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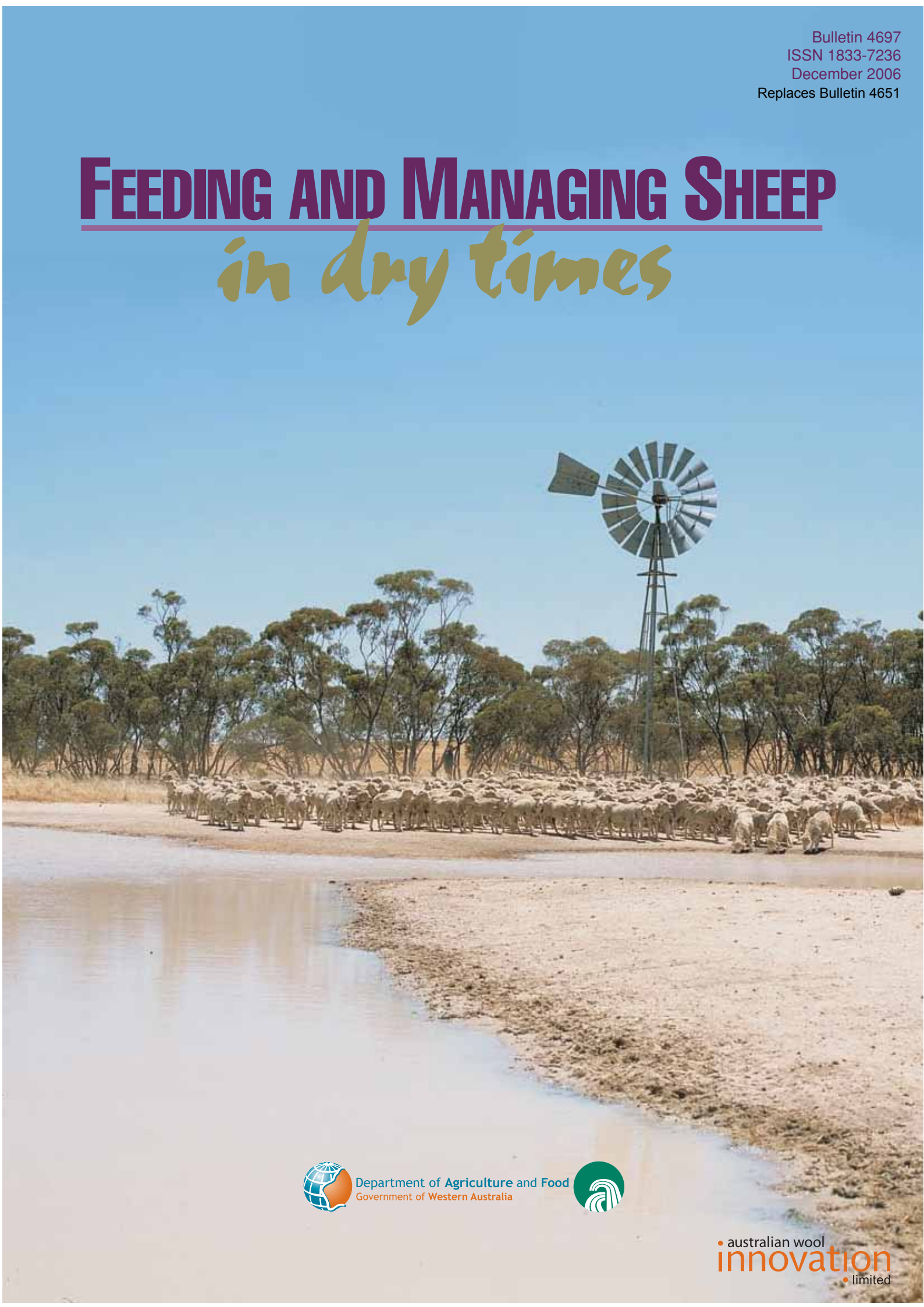
FEEDING AND MANAGING SHEEP *in dry times*



Department of Agriculture and Food
Government of Western Australia

australian wool innovation limited

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Feeding and Managing Sheep in dry times

Prepared by the Department of Agriculture and Food Western Australia (DAFWA)
and Primary Industries and Resources South Australia (PIRSA)

This bulletin is an updated edition of Bulletin 4651 (November 2005) and PIRSA Bulletin 2/94, 'Feeding sheep - includes lot feeding and drought feeding'.

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Introduction

Feeding sheep is a significant cost to any sheep or mixed farm enterprise in southern Australia. The cost is usually managed by annually sourcing feed on-farm. However, this feed source can become scarce when we experience unusual dry spells within seasons (termed a 'dry season', such as a dry winter or spring), a late break to the season, a drought year, or even worse, successive drought years.

Climate change research suggests that southern Australia will experience higher annual temperatures and a decline in mean growing season rainfall (particularly winter and spring) over the coming decades. This will affect the productivity and longevity of pastures, as well as the severity and prevalence of dry seasons and droughts. More than ever, these dry conditions need to be planned for, and carefully managed for the sustainability of the farm business, the sheep industry and the environment.

This publication aims to provide farmers with practical guidelines and examples, for feeding and managing sheep during dry seasons and drought years. Whilst the publication focuses on dry times and confinement feeding systems (feedlots), it does also include some useful information on getting through the normal summer autumn feed gap period.

This publication is a joint effort between the Department of Agriculture and Food Western Australia and Primary Industries and Resources South Australia. It is an update of Bulletin 4651 and originated from the PIRSA produced 'Feeding Sheep' bulletin Number 2/94.

Summer and autumn

Summer and autumn feeding

Summer and autumn are critical for sheep because both the amount and quality of dry feed deteriorates over time. Unless the sheep are hand fed production will often suffer.

The aim of supplementary feeding is to hand feed as little as possible to achieve the required production from the sheep. To achieve this, the sheep need to utilise as much dry feed as possible – i.e. what you hand feed needs to compliment the existing dry feed and not substitute for it. The type of feed and level of feeding will influence the utilisation of dry feed and the production level.

Pasture quality will decline over time due to bacterial breakdown and leaching of nutrients during rain. Digestibility is an indicator of how much energy the feed contains (see page 27). A digestibility value of 75 per cent in early October can drop to 55 per cent by early January. Below 55 per cent digestibility sheep are usually unable to consume enough pasture to maintain their weight.

Pasture quantity also naturally declines over summer and autumn by up to 50 per cent. It is important to utilise pastures and stubbles early in the season before their bulk is lost to natural degradation.

