Supplementary Feeding of Sheep and Beef Cattle

DAVID G. HINTON

SECOND EDITION

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Also available from Landlinks Press:

Feeding Concentrates
Feedlotting Lambs
Running a Small Flock of Sheep Second Edition

Contents

1

Introduction – why feed?

Feeding grain, manufactured feed or conserved fodder to grazing stock is expensive, often wasteful and time consuming, yet sometimes necessary. Deciding when to start, what and how much to feed and when to stop are the questions we will answer as you read.

There are three main reasons to supplement the diets of sheep and cattle. These are:

- to maximise the rate of growth or production (lot feeding)
- to replace a dietary deficiency, such as protein or magnesium
- to compensate for insufficient or poor-quality pasture.

In this book we will consider the most common situation facing farmers: where the pasture quantity and quality are not sufficient to maintain stock in a healthy and productive state or where the stock are unable to meet production and growth targets.

The common dietary requirements of sheep and cattle will be explained in detail, but deficiencies in trace or micro-elements peculiar to particular soil types, areas, feed types and seasons require professional diagnosis and testing and the calculation of exact dosages to correct the specific deficiency.

Lot feeding, where the entire nutritional needs are calculated and supplied to confined stock, requires specialist knowledge and skills that are beyond the intent or scope of this book.

Opportunity lot feeding is a short-term practice of feeding semi-confined stock to seize a buoyant market or cheap feed-supply situation and turn it into a profitable opportunity. This book will provide valuable nutritional information for these short-term situations, but careful research and planning should be conducted to reduce the risks from volatile markets, cost blow-outs and dietary deficiencies.

Supplementary feeding triggers

Five factors can influence or trigger the need to supply grazing stock with supplementary feed:

1. Seasonal variation in pasture growth rate within a year. (See Figure 1.1)

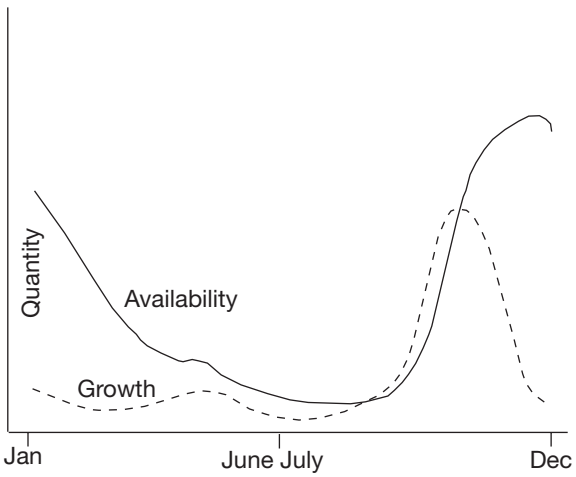


Figure 1.1 Pasture growth and availability in winter rainfall areas.

2. Stocking rate – sheep, cattle or Dry Sheep Equivalents (DSE) per hectare.
3. Stage of breeding or growth. (See Figure 1.2)

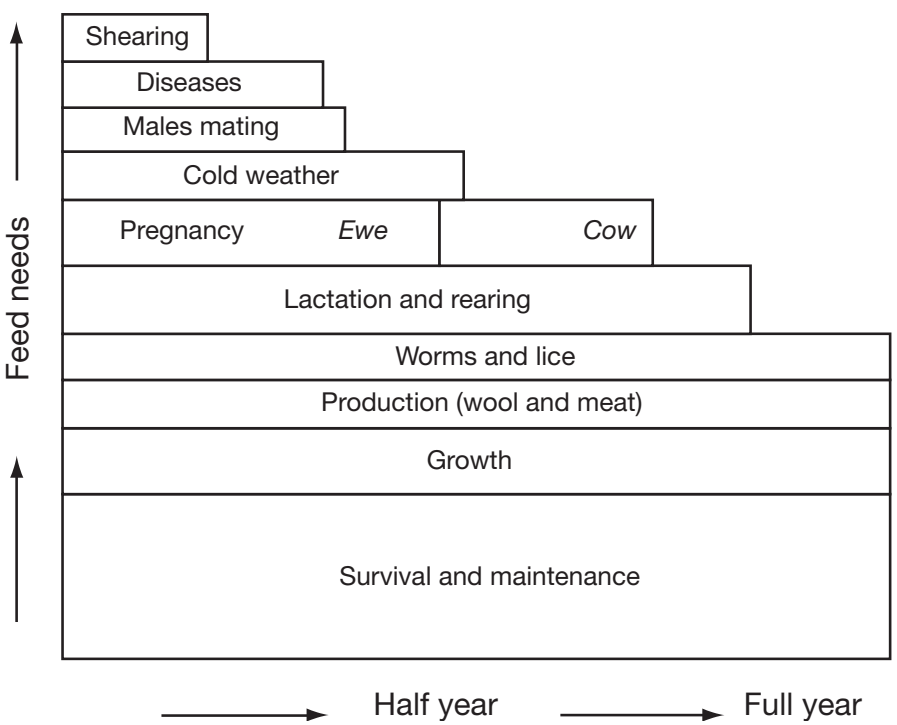


Figure 1.2 Feed requirements of stock at various stages.

4. Failure of normal pasture growth due to drought, fire, disease and abnormal seasons.
5. Weather and environmental effects on sheep and cattle.

Categories of supplementary feeding triggers

These triggers fall into three categories: predictable; unpredictable, but frequently occurring; and infrequent unpredictable.

1. Predictable triggers

Predictable triggers are regular occurrences, such as wet cold winters, calving, lambing and shearing. These can be provided for by using normal management procedures: saving pasture, storing hay or grain, setting appropriate stocking rates and adjusting birth times and stock numbers and types.

2. Unpredictable but frequently occurring triggers

Events like a late autumn break, short spring or cold snap, while unpredictable, do occur frequently. These occurrences must be provided for by feeding fodder in excess of that normally used, agisting extra pasture, culling stock or by having stocking rates that will allow some flexibility.

It is not unusual for pasture growth to fail.

3. Infrequent unpredictable triggers

These infrequent and unpredictable events are often considered to be disasters or major emergencies in communities. Grass or wild fires, droughts and locust plagues are the most common infrequent events. It is not practical to store fodder to allow for these events as enormous quantities are often required, the fodder may deteriorate in quality with prolonged storage and, in any case, the stores are often destroyed by the event. Therefore, agistment and purchasing of fodder are the most realistic options for these infrequent events.

Feeding a supplement is a common alternative in all situations. Supplementary feeding is expensive, so it is very important to know exactly when to start, how much to feed and which type of feed is best.

2

What's in a feed?

Natural feed supplements contain varying amounts of the essential nutrients required by grazing livestock.

The five essentials

There are four types of essential aspects of nutrition to consider when choosing a feed: energy, protein, fibre, and minerals and vitamins. Water is also vitally important for life and health, but it is not a nutrient.

Energy

Energy is obtained from carbohydrates, such as starch and sugars, and from fats and fibre. These feed components provide the energy for animals to maintain their body heat and carry out normal bodily functions and activities. The amount of energy is measured in *megajoules (MJ)* – one million joules. The amount of energy is usually expressed as MJ per kilogram of feed. However, not all energy in plants can be metabolised or used by animals, so only the energy available to the body is measured. This is called the *metabolisable energy (ME)* and energy levels and requirements are therefore quoted as *megajoules of metabolisable energy (MJME)*.

Energy – MJME
Megajoules of metabolisable energy

Protein or crude protein (CP)

Protein is an essential building block of life. Protein is used to create the cells of animal tissues. Feed tests measure crude protein (CP), which includes amino acids (true protein)

and non-protein nitrogen. Animals that are growing or reproducing are creating large quantities of new tissues, so they require more protein than mature animals, which only require maintenance rates. The level of protein in a feed is described as a percentage of the total weight and often expressed as CP%. The percentage of protein varies between plant types (lupins 33%, grass hay 6%) and within species depending on the season, the time of harvest and preservation procedures (for example, oats can vary from 6 to 11% protein).

Protein
CP%

Low-protein feeds make poor weaners.

Late-cut wheat hay: a feed with very high fibre, 54% digestibility, 7.2 MJME/kg DM and 6.8% protein.

Fibre or roughage

Plant fibre is the coarser structural parts of plants, such as husks and stems. For feeds used for grazing animals, the amount of fibre is expressed as high, medium or low. High-fibre feeds, such as hay or straw, are often referred to as roughage.

Fibre is essential for maintaining a healthy digestive tract. Low-fibre feeds, such as wheat, require greater care in feeding and must be supplemented with a high-fibre feed such as mature pasture, hay

or straw. Some poorly preserved hays are often high in fibre and are consequently low in digestibility, energy and protein.

Some fibre is digestible and some is indigestible; this has a large influence on the percentage digestibility rating of feeds. Tests measure the percentage digestible dry matter (DDM) of feeds. Feeds with a DDM of less than 55% are poor quality and will not maintain live weight. Feeds exceeding 65% DDM are generally considered to be of high quality.

Fibre
High
Medium
Low

Minerals and vitamins

Minerals

Minerals are usually adequate in feeds commonly used for sheep and cattle in grazing situations, so, with a few exceptions, they are not an important consideration when choosing a feed.

The exceptions are grass tetany, calcium deficiency and trace elements.

1. Grass tetany – a magnesium deficiency that can be corrected, in part, by feeding a magnesium supplement or clover hay, which has more magnesium than grass hay.
2. Calcium deficiency – some feeds, particularly cereal grains, have insufficient calcium compared with the high levels of phosphorus. This inadequacy for animals is overcome by the addition of 1 to 2% ground limestone to the grain portion of rations. Therefore calcium levels need not be a consideration in the choice of feed, but are important in overall feed management.
3. Trace elements – these may be area- or soil-type-specific, such as deficiencies in copper or molybdenum. Some trace element deficiencies can be identified by tests. Treatments include animal injection, drenching, mineral licks and additives to water or feed. If you suspect a trace element deficiency in your stock, it is important to obtain professional diagnosis and a prescribed dosage rate and method of administration. Overdosing can have negative effects and can even cause death.

Vitamins

Vitamins are essential for good animal health, but normally need to be considered only in artificial or forced-feeding situations, such as feedlots. Grazing animals usually have an adequate supply of vitamins. Thiamine is a vitamin which can cause polioencephalomalacia if deficient in sheep and goats. This deficiency results not from the feed, but from an organism in the rumen that destroys thiamine. The condition is treated by using thiamine supplements, not by selecting feeds high in thiamine. In some severe situations, supplements of vitamins A, D and E will be beneficial.

Water

Providing clean, cool and safe water is essential at all times. Stock will drink more during hot weather, when eating dry feeds or pasture and when lactating (milking). Water may

become toxic if it contains high salt or mineral levels or when contaminated by organisms such as bacteria and algae.

Dams that are polluted by manure or other organic contaminants may become undrinkable and toxic. When dams are low, they may also cause stock to become bogged and even drown. Water troughs with sufficient capacity and back-up reserves are the safest way to provide water, particularly in dry times.

Clean, safe water is always essential; consumption will be higher on dry feeds.

Well-maintained water troughs are the safest way to provide clean drinking water.

Growth-enhancing treatments and additives

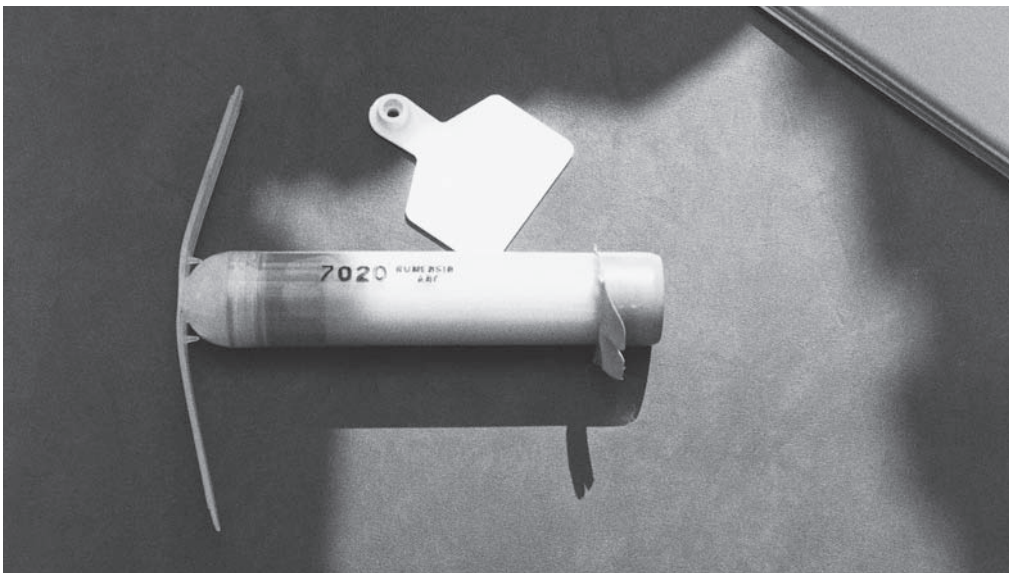
Growth rates and productive performance can be improved by the addition of a variety of treatments and feed additives. The maximum growth rate of any stock is limited by their genetic potential and nutritional and physiological factors. In times of pasture shortage, the limiting growth factor is usually energy or, sometimes, protein. The benefit of other treatments will be lost if inadequate energy or protein is supplied. When the supply of energy and protein is sufficient for maximum potential growth rate or production, then other factors, such as insufficient vitamins and minerals, digestive capacity and digestive malfunction, can limit the potential productivity.

Growth rates can be improved by increasing the amount of energy and protein amounts and by using:

- injectable vitamins, usually vitamin A, D and E
- hormonal growth promotants (treated stock must be identified according to state regulations)
- vitamin and trace mineral premix (recommended when supplements exceed 50% of total intake)
- rumen-function stimulators and modifiers, which improve digestive capacity and reduce acidosis
- concentrated feed additives (as used in feedlots), which contain vitamins, minerals, acidosis inhibitors and rumen-function stimulators
- bloat-preventing feed and water additives and capsules
- urea as a by-pass protein boost. Urea is included in some feed concentrates and licks. You must take extreme care when administering urea as there is a great risk of a fatal overdose.

- protein, or by-pass protein (nitrogen source), which may assist with the utilisation of poor-quality feed by boosting flora and fauna activity in the rumen and therefore improving the digestion rate
- a variety of blocks or licks containing minerals, protein and by-pass protein in various proportions depending on the intended application.

Before undertaking any of the above options, seek professional advice and use tested feeds to avoid wasting money by overdosing, treating unnecessarily and to prevent harm to your animals (you can even cause deaths by incorrect dosing). Use only products registered for the purpose and type of stock, observe the dose rates and withholding periods and declare any treatments on sale vendor declarations.



A rumen-function stimulator capsule.

3

Understanding feeds and feeding

Productive survival condition

Sheep and cattle have a minimum condition for survival below which they will die. While stock may survive at this minimum level, they will not be productive: growth of lambs, calves and young stock will be unsatisfactory; conception rates and milk production will be very low; and, for sheep, the wool is likely to be tender and will grow very slowly, if at all.

In most situations there is little point in feeding animals for survival alone. Supplementary feeding should be started before stock reach their minimum survival condition so that they can be kept at a productive level and return some income for the expenditure on feed. For the purpose of this book, productive survival condition is taken as the minimum level.

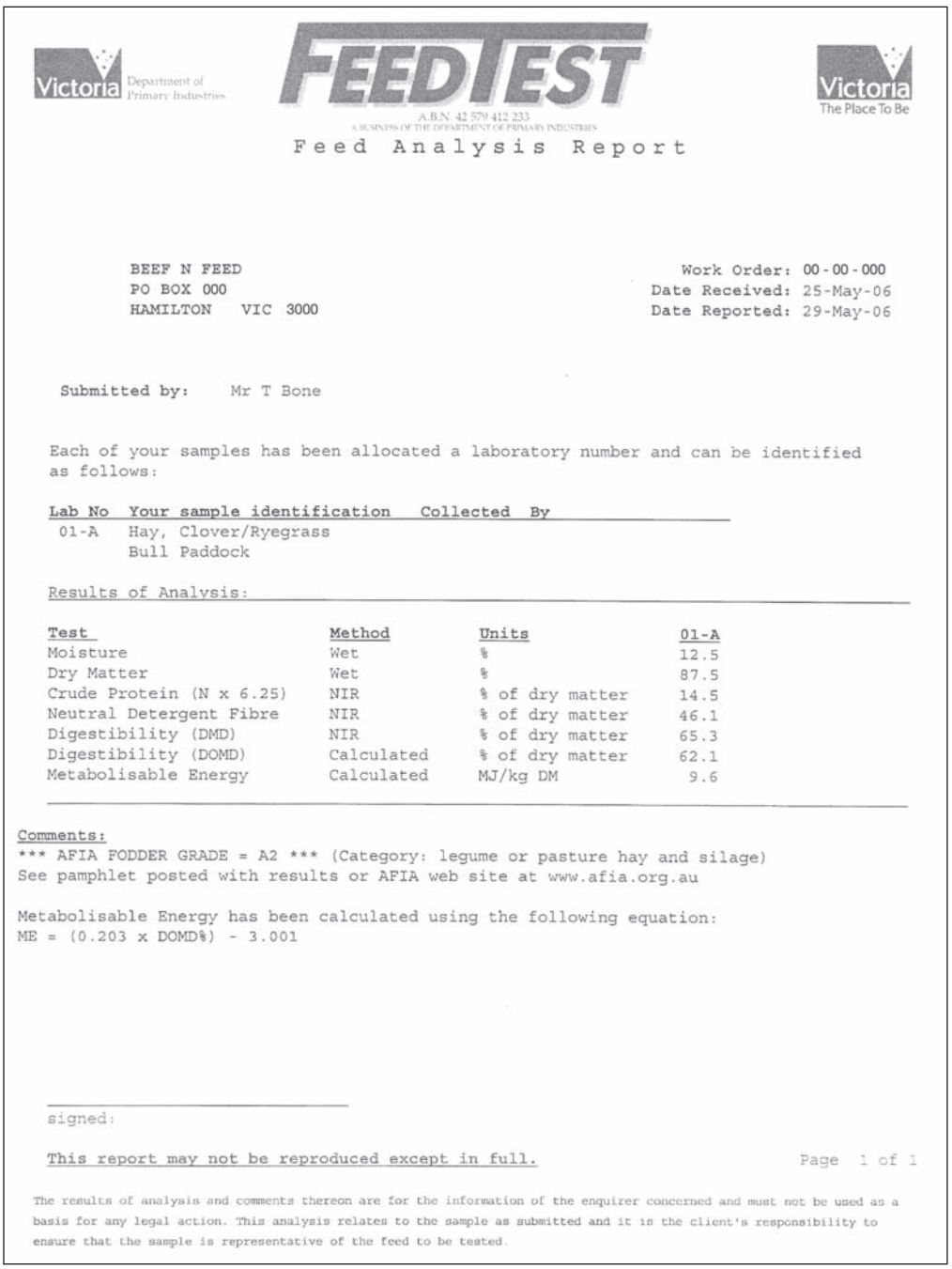
While maintaining animals in a better condition will improve productivity, it is usually not economical to feed for these higher levels of production, unless the animals (or their products) are very valuable.

