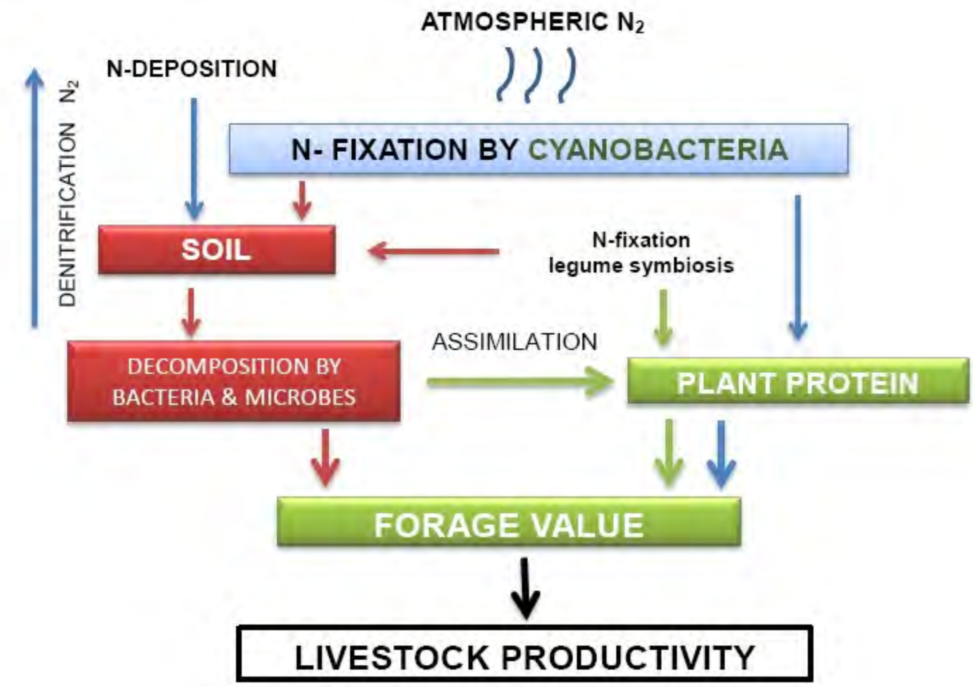


Figure 22: Process of cyanobacteria fixing nitrogen in a grazing ecosystem

Soil fauna

Soil fauna are the easily visible component of the soil biological properties. They are mainly comprised of ants, termites, beetles and earthworms. Their activity is usually at or near soil surface – refer to Figure 23.

These organisms are very important in recycling nutrients, enhancing water infiltration and breaking down of organic material for use by micro-organisms.

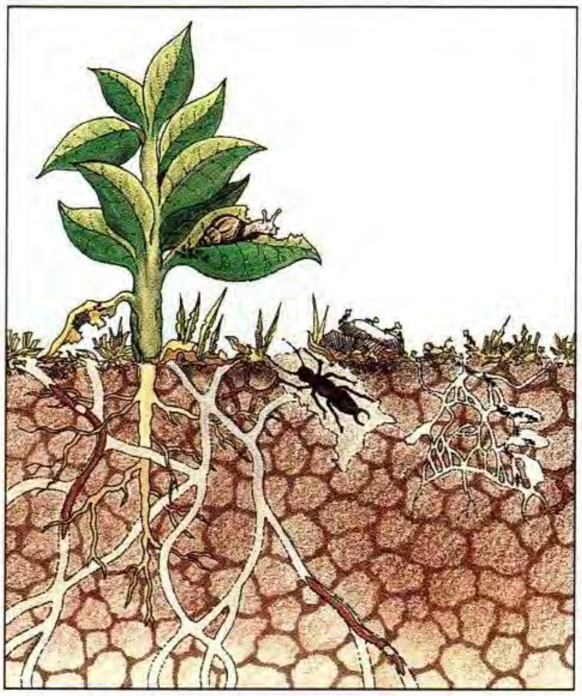


Figure 23: Soil fauna recycling nutrients, enhancing infiltration and breaking down organic matter

Termites are active in mounds or under the soil surface. They ingest grass and plant litter. The channels they form provide transport for recycling of nutrients.