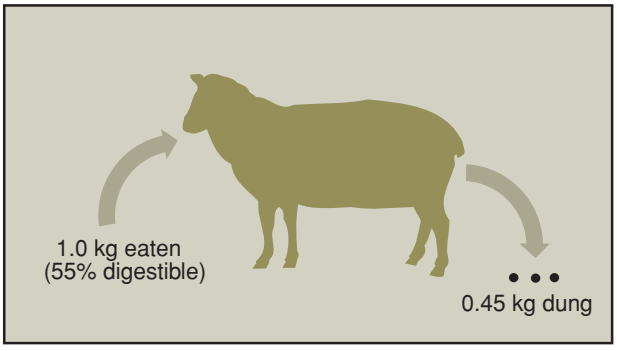


Figure 1.1. Digestibility is a measure of the amount of pasture used by an animal.

Monitoring the sheep

The condition of the sheep should be used as the main indicator as to when and how much supplement is required. Condition scoring a sample of 20 to 30 sheep in each mob is a quick and accurate way to monitor them. (See page 11).

It is advisable that supplementary feeding commences before the mob reach an average of condition score 2. It is more efficient to maintain condition than to lose, and then have to feed to regain condition. Set yourself a target liveweight for the mob (this should be no lower than 40 kg for medium framed Merinos or 45 kg for large framed Merinos) and start feeding before the mob approaches the target. Monitor them every three weeks to assess changes in liveweight and condition and adjust feeding to suit. Individual sheep should not be less than condition score 1.5.

Weight loss is not recommended for weaners and should be maintained at a condition score 2 minimum.

Lactating ewes will often lose condition in lactation. However, the more condition they lose, the more they will have to regain before mating time.

Supplementary feeding

The level of supplementary feeding needed will depend on the class of sheep, their current condition and what is available in the paddock. Table 1.1 gives examples of maintenance rations for feeding of a medium frame ewe where dry feed exists.

Table 1.1. Example maintenance rations for a medium frame ewe (50kg adult) on dry paddock feed*

Class	Oats or g/h/day	Lupins or g/h/day	Lupin/cereal mix (30:70%) g/h/day
Pregnant ewes (Day 0-100)	300	200	250
Pregnant ewes (Day 100-150)	450	300	380
Lactating ewes	600	400	500

* paddock feed - 60% digestibility and providing 70% of the intake.

Table 1.2. Supplementary feeding to maintain weaners on pasture of varying digestibility.		
Type of dry feed	**Digestibility**	**Recommendation for weaners**
Good dry feed	55 to 65%	50 g/h/d of lupins
Poor dry feed	45 to 55%	150 - 200 g/h/d of lupins
Very poor feed e.g. in late summer & autumn	Below 45%	A mix of lupins and oats (250-300 g/h/d of 30% lupins: 70% oats) or 250 g/h/d of lupins

Whilst digestibility of the feed is important for all classes of sheep, it is particularly so for weaners. It is best to avoid any setback with weaners. Table 1.2 provides some supplementary feeding guidelines for weaners.

Calculating supplementary feeding amounts

Whilst the above guidelines are useful, seasonal and district variations have a big impact on the amount of supplementary feeding required. The following steps can determine more accurate feeding levels:

- know what the animals require;
- estimate the value of paddock feed;
- calculate the supplementary feed needed to fill the deficit.

What the sheep require

Sheep require energy, protein and fibre. Details on these are provided in the nutrition section on page 27. Table 1.3 provides a brief summary of the key requirements for different classes of medium frame (50 kg adult) sheep. For larger frame sheep (60kg adult ewe), multiply the requirements by 1.2, or for smaller frame sheep (45kg adult ewe), multiply by 0.9.

The energy requirements of a breeding ewe vary depending on its pregnancy or lactation status. See Table 1.4.

(These outputs are based on Graz Feed®)

Table 1.3. Nutritional requirements to maintain medium frame sheep (50kg adult).			
Class	**Protein (%)**	**Energy (MJ/day)**	**Fibre (%)**
Dry sheep or ewes in early pregnancy	8	7 (Condition score 2) 8.5 (Condition score 3)	10
Weaners (25kg)	14	5	10
Lambing ewes	12	See table below	10

Table 1.4. Approximate energy requirements (MJ/day) of medium frame ewes (50kg adult) to maintain condition before, during and after lambing under dry paddock conditions*

Condition score	Energy (MJ/d) dry	Single twin	Weeks before lambing				Months after lambing		
			8	6	4	2	1	2	3
CS 2	7	S	7	9	10	11.5	16	14	7
		T	9	10	11.5	13.5	24	18	7
CS 3	8.5	S	10	10.5	11.5	13	20	15	8.5
		T	10.5	12	13.5	16.5	25	20	8.5
CS 4	9.5	S	10.5	11	11.5	13.5	20.5	17	9.5
		T	11.5	13	14	18	28	21	9.5

*Based on a 10MJ diet
NB. If feeding for confinement, adjust energy requirements by factor of 0.85

The value of paddock feed

The digestibility of dry feed will have an effect on the amount of feed an animal can consume and the energy level of the feed. Table 1.5 shows how the digestibility and energy can decrease over summer.

By knowing the energy requirement of a sheep, the feed on offer (FOO) and the digestibility of the pasture, and therefore how much of the pasture a sheep can eat, it is possible to estimate how much supplementary feed is required.

Calculating supplementary feeding amounts

Step 1

Determine how much energy your sheep require to maintain condition.

Use Tables 1.3 and 1.4 to determine energy requirement for the class of sheep you intend feeding.

Step 2

Determine how much energy the sheep get from the dry pasture.

This depends on how much energy is in the pasture (Table 1.5) and how much pasture the sheep can eat (Table 1.6).

Pasture energy content (MJ/kg) x amount of pasture eaten (kg/h/d) = energy obtained per day (MJ/d)

Step 3

Determine the energy balance

Subtract the energy requirement from the energy obtained. If the answer is negative the sheep will lose weight if not hand fed.

Energy obtained – sheep requirement = energy balance

Table 1.5. Digestibility and energy decline of dry feed over the summer months.

Digestibility (%)	Energy (MJ)	Month
75	11.4	October
65	9.6	
55	8.0	December
50	7.3	
45	6.5	February

* Use only as a guide, as the digestibility will vary greatly across seasons, districts, and management practises.

Table 1.6. Feed intake (kg DM/day) of dry annual pasture for non-pregnant medium-frame ewes (50kg)

Feed on offer (t DM/ha)	Digestibility 45%	50%	55%	65%
0.5	0.27	0.32	0.37	0.50
1.0	0.41	0.48	0.56	0.74
2.0	0.67	0.78	0.89	0.99

Assumes 20% clover

Step 4

Determine the feed required to make up the deficit

Table 3.3 lists energy values for common supplementary feeds. It is recommended that you get your feed tested for energy, protein and fibre. Use table 3.3 as a guide if you do not have feed test results.

Below is an example of how to make up the energy deficit using these steps.

Step 1

A 50 kg ewe bearing a single lamb, 10 weeks before lambing, will require 8.5 MJ/d of energy for maintenance (from Table 1.4).

