Sustainable Land Use for Red Meat and Wool Production in the Volcanic Plains and Southern Dunes Sub-Region (Limestone Coast, SA)

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Key messages:

- Sustainable dry sheep equivalent (DSE) figures for the Volcanic Plains and Southern Dunes sub-region range from 10 DSE/ha on shallow soils over limestone in western parts of the sub-region to more than 14 DSE/ha on well drained volcanic loams around southern parts of the sub-region.
- Management strategies can be implemented to increase carrying capacity; however farmers should be aware there are also constraints that impact carrying capacity.

Introduction

This sub-region covers all of the Limestone Coast south of a line between Penola and Beachport – see Figure 1.

Rainfall across the sub-region varies from 700mm to 750mm and growing season length varies from 7 to 8 months.

Soils range from rendzina clay flats with areas of peat around Tantanoola, Millicent and Penola to loam soils over clay carrying red gum, and sandy soils over clay originally carrying heath between Mount Burr, Kalangadoo, Nangwarry and Tarpeena along with volcanic soils around Mount Gambier and Glencoe, shallow soils over limestone around Kongorong and peat flats along the coast between Rendelsham and Eight Mile Creek. Large areas of sandy range country have been planted to pine plantations

Determining the correct carrying capacity on the varied soils and climate of the Volcanic Plains and Southern Dunes sub-region will depend on rainfall, soil type, degree of winter waterlogging, grazing management, soil fertility and the type of enterprise. Carrying capacity will also depend on the area able to be cropped and if there is an irrigation license available.

Working out a potential sustainable carrying capacity is complex and this fact sheet has been compiled using data supplied by farmers who are grazing beef cattle, dairy heifers and sheep in the Volcanic Plains and Southern Dunes sub-region, thus providing locally relevant information. No carrying capacity data has been collected from dairy farmers in this sub-region.

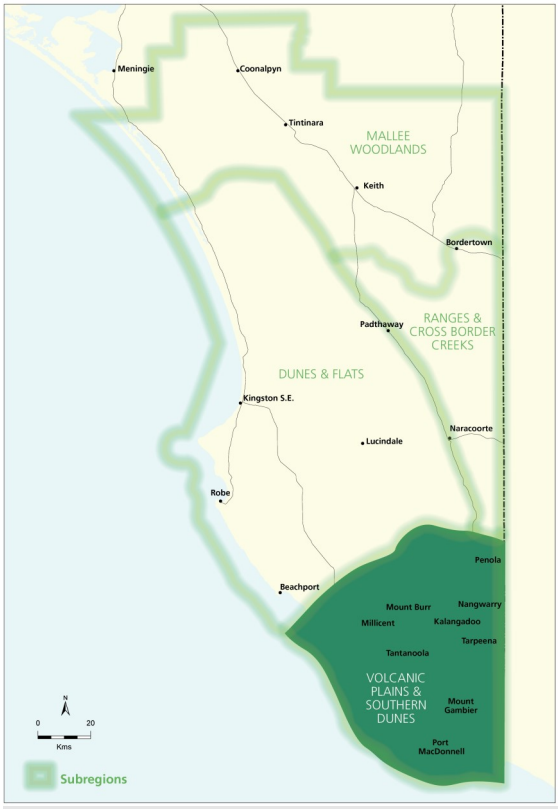

Figure 1: Map showing Volcanic Plains and Southern Dunes sub-region (Limestone Coast, SA)

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Finding a balance in the management of the grazing enterprise between optimum production per animal and production per hectare of land is needed. Overstocking, particularly on soils prone to waterlogging in winter, can result in severe land degradation. Overstocking will also result in the loss of productive pasture species which in turn will significantly reduce livestock production and reduce farm profitability.

Loss of productive pasture species increases infestations of weeds, which can reduce overall productivity, and in some instances also impact on livestock health.

Heavy grazing can cause pugging on waterlogged clay soils resulting in soil damage, loss of pasture and make paddocks less trafficable.