Plants

Plants are an important component of the biological life in the soil. There are many useful inter-relationships between plants and soil which contribute to **nutrient cycling**, **stabilising of soil aggregates** and **creation of soil pores**.

3. Soils in the grazing ecosystem

Soils are a major component of the grazing ecosystem – refer to Figures 24 and 25.

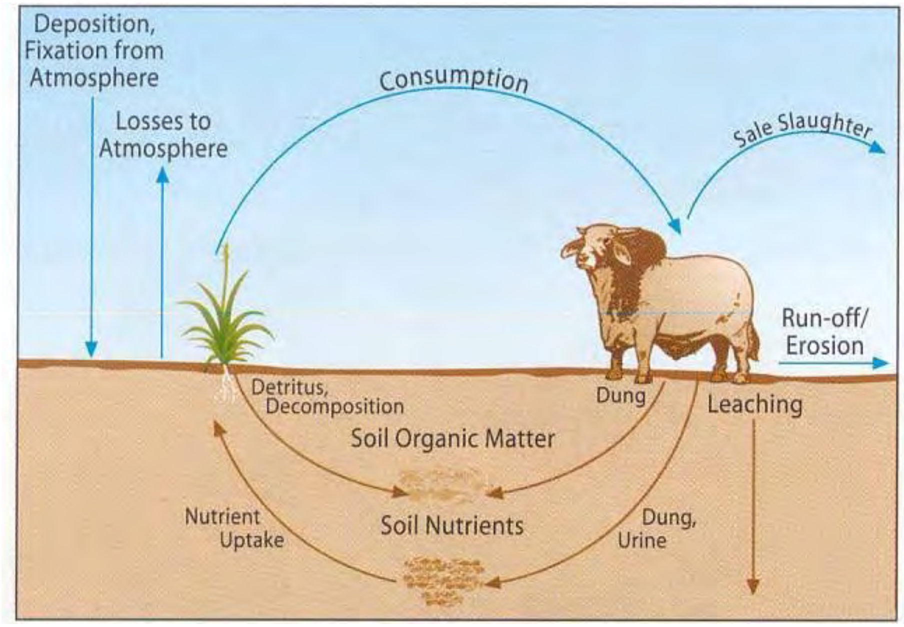


Figure 24: Soils in the grazing ecosystem

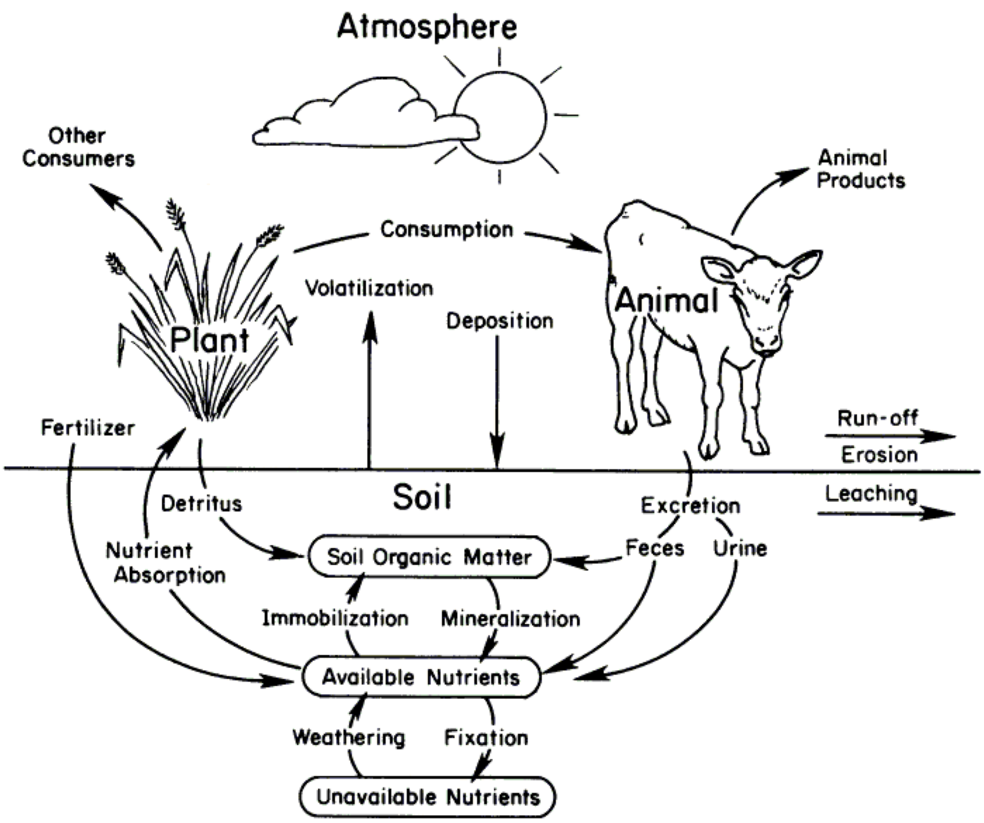