Step 2

Pasture has a digestibility of 45 per cent, therefore1 kg of pasture has 6.5 MJ of energy (from Table 1.5)

FOO is about 1 t DM/ha, therefore a ewe can eat 0.41 kg/d (from Table 1.6)

Energy obtained per day 6.5 MJ x 0.41 kg

= 2.7 MJ

Step 3

Energy obtained from pasture 2.7 MJ/d
Less ewe requirement 8.5 MJ/d
Energy balance = - 5.8 MJ/d

Step 4

Example feed (oats)
Energy in oats is 10.7 MJ/kg of dry matter (from Table 3.3)
Ewe energy deficit 5.8 MJ/d
Amount required $\frac{5.8}{10.7}$

= 0.54 kg/h/d (540 g/h/d)

Convert to an 'as fed' or 'fresh weight' basis

0.54 x 100/92 (DM% from Table 3.3)

Amount to feed = 0.58 kg/h/d (580 g/h/d)

See page 28 for further details on conversion.

Therefore in this example, 580 g/hd/d of oats needs to be supplemented to the ewes for maintenance.

To prepare rations with more than one feed refer to 'Ration formulations' on page 42.

Feeding to encourage dry pasture consumption

The amount of dry pasture and stubble eaten may be improved if small amounts of high protein supplements, such as lupins, are given to stock (especially growing sheep and lactating ewes).

The improvement in pasture use only occurs if the amount of dry feed on offer (FOO) is greater than 1.5 t DM/ha and digestibility is at least 50 per cent.

At rates of lupins above 150 g/hd/d sheep will tend to eat the supplementary feed in preference to the dry feed.

With cereal grains they will reduce the amount of dry pasture intake at all feeding levels.

Monitoring condition of sheep

The condition of livestock can be measured by liveweight or body condition scoring. Condition scoring has advantages over liveweight monitoring during pregnancy and the dry period, due to the developing foetus and variations in gut fill. It works by estimating the amount of soft tissue over the last rib (the 13th) of the sheep.

It can be used:

- to assess whether more or less feed is needed;
- where target condition scores are required (eg. condition score (CS) 3 for mating).

Use of condition scoring

Condition scoring is done by feel. Accuracy improves with practice.

During periods of feed shortage, livestock should be maintained at condition score 2. Below score 2, tender wool is more likely. In the breeding ewe, condition scores near 3 are desirable as ewes below 2 will bear fewer lambs, with lower birthweights and survival rates.

Table 1.7. Recommended condition score targets.

Class of sheep	Recommended condition score
Dry sheep	CS 2+
Weaners	CS 2-3 and on a positive weight gain Aim for 30kg plus liveweight going into summer.
Ewes	CS 3-4 at joining CS 2.5-3 by lambing CS 2-2.5 during lactation

How to condition score

The animal should be standing in a relaxed position. Locate the last rib (the 13th) and using the balls of the fingers and thumb, try to feel the backbone with the thumb and the end of the short ribs with the fingertips immediately behind the last rib.

Feel the muscle and fat cover around the ends of the short ribs and over the backbone. Feel the fullness of the eye muscle.

The degree of roundness of the ends of the bones, the amount of tissue between the bones and the fullness of the eye muscle determines the condition or finish of the animal and consequently the condition score. See Table 1.8 for a description of condition scores.

Condition scoring - feel the backbone with the thumb and the end of the short ribs with the fingertips.

Table 1.8. Description of condition scores.

Score	Backbone	Short ribs
1	The bones form a sharp narrow ridge. Each vertebra can be easily felt as a bone under the skin. There is only a very small eye muscle. The sheep is quite thin (virtually unsaleable).	The ends of the short ribs are very obvious. It is easy to feel the squarish shape of the rib ends. Using fingers spread 1cm apart, it feels like the fingernail under the skin with practically no covering.
2	The bones form a narrow ridge but the points are rounded with muscle. It is easy to press between each bone. There is a reasonable eye muscle. Store condition ideal for wethers and lean meat.	The ends of the short ribs are rounded but it is easy to press between them. Using fingers spread 0.5cm apart, the ends feel rounded like finger ends. They are covered with flesh but it is easy to press under and between them.
3	The vertebrae are only slightly elevated above a full eye muscle. It is possible to feel each rounded bone but not to press between them. (Forward store condition ideal for most lamb markets now. No excess fat).	The ends of short ribs are well rounded and filled in with muscle. Using 4 fingers pressed tightly together, it is possible to feel the rounded end but not between them. They are well covered and filled with muscle
4	It is possible to feel most vertebrae with pressure. The backbone is a smooth slightly raised ridge above full eye muscles and the skin floats over it.	It is only possible to feel or sense one or two short ribs and only possible to press under them with difficulty. It feels like the side of the palm, where maybe one end can just be sensed.
5	The spine may only be felt (if at all) by pressing down firmly between the fat covered eye muscles.	It is virtually impossible to feel under the ends as the triangle formed by the long ribs and hipbone is filled with meat and fat. The short rib ends cannot be felt.

Pasture and sheep management options

In southern Australia summers and autumns are typically dry and various management options can be used to get sheep through this period.

Deferred grazing

Deferred grazing is a tactic that can be used after a late break to the season. It involves removing stock from paddocks to allow pastures to establish. The break of the season is a critical time, as pastures need to develop enough leaf area to make best use of sunlight and available moisture. If sheep are left on pastures during this time, they can uproot seedlings and the impact is worse at high stocking rates. Pastures after the cropping phase can be highly susceptible to over-grazing because of lower plant density. Pasture growth can also be limited by periods of dry, waterlogging or by pest attack.

Early pasture growth can be enhanced by reducing the grazing pressure, applying fertiliser (particularly nitrogen), controlling insect pests or by sowing pasture seed. Pastures that reach 1400 kg DM/ha before mid-winter tend to continue growing through the winter, while pastures that do not reach 1000 kg DM/ha tend to go backwards even at low grazing pressures. If pasture density is reduced, either by heavy stocking at the break or by false breaks, the time taken to reach 1000 kg DM/ha is considerably increased. The later the break of season occurs, the harder it is to reach the 1000 kg DM/ha target before mid-winter. Where pastures fail to grow adequately over winter, lactating ewes and young sheep are likely to need supplementary feeding.

Prevention of overgrazing by deferred grazing can be achieved by concentrating sheep in poorer paddocks (sacrificed paddocks), laneways or by confinement feeding. Supplementary feeding on the paddock through the break may give partial deferment. Sacrificed paddocks should have little or no erosion risk. They could be paddocks to be cropped, which may benefit from heavy grazing.

Deferment after an early break is generally not recommended as there is plenty of time for pastures to reach targets, and growth rates are higher in early months due to warmer conditions. Subsequent rains will germinate additional seedlings to increase plant density.