Many farmers in the Volcanic Plains and Southern Dunes sub-region use irrigated pastures to graze livestock as well as an integrated mixed farming approach involving cropping, small seed and vegetable production and vineyards or orchards which can offer additional grazing opportunities. Irrigation can significantly increase overall carrying capacity by extending the growing season either before the break of the season or as rainfall declines at the end of the growing season. Irrigation also provides opportunity to grow high quality fodder crops without having to rely on stored soil moisture or variable summer rainfall.

Determining the appropriate number of livestock to run on a given area will take into consideration grazing management and livestock feed demand, relative to pasture productivity and the timing of pasture production relative to livestock pasture demand. Landholders in the Volcanic Plains and Southern Dunes sub-region are using the following strategies to manage their livestock to maximise sustainable carrying capacity and to maintain pasture:

- Containment feeding, particularly during late summer and early autumn
- Feedlotting or irrigation to finish animals to target weights
- Changing lambing and calving time, so that time of lactation more closely matches the timing of peak green pasture growth
- Sowing improved pasture species, both annuals and perennials
- Pregnancy scanning to remove dry animals in early pregnancy and to manage single and multiple bearing ewes separately
- Soil and pasture nutrition, especially maintaining adequate soil phosphorus and potassium levels
- Applying lime to achieve and maintain a near neutral soil pH on acidic soils
- Grazing management, especially rotational grazing and reducing paddock size, providing additional stock water points and using temporary electric fencing
- Supplementary feeding hay, silage and grain, along with feed budgeting
- Clay spreading and delving on sandy soils
- Upgrading livestock infrastructure including yards, handling equipment, water and fencing, in order to decrease labour costs
- Winter grazing of vineyards, grazing stubbles or vegetable and pasture seed crop residues
- Genetics and breed of animal, to identify genetically superior animals to improve animal performance
- Grazing crops early in the season and then taking the crop through to grain or hay, or oversowing pastures with cereals and/or annual ryegrass
- Wean lambs and calves at the recommended time frames of 12-14 weeks for lambs and 6-9 months for calves
- Trading livestock to ensure that grazing pressure is appropriate throughout the season
- Applying nitrogen fertiliser to annual ryegrass, cereals and phalaris pastures for additional winter pasture

Whilst most landholders are working hard to continue to improve their soils and in particular, better manage both their sandy and waterlogged soils, individual landholders can still be caught out in a very wet year or a year with late opening rains and a cold winter. The key is to monitor grazing paddocks closely, especially soil moisture and ground cover, then make early decisions as required.

Carrying Capacity and Stocking Pressure

Carrying capacity or long-term stocking rate refers to the number of livestock that a paddock or whole property can support over a period of time (several years) without damaging either the soil or the pasture. This is usually measured as a dry sheep equivalent (DSE) per hectare (ha).

On the other hand, stocking pressure is how many DSE/ha are grazing or using an area of land at a particular time and is a management decision regarding how many animals you are going to put on a particular pasture or in a paddock, and for how long. Good pasture managers use carefully monitored high grazing pressure (100+ DSE/ha) for short periods (2 to 10 days) to manage weeds and surplus green pasture, as well as dry pasture over summer/autumn.

Determining your optimal carrying capacity (long term stocking rate) will rely on many factors including:

- Grazing management
- Livestock type and target markets
- Time of lambing or calving
- Soil type and soil fertility
- Pasture type, persistence and stability
- Labour
- Investment
- Length of the growing season
- Paddock size

Actual carrying capacity can be calculated using historical grazing records (number of animals x DSE x number of days divided by grazing area), or by using one of the numerous grazing record computer programs available.

It is dangerous to target a higher stocking rate without a very flexible and well managed grazing system as soils and pasture can also be easily damaged if grazing and fertiliser management is neglected.

Defining a Dry Sheep Equivalent (DSE)

A DSE is a method of standardising the energy requirements of different classes of livestock, based on their metabolisable energy needs. One DSE is the amount of energy required to maintain a 50kg wether (or dry ewe) in condition score 2.5, which is equivalent to a requirement of 8.5 megajoules (MJ) of metabolisable energy (ME) per day.

A DSE does not indicate how many MJ of ME per day the animals are actually eating, as this will depend on the quality and availability of the feed on offer.

A DSE only indicates the animal ME requirements, not the actual ME intake.