The productive survival condition is different for each type of stock and for each stage of growth and reproduction. The productive survival condition needs to be higher during colder seasons. A list of these minimum body-condition levels, or fat scores, is provided later.

Feed tests

A number of private and government laboratories will test feeds of all types. The laboratory will issue a test certificate indicating, among other things, digestibility, energy value and protein level. This certificate is very valuable to the owner, vendor and purchaser. All feed-testing services will report results on a dry matter (DM) basis, that is, all the moisture is removed from the feed before testing.

Most testing services provide easy-to-use packaging and instruction kits. A feed test will ensure you are getting value for money on your feed purchases and allow you to calculate the correct feeding rates for your animals. For up-to-date information on terminology, tests and methods used visit the Australian Fodder Industry Association on www.afia.org.au.



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Feed Analysis Report

BEEF N FEED
PO BOX 000
HAMILTON VIC 3000

Work Order: 00-00-000
Date Received: 25-May-06
Date Reported: 29-May-06

Submitted by: Mr T Bone

Each of your samples has been allocated a laboratory number and can be identified as follows:

Lab No	Your sample identification	Collected	By
01-A	Hay, Clover/Ryegrass Bull Paddock		

Results of Analysis:

Test	Method	Units	01-A
Moisture	Wet	%	12.5
Dry Matter	Wet	%	87.5
Crude Protein (N x 6.25)	NIR	% of dry matter	14.5
Neutral Detergent Fibre	NIR	% of dry matter	46.1
Digestibility (DMD)	NIR	% of dry matter	65.3
Digestibility (DOMD)	Calculated	% of dry matter	62.1
Metabolisable Energy	Calculated	MJ/kg DM	9.6

Comments:
*** AFIA FODDER GRADE = A2 *** (Category: legume or pasture hay and silage)
See pamphlet posted with results or AFIA web site at www.afia.org.au

Metabolisable Energy has been calculated using the following equation:
ME = (0.203 x DOMD%) - 3.001

signed:

This report may not be reproduced except in full.

Page 1 of 1

The results of analysis and comments thereon are for the information of the enquirer concerned and must not be used as a basis for any legal action. This analysis relates to the sample as submitted and it is the client's responsibility to ensure that the sample is representative of the feed to be tested.

Figure 3.1 A typical feed test report.

Dry matter (DM)

Different fodders contain different moisture levels. The time and method of harvesting, weather, storage and type of fodder all affect the moisture content. The moisture content has a marked effect on the weight of the fodder, but not its feed value.

To purchase feed of 85% DM by weight, simply means you will be purchasing 15% water (usually at a relatively high price for water!). To compare the value of a variety of feeds fairly and accurately, it is essential to eliminate the other variables, such as moisture.

Dry matter
DM%

Therefore, when feeds are tested, results include the percentage dry matter (DM) and all other tests are reported on a dry matter basis – that is, all the moisture is removed from the feed before testing.

Please note:

- In this book, for simplicity, common dry matter percentages have been allowed for in the energy unit figures provided.
- If using feed-test figures, you need to adjust your results to calculate the real value of your fodder.

Let's look at an example of how to convert dry matter energy units to actual energy units:

A batch of oats tested 90% DM (dry matter) and 10 EU (energy units) per kilogram (kg) DM. Therefore, in order to calculate the real value of the oats, you will need to allow for the fact that approximately 1.1 kg of oats is required to provide 1 kg DM and 10 EU. Alternatively, you will need to reduce the EU by the percentage of moisture (10%). Either way, your calculations should show that there are approximately 9 EU in 1 kg of these oats.

EU per kg DM × percent DM = EU in actual feed

10 EU/kg DM × 90% DM = 9 EU/kg of actual feed

Table 3.1 shows the dry matter percentages for some common feeds.

Table 3.1 Common dry matter percentages

Feed type	*Per cent dry matter (DM%)*
Grains and seeds	90
Hay	85
Straw	90
Wilted silage	35–50
Pit silage	20
Mature pasture – green	35–40
Young pasture – green	15–20
Molasses	75

If you know a feed's DM% and the quantity of DM to be fed, it is easy to calculate the actual amount of feed required. If the DM is 80% and you need to feed 2 kg DM per head for 50 cattle, you can use the conversion factor from Table 3.2 and multiply by the kg to be fed and the number of stock.

Table 3.2 Ready Reckoner: dry matter to 'as fed' converter

Kilograms of a feed to be fed to provide 1 kg of dry matter (DM)

% DM of feed	*Kg needed to feed 1 kg DM*	*% DM of feed*	*Kg needed to feed 1 kg DM*
5	20	55	1.82
10	10	60	1.67
15	6.67	65	1.54
20	5.00	70	1.43
25	4.00	75	1.33
30	3.33	80	1.25
35	2.86	85	1.18
40	2.50	90	1.11
45	2.22	95	1.05
50	2.00	100	1.00

From the Ready Reckoner table: the 80% DM line shows that you need to feed 1.25 kg of feed to provide 1 kg DM. So, the total quantity of feed required is:

$$1.25\text{kg} \times 2\ \text{kg/head} \times 50\ \text{head} = 125\ \text{kg}$$

Hay and silage

Choosing hay

The quality and feed value of hay varies widely. Straw is on the lower end of the scale from poor to good quality. Table 3.3 indicates the characteristics of poor and good quality hay (most hay fits somewhere in between). A feed test will provide a precise measure of quality.

Table 3.3 Hay quality guide

	Characteristics	*Range of hays and typical energy values*	
		Hay type	*EU (MJME/kg)*
Poor hay	Yellow or bleached Stalks or stems Seed heads and seeds Musty or mouldy Weather damaged Mice damage	Straw Grass only, cut late Delayed baling Oaten hay, cut late Mostly grass Stalky lucerne, cut late	5 low digestibility 6 low digestibility 6–7 6–7 7 7
Good hay	Green, well preserved Mostly leaf Soft fine stems Flower heads Sweet smell	50/50 clover/grass Oaten hay cut at flowering Lucerne second cut Clover or medic cut at flowering	8 8 8 high protein 8 high protein

Bale shapes, sizes and weights

Knowing how much hay is in a bale is another dilemma facing farmers when feeding or purchasing. The following will provide a general guide, but buying hay by weight (i.e. per tonne) is the best solution.

Small square bales (conventional, 22–33 kg):
The size of a standard small square hay bale (which is actually rectangular) is usually estimated at 40 bales per tonne or 25 kg each. The exact size of small square bales varies slightly between balers and operators. When you are considering buying hay bales from a new supplier, it is best to weigh a few bales first.

Hay comes in many shapes and sizes: sheaves, round, large and small squares.

Large bales

Round and square or rectangular bales come in a range of sizes and shapes. The following table provides the bale dimensions, the equivalent number of conventional small square bales and the approximate number of large bales carried by a standard semi-trailer transport. The weights and dimensions of bales will vary between balers and operators, so buying by weight is always more accurate.

Table 3.4 Approximate hay bale dimensions, weights, square bale equivalents and bales per semi-trailer

Bale size		*Weight per bale (kg)*	*Small square bale equivalent*	*Bales per semi-trailer 40 feet/14.6 m long*
Feet	*Meters*			
Small square bales		25	1	650
Large square bales				
8 × 4 × 4	2.4 × 1.2 × 1.2	750	30	20
8 × 4 × 3	2.4 × 1.2 × 0.9	600	24	30
8 × 4 × 2	2.4 × 1.2 × 0.6	250	10	40
8 × 3 × 3	2.4 × 0.9 × 0.9	300	12	40
8 × 2'8" × 2'8"	2.4 × 0.8 × 0.8	240	9	45
8 × 3 × 2	2.4 × 0.9 × 0.6	200	8	52
Round bales				
6 diameter	1.8 diameter	530	21	26 overwide
5	1.5	370	15	32
4	1.2	240	10	32

Silage

The weight of silage will vary greatly, depending on the type of fodder and the amount of moisture. Testing a supplier's silage for energy and moisture or dry matter content may help you decide whether to buy and transport all that water.

As a very general guide:

- Round bales (wilted silage): 1.2 metre (40–50% DM) 350–500 kg
- Pit silage: 1 cubic metre (35% DM) 600–800 kg
- Wilted silage: 1.4 cubic metres is 1 tonne.

Round baled and wrapped silage (also called wilted silage or haylage).

Rectangular baled silage: wrapped and unwrapped ready to feed.

Pit silage.

4

Cost savings and decision making

Before commencing an extended, and possibly expensive, feeding program, have a look for alternatives or ways of reducing costs. Is there enough cash and feed on hand to be able to feed all stock through to the end of the feed shortage?

There are a number of cost-reducing alternatives that should be seriously considered before embarking on a feeding program.

Cull or sell

Culling of some categories of stock (mobs) or the less productive animals should be considered before supplementary feeding commences. It may be better to sell some mobs early rather than spend money on feeding and still have to dispose of them when supplies or money run out.

You should cull stock that are:

- aged
- faulty in the mouth, feet, legs, udders, wool or are otherwise diseased
- surplus to requirements, particularly replacement breeders
- non-producing breeders (either not pregnant when they should be or are dry when they shouldn't be).

Breeders that should be pregnant, but are empty, should be the first animals to go. Pregnancy testing and culling of empty females is a more economical option than protracted feeding of non-productive females.

Early shearing and culling

For sheep, consider early shearing and disposal, but do your sums carefully. Allow for short staple discounts and less income and offset these against reduced feeding and more pasture available for the remaining sheep.

Winter shearing

Avoid shearing during winter. Delaying until spring will save on feed. Studies have shown that shorn sheep require 69% more feed than woolly sheep during the first four weeks and 27% more during the second four weeks after shearing.

Mob structure

Draft mobs into age and breeding groups so that each group receives just the right amount of feed. Mixed mobs lead to wastage, as those animals with lower requirements often get too much feed and the less competitive stock suffer.

Breeding

During the last four to eight weeks of pregnancy feed requirements increase by 50% and they double for the first four weeks after lambing or calving. Therefore a large saving can be made on feed costs by:

- not joining
- joining fewer females
- humanely destroying lambs at birth
- selling calves at about two weeks.

These are fairly drastic options and should be well thought through, as they will have a severe impact on downstream income.

Early weaning

Early weaning will reduce overall feed consumption as feed conversion into milk is not very efficient. Early weaning can also bring the benefit of allowing you to cull the older cows or ewes earlier than usual.

Merino-type lambs may be weaned onto a high-protein diet as early as six weeks.

Calves can be bucket reared or weaned between six and 12 weeks onto good pasture and/or a high-protein ration.

Lambs and calves need to become accustomed to feeding on supplements before weaning. You need to train them onto the feed to be used before weaning.

Before adopting the more radical early weaning practices, carefully consider the consequences of reduced downstream income and the immediate extra short-term costs and workload.

Body condition

Do not allow your stock's condition to fall too low. Animals in poor condition will:

- return less for the feed consumed
- have tender wool (sheep)
- milk poorly and dry off earlier
- have a higher death rate
- grow more slowly.

It takes a lot more feed to build up an animal in poor condition than to maintain one in a basic productive state. Starting supplementary feeding a little earlier, before your animals' condition deteriorates to below the target, will produce considerable savings. This is even more critical with the onset of cold weather.

Animals in poor condition are inefficient users of feed.

Stock-containment areas

During protracted dry seasons or after wild fires, removing stock from having run of the farm and managing them in containment yards or small paddocks will protect vulnerable pasture and soil and make management easier. Stock-containment areas are explained fully in Chapter 11.

Feed through or sell and replace stock?

In times of an extended dry or drought, a difficult but critical decision is whether or not to sell stock, particularly breeding stock, and repurchase after the drought or to feed stock until the drought is over. It is important to make this decision as early as possible; a change of plan part way through can be very expensive.

You need to think about the following questions before deciding whether to feed or sell and replace:

- Do I have sufficient funds or overdraft to feed until the drought is over?
- What is the value of my stock genetics? Can I replace the current genetics with equivalent breeders at the end of the drought?
- What are the risks of introducing disease, such as footrot and Johne's Disease, when repurchasing? What control and marketability costs would that event impose?
- What are likely restocking costs? Traditionally, stock become scarce and expensive following a drought.
- What are the feed costs? Remember that feed in storage on the farm also has a cost: it could be sold and be converted to income.

Which option is most cost effective? Table 4.1 will help answer that question.

Try several buying and selling cost scenarios for both feed and stock and see how they compare. This will answer the, 'What if …' questions. What if hay doubled in price? What if replacement stock cost $X per head? What if I reach my borrowing limit?

Table 4.1 provides a method of comparing the costs of two options. The table uses an example of 1000 Merino ewes being fed for 180 days (six months). The same process can be applied to any stock or situation. Remember there are other factors to consider (e.g. genetics, disease risks, feed on hand, finances) as outlined in the questions above.

A blank table is provided at the end of this book for your own calculations.

Table 4.1 Comparing costs for feeding or sell and replace options

(Example: 1000 Merino sheep fed for 180 days or sold and replaced)

Option 1. Feed breeding stock through drought				
Cost of feed Feed and price/tonne	A kg/head/day	B $/kg $/T ÷ 1000	C $/head/day A × B	Total feed cost
Barley $320	0.5	0.32	0.160	
Pasture hay $140	0.5	0.14	0.070	
Ground limestone $550	0.011	0.55	0.006	
Total cost of feed	Total of C × number of days to feed × number of head		$0.24 × 180 × 1000	D $43 200
Feeding out cost Cost	E Hourly rate	F Feeding hours/ day	G Cost/day E × F	Total feeding cost
Labour	$16.00	1.5	$24	
Fuel @ $1.20 per litre using 15 litres per hour	$18.00	1.5	$27	
Repairs and maintenance	$4.00	1.5	$6	
Total cost of feeding out	Total of G × number of days to feed		$57 × 180	H $10 260
Opportunity cost of $ Opportunity rate on $ spent (interest lost)	Interest lost p.a. (D + H) × J%	Interest lost for feeding period K × No. of days ÷ 365		Total opportunity cost
J 10%	K $5346	5346 × 180 ÷ 365		L $2636
Total cost	D + H + L			M $56 096
Total cost per head	M ÷ number of head			$56.10

Option 2. Sell stock and replace later					
Sales income			Purchasing costs		
N	*Selling price per head*	$42	V	*Cost per head*	$91
P	*Gross income N × number of head*	$42 000	W	Total of purchases (V × number of head)	$91 000
Q	*Commission P × 5%*	$2100	Total net costs		
R	*Freight ($2.50 per head)*	$2500	X	Net cost of selling and repurchasing (W – U)	$51 756
S	*Net income P – Q – R*	$37 400	Net cost per head (X ÷ No. of head)		$51.76
T	*Interest on income (10% of S for number of days)*	$1844	Compare the net total costs of both options and other considerations.		
U	Total income (S + T)	$39 244			

Is it economical to feed or is it better to sell and replace later?

5

Fat scores and stock classes

Assessing condition or fat score

You can only determine when to start feeding and how much to feed by firstly assessing the condition of your stock. There are two ways of assessing sheep and cattle: by weighing and fat scoring.

Fat scoring is simply determining the amount of fat reserves in specific accessible areas on the animal. The fat score reflects the overall fat and energy reserves of the animal. As fat is used up, the bones feel or appear sharper or more prominent.

Sheep fat scoring

The thick wool on sheep makes it difficult to determine their condition visually. Fat scoring determines the amount of fat stored along the back of the sheep, which consistently reflects the overall fat and energy reserves of the sheep. By feeling the rib area on the back of the sheep, an assessment is made and a rating or score given. Scores of 1 (no fat) to 5 (very fat) are used.

These fat scores can be translated into actual millimetres of fat at slaughter. This is measured at a position called the GR site, which is a point on the

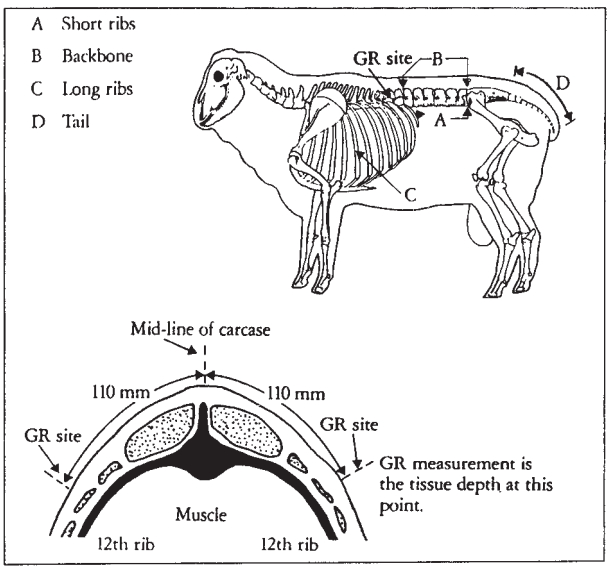
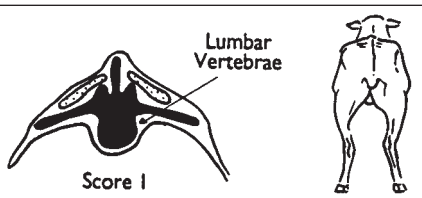
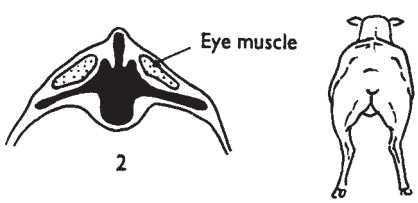
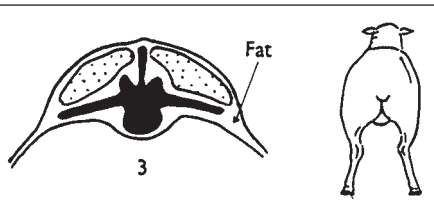
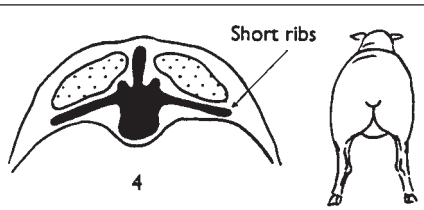
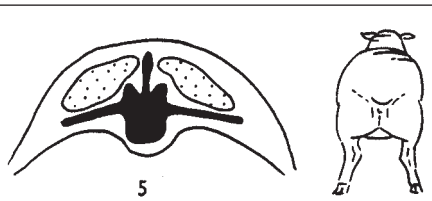


Figure 5.1 Sites for fat scoring sheep.