In areas where winter growth rates are fairly high, there may be little benefit in deferment unless plant densities are low, such as after a crop. Deferment may also result in an increase in broadleaf weed composition.

Use of nitrogen to boost pasture growth rate

Nitrogen fertiliser can be used to boost pasture production especially in seasons with a late break to increase winter growth. This will allow higher stocking rates to be maintained, provide more feed for ewes, allow deferment of pastures on other parts of the farm, and reduce the amount of handfeeding in winter.

Nitrogen application may be an economical way to produce extra feed. If the price of urea is $377 per tonne (at 46 per cent nitrogen) each kilogram of nitrogen costs $0.82. For every kilogram of nitrogen applied an additional 19 kilograms of dry matter per hectare can be produced. That is, 52.6 kilograms of nitrogen produces 1 tonne of dry matter per hectare.

Applying 100 kg urea/ha (i.e. 46 kg N) will produce an extra 874 kg DM/ha at a cost of $37.72 /ha or $0.04 /kg DM. This is a much cheaper option than buying in feed.

The keys to boosting pasture growth with nitrogen include:

- selecting a paddock that is at least 50 per cent grass (preferably ryegrass);
- carrying out soil testing and correcting nutrient deficiencies where required;
- deferring grazing before application to enable pasture to reach 800 to 1000 kg DM/ha of feed on offer;
- applying 30 to 50 kg nitrogen as urea (100 kg gives 46 kg nitrogen) or sulphate of ammonia (200 kg gives 42 kg nitrogen);
- applying nitrogen just before rain to achieve maximum benefit;
- preferably defer grazing for 3 weeks after application to avoid nitrate poisoning. If less than 3 weeks, monitor stock closely;
- do not allow hungry stock unrestricted access;
- a second application of urea applied 5 weeks after the first.

Feed budgeting in the green phase

Feed budgeting is a tool that uses pasture growth rates and animal intake information to help make decisions about sheep management.

Visit Pastures from Space at www.landgate.com.au where estimates of pasture growth rates are available for most regions These estimates are calculated using weather information and satellite images.

How to use pasture growth rates to feed budget

Pasture growth rates (PGRs) are an indication of how fast a pasture is growing. PGRs can be used to calculate whether there will be enough pasture available over a time period to meet the requirements of grazing animals.

Steps to calculating a feed budget

Step 1 ***Estimate grazed PGR.***

Take the predicted PGR for your district and multiply by 0.8 (this allows for the effects of trampling and fouling which are estimated to be about 20 per cent).

Grazed PGR = 0.8 x PGR

Step 2 ***Estimate feed intake.***

Use Table 1.10 to estimate feed intake for your class of sheep. It is important to note that feed intake varies according to animal requirements (age, class, liveweight), the amount of feed available and pasture composition.

Step 3 ***Estimate Feed on Offer (FOO) after a given amount of time.***

FOO is an estimate of all the above ground plant material, both green and dry, and is measured in kilograms or tonnes of dry matter per hectare.

Use the formula, and worked example, to calculate expected FOO.

For example;

Daily change in FOO = grazed PGR - (Stocking rate x Intake)

If a predicted PGR is 12 kg DM/ha/day.

Grazed PGR = 9.6 kg DM/ha/day (12 x 0.8).

Where FOO is 1000 kg DM/ha, estimated intake for a 50 kg lactating ewe with a single lamb is 1.5 kgDM/day (from Table 1.10).

With a stocking rate of 3 ewes/ha:

Daily change in FOO = grazed PGR – (Stocking Rate x Intake)

= 9.6 – (3 x 1.5)

= 5.1 kg DM/ha/day

After 30 days you would expect an increase in FOO of 153 kg DM/ha (30 x 5.1). Starting with a FOO of 1000 kg DM/ha, then at this stocking rate and PGR, you will have 1153 DM/ha after 1 month.

Pastures need to reach 1400 kg FOO before mid winter to grow near to the maximum rate. In dry seasons where this does not happen, supplementary feeding or confinement feeding, is necessary to maintain stock and pasture cover. In the example above supplementary feeding or reducing the stocking rate will need to be considered. A 'Green Feed Budget Paddock Calculator' is available from www.agric.wa.gov.au/sheep.

Pasture growth rates and feed budgeting are only a guide as each paddock is different. Use this method in conjunction with continual assessment of pastures and stock.

Table 1.10. Estimated feed intake (kg/day) of medium frame (50kg) sheep grazing green annual pastures (ie.75% digestibility, 20% legume).

	Feed On Offer (kg DM/ha)				
	300	500	700	1000	1200
Dry or pregnant	0.7	0.8	0.9	1.0	1.2
Mid lactation					
– with single lamb	0.7	1.0	1.2	1.5	1.7
– with twin lambs	0.8	1.1	1.4	1.7	1.9

Note: Lactation includes the lamb intake.

Pregnancy diagnosis in ewes

Pregnancy testing allows for better management of ewes.

Real time scanning (Ultrasound)

Real time ultrasonic scanning is the most accurate and rapid technique to determine foetal number in ewes. If ewes are joined for 5 weeks, accurate scanning for multiple foetuses can be carried out at a minimum of 45, and a maximum of 90 days after rams have been removed. At day 45 (after rams are removed) pregnancy can be detected with 100 per cent accuracy and multiple scanning (number of lambs in utero) to 95 per cent or better. Multiple scanning cannot be carried out accurately after 100 days.

The advantage of real time scanning over other pregnancy testing techniques is being able to identify ewes carrying more than one lamb.

Knowing foetal numbers means that:

- the incidence of pregnancy toxaemia and dystocia can be reduced by adjusting the ration according to the number of foetuses (ie. feeding to requirements);
- dry ewes can be sold, remated or used as dry sheep;
- genetic selection for reproduction is more accurate.

The disadvantages to real time scanning are:

- that it requires an experienced contractor for accurate results;
- the cost.

Udder examination ('Wet and dry' technique)

The wet and dry technique is a quick method of determining pregnancy or if a ewe has reared a lamb. If lambing is spread over six to eight weeks, accuracy will only be obtained by testing twice. The first 'wet and dry' can be done four weeks before the start of lambing, the second, four weeks later on the remaining ewes. To identify ewes that have actually reared a lamb, a 'wet and dry' can be done at marking time.