Figure 25: Soil components and processes in the grazing ecosystem

3.1 Landscape ecology

Landscape ecology involves ecosystem processes. This may be understood through the 'landscape ecology model'. This model describes the processes and responses of the grazing ecosystem – refer to Figure 26.

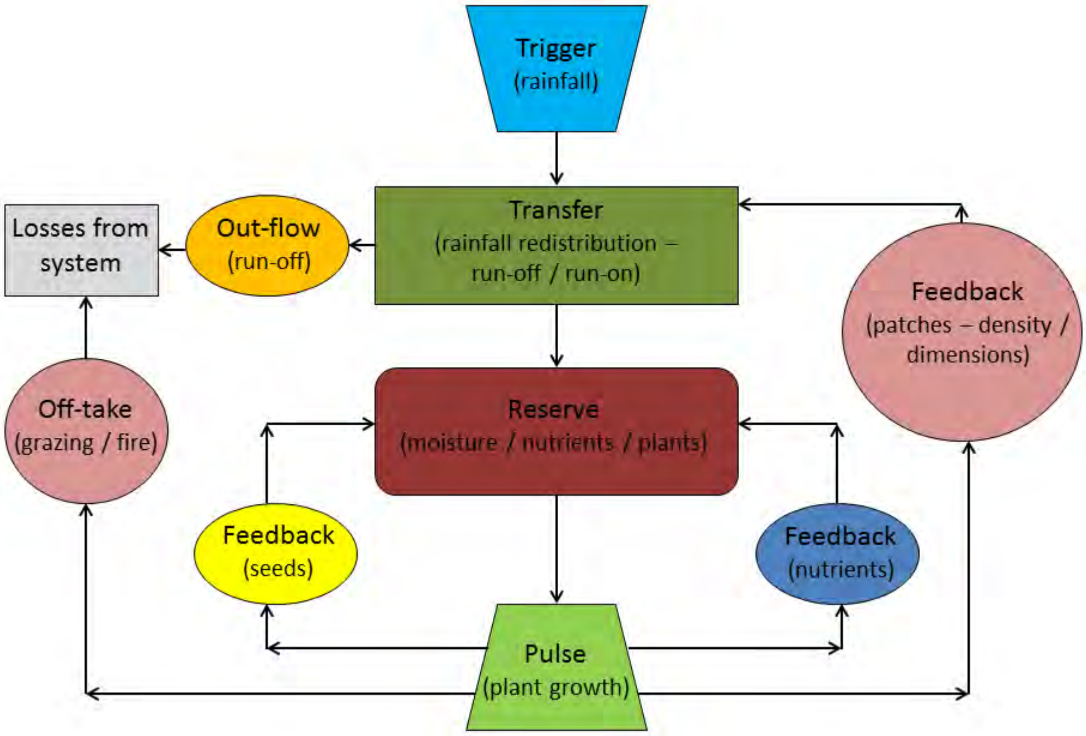


Figure 26 Landscape ecology model - relates to water use efficiency

This model illustrates the importance of plant density in maximizing the opportunity to capture rainfall – refer to Figure 27.