12th rib, 110 mm from the midline. The 12th rib is the second last and 110 mm from the midline is approximately one adult hand width – so simply lay your little finger along the midline pointing forward, then feel for the second last rib with your thumb and there you have the GR site. Move your fingers to the base of the wool so they are touching the skin over the GR site. Roll your fingers horizontally along the skin over the ribs; the ribs will feel like harder bumps.

The GR site is the best site for estimating fat score, as this is where measurement is made in the abattoir. The tail butt is not a reliable site as it does not consistently represent the rest of the carcase.

Table 5.1 Fat scoring sheep (GR descriptions from *Prograze (Victoria) Manual*[1])

Fat score *GR fat depth*	*Description*	*Appearance*
Score 1 0–5 mm fat	**Very lean** Individual ribs are easily felt and no tissue can be felt (sliding) over the ribs. Depressions are quite obvious between ribs.	
Score 2 5–10 mm fat	**Lean** Individual ribs are felt with some tissue able to be felt over the ribs. Depressions between the ribs are obvious.	
Score 3 10–15 mm fat	**Medium** Individual ribs can still be felt but they are quite rounded, with tissue movement felt over the ribs. Depression between the ribs is less obvious.	
Score 4 15–20 mm fat	**Fat** The ribs are less obvious to feel, with only some depression between the ribs. Tissue movement over the ribs is apparent.	
Score 5 >20 mm fat	**Very fat** It is difficult to feel ribs or any depression between the ribs. Sliding over the ribs is easy.	

By assessing a large number of sheep, it is easy to establish a range of fat scores for each mob. Weigh a number of sheep that have an adequate fat score for the particular class of sheep: this weight becomes your target weight for the poorest quarter of the mob.

Select ten sheep from the poorest quarter of each mob, mark them with an easy-to-read number, then weigh them and record each number, weight and fat score. A set of bathroom scales is useful for weighing smaller sheep (see Figure 5.2) – get someone to weigh you while you are holding a sheep and then deduct your own weight.

Figure 5.2 Weighing small sheep using bathroom scales. (Illustration by Elspeth Lacey)

From this information you can monitor the condition of each mob and can provide the exact amount of feed required. Weigh and fat score the marked sheep in each mob every two to four weeks. If the average weight is rising above the target weight, reduce the amount of feed supplement; conversely, if the average is falling below the target weight, increase the ration. Weighing in conjunction with fat scoring provides a reliable check on accuracy.

You also need to make allowances for wool growth, pregnancy, twin pregnancy and lambing.

In some areas, condition scoring of Merino sheep is preferred to fat scoring. This assessment is done using the loin or short ribs and will also provide a reliable method of monitoring the condition of Merino sheep using a similar score of 1 to 5.

Cattle fat scoring

To assess the condition of cattle, observe and feel the loin or short rib area and give a rating or score. Scores from 0 (no fat) to 5 (very fat) are used. The fat score can be further refined by adding the letters H (High) and L (Low) after the score number to indicate half scores. Palpating the tail head for fat cover will also qualify the loin assessment as described below. For example, if the short rib score is 2H and the tail head feels to be a 3 then the overall score is 3L (the score progression is 2, 2H, 3L, 3).

You should weigh or fat score cattle every two to four weeks. If the average weight or fat score rises above or falls below the target weight, then reduce or increase the amount of feed supplement accordingly.

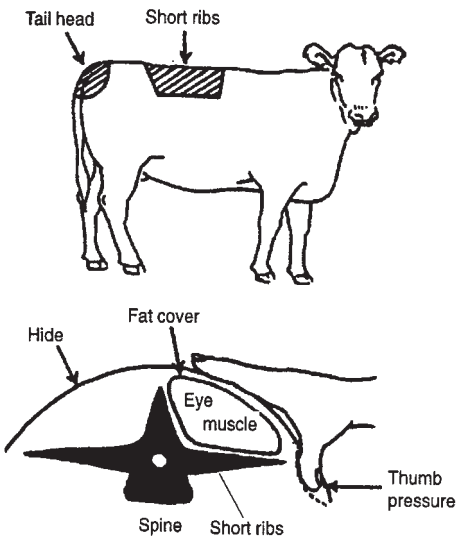
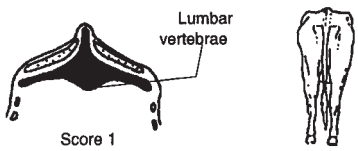
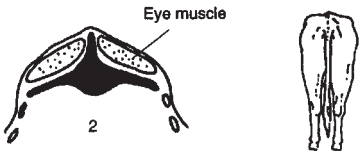
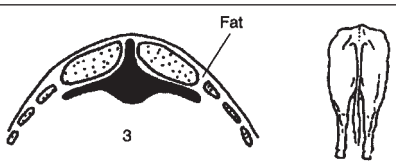
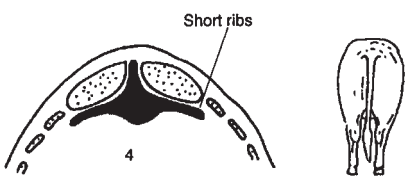
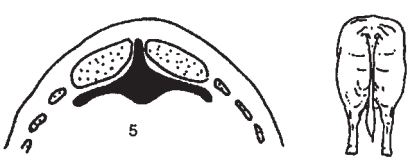


Figure 5.3 Cattle fat scoring assessment areas. Use thumb and finger to feel fat cover.

Table 5.2 Fat scoring cattle (data adapted from *Prograze (Victoria) Manual*[2])

Fat score	*Description*	*Approximate fat P8 rump*		*Appearance*
		Cows	*Steers/ heifers 20 months*	
Score 0	Emaciated (no fat, all rib, hip and tail bones are prominent)	No fat	No fat	
Score 1	The individual short ribs are sharp to the touch, no tail head fat. The hip, bones and ribs are prominent.	0–2 mm	0–2 mm	
Score 2	The individual short ribs can easily be felt, but feel rounded, rather than sharp. There is some tissue cover around the tail head. Individual ribs are no longer visually obvious.	3–6 mm	3–6 mm	
Score 3	The short ribs can only be felt with firm thumb pressure. Areas either side of the tail head have fat cover that can be easily felt.	7–12 mm	3L: 7–9 mm	
Score 4	Short ribs cannot be felt and fat cover around the tail is easily seen as slight mounds, soft to touch. Folds of fat are beginning to develop over ribs and thighs.	4H: 18–22 mm	4L: 13–17 mm	
Score 5	The bone structure of the animal is no longer noticeable and the tail head is almost completely buried in fatty tissue.	23+ mm	18+ mm	

In larger herds, select a few animals that are in the lower quarter of the mob, identify them with ear tags then weigh and fat score them regularly, recording your scores and weights; this will provide an accurate guide as to how the mob is faring.

You also need to make allowances for growth, pregnancy, twin pregnancy and calving.

Visual assessment of cattle

A less reliable alternative to fat scoring is visual assessment. This can be carried out without the need to yard up cattle. Practising visual assessment, and comparing your assessment with fat scores and weights as benchmarks, will develop a useful skill.

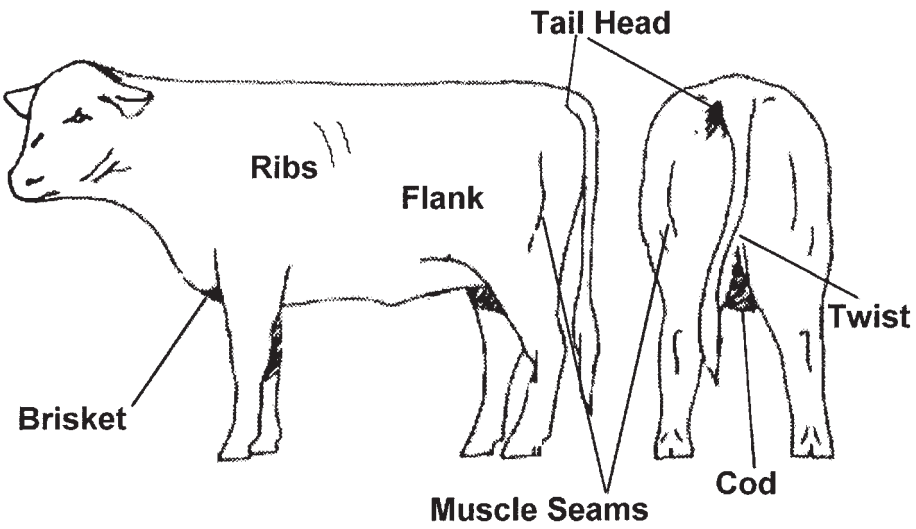


Figure 5.4 Visual assessment reference points for assessing the condition of cattle.

During visual assessment, fat and muscle are observed at three main sites: the flank, brisket and rear. The side, front and rear views are described in Table 5.3. Fat cattle appear square, while well-muscled cattle appear rounded.

As cattle become fatter:

- the brisket, flank and twist fill out giving a squarer appearance
- the muscle seams on the hind quarters become less apparent
- the ribs become less visible
- the tail head softens with rounds of fat increasing behind the tail.

Table 5.3 Visual assessment of cattle

Fatter cattle	Leaner cattle
Rear view	
A more square appearance Top-line is rounder Increasing cod and twist development Knobs of fat increasing on both sides of tail head	A more pronounced tail head Twist is more wrinkled and cut up Little cod development Individual muscle groups more readily distinguished
Side and front view	
Flank has deep gut underlines Deep full briskets (no muscle in this area)	Underlines extend into hind quarters and twist Little fill in brisket

Minimum fat scores for sheep and cattle

While livestock may survive in very poor condition, they are unlikely to be productive, or will perform well below their potential, while they have low fat scores. There is little point in simply keeping stock alive: it is better to have some return for the money spent on feed.

Trial and experience have established minimum fat scores for each class of sheep and cattle to keep them in a productive state that will return some income. Below these minimum scores breeding animals will be less fertile, wool will be tender and reduced and young stock will not make market targets.

Tables 5.4 and 5.5 indicate the minimum fat score for each class to keep them productive. While higher fat scores may increase productivity, it is doubtful whether it is economical to do this using expensive supplementary feeding.

Fat scores for sheep classes

The weight of sheep varies with breed, bloodline, sex, age, time since shearing and stage of pregnancy, so the minimum fat score is the standard measurement used for productive survival condition feeding.

Table 5.4 provides the *minimum* fat score for sheep to function normally and maintain production.

Table 5.4 Minimum fat score for sheep

Type of sheep	*Minimum fat score*
Dry sheep	1.5
Ewe – joining	2
Ewe – pregnant week 1–15	2
Ewe – late pregnant	2.5
Ewe – milking	2
Ram	3
Hogget	1.5
Weaner	2
Prime lamb weaner	2.5–3

A mob will always have a range of fat scores, but the average for the poorest quarter of the mob should not fall below these minimum fat scores. You should record the changes in weight and fat score for the poorest quarter of the mob: this provides a clear picture of progress allowing you to adjust feeding rates accurately.

Fat scores for cattle classes

The weight of cattle varies with breed, bloodline, sex, age and stage of pregnancy, so the minimum fat score is the standard measurement used for productive survival condition feeding.

Table 5.5 provides the *minimum* fat score for cattle to function normally and maintain production during winter.

Table 5.5 Minimum fat score for cattle

Cattle class	*Minimum fat score*
Dry cow	2
Cow/heifer at joining	2.5
Pregnant cow week 1–30	2
Late pregnant cow	3
Cow and calf	2.5
Bull	4
Calf	3
Weaner	2.5
Steer/heifer	2.5

A mob will always have a range of fat scores, but the average for the poorest quarter of the mob should not fall below these minimum fat scores. You should record the changes in weight and fat score for the poorest quarter of the mob: this provides a clear picture of progress allowing you to adjust feeding rates accurately.

Very lean cattle: the result of inadequate feeding.

6

Choosing the best feed – value for money

The best supplementary feed for livestock is the one which provides the best value for money.

Energy considerations

Energy is a major requirement of sheep and cattle. Energy is essential for warmth, growth, activity and production. Energy is usually the first and most important consideration when selecting a feed.

Comparing different feeds based on their cost per kilogram, tonne or bale does not give a true measure of their value for money. You should always compare feeds using a standard measuring unit. The universal standard measure used in Australia is called an Energy Unit (EU), which is one megajoule of metabolisable energy (MJME). Some common energy unit values for frequently used feeds are given in Table 6.1. Using this table, you can compare the cost per EU of different feeds.

Tables 6.7 and 6.8 at the end of this chapter list the less common and unusual feedstuffs and indicate the typical dry matter, energy and crude protein ratings on a dry-matter basis for each feed. You should always be aware of the risks when using unusual feedstuffs. Please read the list of warnings that precedes these two tables before you consider using an unusual feed. Thorough testing for feed value and contaminants is highly recommended.

Table 6.1 Common energy unit values for frequently used feeds

Energy units/kg, as fed

Grains	*Hay*[b]	*Moist feeds*	*Manufactured feed*
Wheat[a] 11–12	Lucerne hay 8	Pasture 1.5–2	Nuts/pellets 10
Oats[b] 10	Straw 5	Crop oats 2	
Barley[a] 11–12	Good hay 8	Silage pit 2	
Triticale[a] 11–12	Poor hay 6	Silage wilted 4	
Lupins 12		Brewers grain 2	
Peas 12		Molasses (cane) 8	

These are 'as fed' values; they have been adjusted to allow for common dry matter percentages.

[a] Wheat, barley, triticale
- Crushed, cracked or rolled – 12 EU for cattle
- Whole – 11 EU for cattle, 12 EU for sheep.

[b] The energy value of oats and hay in particular may vary considerably, so a test to indicate the feed value is recommended.

Finding the cost of a feed per energy unit

1. Cost per kg

- To calculate price in cents/kg, divide feed price $/tonne by 10
- To calculate price in cents/kg for bale or bag, convert the dollars to cents ($2.60 = 260¢) then divide by bale or bag weight (small square bale approximately 25 kg)

2. Cost per energy unit (EU)

- To calculate the price per EU, divide cost per kilogram by the number of energy units in each kilogram (see Table 6.1 above or your feed test results).

Table 6.2 Examples of calculating costs per energy unit (rounded to one decimal place)

Feed	*Cost/energy unit EU (rounded to one decimal place)*
Wheat	$190/tonne ÷ 10 = 19.0c/kg 19.0c/kg for 12 EU = 1.6c/EU.
Oats	$186/tonne ÷ 10 = 18.6c/kg 18.6c/kg for 10 EU = 1.9c/EU.
Hay	$154/tonne ÷ 10 = 15.4c/kg 15.4c/kg for 7 EU = 2.2c/EU.
Hay (small bale)	$2.80 (280c)/bale of 25 kg = 11.2 c/kg 11.2c/kg for 7 EU = 1.6c/EU.
Hay (round bale)	$44 (4400c)/bale of 370 kg = 11.9 c/kg 11.9c/kg for 8 EU = 1.5c/EU.

Be sure to include delivery costs in your calculations.

The differences may seem small, but if sheep are being fed 40 EU per sheep per week the saving by using wheat instead of oats in the above examples is 12 cents per sheep or $120 per thousand sheep per week.

A worksheet for your calculations is included at the end of this book.

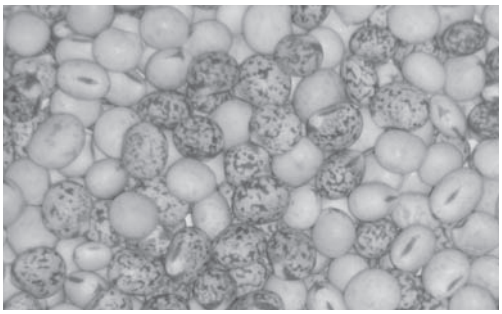
Grain density: a guide to energy value

A rule of thumb for energy value of grains is: *the higher the density the greater the energy value.* The varying density can be seen in the photographs below, but weighing is more reliable.

Density of cereal grains can be measured by weighing one litre of the grain. You can do this using a 1 litre jug and kitchen scales (but remember to deduct the weight of the jug!). Typical grain densities in grams per litre are shown in Table 6.3.

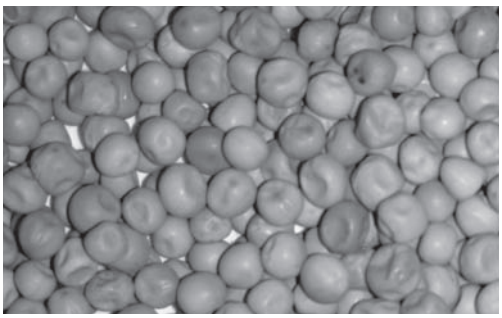
Table 6.3 Typical cereal grain densities in grams per litre

Grain	*Good*	*Average*	*Poor*
Wheat	750	655	560
Barley	700	600	500
Oats	560	500	430

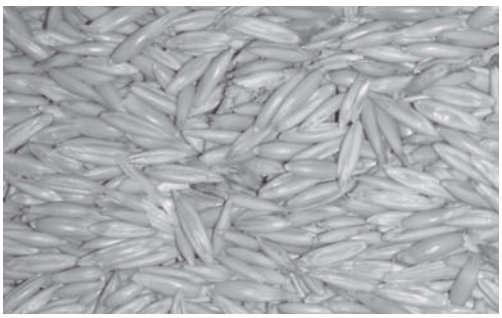


Lupins.

Wheat.



Field peas.



Oats.

Feed-quality barley.

Ewe and lamb pellets.