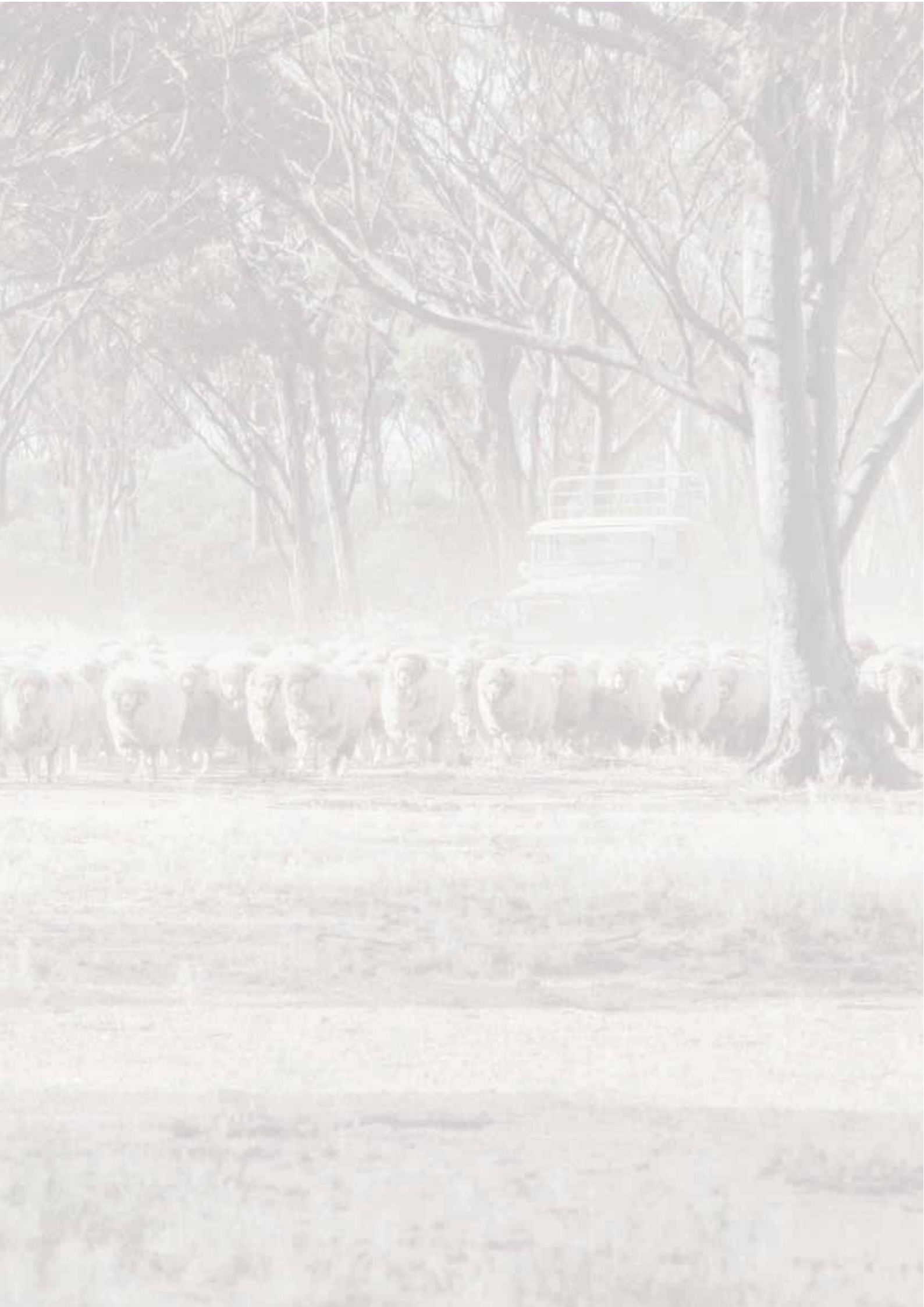
Before lambing, enlargement of the udder and the type of secretion are used to detect pregnancy. If the udder is enlarged, feels firm and warm to touch the ewe can be considered pregnant. If in doubt, milk the ewe and examine the fluid. However, stress of handling at this time may not be justified. In late pregnancy a ewe's udder will contain thick creamy, coloured milk (colostrum) or thick, sticky, honey coloured fluid. Barren ewes that are fat, or have been grazing oestrogenic clovers, may have enlarged udders that are soft and cold to the touch. The udder can contain watery fluid or thick white milk.

At marking time, careful udder examination will indicate ewes suckling lambs, ewes that have lambed but not reared a lamb, and barren ewes. The udders of milking ewes contain bright white milk and clean teats. Ewes that have lambed but lost their lamb will have udders containing a clear watery fluid that is flecked with small white lumps. The breech and udder area may be blood stained. Barren ewes are usually in better condition than ewes that have lambed and their udders will be the same as they were at the pre-lambing wet and dry examination.

Important - extreme care should be taken when yarding heavily pregnant ewes. Depriving ewes of food late in pregnancy, as could happen if yarded, may cause the onset of pregnancy toxaemia.

A mating harness, such as the “Sire sine” harness, can be fitted to rams, or teasers, a month after mating.

The crayons fitted onto the harness will identify any non-pregnant ewes. Use teaser rams if you don’t want the ewes to become pregnant. This is a cheap and easy method of pregnancy testing that is not often used.



Dry seasons and droughts

Sheep strategies and economics

There are a number of tactical management strategies that can be implemented during a normal summer, a dry season or a drought. There are also a number of strategic decisions that need to be made during a drought. Strategic decisions need to be made early in drought years whilst tactical decisions can be implemented when, and if, the appropriate conditions prevail. Details on these tactical management options can be found under sheep management options. See page 23.

The three major strategic options available during a feed shortage are to sell, to agist or to feed. Depending on the situation a combination of these will often be used.

The options used will be affected by a number of factors, including:

- current stocking rate and flock structure;
- current feed reserves on hand and predicted stock numbers;
- current sale price of the sheep compared with the expected purchase price of similar sheep after the dry period;
- cost and availability of feed;
- cost and availability of agistment;
- water supplies;
- erosion risks;
- available finance;
- income expected from sheep if they are kept;

Table 2.1. Summary of the advantages and disadvantages of each strategic option.

	Advantages	Disadvantages
Selling	• No cash outlay. • Interest earned on sale proceeds. • Better performance of remaining stock. • More time for other activities. • Less damage to pasture and soil. • Opportunity to improve flock genetics.	• Costs of restocking at a later date. • Difficulty in finding replacement stock. • Loss of income, especially wool. • Loss of genetics. • Breeding cycle is disrupted. • Tax liability. • Bought sheep may have a different shearing time. • Disease and weed risk with replacement
Agistment	• Usually cheaper than hand feeding. • Full production may be possible. • Damage to pastures and soil is minimised. • No loss of genetics. • Breeding programs not broken.	• Transport and management costs, (especially travel time taken to check stock). • Inadequate equipment (shearing shed, yards etc). • Risk of a higher death rate. • Risk of animal health problems, especially when moving from low rainfall into high rainfall areas (e.g. selenium, cobalt, footrot, worms) • Biosecurity risks (e.g. weed seeds). • Risk of stock theft.
Feeding	• Income can still be earned from sale of wool and store animals. • No costs of restocking. • Breeding cycle is maintained.	• Can be very costly, especially if feed shortage is longer than expected. • Damage to pastures and soil (unless a confinement feeding systems is used). • Time consuming. • Young stock may under-perform if the ration is not correct. • Weed seeds may be introduced. • Knowledge of feeding is needed.