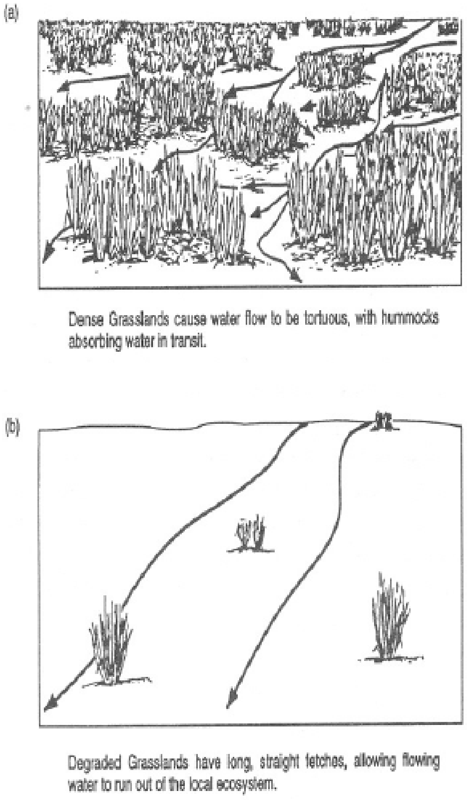


Figure 5.2. Transfers of water: (*a*) short tortuous flows in a functional landscape with dense grass tussocks; and (*b*) long straight flows in a dysfunctional landscape with few tussocks.

Figure 27 The importance of grass density in capturing rainfall and nutrients

Biopores formed following the death of plant roots and by soil fauna are important in enhancing infiltration – refer to Figure 28.

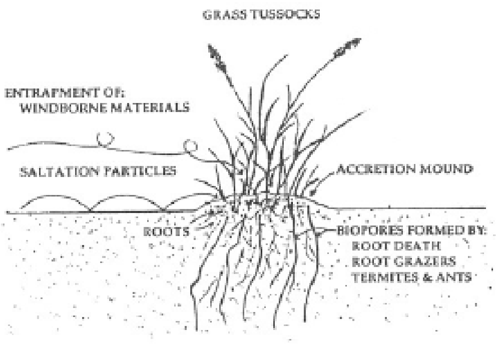


Fig. 2.2. Diagram illustrating the build-up of a mound by a perennial grass tussock with the accumulation of wind-blown materials, and the formation of biopore channels into the soil.

Figure 28 Biopores increase infiltration by acting as 'preferred pathways'

The landscape ecology model highlights the importance of the protection of the soil surface by ground cover. This protects the soil from raindrop impact and erosion by overland flow of water – refer to Figure 29.