Protein, fibre and quality considerations

Three important considerations are protein, fibre and feed quality (as measured by digestibility).

Protein

Protein is required for building body tissues. Protein levels in most feeds will be adequate for mature stock. If there is some green pasture available, then protein levels will usually be adequate. If there is only poor-quality dry pasture, then weaners and young stock may require a small supplement (4–10%) of lupins, peas or legume hay (lucerne or clover) to raise the protein level. Grass, cereal hay, straw and oats often have low levels of protein.

Table 6.4 Protein values (% DM) for common feeds

Grains	*Hay and straw*	*Moist feeds*	*Manufactured feed*
Wheat 11	Lucerne hay 16–20	Pasture 2–30	Nuts/pellets 9–12
Oats 5–10	Good hay 8	Crop oats 8–14	
Barley 11	Poor hay 7	Silage pit 8–18	
Triticale 11	Straw 1–4	Silage wilted 14–18	
Lupins 30–33		Brewers grain 25	
Peas 23–25		Molasses (cane) 6	

The protein levels required by different stock are provided in Tables 8.3 to 8.8 in Chapter 8 and Tables 9.1 and 9.2 in Chapter 9.

A feed test will indicate the percentage of protein in each feed sample. This provides an accurate picture and eliminates the guesswork.

Fibre

Fibre, also known as roughage, is essential for a healthy digestive tract. However, too much fibre in the feed can reduce its nutritional value, resulting in retarded growth and reproductive performance and even death from conditions such as pregnancy toxaemia.

Table 6.5 Fibre ratings for common feeds

L – low, M – medium, H – high

Grains	*Hay and straw*	*Moist feeds*	*Manufactured feed*
Wheat L	Lucerne hay H	Pasture M–H	Nuts/pellets M
Oats M	Good hay H	Crop oats M	
Barley L	Poor hay H	Silage pit M	
Triticale L	Straw H	Silage wilted M	
Lupins M		Brewers grain L	
Peas M		Molasses (cane) L	

Feed quality and digestibility

The ability of an animal's digestive system to process feed, and the speed at which it can do this, is an indicator of feed quality and is referred to as digestibility. The longer it takes to digest feed, the greater the energy used in the process and the greater the length of time before the animal can consume more. If you provide feeds with a low digestibility, you will reduce the digestive capacity of your animals. When the potential digestive capacity is not being reached, the rate of nutrition, production and growth will slow proportionally.

High fibre levels usually relate to lower digestibility and therefore reduce the quality of a feed. Generally:

- grains and actively growing leaves have good digestibility
- plants in the reproductive stage have lower digestibility
- stalks and stems are less digestible than leaves.

Digestibility of some feeds can be poor, so taking care to purchase good-quality feed is important. The species of plant, age, stage of the plant at harvesting and the preservation method all greatly affect the digestibility of leaf fodders, such as hay. Hay that is cut too late will be less digestible and have lower protein and energy values.

Digestibility is expressed as a percentage: higher percentages indicate higher digestibility and therefore better quality of feed. A digestibility of 75% indicates that 25% of the feed passes through the animal without providing any nutritional benefit. Table 6.6 shows some typical digestibility ranges for various stages of growth and plant species.

Table 6.6 Typical pasture and grain digestibility ranges for stages of growth and plant species

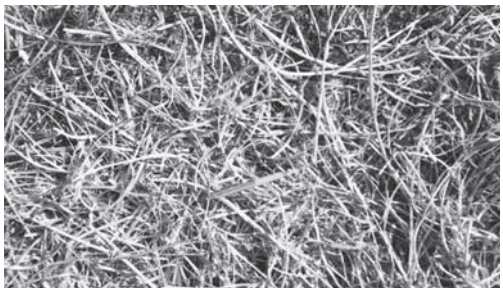
Digestibility % and category	*Stage of growth or grain*	*Plant species examples*
Very high 75–85%	Leaf mid-growing season, best species Most processed grains	Persian and white clover Processed grains including wheat, barley, oats, triticale, peas, lupins
High 66–74%	Leafy, but not flowering Some whole grains	Subterranean clover, lucerne, phalaris, perennial ryegrass, tall fescue Whole grain – oats, lupins, peas
Average 60–65%	Flowers emerging in grasses Some whole cereal grains	Soft brome, cocksfoot, barley grass Whole grain – wheat, barley, triticale
Low 53–59%	Grasses in full flower	Silver grass, kangaroo grass, sweet vernal, onion grass
Very low 35–52%	Dead plants	Any dead herbage material; woody stems and stalks will be at lower end

Dead pasture (<60% digestibility) will usually have a lower digestibility than the same growing pasture (>53% digestibility). Generally, legume pasture will have a greater digestibility, and therefore promote a faster growth rate, than the equivalent mass of grass pastures.

Sheep tend to waste hay that is not of excellent quality. This is not only because of its low digestibility, but also because it is less palatable for their small mouths: the sheep cannot handle the long, fibrous and tough stalks and stems.

Bulky feeds, such as hay and straw, will not be able to provide sufficient nutrients and energy for late-pregnant or young animals; you may need to provide some grain or highly digestible supplement.

Poor quality hay, mostly stems, cut too late and little clover.



Coarse stalky lucerne hay: low digestibility and palatability.

Nutritional value of unusual feeds

Almost any grown product will have some nutritional value. Table 6.7 provides a list of some less common feeds and Table 6.8 some unusual products and by-products that have potential feed value. The lists provide an indicative measure for dry matter (DM%), energy units (MJME/kg/DM) and crude protein percentage (CP% DM) for each feed. Table 6.7 gives an average figure and also the range of results for some feeds – the range is a valuable figure as it indicates the highest and lowest readings and demonstrates the wide variation that can occur.

Feeds with low energy values may be useful as roughage if combined with a grain ration. High-protein feeds can be blended with other feeds to improve protein levels.

Warnings when using unusual feeds

When using the following two tables and considering unusual or unfamiliar feeds, you should heed the following warnings and advice:

- These lists and the tests are derived from a variety of sources and over an extended period of time, so be aware that not all products of the same name will be identical in feed value – a feed test is recommended.
- Variations may exist between species of plant, season and processing method.
- The listed products have not been tested for palatability or suitability for sheep or cattle.
- Storage and feeding of some products, particularly wet feeds, may present difficulties.
- Be aware of the risk of contaminating chemicals, such as agricultural chemicals, preservatives, solvents, fermentation products and container contaminants (dirty containers) and organisms, such as fungi and bacteria (including moulds, *Listeria*, *Clostridium botulinum* and *Salmonella*). Thorough testing for contaminants and suitability for animal feeding is essential. Ask the supplier for a written statement certifying a feed's suitability for animal feeding and any known tests or contaminants.
- Feeds containing 'Restricted Animal Material' cannot by law be fed to sheep or cattle. Restricted Animal Material is any material taken from a vertebrate animal, other than gelatin, milk products, oils extracted from fish, treated tallow or treated cooking oil. It includes rendered products, such as blood meal, meat meal, meat and bone meal, fish meal, poultry meal and feather meal, and compounded feeds made from these products.
- Many products cannot be fed as a sole ration – they should only be used as a blend with conventional feeds. Seek expert advice, introduce the new feed carefully and monitor your animals' progress.

Table 6.7 Energy, protein and dry matter composition of less common feeds (rounded down to whole number). All these results are given on a dry matter basis – if used for calculations as shown in this book they need to be converted to an 'as fed' basis.

Feed	*Approximate dry matter (DM%)*		*Metabolisable energy (MJME/kg DM)*		*Crude protein (CP%)*	
	Average	*Range*	*Average*	*Range*	*Average*	*Range*
Grain and grain products						
Barley grain	88	81–97	12	8–13	10	6–19
Bean offal	91	–	9	–	16	–
Bean pollard	91	–	9	–	17	–
Biscuits	95	–	16	–	6	–
Bread	61	–	14	–	16	–
Brewers grain	28	13–60	10	8–14	21	9–28
Buckwheat	90		9		11	
Canola meal	90	87–93	12	9–15	37	27–42
Corn meal	88	–	14	–	19	–
Cottonseed meal	89	87–95	11	9–12	43	39–48
Cottonseed whole	91	–	14	–	23	–
Faba bean pollard	90	–	9	–	16	–
Lupin seed	91	86–95	12	11–14	32	21–43
Maize grain	84	60–96	13	12–14	10	7–21
Oats	91	80–93	10	5–14	9	4–15
Oat hulls	92	–	6	–	4	–
Pea pollard	91	–	9	–	17	–
Rice bran	90	89–90	13	9–15	15	12–19
Rice pollard	89	–	14	–	16	–
Rice hulls	91	–	3	–	3	–
Safflower meal	95		9		25	
Sorghum grain	89	86–94	13	12–14	10	9–13
Soyabean meal	85	11–93	14	13–16	43	29–53
Sunflower meal	90	86–92	9	8–14	34	20–39
Triticale grain	89	80–96	13	11–13	11	6–18
Wheat grain	89	80–92	13	10–14	12	7–22
Wheat bran	34	15–89	12	10–13	17	8–29
Silage, hay straw						
Barley silage	39	20–64	9	5–11	10	5–22
Barley hay	87	66–93	8	4–11	8	1–14
Barley straw	89	73–93	6	2–8	2	0.2–28
Clover silage (generic)	41	20–79	9	8–10	19	12–27
Clover hay (generic)	86	61–93	8	6–11	17	6–26

Feed	*Approximate dry matter (DM%)*		*Metabolisable energy (MJME/kg DM)*		*Crude protein (CP%)*	
	Average	*Range*	*Average*	*Range*	*Average*	*Range*
Grass silage	43	17–89	9	4–12	13	5–26
Grass hay	86	51–94	8	4–10	8	0.7–17
Legume dominant + grass mix silage	42	13–68	9	5–11	16	7–28
Legume dominant + grass mix hay	86	45–95	8	5–11	14	4–25
Lucerne silage	49	15–87	9	4–10	20	5–32
Lucerne hay	87	36–96	9	5–11	18	5–29
Lucerne straw	86	68–93	5	4–6	8	5–14
Maize silage	30	9–84	10	5–13	7	3–17
Oaten silage	40	18–82	8	5–11	9	3–19
Oaten hay	88	40–96	8	4–11	6	1–16
Oaten straw	89	80–93	6	4–10	2	0.1–11
Pasture silage	43	10–87	9	2–11	14	3–27
Pasture hay	86	48–95	8	5–11	10	1–30
Pea hay	88	–	9	–	14	–
Pea pollard	91	–	9	–	17	–
Persian clover silage	42	23–81	9	8–11	17	8–23
Persian clover hay	85	67–93	9	7–11	16	5–23
Rice straw	85	52–93	6	5–8	4	1–5
Subclover silage	37	20–59	9	5–10	18	12–26
Subclover hay	86	71–93	8	6–10	17	7–25
Triticale silage	42	20–71	9	7–11	10	4–24
Triticale hay	86	54–93	8	4–10	7	1–16
Triticale straw	89	62–95	6	4–9	2	0.7–6
Wheat silage	44	27–69	8	4–10	10	6–16
Wheat hay	87	46–95	8	4–11	8	0.1–17
Wheat straw	92	64–96	5	3–9	2	0.2–8

Source – FEEDTEST® Hamilton Vic.

Table 6.8 Energy, protein and dry matter composition of unusual feedstuffs (rounded down to whole number).
All these results are given on a dry matter basis – if used for calculations as shown in this book they need to be converted to an 'as fed' basis.

Feed	*Approximate dry matter (DM%)*	*Metabolisable energy (MJME/kg DM)*	*Crude protein (CP%)*
Fruit and vegetable products and by-products			
Acorns	70	7	5
Almond hulls[a]	88	9	5
Almond hulls and shells, 20% CF[b]	90	7	2
Apple pomace, dried	89	10	5
Apple pulp silage	21	11	8
Apples	17	10	3
Apricots, dried	90	12	6
Banana skins, dried, ground	88	9	8
Bananas	24	13	4
Brassicas[a]	9	14	16
Broccoli	11	10	33
Brussels sprouts	15	11	33
Cabbage	9	13	25
Cabbage leaves	15	10	14
Carrot pulp[a]	10	12	9
Carrots	13	12	10
Cauliflower	9	10	30
Citrus molasses[a]	43	14	8
Citrus pulp/peel[a]	15	12	9
Copra meal[a]	91	11	23
Corn cobs, ground	90	7	3
Grape marc[a]	49	6	13
Grape pomace, dried	91	5	13
Grape pomace, without stems, dried	91	9	14
Grape/pear/apple pomace, dried	92	6	7
Grapefruit	14	13	8
Kelp, dried	91	5	7
Lemon pulp, dried	93	12	7
Lettuce	5	8	22
Melon	4	11	11
Molasses [a]	61	14	14
Onions	91	9	13
Orange pulp, dried	88	12	8
Orange pulp, wet	25	12	9
Oranges	13	12	7

Feed	*Approximate dry matter (DM%)*	*Metabolisable energy (MJME/kg DM)*	*Crude protein (CP%)*
Peaches	10	12	9
Peanut meal, Mech extd[c]	93	12	52
Peanut meal, Solv extd[d]	92	12	52
Peanut skins	94	10	17
Pears	17	13	6
Pineapples	15	12	3
Potato by-product (fat >2%) partially cooked in oil[a]	32	14	9
Potato by-product (fat assumed = 2%)[a]	23	13	11
Potatoes[a]	18	14	8
Pumpkin	9	13	16
Raisin pulp, dried	89	8	11
Raisin, cull	85	7	4
Tomato pulp[a]	27	8	20
Tomato pomace, silage	29	10	19
Tomatoes	6	10	16
Turnips	9	13	14
Grain and grain products additional to Table 6.7			
Bakery waste, dried	92	13	11
Linseed	94	17	20
Linseed meal, 37% protein, Mech extd[c]	91	12	38
Oats, sprouted five days	13	10	18
Rice de-hulled	90	15	7
Rye	90	14	11
Rye bran	91	9	17
Safflower seeds	94	13	17
Sunflower seeds	94	12	18
Milk, manufactured and miscellaneous products			
Milk, cattle, skim, dried	94	13	36
Milk, cattle, whole, dried	94	15	27
Milk, colostrums	25	15	46
Whey, dried	93	12	14
Whey, liquid[a]	7	14	22
Yeast, brewers, dried	93	12	47

Notes:

[a] These figures supplied by FEEDTEST® analysis 2003

[b] CF = Crude fibre

[c] Mech extd = Mechanical extracted

[d] Solv extd = Solvent extracted

Source: Hollier and Wallis (2003)[3]

7

When and how to feed supplements

This chapter discusses the triggers and methods for starting feeding, adjusting rations and finishing feeding, along with additives and techniques for feeding. Chapter 11 provides additional information on the option of locking stock up in a stock-containment area during prolonged dry seasons or droughts.

When to start

Feed will be wasted if supplementary feeding starts too early, but deaths, sickness, infertility, tender wool and production losses will increase if feeding starts too late.

You should commence feeding as soon as the poorest stock approach their minimum fat or condition score. This allows you time to introduce feed slowly, before any damage is done.

A late start to supplementary feeding will result in unproductive and weak stock, or even death.

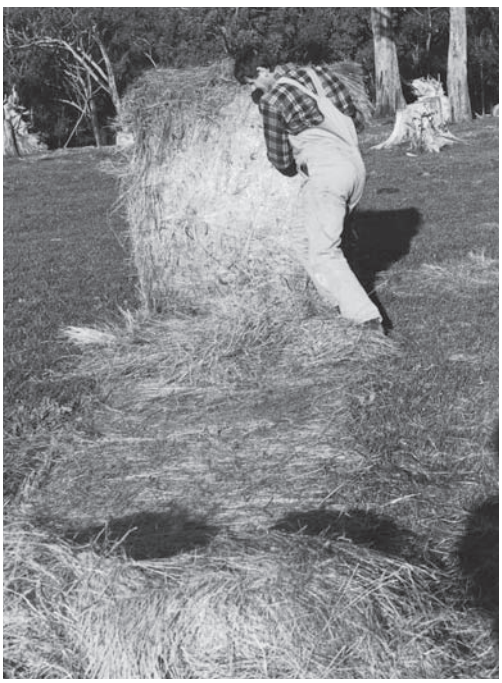
How to start

Introducing new feeds or changing rations must always be done slowly to avoid digestive upsets and deaths. Sheep and cattle are ruminants; that is, feed is pre-digested in a fermentation-like process in the first part of their stomach complex, known as the rumen. Microorganisms in the rumen begin the digestion of food. Different types of 'microflora and fauna' are needed to digest different feeds. When a new feed is introduced, new types of microorganisms need time to build up their numbers. A rapid change from pasture to grain, for example, means there are insufficient of the right organisms to handle the grain,

so the digestive process slows right down, often causing severe digestion problems, such as acidosis or impaction, and even death. Digestive upsets are indicated by lethargy, depressed demeanour, not feeding and diarrhoea. Any changes in diet need to be introduced slowly and progressively over a period of up to three weeks.

Sheep

The main feed supplements for sheep are grain and hay.



Introduce new feeds gradually in measured quantities.

Grain

Start grains at 50 grams (g) per head per feed and increase in 50 to 100 g steps as long as all sheep are feeding. Allow two to three weeks to reach a full ration of grain. Adding up to 2% sodium bentonite to grain will help reduce the risk of grain poisoning (acidosis).

Hay

Good-quality hay is unlikely to cause digestive problems, but should be introduced gradually because sheep, especially young animals, need to be trained to accept hay.

Closely supervise the mobs while changing rations. If there is any sign of scouring or digestive upset, do not increase the amount of new feed until the sheep are stabilised. Hay can always be fed as an additional supplement to grain to maintain adequate nutrition during periods of digestive upsets.

Cattle

The main feed supplements for cattle are grain and hay.

Grain

Start grains at 100 grams (g) per feed and increase in 100 g steps as long as all cattle are feeding. Allow two to three weeks to reach a full ration of grain. Adding up to 2% sodium bentonite to grain will help reduce the risk of grain poisoning.

Hay

Reasonable-quality hay is unlikely to cause digestive problems, but should be introduced gradually. The one exception is lucerne hay, which may cause bloat. Closely supervise mobs while changing rations. If there is any sign of scouring or digestive upset, do not increase the amount of new feed until the cattle are stabilised. Hay, or other roughage, should always be fed as an additional supplement with grain to maintain adequate roughage or fibre.