Please note that a DSE is only a rough estimate of an animal's feed requirements. The DSE rating will vary considerably depending on whether the calculation is based on actual ME intake, or ME requirements.

For example, using the table below, the DSE rating of a 60kg ewe with one lamb is based on her ME requirement, which is 21MJ/day, so her DSE rating is 21 ÷ 8.5 = 2.5.

If the same ewe is grazing a high-quality pasture with 1800kg/ha feed on offer she may have an ME intake of 28MJ/day, so her DSE rating (based on ME intake) will then be 28 ÷ 8.5 = 3.3.

So, a DSE rating will depend on whether the calculation is based on requirements or intake. In this fact sheet, all DSE calculations are based on requirements.

Table 1: DSE Ratings for Various Classes of Livestock Based on ME Requirements

Mature Ewes

Liveweight (kg)	Dry	Pregnant (last month)		Lactating (average to weaning)		Average for Year
		Single	Twin	Single	Twin	
50	1.0	1.4	1.6	2.1	2.7	1.5
60	1.2	1.6	1.9	2.5	3.1	1.8
70	1.3	1.8	2.2	2.8	3.6	2

Growing Lambs

Liveweight (kg)	Growth (g/day)			
	50	100	150	350
20	0.7	0.8	1.0	1.2
30	0.9	1.0	1.2	1.7
40	1.1	1.3	1.6	2.3

Wethers

Liveweight (kg)	Maintenance
50	1.0
60	1.2
70	1.4

Breeding Cattle

Liveweight (kg)	Dry	Pregnant	Lactating		Average for Year
			0-3mth	3-9mth	
400	4.6	6.2	10	13.8	9
500	5.4	6.9	10.8	15.4	12
600	6.2	7.7	12.3	16.9	14

Growing Cattle

Liveweight (kg)	Growth (kg/day)		
	Maintenance	0.5	1
200	3.1	5.4	7.7
300	3.8	7.3	9.2
400	4.6	9.2	10.8

Estimated carrying capacities and pasture growth rates for the Volcanic Plains and Southern Dunes sub-region

The table below contains estimates of long-term carrying capacity (stocking rate) based on information collected by surveying farmers across the Volcanic Plains and Southern Dunes sub-region. There are many variables affecting the carrying capacity and pasture performance, so these figures can only be used as a general guide under normal seasonal conditions.

Pasture growth tables (see page 6) can be used for an approximate feed budget as the pasture requirements of a DSE are approximately 1 kg pasture dry matter per day.

The figures in table 2 assume no irrigation. Farmers with irrigation who provided information for this fact sheet were able to carry more DSE/ha, as were some farmers with a high standard of land, feed base and animal management practices.

Table 2: Estimated long-term carrying capacities (stocking rate)

Area	Growing Season (months)	Pasture	DSE/ha Range
Rendzina clay flats and peat soils around Rendlesham, Millicent, Tantanoola, Eight Mile Creek and Penola	8.0 to 8.5	Phalaris, perennial ryegrass, white, strawberry, persian and sub clovers	12.0 to 15.0
Volcanic and terra rosa soils mostly around Glencoe, Mount Gambier and Penola	8.0 to 8.5	Phalaris, perennial ryegrass, cocksfoot, white, strawberry and sub clovers	12.0 to 16.0
Red gum soils. Sandy loam soils over clay carrying red gums	7.5 to 8.0	Phalaris, perennial ryegrass and sub clover	12.0 to 14.0
Heath soils. Sandy to sandy loam soils over clay or coffee rock originally carrying heath	7.0 to 7.5	Phalaris, perennial ryegrass, tall fescue, strawberry and sub clovers	10.0 to 12.0
Shallow soils over limestone mostly west of a line running from Rendelsham to Tantanoola, Kongorong and Donovans	Deep ripped and rolled 7.0	Cocksfoot, phalaris, lucerne and sub clover	10.0 to 12.0
	Untreated 6.0	Annual grasses and sub clover	8.0