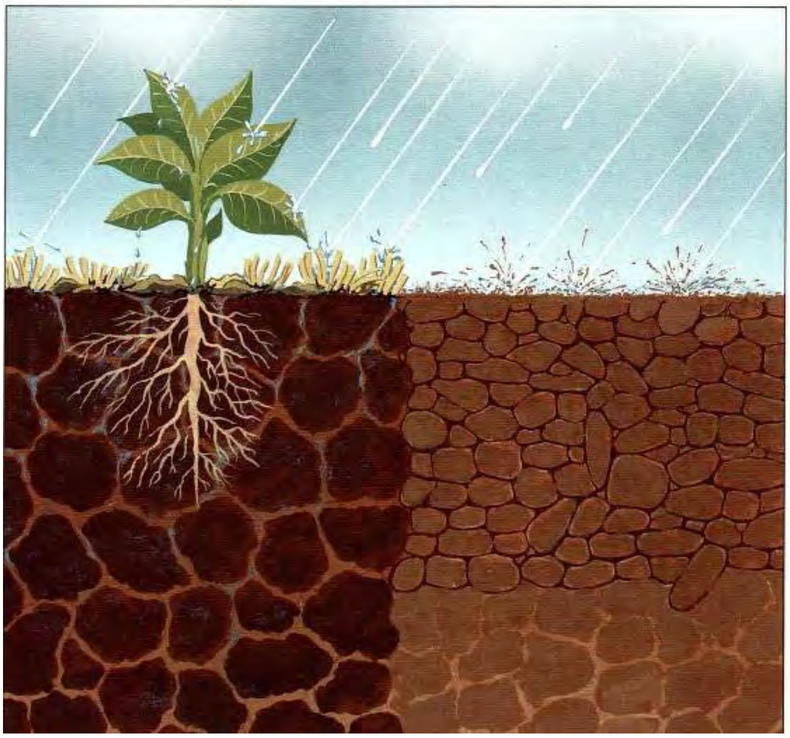


Figure 29 Protection of the soil from raindrop impact and overland flow

The model provides the opportunity to assess the three main aspects of how a particular landscape is functioning: i.e. **soil stability**, **nutrient cycling** and **water infiltration**.

4. Management of soils in the grazing ecosystem

Soil structure

Excessive raindrop impact (or sometimes excessive animal trampling) breaks bonds in the soil peds, resulting in reduction of pore space (porosity). As a consequence, water infiltration and storage are reduced and run-off increases.

The effective 'clay content' of soil can be maintained or increased through adequate organic matter. This will enhance the resilience of soil structure.

Management

Grazing management should ensure there is sufficient organic matter present at the end of each grazing period. This could involve assessing a predetermined amount to be left (kg/ha), rather than using the percentage utilization principle. (As a general guide, approximately 1000 kg/ha should be retained at the end of a grazing period).

Soil fertility

If organic matter is very fibrous and has a low nitrogen content, the soil microbes will retain much of the available nitrogen, resulting in a reduction of plant growth. Current research into buffel grass rundown has demonstrated that significant amounts of nitrogen are tied-up in dead pant material.

Management

To address the fertility issue, grazing management needs to balance adequate utilisation for livestock needs with allowing sufficient organic matter residue (which can be easily broken down) to remain. Moribund grass material should not be allowed to accumulate.

Organic matter

Hoof impact

While there is often concern about the negative effect of trampling, the action of hooves can increases the incorporation and breakdown of organic matter.

Management

Grazing management should minimize the potential for damage by hoof impact, but ensure this 'tool' is used to maximize organic matter incorporation and breakdown. It may be attained by monitoring of the impact of the livestock and adjusting the timing and length of grazing and rest periods.

Fire

Burning can reduce organic matter and result in the sealing of the soil surface. The level of effect relates to fire intensity and burning frequency.

Management

Burning should be timed to maximise grass re-growth and minimise risk of damage to the ecosystem. Burning after significant rain (with 'cool fire') will usually be the preferred option.

Soil pH

Introduced legumes may increase soil acidity. Organic matter acts as a buffer against pH changes and ensuring there is a consistent turnover of organic matter will contribute to minimising this effect.

Management

Grazing management (and burning management) should ensure there is sufficient organic matter present at the end of each grazing period.

Water infiltration

Organic matter supports soil organisms (more opportunity for soil fauna biopores) and provides material for plant biopores. To have adequate organic material requires matching stocking rate to forage available.

Management

Grazing management should ensure there is sufficient organic matter at the end of each grazing period

Compaction by trampling

Compaction of peds may reduce soil porosity (reducing infiltration, aeration and drainage), seed entry to soil and plant emergence. Soils with higher clay content are usually more vulnerable to compaction. Increasing soil moisture increases vulnerability to compaction.

Management

The potential for compaction on vulnerable soils may be reduced by minimising grazing when soils are wet and resting if soils have been compacted.