Adjusting rations

Using the method of weighing and fat scoring marked stock (see 'Assessing condition or fat score' in Chapter 5), carefully monitor the condition of each mob. Regular adjustment of rations will ensure that stock do not suffer, production is not affected and feed is not wasted.

Cold weather and post-shearing allowance

During periods of cold wet weather a 20% increase in feed is often required to replace lost body heat.

Increase feed before and after shearing, particularly for poor-conditioned sheep. The lighter sheep have few fat reserves to sustain them and little fat cover to provide insulation. During cold weather energy requirements can increase up to 69% during the first four weeks after shearing and about 27% for the following four weeks.

Drought-breaking rains call for a higher level of feeding.

When and how to stop feeding

You should withdraw supplementary rations gradually to allow the stock's digestive system to adjust to green pasture. New pasture is high in moisture and low in energy value and will not sustain stock in the first few weeks. Gradually reduce the amount of supplement per feed over at least two weeks, and for longer during cold weather. Experience shows that during droughts most stock die after drought-breaking rains. You should continue supplementary feeding until new growth is mature enough to fully support the stock.

Mineral and vitamin additives to rations

Various natural and manufactured products may be added to supplementary feed, depending on your circumstances. Common additives include ground limestone, salt, digestive buffers and vitamins.

Ground limestone

Sheep and cattle fed on high-grain diets, or over an extended period, require a calcium supplement. To prevent calcium deficiency, add 2%, by weight, of finely ground agricultural limestone (calcium carbonate) to cereal grain (that is, add 20 kg of limestone to every tonne of grain). The addition of calcium may be particularly important in preventing milk fever.

Salt

Similarly, adding 0.5% salt in the ration is recommended, unless your water supply has sufficient salt content.

Digestive buffer

Adding a maximum of 1 to 2%, by weight, of sodium bentonite – a rumen buffer – to grain will help reduce the risk of grain poisoning, particularly during the introductory stages. Sodium bentonite is also included in some licks or blocks.

Vitamins

For short-term feeding, particularly where some green pasture is available, you do not need to add vitamins and minerals. However, you may need to add vitamin A if stock have been without green feed or good-quality green hay for several months (cattle and sheep more than six months, lambs three to four months). A single drench of vitamin A will be adequate for around six months in adults. Seek professional diagnosis before treating.

Vitamin E has a close relationship to selenium and animals with a vitamin E deficiency will exhibit selenium deficiency symptoms. In areas that are known to have selenium-deficient soils, owners need to be alert for the symptoms of ill-thrift, white muscle disease and lamb deaths and obtain a professional diagnosis. If tests confirm the diagnosis, the condition can be readily treated by a number of methods.

Feeding techniques

Choose a feeding method that is not wasteful.

It is just as important to feed your animals using the most appropriate method as it is to use the right feed. Expensive feed can easily be wasted if the best feeding technique and situation are not used. Mud, birds and trampling all cause supplementary feed to be wasted.

Sheep

There are various techniques used for feeding grain, hay and silage to sheep.

Grain

For productive survival purposes, all the common feeds can be fed whole. If grain is milled or rolled then feeding troughs are necessary to avoid wastage.

Trail feeding – Trail grain onto firm and, if possible, dry ground ensuring all sheep have access to the trail. Once sheep are established on a feed, it is best to feed them only two or three times per week: this reduces labour and encourages sheep to forage for paddock feed. If the feeding ground is muddy increase the ration by 0.5 kg per head per week to allow for wastage. Trail feeding of lambing ewes may result in many lambs being deserted at feeding time, but broadcasting grain can overcome this problem.

Broadcasting – Weekly broadcasting of large grains (peas or lupins) onto firm ground through a super spreader will overcome the problem of the most assertive sheep gorging themselves on paddock trails or spills of grain. Broadcasting is not recommended if there are large cracks in the ground, if the surface is muddy or if crickets are present.

Feeders – A variety of commercially produced and home-made feeders are available

Seed or super spreaders can be used to broadcast peas or lupins.

Sheep feeder.

for use with grains, pellets and milled feed mixes. Their use is usually limited to feeding small quantities, to avoid over indulging, and for small groups, such as stud rams.

Sheep fed in troughs require 15–20 cm of double-sided trough space per sheep (or 15–20 m per 100 sheep), depending on the size of the animals and their fleece length, to ensure they all have equal opportunity to access the feed. Feed troughs raised 15–30 cm above the ground are less prone to fouling and allow the animals to make a more orderly approach. Narrow and raised troughs can be difficult to fill from feed carts or bins.

Low-cost sheep feeders can be made from:

- tyres cut in half around the circumference
- clean 20- or 60-litre drums cut vertically and joined end-to-end
- C-section steel
- old spouting and inverted ridge capping
- discarded conveyor belt formed into a U shape between steel posts
- old corrugated iron bent in a U shape between steel posts.

Hay and silage

Hay needs to be well spread out to ensure that even the shy feeders have access. Large bales left for self-feeding are wasteful as the more aggressive sheep tend to dominate the bales and foul much of the hay. Sheep devour large round bales from the bottom up, undermining them until they collapse. Occasionally bales will collapse on top of sheep killing some animals, particularly lambs.

Feeding hay and silage two or three times per week is best. Self-feeders are useful for lambing ewes or where hay is fed as a small supplement with grain.

A silage or hay self-feeder for sheep saves waste.

Cattle

Where some grazing is available, use supplementary feed only two or three times per week to reduce labour and encourage stock to forage for feed in the paddock. Firm, and preferably dry, areas should be used for feeding sites; gravel pads are best around semi-permanent feeding stations.

Grain

Wheat, barley and triticale need to be milled or rolled to avoid wastage. Rolling, or very light crushing, improves the digestibility of wheat, barley and triticale by 25% and oats by around 5%. Do not crush the grain too finely: it should not become dusty. Milled or rolled grains should be fed in troughs or self-feeders. Commercially produced and home-made feeders are available; self-feeders are usually used for small supplements and in small herds, such as studs, or for opportunity lot feeding.

A grain self-feeder for cattle allows continuous access, but slow supply, of free flowing feeds. The feeder trough is protected from the rain.

A grain self-feeder for sheep or cattle: note the rain protection and skids for easy relocation.

Cattle feeders need to provide 25 to 45 cm of single-sided trough space per animal, depending on the animals' size and age. Before constructing feed troughs, make sure you consider how the troughs will be filled, particularly if you intend to use feed carts or bins. Troughs can be placed along a fence line or have a raised separating wire to stop cattle crossing over, or stepping into, the troughs.

Low-cost cattle feeders can be made from:

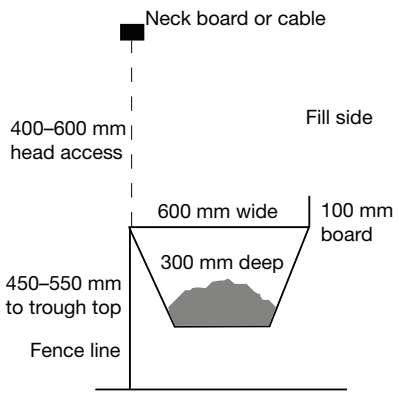


Figure 7.1 A good design for a cattle-feeding trough

- large tyres cut in half around the circumference
- clean drums cut vertically and welded end-to-end, with legs to raise and stabilise
- old corrugated iron or conveyor belt bent in a U shape between steel posts with a wire above to stop cattle crossing over them.

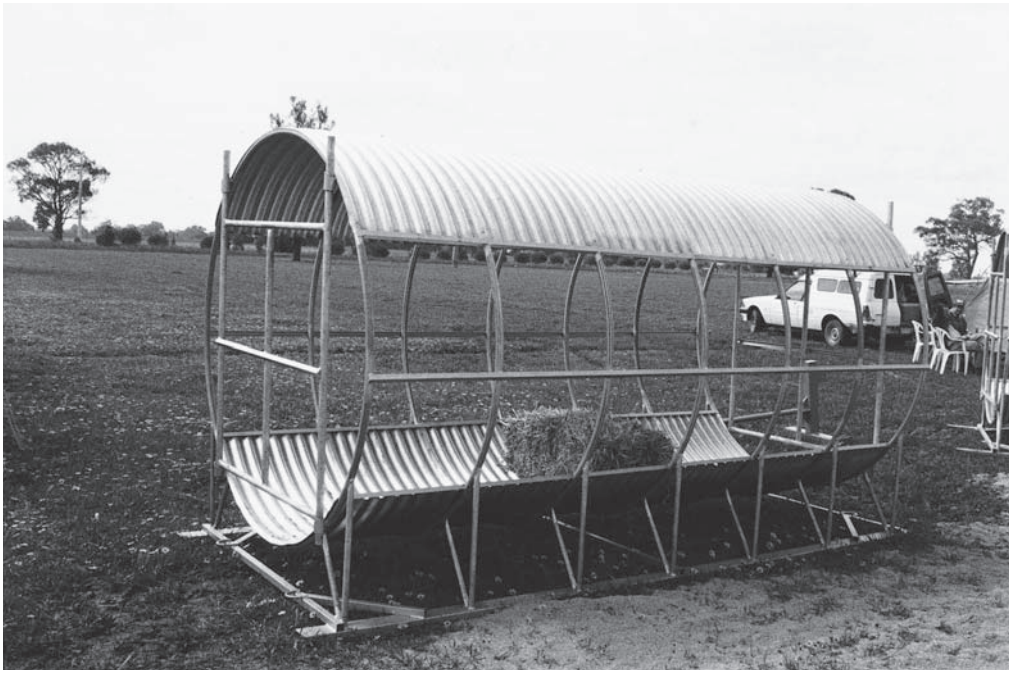
A purpose-built trough would be a minimum of 600 mm across the top and 450 mm off the ground and 300 mm deep. Place a neck cable or board 400–600 mm

above the trough to stop cattle climbing into or over the trough. Situate these troughs on fence lines and fill them from outside the paddock.

Hay and silage

Hay and silage need to be well spread so that even the shy feeders have access. Large bales left for self-feeding can be dominated by more aggressive cattle. Self-feeders are useful and save wastage.

Cattle hay feeders save waste.



A round bale self-feeder with rain protection.

A home-made self-feeder for cattle.

A silage feeder.

Water

Ensure an adequate supply of high-quality water is available at all time. Stock being fed dry rations will drink more than those grazing pasture. Feeding areas should be well away from the water supply to avoid fouling of both areas.

8

How much to feed – the Ready Reckoner

Your choice

Two methods of working out how much to feed are offered.

- The Ready Reckoner
- Calculate your own stock ration (see Chapter 9).

The Ready Reckoner method provides a general guide based on common energy and protein values. You will need to know the weight and class of the stock to be fed and your chosen supplementary feed.

On the other hand, if you have reliable information about your stock and intended feed supplement, you will be able to calculate a more precise ration and have a more complete understanding and control of your stock's nutrition.

Good storage maintains quality.

Silos come in all sizes for all situations.

The Ready Reckoner

Use Tables 8.3 to 8.8 and the steps outlined on the following pages to work out how much supplement you should feed your stock. Choose the appropriate table for the percentage of pasture to be replaced by a supplement. IMPORTANT: the final figure is given as kilograms of supplementary feed required per DAY for cattle and per WEEK for sheep (see below).

Table 8.1 Table selection guide

Percentage supplement of total intake	*Sheep*	*Cattle*
10, 20, 40%	Table 8.3 (20%)	Table 8.6 (20%)
25, 50, 100%	Table 8.4 (50%)	Table 8.7 (50%)
75%	Table 8.5 (75%)	Table 8.8 (75%)

To work out how much feed to provide, follow these seven simple steps:

Step 1

- Select the appropriate Ready Reckoner table from Tables 8.3–8.5 for sheep or 8.6–8.8 for cattle and the estimated percentage of supplement (boxes in upper-right-hand corner of each table).

Step 2

- Check that your chosen feed or feeds have adequate protein for the class of stock. Use Table 8.2 and the right-hand column of the chosen Ready Reckoner (Tables 8.3–8.8) which indicates the minimum protein requirements of this class of stock – compare these two figures. If the amount of protein is inadequate then choose a different feed or combination of feeds.
- Check that the feed's fibre content is adequate (medium) using Table 8.2. If a low-fibre feed is chosen, then pasture or a high-fibre supplement will be needed as part of the diet so that a medium (M) level of fibre is available. The Ready Reckoner may indicate that some high-fibre feeds are not suitable (NS) for particular classes of stock; if so, choose another feed or combination of feeds.

Table 8.2 Protein (% DM) and fibre ratings for common feeds

L – low; M – medium; H – high

Grains			*Hay and straw*			*Moist feeds*			*Manufactured feed*		
Feed	*Protein %*	*Fibre*	*Feed*	*Protein %*	*Fibre*	*Feed*	*Protein %*	*Fibre*	*Feed*	*Protein %*	*Fibre*
Wheat	11	L	Lucerne hay	16–20	H	Pasture	2–30	M–H	Nuts/ pellets	9–12	M
Oats	5–10	M	Good hay	8	H	Crop oats	8–14	M			
Barley	11	L	Poor hay	7	H	Silage pit	8–18	M			
Triticale	11	L	Straw	1–4	H	Silage wilted	14–18	M			
Lupins	30–33	M				Brewers grain	25	L			
Peas	23–25	M				Molasses (cane)	6	L			

Step 3
- Select the stock class, weight and growth rate (left columns) on the Ready Reckoner.

Step 4
- Select the feed or EU category (top rows).

Step 5
- Read the number where the above row and column meet – this is the number of kilograms of feed per animal.

Step 6
- If necessary, double (× 2) or halve (÷ 2) this figure to obtain the chosen feed rate, as indicated in the top-right-hand corner.

Step 7
- Multiply this figure by the number of stock to be fed. This gives the kg of feed required per DAY for cattle and per WEEK for sheep. This total figure is then accumulated or spread over the frequency of feeding days. For example, if cattle are fed every second day, then double the daily rate. For sheep, divide the weekly rate by the number of feeds per week. For example, if fed twice a week, halve the weekly amount; if fed three times per week, then divide the weekly weight in kg by 3.

Supplementary feeding is a measured response to stock and pasture conditions.

Table 8.3 A 20% ration for sheep of various classes
Caution – Introduce and change rations slowly and progressively.

Sheep	**20% ration** The other 80% to be supplied from pasture.	**For 10% ration ÷ 2** 90% from pasture	**For 40% ration × 2** 60% from pasture

Feed			**Hay**				**Grains**			**Combination**			**Silage**	**Protein min. %**
			Straw	Poor	Medium	Good	Oats, nuts	Wheat, barley, triticale, peas, lupins (most 12 EU)		Oats, lupins 80/20%	Wheat, good hay 60/40%	Poor hay, barley variable	Silage 40% DM	
Energy units/kg (as fed)			5	6	7	8	10	11	12	10/12	12/8	6/12	4	
Sheep	Weight kg	Growth kg/day	**kg of feed per WEEK per sheep (fed in up to three feeds)**											
Dry mature 35	35	0	1.6	1.3	1.1	1.0	0.8	0.7	0.7	0.7/0.2	0.4/0.4	0.8/0.3	2.0	6
Dry mature 45	45	0	1.9	1.6	1.4	1.2	1.0	0.9	0.8	0.8/0.2	0.5/0.5	1.0/0.3	2.4	6
Pregnant last 4 weeks	40	0	NS	NS	NS	NS	1.1	1.0	0.9	0.9/0.2	NS	NS	2.8	8
Pregnant last 4 weeks	50	0	NS	NS	NS	NS	1.3	1.2	1.1	1.1/0.2	NS	NS	3.2	8
Ewe & lamb week 1–4	50	0	NS	NS	NS	2.6	2.0	1.8	1.7	1.6/0.4	1.0/1.1	0.3/1.5	5.0	10
Milking ewe week >4[b]	50	0	NS	NS	NS	2.0	1.6	1.5	1.3	1.3/0.3	0.8/0.8	1.1/0.9	4.0	10
Lamb <15 kg	15	0.1	NS	NS	NS	NS	0.7[a]	0.6	0.6	0.6/0.1	NS	NS	1.7	12
Weaner >15 kg	20	0.1	NS	NS	NS	1.0	0.8[a]	0.7	0.7	0.7/0.2	0.4/0.4	0.1/0.6	1.8	12
Hogget >25 kg	30	0.1	NS	NS	1.1	1.1	0.9[a]	0.8	0.8	0.7/0.2	0.5/0.5	0.5/0.5	2.2	10
Ram[c]	50	0	2.0	1.7	1.4	1.3	1.0	0.9	0.8	0.8/0.2	0.5/0.5	1.0/0.5	2.8	8
Ram[c]	70	0	2.6	2.2	1.9	1.7	1.3	1.2	1.1	1.1/0.2	0.7/0.7	1.3/0.4	3.3	8

NS – Not suitable
In cold wet weather add 20%

[a] Use high-protein nuts (pellets)
[b] Add an allowance for lamb (lamb <15 kg)
[c] Rams – 10% extra just before and during mating

Table 8.4 A half-ration (50%) for sheep of various classes
Caution – 100% ration (nil pasture) for a very short time only.
Introduce and change rations slowly and progressively.