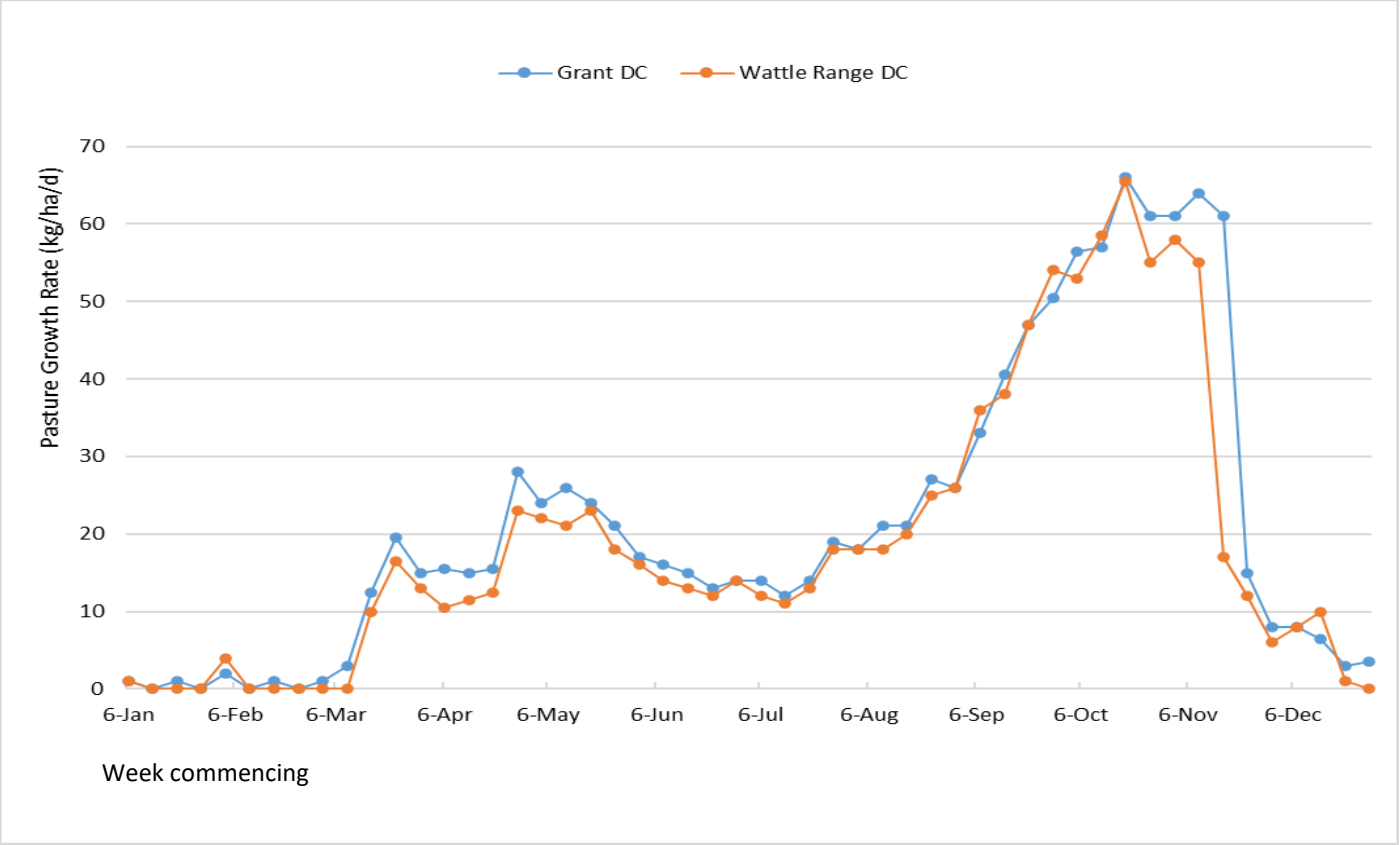

Figure 2: Median daily pasture growth rate 2003-2017 in the Grant and Wattle Range council areas. Source: Pastures from Space.

Strategies to Increase Sustainable Carrying Capacity

Sowing improved pasture combined with **pasture nutrition and fertiliser management** are key to ensuring sustainable increased pasture production in this region. This involves regular soil testing and the annual application of phosphorus (plus sulphur and potassium if required), along with lime applications to correct soil acidity. This allows for increased stocking rates and therefore increased profitability.