- potential impact of decisions on the farm business in subsequent years; and
- the opportunity and risks involved in increased cropping in the year after a drought, rather than buying sheep back at inflated prices.

Strategic management decisions

Sell some sheep

The decision to sell is best made earlier rather than later. This will help avoid the problem of a heavy feed bill, stock losses and depreciated stock values. The aim should be to retain stock that will be most valuable after the feed shortage, such as young ewes. In principle, the flock can be culled in the following order: wethers – older ewes – dry ewes - lambs. Whilst ewe lambs hold your best breeding potential, they can be more expensive to feed due to their extra protein requirements for growth.

Order of selling sheep.

1. Oldest age group of wethers.
2. Cull hoggets.
3. Ewes culled for faulty udders, mouths, shy feeders, poor-doers or black wool.
4. Second oldest age group of wethers.
5. All remaining adult wethers.
6. Wether lambs.
7. Oldest age group of ewes.

Note: Many people sell their lambs too early – remember they are your future flock.

Agistment

Agistment is often the cheapest option available - if it can be found. Agisting sheep will reduce the stocking rate on the farm.

See page 65 for more information on agistment.

Feeding sheep

The type and quantity of feed required will depend on your overall goal. In a normal summer a maintenance ration may be required as opposed to a drought year where a drought (or survival) ration may be used.

The decision to feed needs to be made carefully, taking into account;

- labour required to feed;
- the length of time feeding may be necessary (calculate the cost given the 'best case', 'average' and 'worst case' scenario);
- feed availability and its cost.

Do not necessarilly assume the 'worst case' scenario.

Once the feeding option is chosen it is important to see it right through and not to get into a situation where you run out of feed (although opportunities to agist or sell may come along).

Economics - calculating the costs

The following examples show the key items that need to be considered. Producers should use their own figures to determine the economics for their situation.

Selling and replacing stock at a later date

The example assumes 10 months between sale and restocking for adult sheep.

The most difficult part of this calculation is estimating a price for replacement stock in the future.

Sell and replace.		
	Income ($ / head)	**Expenditure ($ / head)**
Sell sheep off shears (net proceeds)	30.00	
Interest earned (10 months @4.5%)	1.13	
Purchase replacements off shears (landed on farm)		50.00
Precautionary drench		0.20
Totals	31.13	50.20
Net		-19.07

Agistment

Historically the price of agistment has been in the order of 15 to 30 cents per head per week. During times

Agist.		
	Income ($ / head)	**Expenditure ($ / head)**
Transport to agistment block		2.00
Agistment fees (43 weeks @ 50 c/hd/week)		21.50
Inspection costs (10 trips)		2.50
Allowance for 2% extra deaths		0.60
Transport back to home block		2.00
Precautionary drench		0.20
Value of wool production (4.5kg greasy @ $3.50/kg)	15.75	
Interest paid on agistment fees (10 months @ 9.0% p.a.)		1.61
Totals	15.75	30.41
Net		-14.66

of feed shortage these prices come under pressure and are likely to rise to as much as 75 cents per head per week. Other major expenses associated with agistment include transport and extra management of the sheep whilst on the agistment property.

An example calculation, again using a 10 month time frame is provided on the previous page.

Feeding

The feed costs will depend greatly on availability of feeds and the type of rations you choose. See page 39 for further information on rations.

Retain and feed.		
	Income ($ / head)	**Expenditure ($ / head)**
Feed cost @ 65c/hd/wk (43 weeks)		27.95
Storage and handling allowance		1.00
Value of wool production (4.5kg greasy @ $3.50/kg)	15.75	
Interest paid on feed cost (10 months @ 9.0% p.a.)		2.10
Totals	15.75	31.05
Net		-15.30

In the example above we have used the least cost ration for dry adult sheep at 65 cents per head. If ewes were fed into late pregnancy or into lambing the cost would be much higher (but lambs would be produced).

Risk management

Whatever strategy you choose, take into account the risks involved.

Some points to consider include:

- What if the drought breaks early or later than budgeted for?
- What if the following year is also a drought?
- What are the chances the banks will refuse you carry-on finance?
- Could you crop more next year and purchase replacement sheep a year later?
- What would be the long-term implications on pasture density by cropping more?

Establishing confinement feeding systems

Confinement feeding is a valuable option not only for maintenance feeding during a drought, but also for use during a normal season to allow deferred grazing during autumn, or production feeding to turn off lambs. Confinement feeding (previously known as lot feeding or feedlotting) are intensive feeding systems in a confined area where all, or the majority of feed and water are supplied to sheep. Establishing these feeding areas requires consideration of location, equipment and costs.

There are a number of benefits to confining sheep to smaller areas, particularly in drought years.

It is worth considering confinement feeding if:

- there is risk of erosion if grazing continues;
- there is a risk of weed seeds, in bought fodder; or
- sheep are still losing weight, or condition, on a full survival ration in the paddock.

Selecting a site

The following are points to consider when selecting a confinement feeding area.

- The site should be well-drained, protected from prevailing winds, convenient to yards, silos, and a water source. A site should be located close enough to base to minimise travel but far enough to avoid the potential affects of dust and smell.
- Select a site that minimises water pollution risks caused by nutrient run-off. The site should be located at least 50m from intermittently flowing watercourses and 100m from permanent streams or rivers. Avoid sites upslope from dams so that run-off does not contaminate the dam.
- A slope of about three to four per cent is desirable to aid run-off without causing erosion. Grade banks placed above confined feeding areas on sloping sites will reduce run off and the longest side of the feeding enclosure should be aligned with the contour.
- Choose an appropriate soil type such as a hard clay or loamy soil. The most suitable soil types are those that do not become too dusty in summer, and do not cause too much mud, run off or leaching over winter.

Select an area that is well drained and protected from the prevailing winds.

- Trees, sheds or shelters for shade and protection are desirable but not essential. Trees in a confined area need to be protected from ringbarking.

Stocking density

When considering stock density, it is important to find a balance between dust and mud. Stocking density has implications for sheep health and performance in a confinement system. Allowing too much space will result in sheep walking more, raising dust and wasting energy. Dust can also lead to problems such as pinkeye and wool contamination. However, if animals are not given enough space, unhygienic, stressful conditions may result. The area should also be large enough for vehicles to turn around in. In wet conditions small areas can become very muddy. It would be best to let the sheep out into a small paddock while the confined area dries out. Otherwise straw bedding can be added to the pen to help keep the area and sheep dry. Table 2.2 provides a guide for minimum space allowances for different classes of sheep.

Table 2.2. Minimum recommended space allowances for different classes of sheep in a confined area.