Sheep	**50% ration** The other half to be supplied from pasture.	**For 25% ration ÷ 2** 75% from pasture	**For 100% ration × 2** Short-term ration, nil from pasture

Feed			**Hay**				**Grains**			**Combination**			**Silage**	**Protein min. %**
			Straw	Poor	Medium	Good	Oats, nuts	Wheat, barley, triticale, peas, lupins (most 12 EU)		Oats, lupins 80/20%	Wheat, good hay 60/40%	Poor hay, barley variable	Silage 40% DM	
Energy units/kg (as fed)			5	6	7	8	10	11	12	10/12	12/8	6/12	4	
Sheep	Weight kg	Growth kg/day	**kg of feed per WEEK per sheep (fed in up to three feeds)**											
Dry mature 35	35	0	4.0	3.3	2.9	2.5	2.0	1.8	1.7	1.6/0.3	1.0/1.0	2.0/0.7	5.0	6
Dry mature 45	45	0	4.8	4.0	3.4	3.0	2.4	2.2	2.0	1.9/0.4	1.2/0.8	2.4/0.8	6.0	6
Pregnant last 4 weeks	40	0	NS	NS	NS	NS	2.8	2.5	2.3	2.2/0.5	NS	NS	6.9	8
Pregnant last 4 weeks	50	0	NS	NS	NS	NS	3.3	3.0	2.7	2.6/0.5	NS	NS	8.1	8
Ewe & lamb week 1–4	50	0	NS	NS	NS	6.4	5.0	4.5	4.2	4.0/0.8	2.5/2.6	0.8/4.1	12.5	10
Milking ewe week >4[b]	50	0	NS	NS	NS	5.0	4.0	3.6	3.3	3.2/0.7	2.0/2.0	2.7/2.2	10.0	10
Lamb <15 kg	15	0.1	NS	NS	NS	NS	1.7[a]	1.6	1.4	1.4/0.3	NS	NS	4.3	12
Weaner >15 kg	20	0.1	NS	NS	NS	2.3	1.8[a]	1.8	1.5	1.4/0.3	0.9/0.9	0.3/1.4	4.5	12
Hogget >25 kg	30	0.1	NS	NS	3.3	2.9	2.3[a]	2.1	1.9	1.8/0.4	1.2/1.2	1.1/1.3	5.6	10
Ram[c]	50	0	5.0	4.2	3.6	3.1	2.5	2.3	2.1	2.0/0.4	1.3/1.2	2.5/1.2	7.1	8
Ram[c]	70	0	6.6	5.5	4.7	4.1	3.3	3.0	2.8	2.6/0.6	1.7/1.6	3.3/1.0	8.3	8

NS – Not suitable
In cold wet weather add 20%

[a] Use high-protein nuts (pellets)
[b] Add an allowance for lamb (lamb <15 kg)
[c] Rams – 10% extra just before and during mating

Table 8.5 A 75% ration for sheep of various classes
Caution – Introduce and change rations slowly and progressively.

Sheep	**75% ration** The other 25% to be supplied from pasture.		

Feed			**Hay**				**Grains**			**Combination**			**Silage**	**Protein min. %**
			Straw	Poor	Medium	Good	Oats, nuts	Wheat, barley, triticale, peas, lupins (most 12 EU)		Oats, lupins 80/20%	Wheat, good hay 60/40%	Poor hay, barley variable	Silage 40% DM	
Energy units/kg (as fed)			5	6	7	8	10	11	12	10/12	12/8	6/12	4	
Sheep	Weight kg	Growth kg/day	**kg of feed per WEEK per sheep (fed in up to three feeds)**											
Dry mature 35	35	0	6.0	5.0	4.4	3.8	3.0	2.7	2.5	2.4/0.5	1.5/1.5	3.0/1.1	7.5	6
Dry mature 45	45	0	7.2	6.0	5.1	4.5	3.6	3.3	3.0	2.9/0.6	1.8/1.8	3.6/1.2	9.0	6
Pregnant last 4 weeks	40	0	NS	NS	NS	NS	3.9	3.8	3.5	3.3/0.4	NS	NS	10.4	8
Pregnant last 4 weeks	50	0	NS	NS	NS	NS	5.0	4.4	4.1	3.9/0.8	NS	NS	12.1	8
Ewe & lamb week 1–4	50	0	NS	NS	NS	9.6	7.5	6.8	6.2	6.0/1.2	3.7/3.9	1.2/6.2	18.8	10
Milking ewe week >4[b]	50	0	NS	NS	NS	7.5	6.0	5.5	5.0	4.8/1.1	3.0/3.0	4.1/3.3	15.0	10
Lamb <15 kg	15	0.1	NS	NS	NS	NS	2.6[a]	2.4	2.2	2.1/0.5	NS	NS	6.5	12
Weaner >15 kg	20	0.1	NS	NS	NS	3.5	2.7[a]	2.7	2.5	2.1/0.5	1.5/1.4	0.5/2.1	6.8	12
Hogget >25 kg	30	0.1	NS	NS	5.0	4.4	3.5[a]	3.1	2.9	2.7/0.6	1.8/1.8	1.7/2.0	8.4	10
Ram[c]	50	0	7.5	6.3	5.4	4.7	3.8	3.4	3.2	3.0/0.6	1.9/1.9	3.8/1.8	10.7	8
Ram[c]	70	0	10.1	8.3	7.8.	6.2	5.0	4.5	4.2	3.9/0.5	2.5/2.5	5.0/1.5	12.5	8

NS – Not suitable
In cold wet weather add 20%

[a] Use high-protein nuts (pellets)
[b] Add an allowance for lamb (lamb <15 kg)
[c] Rams – 10% extra just before and during mating

Table 8.6 A 20% ration for beef cattle of various classes
Caution – Introduce and change rations slowly and progressively.

Cattle	**20% ration** The other 80% to be supplied from pasture.	**For 10% ration ÷ 2** 90% from pasture	**For 40% ration × 2** 60% from pasture

Feed			**Hay**				**Grains**			**Combination**			**Silage**	**Protein min. %**
			Straw	Poor	Medium	Good	Oats, nuts	Wheat, barley, triticale (whole)	Peas, lupins, rolled wheat[c]	Oats, peas 80/20%	Barley, good hay 40/60%	Poor hay, wheat 80/20%	Silage 40% DM	
Energy units/kg (as fed)			5	6	7	8	10	11	12	10/12	11/8	6/11	4	
Cattle	Weight kg	Growth kg/day	**kg of feed per DAY per head of cattle**											
Dry cow	350	0	NS	NS	1.6	1.4	1.1	1.0	0.9	0.9/0.2	0.4/0.9	1.5/0.2	2.8	6
Dry cow	450	0	NS	2.1	1.8	1.6	1.3	1.2	1.1	1.1/0.2	0.5/1.0	1.7/0.2	3.2	6
Dry cow	550	0	NS	2.4	2.1	1.8	1.4	1.3	1.2	1.1/0.3	0.5/1.1	1.9/0.3	3.6	6
Heifer and calf	350	0.5	NS	NS	NS	2.3	1.8	1.7	1.5	1.5/0.3	0.7/1.4	2.4/0.4	4.6	11
Cow and calf	450	0.5	NS	NS	NS	2.1	1.7	1.5	1.4	1.4/0.3	0.6/1.3	2.3/0.3	4.3	10
Cow and calf	550	0.5	NS	NS	NS	2.4	1.9	1.7	1.6	1.5/0.3	0.7/1.5	2.6/0.4	4.8	10
Calf weaned	150	0.5	NS	NS	NS	0.9	0.7[a]	0.7	0.6	1.6/0.1	0.3/0.6	NS	1.9	12
Steer/heifer	200	0.5	NS	NS	1.3	1.1	0.9[a]	0.8	0.7	1.7/0.1	0.3/0.7	NS	2.2	11
Steer/heifer	300	0.5	NS	NS	1.6	1.4	1.1	1.0	1.0	0.9/0.2	0.4/0.9	NS	2.9	10
Steer/heifer	400	0.5	NS	NS	2.0	1.8	1.4	1.3	1.2	1.1/0.3	0.5/1.1	NS	3.6	9
Steer/heifer	500	0	3.3	1.8	1.6	1.4	1.1	1.0	0.9	0.9/0.2	0.4/0.9	1.5/0.2	2.8	7
Young bull	300	1.0	NS	NS	NS	1.9	1.5[a]	1.4	1.3	1.2/0.3	0.6/1.2	NS	3.8	13
Bull[b]	500	0.5	NS	NS	2.3	2.1	1.6[a]	1.5	1.4	1.3/0.3	0.6/1.3	NS	4.1	11
Bull[b]	800	0	3.2	2.7	2.3	2.1	1.6	1.5	1.4	1.3/0.3	0.6/1.3	2.2/0.3	4.1	10

NS – Not suitable
In cold wet weather add 20%

[a] Use high-protein nuts (pellets)
[b] Bulls – 10% extra just before and during mating

[c] Rolled, cracked or crushed wheat, barley and triticale have a higher energy value (EU = 12)

Table 8.7 A half-ration (50%) for beef cattle of various classes
Caution – 100% ration (nil pasture) for a very short time only.
Introduce and change rations slowly and progressively.

Cattle	**50% ration** The other half to be supplied from pasture.	**For 25% ration ÷ 2** 75% from pasture	**For 100% ration × 2** Short-term ration, nil from pasture

Feed			**Hay**				**Grains**			**Combination**			**Silage**	**Protein min. %**
			Straw	Poor	Medium	Good	Oats, nuts	Wheat, barley, triticale (whole)	Peas, lupins, rolled wheat[c]	Oats, peas 80/20%	Barley, good hay 40/60%	Poor hay, wheat 80/20%	Silage 40% DM	
Energy units/kg (as fed)			5	6	7	8	10	11	12	10/12	11/8	6/11	4	
Cattle	Weight kg	Growth kg/day	**kg of feed per DAY per head of cattle**											
Dry cow	350	0	NS	NS	3.9	3.4	2.8	2.5	2.3	2.3/0.5	1.0/2.1	3.7/0.5	6.9	6
Dry cow	450	0	NS	5.3	4.6	4.0	3.2	2.9	2.7	2.6/0.6	1.2/2.4	4.3/0.6	8.0	6
Dry cow	550	0	NS	6.0	5.1	4.5	3.6	3.3	3.0	2.9/0.6	1.3/2.7	4.8/0.7	9.0	6
Heifer and calf	350	0.5	NS	NS	NS	5.7	4.6	4.1	3.8	3.7/0.8	1.7/3.4	6.1/0.8	11.4	11
Cow and calf	450	0.5	NS	NS	NS	5.3	4.3	3.9	3.5	3.5/0.7	1.6/3.2	5.7/0.8	10.6	10
Cow and calf	550	0.5	NS	NS	NS	5.9	4.8	4.3	4.0	3.9/0.8	1.7/3.6	6.3/0.9	11.9	10
Calf weaned	150	0.5	NS	NS	NS	2.3	1.9[a]	1.7	1.5	1.5/0.3	0.7/1.4	NS	4.6	12
Steer/heifer	200	0.5	NS	NS	3.1	2.8	2.2[a]	2.0	1.8	1.8/0.4	0.8/1.7	NS	5.5	11
Steer/heifer	300	0.5	NS	NS	4.1	3.6	2.9	2.6	2.4	2.3/0.5	1.1/2.2	NS	7.1	10
Steer/heifer	400	0.5	NS	NS	5.1	4.4	3.6	3.2	3.0	2.9/0.6	1.3/2.7	NS	8.9	9
Steer/heifer	500	0	5.5	4.6	3.9	3.4	2.8	2.5	2.3	2.3/0.5	1.0/2.1	3.7/0.5	6.9	7
Young bull	300	1.0	NS	NS	NS	4.8	3.8[a]	3.5	3.2	3.1/0.7	1.4/2.9	NS	9.5	13
Bull[b]	500	0.5	NS	NS	5.9	5.1	4.1[a]	3.7	3.4	3.3/0.7	1.5/3.1	NS	10.3	11
Bull[b]	800	0	8.1	6.8	5.8	5.1	4.1	3.7	3.4	3.3/0.7	1.5/3.1	5.5/0.8	10.1	10

NS – Not suitable
In cold wet weather add 20%

a Use high-protein nuts (pellets)
b Bulls – 10% extra just before and during mating

c Rolled, cracked or crushed wheat, barley and triticale have a higher energy value (EU = 12)

Table 8.8 A 75% ration for beef cattle of various classes
Caution – Introduce and change rations slowly and progressively.

Cattle	**75% ration** The other 25% to be supplied from pasture.		

Feed			**Hay**				**Grains**			**Combination**			**Silage**	**Protein min. %**
			Straw	Poor	Medium	Good	Oats, nuts	Wheat, barley, triticale (whole)	Peas, lupins, rolled wheat[c]	Oats, peas 80/20%	Barley, good hay 40/60%	Poor hay, wheat 80/20%	Silage 40% DM	
Energy units/kg (as fed)			5	6	7	8	10	11	12	10/12	11/8	6/11	4	
Cattle	Weight kg	Growth kg/day	**kg of feed per DAY per head of cattle**											
Dry cow	350	0	NS	NS	5.9	5.1	4.2	3.8	3.5	3.4/0.7	1.5/3.1	5.6/0.8	10.4	6
Dry cow	450	0	NS	8.0	6.9	6.0	4.8	4.4	4.1	3.9/0.8	1.8/3.6	6.5/0.9	12.0	6
Dry cow	550	0	NS	9.0	7.7	6.8	5.4	5.0	4.5	4.3/0.9	2.0/4.1	7.2/1.1	13.5	6
Heifer and calf	350	0.5	NS	NS	NS	8.6	6.9	6.2	5.7	4.8/1.2	2.5/5.2	9.2/1.2	17.5	11
Cow and calf	450	0.5	NS	NS	NS	8.0	6.5	5.9	5.3	5.2/1.1	2.4/4.8	8.6/1.2	15.9	10
Cow and calf	550	0.5	NS	NS	NS	8.9	7.2	6.5	6.0	5.8/1.2	2.6/5.4	9.5/1.4	17.9	10
Calf weaned	150	0.5	NS	NS	NS	3.5	2.9[a]	2.6	2.3	2.3/0.5	1.1/2.1	NS	6.9	12
Steer/heifer	200	0.5	NS	NS	4.7	4.2	3.3[a]	3.0	2.7	2.7/0.6	1.2/2.5	NS	8.3	11
Steer/heifer	300	0.5	NS	NS	6.2	5.4	4.4	3.9	3.6	3.5/0.7	1.6/3.3	NS	10.7	10
Steer/heifer	400	0.5	NS	NS	7.7	6.6	5.4	4.8	4.5	4.3/0.9	1.9/4.0	NS	13.4	9
Steer/heifer	500	0	8.3	6.9	5.9	5.1	4.2	3.8	3.5	3.4/0.7	1.5/3.1	5.6/0.8	10.4	7
Young bull	300	1.0	NS	NS	NS	7.2	5.7[a]	5.3	4.8	4.6/1.0	2.1/4.3	NS	14.3	13
Bull[b]	500	0.5	NS	NS	8.9	7.7	6.2[a]	5.6	5.1	5.0/1.0	2.3/4.6	NS	15.5	11
Bull[b]	800	0	12.2	10.2	8.7	7.7	6.2	5.6	5.1	5.0/1.0	2.3/4.6	8.3/1.2	15.2	10

NS – Not suitable
In cold wet weather add 20%

[a] Use high-protein nuts (pellets)
[b] Bulls – 10% extra just before and during mating

[c] Rolled, cracked or crushed wheat, barley and triticale have a higher energy value (EU = 12)

9

How much to feed – calculate your own stock ration

This chapter is an alternative to using the Ready Reckoner in the previous chapter. If you use both methods, you will be able to double-check that your calculations are correct.

You can calculate your own rations using Tables 9.1 (sheep) and 9.2 (cattle) and the five-step method explained in detail below. These tables contain all the essential stock figures for your calculations.

Table 9.1 Total weekly protein and energy requirements for sheep of various weights and classes

Sheep weight at minimum fat score (kg)		**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**60**	**70**	**Minimum EU of feed[c]**
Sheep class	**Protein %**	**Energy units (EU) per week (MJME/week)**										
Dry mature	6	–	–	35	38	40	44	48	52	56	–	5
Pregnant last 4 weeks	8	–	–	–	57	60	66	72	78	84	90	11
Ewe/lamb weeks 1 to 4[a]	10	–	–	–	76	80	88	99	103	112	–	10
Ewe/lamb > week 5[a]	10	–	–	–	58	62	70	80	84	88	–	7
Rams (mating add 10%)	8	–	–	–	42	44	48	53	57	62	66	6
Lambs/weaners[b]	12/10	34	36	40	45	42	–	–	–	–	–	12/8

Notes:

[a] Ewes require some roughage (hay or dry pasture). Lambs over five weeks will require an additional and increasing supplement or pasture.

[b] Lambs and weaners require some roughage (hay) and a green pick or protein supplement. This feeding rate allows for a moderate growth rate.

[c] The minimum EU of feed applies to dry feeds or dry matter EU. As a general guide for moist feeds, such as silage, halve the minimum EU.

Hay sheds and silos give greater feed options.

Table 9.2 Total daily protein and energy requirements for cattle of various weights and classes

Cattle class	*Growth rate (kg/day)*	*Protein (%)*	*Energy units (MJME/day)*	*Minimum EU of feed*[a]
Dry cow 350 kg	0	6	55	7
Dry cow 450 kg	0	6	64	7
Dry cow 550 kg	0	6	72	7
Heifer and calf	0.5	11	91	11
Cow and calf 450 kg	0	10	85	9
Cow and calf 550 kg	0	10	95	9
Calf weaned 150 kg	0.5	12	37	9
	1.0	13	50	12
Steer/heifer 200 kg	0.5	11	44	8
	1.0	13	59	11
Steer/heifer 300 kg	0.5	10	57	8
	1.0	13	76	10
Steer/heifer 400 kg	0.5	9	71	8
	1.0	13	93	10
Steer/heifer 500 kg	0	7	55	6
	0.5	10	82	8
	1.0	12	108	10
Young bull 300 kg	1.0	13	76	10
Bull 500 kg	0.5	11	82	8
Bull 800 kg	0	10	81	6

[a] The minimum EU of feed applies to dry feeds or dry matter EU. As a general guide for moist feeds, such as silage, halve the minimum EU.

Step 1: Choose a feed or feeds with adequate protein, energy and fibre levels for the class of stock

Use Table 9.1 for sheep, or Table 9.2 for cattle, and the feed energy, protein and fibre ratings in Table 9.3. If you have a feed test analysis use this in preference to Table 9.3, but convert these figures to 'as fed' rather than dry matter (see Chapter 3).

- Choose a feed with adequate protein by comparing the 'Protein %' column of Table 9.1 for sheep, or Table 9.2 for cattle, with the protein of your feed (Table 9.3). The protein percentage of the feed should be equal too, or greater than, the minimum in the relevant table.
- Check that the EU level in the chosen feed is equal to, or greater than, the minimum required as shown in the last column of Table 9.1 for sheep or Table 9.2 for cattle.
- Check that the fibre rating of the feeds and pasture mix is at least a medium (M) rating. To modify a low-fibre diet, add pasture or some high-fibre feeds. Similarly, for a high-fibre feed, add some low- or medium-fibre feed or pasture; the EU level column will indicate the suitability for the target class of stock.

For best results choose fodder appropriate for the type of stock and conditions.