Salinity/sodicity

Management

The issues of salinity and sodicity can be addressed by maximizing pasture vigour (increases rooting depth) through grazing management. Fencing off susceptible areas may be required. Salt tolerant species can be established - to lower the water table.

Sodic soils can be treated with gypsum (calcium sulphate), and/or lime (calcium carbonate).

Increasing organic matter is useful to ameliorate sodic soils. The organic material can hold the soil particles together, reducing the risk of dispersion – refer to Figure 30. The organic material also slows down rate of wetting of soil aggregates, reducing the potential for slaking.

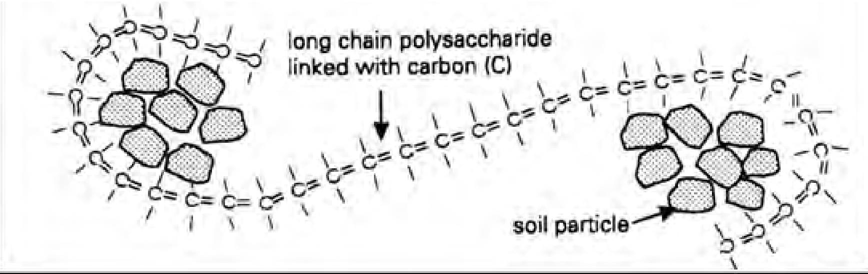


Figure 30 Organic material reducing dispersion and slaking in sodic soils

5. Examining soils in the paddock

Soil surface assessment

Rainsplash protection of the soil surface

Assesses degree to which physical cover and projected plant **cover reduces the impact of raindrops** (express as %)

- Include:
  - vegetation to 0.5 m high
  - rocks >2 cm
  - woody, etc material >1 cm height/width
- Exclude:
  - annual/ephemeral herbage
  - foliage at heights >0.5 m
  - litter

Projected cover (%)	Rainsplash protection
<1	Nil
1-15	Low
15-30	Moderate
30-50	High
>50	Very high

Perennial vegetation cover

Estimate 'basal cover' (i.e. crown) of perennial plants and/or canopy cover of trees and shrubs (express as %).

Assesses **contribution of below-ground biomass of perennial vegetation to:**

- **nutrient cycling**
- **infiltration**

Note:

- grasses – sum butt lengths
- trees/shrubs – cover and density of canopy
- exclude – annual/ephemeral herbage

Basal + canopy cover (%)	Contribution
<1	Nil
1-10	Low
10-20	Moderate
>20	High
>50	Very high

Litter

Note amount (% cover) of plant litter relates to **litter contribution to nutrient cycling**.

Plant litter cover (%)	Contribution
<1	Nil
1-10	Low
10-20	Moderate
>20	High
>50	Very high

Biological soil crusts (BSC)

Note the cover (%) of BSC on the soil surface relates to:

- **soil stability**
- **nutrient cycling**
- **C sequestration**
- **nitrogen fixation**

Add water from spray bottle and observe after 20 seconds for greening (photosynthesis)

BSC cover (%)	Contribution
<1	Negligible
1-10	Slight
10-50	Moderate
>50	High – very high

Crust-brokenness

Assesses extent of brokenness of soil surface crust indicates **loose soil material vulnerable to erosion**.

Crust brokenness	Erosion vulnerability
No crust	Not vulnerable
Extensive	Highly
Moderate	Moderate
Slight	Slight
Intact/smooth	Negligible

Soil erosion

Assesses **type and severity of recent/current soil erosion**:

- Types of erosion:
    - sheeting (water, wind)
        - pedestal
        - terracette
    - rill (<30 cm deep)
    - gully (>30 cm deep)
        - scalding

Erosion severity
Insignificant
Slight
Moderate
Severe

5.2 Soil profile assessment

Soil profile

This will include:

- Profile form
- Structure
- Texture
- pH

GRAZING BMP BEST MANAGEMENT PRACTICES

References and further reading

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