Class	Space allowance (sq. m)
Lambs	2-4
Dry adults	2-5
Ewes in late pregnancy	5-10
Ewes with lambs at foot	10-15

Mob size

Several smaller groups are easier to manage than one large mob. Mob size should be no more than 500 sheep and farmer experience suggests smaller mobs of 200 are better for young sheep. For example, if 5 m^2 per head allowance is made for a mob of 500 dry ewes, then the confinement system would need to be 2500 m^2 (for example, 50 m x 50 m or 25 m x 100 m). The mob size can then be adjusted according to the class of sheep run in confinement. Having more than one pen allows for sheep to be separated according to class or age and allows for pens to be spelled.

Figure 2.1 and 2.2 show some basic designs for a confinement feeding system.

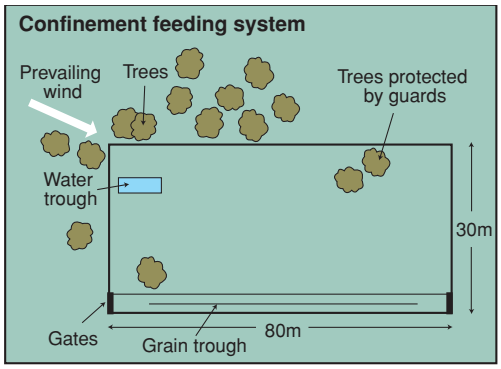


Figure 2.1 Simple confinement feeding system for up to 500 sheep.

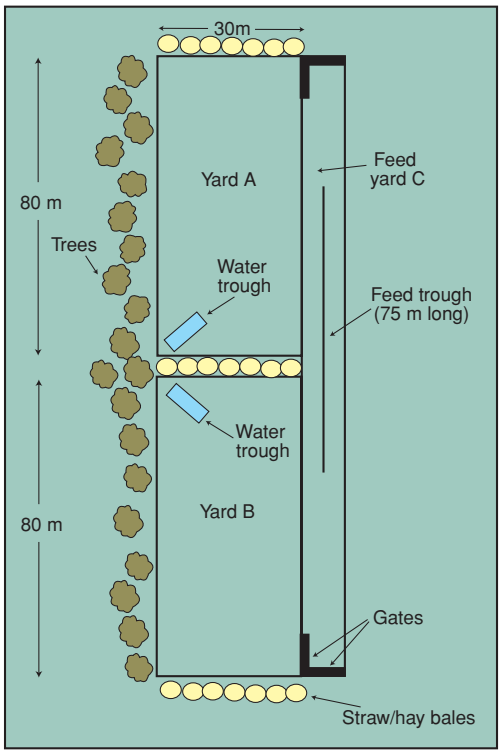


Figure 2.2 Confinement feeding system for two mobs of 500 sheep.

Extra trough length is required with single sided access.

Feed troughs

Troughing is necessary to prevent feed wastage and animal health problems (salmonellosis, coccidiosis) and does not need to be expensive. Troughs can be designed so sheep have access to one side or both sides, and so they cannot stand in them and foul the feed. Whether troughs or self–feeders are chosen, it is important that the correct feed space allowance is provided to avoid shy feeding.

Feed troughs are a good idea if, you want to control the amount of feed animals are to consume, such as during a drought or for maintenance purposes. Allow 10 to 15 cm per lamb or 15 to 20 cm per adult of trough length (use the upper end of this allowance for sheep with wool longer than 2 cm). If animals have access to only one side of a trough, the trough length will need to be doubled.

Troughs can be designed relatively easily with materials on hand and to the appropriate dimensions to satisfy the needs of sheep.

'Nepowie' shadecloth feeders.

Simple galvanised feed troughs.

Troughs are best raised off the ground to reduce fouling. However, this may not be practical where a feed trailer has to straddle the trough. Lift the top edge up to 40 – 45 cm for weaners and 50 – 55 cm for adults. Some of the materials that troughing can be made out of include conveyor belt matting, galvanised iron, shade cloth, tarpaulin and commercial channelling.

Different types of self-feeders are available and are suited to a production feeding situation where feed does not need to be rationed.

Self-feeders

Self-feeders are a good way to reduce labour when feeding for production. However, they are not a good option when ration feeding such as during a drought or when maintaining stock. Self-feeders are more suited to the finishing of stock where maximum feed intake is required to get sheep to a marketable weight.

Simply designed water troughing.

Less trough space is necessary for self-feeders. Allow 4 to 5 cm per lamb and 5 to 10 cm per adult (use the upper end of this allowance for sheep with wool longer than 2 cm). Sheep tend to arrange themselves better around circular self-feeders than rectangular self-feeders.

If hay is being fed and it is not chopped and mixed in with grain, a large amount of wastage can occur. Consider surrounding the large bales in weldmesh or panelling (such as portable sheep yards) so that wastage is reduced but animals can still access the roughage source. Hayracks can be used for large square bales. It is also important to prevent sheep from climbing on top of hay bales or rolls, as it is possible for bales to collapse and sheep to be suffocated or crushed. This applies particularly to lambs.

Water

A guaranteed supply of good quality water is essential in a confinement feeding system. The amount of water any sheep will consume depends on the weather, type of feed, quality of water and their physiological stage (eg. pregnant, lactating). Dams should be fenced out of the confinement area and stock watered in troughs. These need to be cleaned regularly, as contamination with faeces, dust and feed will reduce water intake. Place water troughs at the opposite end to hay and feed sources to reduce fouling. A minimum trough length of 30 cm plus 1.5 cm per sheep (with one-sided trough access) is recommended for mobs of up to 500 (that is, a trough length of 7.8 m is the minimum requirement for a mob of 500 sheep). This is provided that inlet pipe sizes and water pressure are sufficient to keep water in troughs under all circumstances.

See page 61 for more information on water.

Suitable water troughs for use in a confinement feeding system.

Sheep are capable of wasting large amounts of hay if it is not placed in some form of rack.

Sheep management options

Planning is the key to making sound sheep management decisions during dry seasons, droughts and late breaks. There are a number of strategies that can be used to minimise financial loss, ensure welfare of stock and protect the land for the future.

Making the decision to confine sheep

Deciding when to remove sheep from paddocks and into confinement areas is dependent on available paddock feed, condition and class of sheep, and erosion risk.

A guide as to what 50 % groundcover with about 30 % anchored material looks like in a stubble paddock.

Monitoring the erosion risk

Planning for dry times and assessing the erosion risk should start when pastures have dried off. Erosion risk is affected by windiness, how dry and loose the soil surface is, and the amount of ground cover.

The risk of erosion will be low if at least 50 per cent of the ground is covered by stable rough elements such as straw, pasture plants, stones or soil clods. The surface condition of the soil will also affect erosion susceptibility (for example, is it loose and powdery). To assess the erosion risk, inspect all parts of the paddock using a 0.1 m^2 quadrat (such as a Hoegrass® square). There should be more ground cover than bare ground within this square (that is, more than 50 per cent cover) and 30 per cent of this should be anchored to ensure ground cover is not lost in a 50 kilometre per hour windstorm.