Table 9.3 Energy (EU), protein % (DM) and fibre ratings for common feeds, as fed

Grains				*Hay[b] and straw*				*Moist feeds*				*Manufactured feed*			
Feed	*EU*	*Protein %*	*Fibre*	*Feed*	*EU*	*Protein %*	*Fibre*	*Feed*	*EU*	*Protein %*	*Fibre*	*Feed*	*EU*	*Protein %*	*Fibre*
Wheat	11–12[a]	11	L	Lucerne hay	8	16–20	H	Pasture	1.5–2	2–30	M–H	Nuts/ pellets	10	9–12	M
Oats	10[b]	5–10	M	Good hay	8	8	H	Crop oats	2	8–14	M				
Barley	11–12[a]	11	L	Poor hay	6	7	H	Silage pit	2	8–18	M				
Triticale	11–12[a]	11	L	Straw	5	1–4	H	Silage wilted	4	14–18	M				
Lupins	12	30–33	M					Brewers grain	2	25	L				
Peas	12	23–25	M					Molasses (cane)	8	6	L				

These are 'as fed' values; they have been adjusted to allow for common dry matter percentages.

[a] Wheat, barley, triticale
- Crushed, cracked or rolled – 12 EU for cattle
- Whole – 11 EU for cattle, 12 EU for sheep.

[b] The energy and protein value of oats and hay in particular may vary considerably; test to determine the true feed value.

Step 2: Calculate the amount of feed needed to meet the total energy units requirement for the class of stock

As previously discussed, energy is the most important need of sheep and cattle. The energy requirements of stock are measured in energy units (EU).

Note: Energy requirements for CATTLE are given per DAY; energy requirements for SHEEP are given per WEEK.

To calculate the total feed needed, simply divide the number of energy units in your chosen feed (Table 9.3) into the energy units required for each class of stock (Tables 9.1 and 9.2).

Examples:

Wether 45 kg		48 EU/week
feed = wheat (12 EU)	÷	12 EU/kg
	=	4 kg wheat/week
Ewe and one-week-old lamb		99 EU/week
feed = oats (10 EU)	÷	10 EU/kg
	=	9.9 kg oats/week
Dry cow 450 kg		64 EU/day
feed = good hay (8 EU)	÷	8 EU/kg
	=	8 kg hay/day

For your calculations:

Stock class		. . . EU/day or EU/week
feed	÷	. . . EU/kg
	=	. . . kg/day or kg/week

Worksheets for your calculations are included at the end of this book.

Calculating a two-feed supplement

To provide sufficient protein and fibre, or to use up feed on hand, it may occasionally be necessary to feed two types of fodder simultaneously. Use the same figures from the tables above and divide the EU by the proportion of each fodder. Follow the example below.

Example of a two-feed supplement –

Wether 45 kg		48 EU fed 90% oats and 10% lupins
Divide the EU proportionally:		
48 EU × 90 ÷ 100	=	43 EU of oats
	+	5 EU of lupins
	=	48 EU total
feed = 90% oats		43 EU/week
	÷	10 EU/kg
	=	4.3 kg oats/week
and 10% lupins		5 EU/week
	÷	12 EU/kg
	=	0.4 kg lupins/week

Step 3: Reduce this feed ration by the estimated proportion obtained from grazing pasture

The amount of supplement to be fed is dependent on the requirement of each class of stock minus the amount obtained by grazing pasture. Most paddocks will provide some nutrition: for each mob estimate the percentage of nutrition that will come from paddock feed. Then reduce the total ration calculated in Step 2 by the same percentage. This is the feed required per head.

Pasture usually provides a substantial proportion of feeding requirements.

Examples:

Grazing 25%

Ration 4 kg wheat (100%) reduced 25%

OR 100% – 25% = 75%

4 × 75% (75/100*) = 3 kg wheat to feed

(*Note: Use the calculator % button; alternatively 75 ÷ 100)

Grazing 30%

Ration 9 kg hay (100%) reduced 30%

OR 100% – 30% = 70%

9 × 70% = 6.3 kg hay to feed

Grazing 40%

Ration 9.5 kg oats (100%) reduced 40%

OR 100% – 40% = 60%

9.5 × 60% = 5.7 kg oats to feed

Worksheets for your calculations are included at the end of this book.

Step 4: Check that the maximum daily intake is not exceeded

All classes of stock should be limited to a daily consumption equalling 2–3% of their body weight; this should be kept in mind if you are providing low-quality feeds (e.g. a 35 kg wether has a maximum consumption of around 1 kg per day or 7 kg per week; a 350 kg heifer with calf has a maximum consumption of around 8 kg per day).

The minimum EU indicated in the right-hand columns of the tables for sheep (Table 9.1) and cattle (Table 9.2) are designed to keep the feed intake within the maximum consumption limits.

Should you wish to double-check, simply calculate 2–3% of the weight of the animal to obtain the maximum daily intake, then multiply this figure by the percentage of the total intake that is to be fed as a supplement (e.g. 10, 25 or 50%). If the amount of supplement required exceeds this figure, you will need to use a more concentrated (higher EU) feed supplement.

Step 5: Multiply the daily or weekly rate by the number of cattle or sheep, respectively, to be fed

This gives the kg of feed required per DAY for CATTLE and per WEEK for SHEEP. This total figure is then spread over the number of feeding days. For example, if cattle are fed every second day, then double the daily rate. For sheep, divide the weekly rate by the number of feeds per week: for example, if fed twice a week halve the weekly amount; if three times per week, divide the weekly kg by 3.

Use pasture and save supplementary fodder until required. Assessment skills are the key.

10

Stock health

Health considerations during feeding

Animals that are under feed stress or being fed a supplementary diet are more susceptible to a number of diseases and conditions affecting their health. Therefore you must supervise your stock more frequently, and more thoroughly, than normal during these times. Look carefully for any sign of ill-health or anything abnormal.

Table 10.1 provides a quick-find checklist of signs and symptoms of possible diseases or conditions that may occur during supplementary feeding. The conditions listed are described below together with suggestions for prevention and treatment.

Disease and inadequate nutrition cause weakness and lower productivity.

Table 10.1 Disease signs and symptoms checklist

Sign or symptom	*Disease or condition*
Condition or weight loss	Insufficient feed in total or through bullying or insufficient access to feed Worms Poor-quality feed, low protein Sand or gravel in stomach Grain poisoning, acidosis
Scours (diarrhoea)	Digestive upset owing to change of feed Grain poisoning, acidosis Worms Bowel infection
Sudden death (often found dead)	Enterotoxaemia Black leg Grass tetany Bloat
Gradual death (one to two days)	Enterotoxaemia (mature animals) Worms Grain poisoning, acidosis Bowel infection Stress from weather, handling, reproduction Lupinosis Tetanus Milk fever Pregnancy toxaemia, acetonaemia Poisoning (plant or chemical) Bladder stones Polioencephalomalacia
Nervous, shakes, staggers	Enterotoxaemia Tetanus Grass tetany Pregnancy toxaemia, acetonaemia Plant poisoning
Not eating	Bullying (dominant animals keep them away) Grain poisoning, acidosis Bowel infection Bloat Weakness Pregnancy toxaemia, acetonaemia Polioencephalomalacia
Weakness	Insufficient feed (various reasons) Poor-quality feed or inappropriate feed Worms Milk fever Stress from weather, handling, reproduction Pregnancy toxaemia, acetonaemia Bladder stones
Lameness	Founder Excessive grain
Blindness	Pink eye Grass seeds Pregnancy toxaemia, acetonaemia Polioencephalomalacia

Bladder stones (urinary calculi)

A small chemical stone is formed in the urinary bladder and may become stuck in the urinary tract. This condition is often associated with grain feeding and water shortage. Wethers are more susceptible than ewes and cattle to bladder stones, but stones may also affect steers fed on grain diets for long periods. The animals become restless then distressed and eventually dopey with swollen, urine-filled abdomens (water-belly) or swollen pizzles. Death will follow in a few days.

Prevention and treatment

Adding 1–2% ground limestone to grain diets and providing plenty of water may help to minimise cases. Salt licks placed near watering points can stimulate stock to drink more water and therefore flush out the stones while they are still small. Ensure your stock have access to drinkable water that is not stagnant, fouled or high in salt. Treatment for bladder stones is rarely successful.

Bloat

Bloat most commonly affects cattle feeding on pasture that has significant quantities of legumes (clovers and lucerne) or in feedlots, but may also occur in cattle being fed grain supplements. Finely ground grains are more likely to cause bloat. Bloat results from a build-up of gas and/or froth in the rumen. The abdomen and left flank become distended. The animal becomes uncomfortable and distressed and its breathing becomes laboured. Severe bloat can kill animals rapidly.

Prevention and treatment

Bloat is prevented by limiting access to legume pasture by strip grazing, feeding non-legume roughages, such as straw, and using proprietary feed and water additives or providing slow-release anti-bloat capsules that give 100-day protection.

Treatment of low-grade chronic bloat involves removing the animal promptly from the offending feed or pasture, increasing the level of roughage in the diet, increasing exercise and administering anti-bloat oil by mouth. This combination may be sufficient to bring relief.

Acute bloat is life threatening and requires stomach tubing for gassy bloat, or drenching with anti-bloat oils for frothy bloat. For very severe acute bloat, experienced operators may stab the rumen using a trocar and cannular or knife, but veterinary advice should be sought urgently.

In the absence of proprietary anti-bloat oils, Brightling (in *Livestock Diseases in Australia*) suggests the use of 250 mL of paraffin oil or vegetable oils, such as peanut, linseed or cottonseed oil, to save the animal.[4] Hungerford (in *Hungerford's Diseases of Livestock*) suggests that in the absence of any suitable oils 250 mL of cream or one litre of milk by drench may bring relief.[5]

You will need to repeat treatments regularly until symptoms subside, provide roughage and exercise, and check the animals frequently for sign of re-occurrence.

If an animal becomes extremely distressed and does not respond to drenches then it may be necessary to stab the affected animal with a trocar and cannular, large-gauge hypodermic needle (e.g. milk fever needle) or sharp pointed knife. The correct stab point is on the left flank, a hand's width behind the last rib and the same distance below the side

of the backbone. Leave the cannular or stabbing instrument in the wound while the gas escapes. Anti-bloat oil may also be injected through the hole. In cases of frothy bloat the hole may block and bloat oil will be needed to act as a surfactant. You should call a veterinarian to repair the wound and prevent infection. Detailed articles on this procedure, and bloat in general, can be found in Brightling (2006)[4] and Hungerford (1990)[5].

Bowel infection

A number of organisms can cause mild to severe infections in the intestines, resulting in scours (diarrhoea). An animal suffering from scours rapidly becomes dehydrated, which often leads to weakness and eventual death.

Changes in feeding, particularly in young stock, can cause bowel movement to slow, which may allow harmful organisms to build up to critical numbers. Contaminated feed or water can also introduce serious or fatal organisms. If you see any blood spots in the scour, consult a veterinarian promptly.

Prevention and treatment

Treatment usually involves correcting the dehydration with electrolyte replacers and plenty of water. A few organisms, such as *Salmonella* and *Coccidia*, may require antibiotic treatment to be prescribed by a veterinarian.

Deficiencies and toxicities

A wide range of dietary deficiencies can occur and expert advice and testing is usually required for confirmation. Copper and selenium are the most common and relate to specific soil types while calcium and phosphorus deficiencies are associated with feed types and fertiliser history.

Toxicity or poisoning occasionally occurs. The most common cases are associated with liver damage caused by plants such as Heliotrope or Paterson's Curse, which result in an abnormally high, and eventually toxic, accumulation of chemicals, such as copper. Overdosing with mineral supplements is another possible risk.

A phosphorus-deficient cow, which is crippled with swollen painful joints.

Contamination of feed or water supplies and containers, while not common, needs to be considered when sourcing unfamiliar supplies. Possible causes of contamination that can cause sickness and death include seed treatments, such as pickled seed grains, insecticides, faeces and even dead rats and mice. Feed troughs made out of second-hand drums previously used for toxic chemicals can also be a source of poisoning. Lead-based paints on old iron or timber also pose a risk.

Prevention and treatment
To prevent deficiencies, be aware of local soil risks and follow the recommendations in this book.

Prevention of toxicities is by careful management of the risks described. Close observation of stock for early abnormal signs, prompt professional diagnosis and treatment are essential to avoid losses.

Enterotoxaemia (pulpy kidney)

Enterotoxaemia causes sudden death and can result in many stock dying. A change of diet, or starchy food that slows the gut, will often trigger an outbreak. Grain feeding, a change of feeds or periods off feed, such as during transporting or yarding, can all create these conditions.

The signs of enterotoxaemia are:

- in young animals: death within two to three hours, convulsions and rapid decomposition
- in older animals: distress, eventual collapse with legs extended and back and neck arched.

Prevention and treatment
Treatment is not possible, but prevention is cheap and easy. Simply ensure, for both sheep and cattle, that their 5-in-1 Clostridial (or 6-in-1 Clostridial + cheesy gland for sheep) vaccination protection is up to date. If it is not, you should vaccinate promptly. Young stock require two vaccinations four to six weeks apart. All stock require an annual injection to keep protection at an effective level. Vaccination before commencing a grain-feeding program is the best practice.

Founder (laminitis)

Founder is a rare disease in sheep and cattle. Founder may occur after stock have gorged on large amounts of grain, such as wheat. The inner layers or laminae of the hooves become inflamed; this causes severe lameness, hot feet, distortion and even separation of the hooves from the feet.

Prevention and treatment
Treatment involves removing the offending grain from the diet. Veterinary treatment can reduce effects in severe cases. Avoid grain spills, prevent access around silos and look out for gorging by dominant animals.

Grain poisoning

Grain sickness occurs when excessive grain is eaten. The grain swells and produces lactic acid that damages the digestive tract – a condition called acidosis. This can result in scours and deaths.

The primary causes of grain poisoning are:

- insufficient trough space or too short a trail
- using guesswork instead of measured quantities
- introducing grain to the diet too rapidly (too much, too soon)
- changing grain types

- over-indulgence by dominant animals
- insufficient roughage, spills and access to silo areas.

The signs of grain poisoning include progressive discomfort 12 to 36 hours after engorgement, thick porridgy scours, loss of appetite, weakness and staggering gait and finally death. Bloat and founder (laminitis) often follow grain poisoning in survivors.

Prevention and treatment

Prevent your stock from accessing spilt grain, increase roughage in their diet and follow the recommendations for grain feeding. Sodium bentonite (1–2% of grain) can be used as a buffer in grain rations, particularly during the first few weeks or when introducing a new ration or feed. Manufactured feeds, such as pellets, also carry a higher risk as they are predominantly grain based, although they may include a rumen buffer.

Animals with mild grain poisoning may recover without treatment. Remove the animals' access to grain and give them hay. For severe cases, seek veterinary advice early and get prompt treatment before irreparable damage occurs. Common first aid treatments are:

- Cattle – remove from grain feed and provide hay only. Drench with 120 g sodium bicarbonate (bi-carb soda) dissolved in water and repeat 60 g every three hours for three doses plus electrolytes and water.
- Sheep – drench with 15 g sodium bicarbonate (bi-carb soda) in 1 litre of water.

Grass tetany (hypomagnesaemia)

Grass tetany is caused by a magnesium deficiency. It usually occurs in cows and ewes for up to four and two months after calving and lambing, respectively, when grazing grass-dominant pastures (with little clover or medic present).

Stock with grass tetany are often found dead. Sheep collapse on their side with their heads thrown back, legs paddling and they may die within minutes. Cows become nervous, they begin shaking and may become aggressive, and then they collapse and die rapidly.

Prevention and treatment

To prevent grass tetany, graze susceptible cows and ewes on balanced grass/clover pastures or feed them clover hay. In severe cases, feed 'Causmag' with the hay every second day: 30 g per cow and 15 g per ewe. Cattle may be given a magnesium capsule, which will provide a slow release supplement over 90 days.

To treat grass tetany, inject 2-in-1 magnesium/calcium milk fever treatment at the first sign of a problem and follow-up with 'Causmag' in good quality feed.

Milk fever (hypocalcaemia)

Milk fever is caused by a drop in blood calcium levels. It is most common in cows and ewes just before, or after, calving and lambing.

Calcium deficiency may be caused by:

- animals starving when yarded, during very cold weather or during transportation
- a grain diet for a prolonged period without calcium supplements (limestone)
- stock grazing on green oats, wheat or rapidly growing grasses.

An animal suffering from milk fever may have its neck turned back and, if not treated, will go down suddenly on its side often with its legs stretched out behind and will usually die within a few hours.

Prevention and treatment
To prevent milk fever in pregnant and milking ewes and cows, avoid long periods without feed and add ground limestone (1–2% by weight of grain) to their grain rations.

Treat milk fever early with calcium borogluconate injected under the skin at the recommended rate and provide good-quality feed.

Pink eye (contagious ophthalmia)

Pink eye is an infection of the eye that usually occurs during dry periods. Dust, grass seeds and flies – common components of feeding situations – will aid the spread of the disease.

The signs of pink eye are: inflammation around the eye ball; excessive tears often wetting the cheek; the eye surface develops a blue haze, which becomes opaque and white as the affected eye goes blind. Stock with both eyes affected will be totally blind and may have difficulty finding supplementary feed and water. Pink eye is more common in younger stock and large numbers of animals may be affected.

Prevention and treatment
To treat pink eye, check under the eyelids and remove any grass seeds. Most animals will recover unassisted over two to three weeks. Placing animals in a yard to treat pink eye will only increase the spread of the disease. Blind animals will usually cope while in a mob and in familiar surroundings. Antibiotic ointments applied daily will assist recovery, but are not very practical. Medicated eye patches are available for cattle.

Plant-related poisoning

In conditions where there is little else to eat, stock can resort to eating poisonous plants. Plant poisoning can produce a range of symptoms including rapid death, slow death, infertility, lactation, staggers, nervous signs and yellows. Some plants may be toxic only at certain stages of growth or under specific conditions and their poisonous effects may be cumulative before causing signs of disease.

Look out for unusual weeds brought in with fodder and for animals grazing plants that they don't normally eat. With the first rains, normally unpalatable plants, such as sorrel and bracken, are often first to emerge and get eaten by stock that are hungry for green feed. Poisoning and/or bladder stones can result.

A number of plants can carry fungal or bacterial contaminants at specific times. These organisms can cause staggering and death. Examples are:

- lupinosis from lupin stubble, grain or hay
- ergot poisoning from paspalum
- annual ryegrass toxicity from annual ryegrass
- rye grass staggers from green perennial ryegrass

Prevention and treatment
If you suspect plant poisoning of any kind, seek prompt veterinary diagnosis.