Some livestock farmers in the Volcanic Plains and Southern Dunes sub-region are mixed enterprise farmers who run **complementary cropping and livestock programs**. Stubbles are a major feed source at the end of harvest and are used to maintain core breeding animals as well as to fatten young stock. The cropping program also provides an opportunity for farmers to grow their own supplementary feed, making them less vulnerable to volatile hay and grain markets, particularly in times of widespread feed shortages.

Early sowing cereals for grazing (not necessarily for grain) has become more common to help fill the winter feed gap in the region. Sowing cereals for lambing ewes has enabled farmers to set stock lambing ewes and to minimise feeding during the lambing period. These farmers are sowing cereals with a companion species such as vetch, sub clover/medic or ryegrass to maximise the value of the feed.

Figure 3: Cereals can be used for valuable winter grazing .

Nitrogen (N) fertiliser: Phalaris, perennial ryegrass and cocksfoot based pastures along with cereals and annual ryegrass are highly responsive to nitrogen fertiliser. This is applied to annual pastures/crops at seeding with additional applications before the three-leaf stage and again following each grazing, or to permanent pastures before and during winter. Farmers are applying several applications of up to 30-35kg/ha nitrogen/application during early and mid-winter. Regular small applications (less than 35kg/ha N) are recommended rather than single large doses.

Gibberellic acid stimulates cell expansion resulting in pasture (and weed) leaf and stems becoming longer and pasture growth rates increasing. It is easily and quickly applied with a boom spray. Often a small amount (25 litres/ha) of liquid nitrogen fertiliser is added to further improve plant response. Gibberellic acid is applied during winter when soil temperatures are lowest and plant production of naturally occurring gibberellic acid is lowest. The use of gibberellic acid does not increase tiller growth or pasture vigour.

Containment feeding sheep to enable deferred grazing following the opening rains is a strategy used to increase carrying capacity outside of dry or drought season management. In this region, containment feeding is increasingly used for a short period (4 to 6 weeks) during late autumn and early winter to allow pastures to germinate, establish a root system and reach sufficient leaf area to maximise pasture growth rate during winter. This also maximises supplementary feed efficiency and prevents livestock chasing the pasture 'green pick' and subsequently expending more energy than they obtain from grazing.

Care must be taken when selecting suitable sites for containment to limit the impact on native vegetation and to minimise nutrient runoff or nutrient infiltration to the water table.

Figure 4: Sheep being fed in containment in the Volcanic Plains and Southern Dunes sub-region.

Time of lambing is an important consideration as it has a significant impact on winter carrying capacity as well as lamb and ewe survival. Autumn lambing requires significant amounts of supplementary feeding (or irrigation) because dryland pasture reserves and quality are almost always inadequate for lactating ewes. However autumn lambing also provides greater opportunity to finish lambs before pasture quality declines and grass seed infestations of lambs becomes a problem, particularly in situations where grass seed free paddocks have not been prepared.

Later lambing (in winter) ensures adequate pasture is available to meet the demands of lambing ewes therefore increasing ewe and lamb survival and lamb growth rates. However, a later lambing may impact on the ability to finish lambs particularly if adequate stubbles or alternative means of finishing lambs other than pasture are not available.

Traditionally farmers in the Volcanic Plains and Southern Dunes sub-region have aligned **time of calving** of their herds to autumn or early winter. In this sub-region, calving in spring compared with autumn or early winter can significantly reduce calf weaning weight due to the spring born calf spending several months on dry summer pasture whilst still young and its nutritional requirements are high. Some farmers are choosing to start calving in July/August. Later dropped calves (and their mothers) are then grazing an abundance of spring pasture putting less pressure on cows in early winter. The impact of later calving on the growth rate of weaner calves can be mitigated on summer active pastures such as lucerne, perennial ryegrass, cocksfoot, tall fescue or white clover, especially in paddocks with irrigation or along the coast.

Weaning calves at around six months rather than the traditional 9-10 months and weaning lambs at 12-14 weeks means better quality pastures can be allocated to weaners, and cows and ewes have more time to recover. Better utilisation and allocation of pasture results in improved weaner calf/lamb performance, reducing the time to make target sale weights which in turn improves the overall profitability and carrying capacity of the livestock enterprise.