Polioencephalomalacia

Polio or star gazers can be associated with the commencement of supplementary feeding or a change in the energy ration. Sheep become blind, dopey and separate from the mob and die unless treated early with thiamine (Vitamin B1).

Prevention and treatment

Prompt diagnosis is essential: a preventive thiamine drench is available.

Pregnancy toxaemia (twin lamb disease), acetonaemia

Pregnancy toxaemia is caused by a glucose deficiency in late pregnancy, or early lactation in cows, when energy demands are high and feed intake inadequate. It occurs mostly in high-producing dairy cattle (usually called acetonaemia) and in ewes carrying more than one lamb: these ewes have less room in their stomachs to consume the required amount of feed. As the animals rapidly use up their fat reserves, toxic waste products (ketones) are produced causing irreversible brain damage.

Any activity that causes stress and reduces feeding time, such as yarding, calving, diseases or bad weather, may precipitate cases of pregnancy toxaemia.

An animal with pregnancy toxaemia or acetonaemia may:

- become lethargic, stop eating, appear dopey and separate from the others
- (after a few days) stagger, appear blind, sit down, have acetone-smelling breath – very sweet, like nail polish remover
- finally lapse into unconsciousness and die.

This ewe eventually died as a result of untreated pregnancy toxaemia.

Prevention and treatment

To prevent pregnancy toxaemia, reduce stress in late pregnancy, and provide a steadily rising amount of high-quality feed. Poor-quality feed, such as old pasture or average hay, will be inadequate. If the feed seems inadequate, then supplement with grain.

Pregnancy toxaemia must be treated early, before the animal goes down (is unable to stand). Inject dextrose, or milk-fever treatment containing dextrose, under the skin and/or drench with 'Vy-trate', 'Ceton', 'Protcol', 'Ketol' (follow label recommendations) or glucose until full recovery. Provide the patient with a concentrated feed supplement to prevent a relapse.

Sand or gravel in the stomach

During droughts and extended feed deficiency periods, when stock graze close to the ground and eat feed supplements off bare ground, animals are likely to consume a quantity of soil with their food. The heavier parts of the soil, such as sand, gravel or stones, accumulate in part of the stomach (abomasum) where they are abrasive, causing

considerable damage and eventually deterring the affected animal from eating. At the end of the dry period the stock are able to graze fresh green feed, which is low in fibre and therefore unable to dislodge the offending material.

An animal with sand or gravel in the stomach will be:

- unwell
- reluctant to eat
- possibly hunched-up as though uncomfortable
- losing condition and hollowed out from not feeding.

The animal will die slowly as it wastes away. A post-mortem is the only way to confirm the cause because the signs are similar to several other conditions. By the time signs are readily obvious the likelihood of recovery is low.

Prevention and treatment

Prevention and treatment is by feeding plenty of roughage, such as coarse hay. This gradually drags the gravel from the stomach through the intestines and out. Feeding roughage should continue for sometime after fresh pasture is available. Recovery from severe cases is not likely, so preventive treatment is very important.

Stress

Additional stress from cold and/or wet weather, mustering, lambing, calving, milking or shearing may produce health problems that are not normally encountered. Body heat loss is greatest in wet windy periods and these times are therefore the most stressful on stock. Lean or poor-conditioned stock are the most susceptible to cold stress.

Stress caused by the natural environment (wind, temperature, rain) and new pasture can result in weakness, increased susceptibility to disease and even death.

It is not uncommon during feed shortages for most deaths to occur after the drought breaking rains have arrived. This is when the weather is often colder, animals start grazing on green pasture, which causes digestive upsets (young pastures have a low energy value), and hand feeding is stopped or has been reduced too quickly.

Prevention and treatment

Stress can be reduced by providing extra feed, gentler handling, controlling parasites and providing shelter. Expert veterinarian advice should be sought early in the event of unusual sickness or death.

Worms

Stock grazing on very short pasture, or in concentrated areas around a feeding site, are susceptible to a rapid build-up of intestinal parasites (worms). Scours or diarrhoea indicate that considerable damage and weight loss have already occurred. A worm test, or

faecal (dung) worm egg count, will confirm if worms are the problem or some other cause needs to be investigated.

Prevention and treatment
Always follow the recommended worm control program for your area. Test and treat as recommended.

This calf died as a result of untreated intestinal worms.

11

Stock-containment areas

During droughts or extended dry periods it is now considered best practice to remove stock from having the run of the farm and confine them in specially prepared feeding and holding areas. These stock-containment areas (SCA) provide considerable advantages for the land, stock and farm operator.

An SCA is a carefully selected area set up to hold, feed and water core farm-stock, usually breeders, during dry periods. The SCA becomes a permanent part of the property's infrastructure and management plan and, once established, it is readily available for use during dry seasons or other emergencies, such as during and after wild fires.

Why have a stock-containment area?

Unconfined grazing and trampling by stock on drought- or fire-affected land will put considerable stress on land that is already in a vulnerable state. Once two-thirds of the soil surface has become exposed due to vegetation removal, the wind will start blowing away soil particles. Stock trampling and vehicular traffic merely aggravate the situation. Wind eroded and bare soil will be predisposed to water erosion when rain returns. Soil loss from the farm also means nutrient loss and probably permanent structural damage.

Other than selling all stock, one of the best ways of keeping vegetative cover from falling to a critical level is to remove stock from all paddocks before any damage occurs and place them in an SCA. Considerable savings can also be made for the stock and operation costs.

Vulnerable soil and pasture – almost two-thirds of the ground is bare – needs protection.

Advantages of stock-containment areas

- The vegetative cover is protected on the majority of property, retaining soil and nutrients for a quick recovery when it rains
- Reduces soil erosion from wind and water
- Stock do not waste energy walking long distances in search of food
- Efficient stock feeding, watering and handling (they are all in one area)
- Easier to ensure all stock are adequately fed and monitored
- Less stress on flora and fauna values of the property
- Pasture species are not wiped out by overgrazing
- Weed-seed contamination from imported feed is restricted to a small area
- Easier to provide shelter and shade
- Less fuel and time driving over the property to feed and inspect stock.

When is an SCA not recommended?

An SCA is not suitable for late-pregnant and lambing ewes due to mismothering and desertion in the crowded environment. Infection of newborn lambs will also occur in the highly contaminated environment, particularly through the umbilical cord, resulting in arthritis, septicaemia and other serious infections and causing many deaths. Mismothering problems will be less of a risk with calving cows, particularly if lightly stocked, but a clean, grassed paddock would be a better option, reducing both infection and mismothering risks.

Sizes and requirements for an SCA

For efficient operation, supervision and animal husbandry and welfare reasons, it is best to limit individual SCAs to around 2500 square metres; such an area will carry 500 sheep or 160 cattle. To carry extra stock, build multiple SCAs.

Eight hundred sheep after two months in a 10-acre stock-containment area.

Make the following minimum allowances:

- 5 square metres per sheep
- 15 square metres per head of cattle
- Provide sufficient holding areas or pens to allow segregation of each class and size of stock, including: ewes, rams, weaners, bulls, cows, cows and calves, yearlings and sick or injured animals
- Provide isolation areas for sick, injured, stressed or bullied animals or those that are not feeding.

The requirements for an SCA include:

- strong reliable fencing suitable for the class of stock; it must be able to withstand heavy pressure
- appropriate subdivision to separate different classes of stock
- a reliable reticulated supply of water and watering troughs large enough to cope with greatest demand
- stabilisation of soil around water and feed troughs using rock or gravel
- feed and water troughs separated and located away from stock camping areas and trees
- vehicle access for feeding, cleaning, animal husbandry, dead or downer stock removal and stock movement
- trees should be protected from stock damage
- a nutrient filter or trap established downhill from the SCA; a vegetation barrier, wire netting or shade-cloth type mesh will usually work.

Good vehicle access to an SCA.

Choosing the best site for an SCA

Site selection is very important. The best site for an SCA will have well-drained, stable soils, such as a clay or clay loam on moderately sloping terrain, to allow drainage, but not wash or erosion. The SCA should be conveniently located in relation to the homestead and farmyard, but far enough away and downwind of the farmyard, homestead and neighbours to avoid dust, noise and smell nuisances. To avoid irreversible damage, keep the SCA well away from areas of remnant native vegetation and at least 500 metres away from water courses and water storages particularly if no effluent management methods are used. The SCA should be situated in the lee of shelter and shade.

A well-chosen SCA site: shade, gentle slope, stable ground and plenty of room.

Feeding and watering in an SCA

Feeding troughs should be of robust construction and preferably elevated. Troughs should be able to hold a day's feed and designed to prevent stock standing in them. A divider or cable will provide a suitable barrier or you could install the trough hard against a fence, allowing access from only one side. Each sheep require 15 cm of trough edge and cattle require 25–45 cm per head, depending on their age and size.

Introduce rations slowly, including plenty of roughage, and supervise the animals closely. Feed buffers are a useful additive, particularly in the early stages. The ration must be well planned and provide the total nutritional requirements of the stock. In addition to the rations suggested in this book, professional help is recommended to personalise the ration to the particular size, weight, age and class of your stock. Manufactured feed companies and agricultural advisers will be able to assist. For long-term feeding, additional mineral and vitamin supplements may be required.

Water quality and security of supply are critical. Daily inspection of the water supply system and water is essential and any defects must be rectified immediately. The water supply should be clean, cool and within salt and mineral limits. Table 11.1 provides a guide to acceptable salt levels expressed as both parts per million (ppm) and electroconductivity (EC).

Table 11.1 A guide to maximum desirable[a] salt levels[b] for stock water for sheep and cattle

Adult	10 000 ppm	(16 700 EC[c])
Lactating	5000 ppm	(8300 EC)
Young	5000 ppm	(8300 EC)

Notes:
[a] Stock need to be introduced slowly to water at these upper levels of salt
[b] Bore water should be tested for other toxic minerals, such as magnesium
[c] EC units as µS/cm at 21°C
Source: Thomas (2002)[6]

Allow for an adequate flow rate and reserves for each day and for long-term use. Indicative rates and volumes are given in Table 11.2. Provide natural or artificial shade to keep your animals cool – they will drink less and be less stressed.

Table 11.2 Water requirements of livestock; long-term and daily demand

The maximum daily demand for water must be used to determine the rate of water supply to the troughs. The long-term average consumption should be used to determine the total volume of the main water storage (i.e. dam) required.

Stock class	*Maximum daily demand (trough flow calculation) L/head/day*	*Long-term average (dam capacity calculation) L/head/day*
Sheep		
Lactating	14	7
Dry	10	5
Weaners	5	2.5

Stock class	*Maximum daily demand (trough flow calculation) L/head/day*	*Long-term average (dam capacity calculation) L/head/day*
Cattle		
Lactating	160	80
Dry	100	50
Weaners	50	2

Note: These quantities are for water of a low salt content, stock of average size and in an area with shade and shelter.
Source: Thomas (2002)[7]

Water troughs should be large enough to allow 10% of stock to drink at the same time. Five hundred (500) sheep need approximately 15 metres of trough edge and 100 cattle need 5 metres of trough edge.

The volume of troughs should be sufficient to prevent water becoming too hot to drink and to act as a storage buffer for peak-demand periods. Select a water trough that is easy to clean as this must be done frequently. Float valves should be protected from damage by stock and be of a non-restrictive type; that is, they are capable of delivering a large volume of water on demand.

Supervision in an SCA

As sick or weak stock will not necessarily separate from the mob, you must examine the mob closely for signs of ill-health, such as blindness, not eating, shy feeders, injury and scours. You must be able to promptly locate and dispose of dead or downer stock and be able to isolate and treat sick and shy feeders. If you encounter problems, seek professional advice and diagnosis early to avoid rapid spread of disease or suffering.

You should monitor the condition of stock in an SCA regularly to ensure that the target fat score is being maintained and the feeding rates are adequate, but not excessive.

Suitable equipment and infrastructure are essential for SCAs.

12

Your worksheets

Calculating costs

A worked example is shown in the first row of the worksheet to demonstrate how the worksheet is to be used.

Notes:

- Feed costs in c/kg = feed costs in $/tonne ÷ 10
- Feed costs in c/EU = feed costs in c/kg ÷ EU/kg
- Include delivery charges
- To calculate the figure in column B for feed purchased by bale or bag, divide the price in cents by weight in kg of the bale of bag.

Feed	**[A] Cost ($/tonne)**	**[B] Cost (c/kg) [B = A ÷ 10]**	**[C] Energy units (EU/kg) [see Table 9.3]**	**[D] Cost (c/EU) [D = B ÷ C]**
Wheat	210	21	12	1.75

Calculating rations

A worked example is shown in the first row of the worksheet to demonstrate how the worksheet is to be used.

Sheep worksheet

Notes:

- Ration per WEEK
- Feed required (kg/week per sheep) = energy required (EU/week per sheep) ÷ energy value (EU/kg)
- Supplement (kg/week per sheep) = feed required (kg/week per sheep) less the proportion provided by grazing
- Column E: calculate (C × D%) first, use the % key or divide by 100, then subtract from C.

Sheep class and weight	**[A] Energy required (EU/week/ sheep) [see Table 9.1]**	**Feed**	**[B] Energy value (EU/kg) [see Table 9.3]**	**[C] Feed required (kg/week/ sheep) [C = A ÷ B]**	**[D] Estimated grazing (%)**	**[E] Supplement (kg/ week/sheep) [E = C – (C × D%)]**
Wether 45 kg	48	Wheat	12	4	25	3

Calculating rations

A worked example is shown in the first row of the worksheet to demonstrate how the worksheet is to be used.

Cattle worksheet

Notes:

- Ration per DAY
- Feed required (kg/day per head) = energy required (EU/day per head) ÷ energy value (EU/kg)
- Supplement (kg/day per head) = feed required (kg/day per head) less the proportion provided by grazing
- Column E: calculate (C × D%) first, use the % key or divide by 100, then subtract from C.

Cattle class and weight	**[A] Energy required (EU/day/head) [see Table 9.2]**	**Feed**	**[B] Energy value (EU/kg) [see Table 9.3]**	**[C] Feed required (kg/day/ head) [C = A ÷ B]**	**[D] Estimated grazing (%)**	**[E] Supplement (kg/day/head) [E = C – (C × D%)]**
Cow and calf 550kg	95	Good hay	8	11.9	50	6

Comparing costs for feeding or sell and replace livestock options

Option 1. Feed breeding stock through drought				
Cost of feed **Feed and price/ tonne**	**A** **kg/head/day**	**B** **$/kg** **$/T ÷ 1000**	**C** **$/head/day** **A × B**	**Total feed cost**
Total cost of feed	**Total of C × number of days to feed × number of head**		**$ _____ × _____ × _____**	**D** **$**
Feeding out cost **Cost**	**E** **Hourly rate**	**F** **Feeding hours/ day**	**G** **Cost/day** **E × F**	**Total feeding cost**
Labour				
Fuel @ $____ per litre using ____ litres per hour				
Repairs and maintenance				
Total cost of feeding out	**Total of G × number of days to feed**		**$ _____ × _____**	**H** **$**
Opportunity cost of $ Opportunity rate on $ spent (interest lost)	Interest lost p.a. (D + H) × J%	Interest lost for feeding period K × No. of days ÷ 365		**Total opportunity cost**
J ____%	**K** $	____×____ ÷ 365		**L $**
Total cost	**D + H + L**			**M $**
Total cost per head	**M ÷ number of head**			**$**____

Option 2. Sell stock and replace later					
Sales income			Purchasing costs		
N	Selling price per head	$	V	Cost per head	$
P	Gross income N × number of head	$	W	Total of purchases (V × number of head)	$
Q	Commission P × __%	$	Total net costs		
R	Freight ($____ per head)	$	X	Net cost of selling and repurchasing (W – U)	**$**
S	Net income P – Q – R	$	Net cost per head (X ÷ No. of head)		**$**____
T	Interest on income (__% of S for number of days)	$	Compare the net total costs of both options and other considerations.		
U	Total income (S + T)	$			

Information and further reading

Information sources

FEEDTEST® Hamilton (Vic), a business of the Department of Primary Industries, Victoria.
Information Notes/Agnotes/Fact sheets, Department of Primary Industries/Agriculture in each state:

- Victoria: www.dpi.vic.gov.au
- New South Wales: www.dpi.nsw.gov.au
- Queensland: www.dpi.qld.gov.au
- Western Australia: www.agric.wa.gov.au
- South Australia: www.pir.sa.gov.au
- Tasmania: www.dpiwe.tas.gov.au
- Northern Territory: www.primaryindustry.nt.gov.au

Meat and Livestock Australia: www.mla.com.au/publications

Further reading

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Mason, W., Warn, L., and Cahill, G. (2003). *Towards Sustainable Grazing, The Professional Producers Guide*. (Meat and Livestock Australia Ltd: Sydney.)

'Prime Notes'. (CD-ROM) (Department of Primary Industries: Queensland.) [5000 fact sheets from government and industry Australia wide, updated annually. Available from most Agriculture/Primary Industries Departments.]

'Tips and Tools'. (Meat and Livestock Australia.) [Fact sheets: numerous titles and subjects.]

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1 Prograze* 2003 (Victoria) Manual, *Sheep Production from Pasture*. Department of Primary Industries (Vic) and Meat and Livestock Australia (MLA), page 30.

2 Prograze* 2003 (Victoria) Manual, *Beef Production from Pasture*. Department of Primary Industries (Vic) and Meat and Livestock Australia (MLA), page 50.

3 Hollier, T., and Wallis, C. (Eds) (2003). The feed value of unusual feedstuffs. In *Drought Feeding and Management of Beef Cattle*. Department of Primary Industries (Vic), pages 58–60.

4 Brightling, A. (2006). *Livestock Diseases in Australia*. (C.H. Jerram and Associates Science Publishers: Victoria). 'Bloat', pages 192–195.

5 Hungerford, T.G. (1990). *Diseases of Livestock,* 9th edition. (McGraw-Hill Book Company: Sydney). 'Bloat', pages 436–440.

6 Thomas, P.R. (2002). Water supply for stock containment areas. In *Drought Preparation and Survival Guide*. (Ed. D. Hinton) Department of Natural Resources and Environment, Victoria, page 57.

7 Thomas, P.R. (2002). Water supply for stock containment areas. In *Drought Preparation and Survival Guide*. (Ed. D. Hinton) Department of Natural Resources and Environment, Victoria, page 58.

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