Insect control on pastures (and crops) is important. Lucerne flea, red legged earth mite and both black and red cockchafers should be monitored, particularly in sandy paddocks. Pastures are most susceptible to insect damage at the time of emergence. Diamondback moths can also damage brassica forage crops, and if present, should be controlled early before they become established in a brassica crop.

Improved grazing and pasture management has significantly contributed to increasing carrying capacity in this sub-region, with improved pasture species and increased feed utilisation resulting from subdividing paddocks and providing additional water supplies allowing paddocks to be rotationally grazed.

Subdividing paddocks enables more even grazing across all paddocks and within paddocks and helps prevent the "baring out" of areas favoured by livestock. Smaller paddocks can help to increase pasture utilisation, improve the quality of feed, increase pasture productivity and protect the soil from erosion. This in turn can increase the profitability and productivity of the livestock enterprise.

Ripping and rolling shallow limestone soils has resulted in a considerable improvement in dryland pasture productivity (see carrying capacity table on page 5) albeit at a considerable per hectare cost. Ripping and rolling has resulted in an even larger increase in productivity in irrigated pastures.

Clay spreading and delving has been used to modify non wetting sands resulting in improved moisture holding capacity and infiltration, reduce leaching of fertilisers through the soil profile, improved microbe activity in the soil, increased frost resistance and reduced wind erosion. This has brought about increased quality and productivity of pastures on deep sands.

Grazing waterlogged paddocks can result in pugging and pasture/soil damage. The impact of pugging can be minimised by deferred grazing (and application of N fertiliser) in early winter so that wet paddocks have 1500-1800 kg/ha dry matter of feed on offer before they are grazed, and by reducing grazing pressure in wet paddocks by spreading animals across several paddocks.

The **type of livestock** within an enterprise has a significant impact on the potential carrying capacity. Many farmers have reduced their breeder numbers to incorporate a component of trading animals which can be introduced or off loaded depending on feed availability. Some farmers are **using genetics** to influence carrying capacity on their properties, aiming for a more moderate frame size, which requires less maintenance energy than larger-framed animals. In this sub-region, red meat production is important and there has been a shift from wool to meat for prime lambs and beef.

Frequent feed budgeting is needed to make sure there is enough feed ahead on the farm to meet future livestock needs. This is extremely important if you are running a higher-than-average stocking rate to ensure you are not caught out with inadequate feed resources.

Figure 5: Dense pasture in early winter following deferred grazing in late autumn, with adequate soil fertility and a late summer phosphorus fertiliser application.

This can result in costly damage to your soil and pastures, and may also result in paying more than necessary for supplementary feed.

Dryland brassica fodder crops sown in early spring are an effective way of cleaning a run-down pasture and still providing useful high-quality feed for livestock during summer/autumn, dependent on the amount of summer rainfall and water storage capacity (depth) of soil.

Pregnancy scanning enables individual management of ewes or cows according to their pregnancy status. Dry females can be sold, re-mated or stocked at higher rates. In ewes, single and multiple bearing ewes can be identified and managed according to nutritional requirements and enabling optimal use of pasture and feed resources. It enables farmers to calculate lamb or calf losses between scanning and marking and also measure the reproductive potential of their flock or herd.

Drainage is common in this area; beginning in the mid 1800s, hundreds of kilometres of drains were dug in this sub-region to help move surface water into swamps, to the coast or north towards the Coorong wetlands. This has resulted in reduced waterlogging and reduced land salinisation, leading to improved carrying capacity and the ability to grow crops (and lucerne) in paddocks where this was not possible before drainage.

Figure 6: Brassica fodder crop.

Encourage **dung beetles** by taking care with your cattle drenching program, and ensuring you have the complete suite of winter, spring, summer and autumn active beetle species. Dung beetles aerate the soil and incorporate animal dung into the soil to reduce pasture loss due to uneaten pasture around dung pats.

Unsuccessful Strategies Implemented by Farmers

Some improved pasture species have been sown and not persisted well. These have included **biserulla** on sandy soils, **chicory** in paddocks prone to water logging or in paddocks with a heavy capeweed infestation and **lucerne** where soil $pH_{(water)}$ is less than 6.0 especially at 30-40cm depth.

Shrubs such as tagasaste and salt bush have proven hard to manage properly to ensure they remain productive.

Constraints Impacting on Potential Carrying Capacity

Soil constraints in surface and subsoil layers are common in the Volcanic Plains and Southern Dunes sub-region. These may be a barrier to increasing carrying capacity. Constraints include:

- Shallow sheet limestone layer, which restricts root growth and reduces the persistence of perennial grasses.
- Highly alkaline soils on some flats (pH_{water} higher than 8.0) restricting pasture legume growth and persistence, leading to nutrient and trace element imbalances in sheep and cattle.
- Water logging in paddocks not close to a drain.
- Soil acidity (low pH) in dunes in both surface and subsurface layers, and in the surface in sand over clay soils. Soil acidity can also be present in the surface of sandy soils where there is limestone at depth.
- Plant Available Water Capacity (PAWC) can also be low on shallow soils.

Constraints Impacting on Potential Carrying Capacity (continued)

Soil testing is essential to identify the need for beneficial amendments, such as lime or gypsum for soil amelioration. Thorough investigation is warranted to determine the chemical and physical condition in the top 30cm before conducting any soil amelioration activity (such as deep ripping or mixing) to avoid causing further degradation.

Inadequate **fertiliser application**, particularly phosphorus, sulphur, potassium and nitrogen are major constraints to maximising pasture productivity. If soil nutrients are lacking, pastures will be unable to reach their potential regardless of how much water and sunlight is available and how effective grazing management is. Soil testing is essential to identify optimum phosphorus, sulphur and potassium application levels.

Figure 7: Heifers grazing in the Volcanic Plains and Southern Dunes sub-region.

Weed infested pastures impact on carrying capacity. Weeds are often a lower feed value (especially in spring), affect animal health and lower the value of animal products as a result of grass seed infestation. Weeds may arise from livestock overgrazing paddocks in autumn, or by livestock preferentially grazing desirable pasture species rather than weeds, highlighting the importance of grazing management in weed control. Good weed control is critical when establishing new pastures.

The **autumn/winter feed gap** can be a challenge, particularly in seasons with a late break, when there is a narrow window of time before ground temperatures drop significantly, or become waterlogged, reducing pasture growth. Farmers in the district use various strategies to combat this issue including deferred grazing, coupled with containment feeding and supplementary feeding, dry sowing cereals (or annual Italian ryegrass) to maximise early feed production, soil testing and applying adequate phosphorus, sulphur and potassium and applying nitrogen fertiliser and/or gibberellic acid in early winter.

Grass tetany is a common cause of beef cow deaths especially older cows calving in autumn. Some beef farmers have moved to a late winter/spring calving to reduce deaths due to grass tetany, along with improving the legume content of pastures in phalaris dominant pastures on heavy soils.

Trace element deficiencies in livestock are common – in particular copper, selenium and cobalt. The coastal sand dune country south of Mount Gambier and north along the coast to Robe is particularly prone to cobalt deficiency.

Copper is usually applied in autumn with fertiliser, following a positive diagnosis after leaves from actively growing pasture are collected in winter. **Cobalt and selenium** can be administered directly to animals following an analysis of livestock blood collected by a veterinarian or by the analysis of pasture tissue tests by a livestock consultant.

Poor utilisation of pasture occurs either through under or over grazing as a result of inadequate **grazing management**. Good grazing management makes the best use of pasture grown through managing the frequency and intensity of livestock grazing the pasture. Different pastures have particular characteristics meaning they respond differently to grazing and it is important to understand this to maintain productive pastures.

For further information, please contact your local livestock consultant, soils consultant, or agronomist.

This fact sheet has been compiled by Tim Prance, Pastures and Grazing Systems Consultant, T Prance Rural Consulting with information sourced from local consultants and farmers across the Volcanic Plains and Southern Dunes sub-region.

The aim of this fact sheet is to capture and formalise local intelligence on sustainable land use for red meat and wool production in the Volcanic Plains and Southern Dunes sub-region.

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