When deciding whether to graze a paddock or not, estimate the amount of dry matter in a paddock. Allow approximately 2 kilograms of dry matter per sheep per day for consumption, trampling and the normal deterioration in pasture that occurs over summer. This means you can estimate potential grazing days for the paddock. It is only a guide so keep monitoring the situation, particularly after summer rains.

Managing shy feeders and poor doers

Behaviour of sheep in confinement is different to that in paddocks. In paddocks sheep are able to graze what they prefer, whenever they want. In confinement, sheep have to eat and drink from troughs with limited scope for diet selection. They have to live closely with other sheep and have no opportunity to move out to pasture and forage. It can sometimes take up to four weeks for sheep to settle down and perform as required in confinement, although most commonly they adapt within two weeks. Some sheep will be 'poor doers' and will have to be removed and fed separately, or returned to the paddock.

Some sheep become poor doers because they cannot compete well for feed. These 'shy feeders' can be worse in confinement than when fed in the paddock. To minimise the number of shy feeders, it is important to ensure trough length, the amount of feed offered and how often it is fed is correct for the mob size and confinement system. It is better to feed large amounts less often (twice weekly) than small amounts regularly to minimise dominant sheep consuming more than their share.

Releasing sheep back onto paddocks from confinement feeding

Reintroduction from confinement to pasture should be a gradual process to allow the rumen time to adapt from a grain based diet. An abrupt change to green feed may lead to scouring, pulpy kidney, tender wool or pregnancy toxaemia.

It is recommended to release sheep onto green feed for a couple of hours, after their normal feed so they do not go out hungry, then return them to confinement. This should be done for increasing periods over a week. Hay should be fed for the first few days on the final introduction to the paddock.

If the ewes are in late pregnancy, or if the paddock feed is poor, keep feeding the full ration during the first week in the paddock. Depending on the paddock feed condition, continue hand feeding and monitoring stock until it is obvious they don't need it. Ewes in late pregnancy that are released onto lush pasture should be offered a mixture of 50:50 salt:stocklime to prevent calcium deficiency during lactation. Put it in a container near to water or feed.

Delaying joining

Ewes in late pregnancy require up to one and a half times more feed than in early pregnancy, and lactating ewes require around three times as much as a dry ewe. During a drought, it is an option to delay mating so that late pregnancy occurs after the expected break of the season. This will better match feed availability from green pasture which is the cheapest source of food for ewes in late pregnancy and lactation. However, consider how the delayed lambing fits in with other farm operations such as shearing.

Not mating all ewes

This is an extreme decision, but it may be necessary in some situations. A strategy in very dry seasons is to not mate the ewe hoggets. In many instances these will be light in weight and may give quite poor lambing percentages if mated. Not mating will make management easier, save a little on feeding the pregnant flock and will reduce the risk of ewe losses during the autumn and at the break of the season. Offset against this, are a few less lambs and the slowing of genetic gains.

Joining in a confined area

Farmer experience suggests that good results can be achieved from joining rams with ewes in confinement. This may be a response to better nutrition of rams and ewes than they would otherwise receive. It may also be a result of better access by rams to ewes during close confinement, particularly with maiden ewes. Provision of shade becomes important when joining in confinement to minimise heat stress on rams. If rams are being fed 500 grams of lupins per head per day, they will need to be carefully introduced to cereal grain before being put into confinement with the ewes. The general principles for joining still apply.

Lambing in a confined area

Lambing in confinement is not recommended due to the risk of mismothering and health problems. It is preferable that ewes be released from confinement prior to lambing and fed a late pregnancy, or lactation, ration in a sheltered paddock. If considering lambing in confinement during extremely poor seasons it is recommended that professional advice be sought.

A better option during poor seasons is to plan a lambing paddock with adequate ground cover to release ewes into prior to lambing. Care must be taken to release sheep gradually to the paddock. It may be necessary to continue feeding in the paddock.

To mules or not to mules?

During a drought the decision to mules may be a difficult one as lambs are probably in poor condition. However, leaving Merino lambs unmulesed predisposes them to flystrike for the remainder of their lives.

Even if wether lambs are to be sold within the next twelve months, at very least they should have their tails docked.

If you choose not to mules, be prepared for an increase in complimentary husbandry practices such as crutching and jetting to deal with the problem of flystrike.

It is advisable to mules ewe lambs to be retained as replacements. In the event these ewes are sold, being mulesed will make them a more saleable proposition.

Lambs should be marked, vaccinated and mulesed at as young an age as possible and before weaning so that they have the benefit of the ewes milk. To help minimise infection and arthritis, ensure lambs are placed on their feet when released from the mulesing cradle.

Early weaning

Early weaning is valuable when dealing with a feed shortage, and is also worth considering during good years. However, to be successful it requires good management.

The feed requirements of a ewe with lamb at foot are higher than if the ewe and lamb are fed separately. This means that allowing lambs to suckle for longer than they actually need can be costly. It makes good sense to wean lambs as early as possible, especially when feed supply is tight or the cost of supplements is high.

Early weaning offers other advantages, these include:

- extra management flexibility (ewes can be sold, sent away for agistment, etc.);
- lambs can be given the best feed;
- ewe rations can be reduced;
- the overall cost of feeding can be reduced;
- lambs that are weaned early will have a lower worm burden and a worm control program for the lambs can be started earlier;
- ewes will have longer to recover from the stress of lambing before the next joining.

The disadvantages of early weaning include:

- late-dropped lambs might be too young, especially if the joining period was long. This could lead to an increased death rate, or a large number of poor doers going into the first summer. Weaners need to reach more than 20 kg liveweight before they can use dry pastures or stubbles;
- early weaned lambs require a higher protein diet (15 to 18 per cent) than does a ewe with lamb at foot. If good green feed is not available, high protein feed may be hard to find and expensive.

Management of early weaned lambs

In flocks with a five week mating period, lambs can be weaned as early as 10 weeks after the start of lambing (average age will be eight weeks), providing they are more than 10 kilograms in liveweight and can go onto a high protein diet. Mulesing and weaning need to be at least four weeks apart to allow wounds to heal and to minimise stress.

Early weaned lambs need to go onto a pasture that has been spelled to provide good green feed. Alternatively, feed a high protein supplement (lupins or peas, plus cereal grain and hay or sheep pellets) with at least 15 per cent protein. Any grain or pellet supplement for weaned lambs must be introduced gradually over a three week period. Ideally this would have started while they were still on their mothers. Leaving a few older ewes with the weaners will help settle them down and teach them to eat grain. A worm drench at weaning is recommended. The second vaccination should also be given at this time.

Creep feeding

If early weaning is impractical, 'creep feeding' is another option. This involves placing feed in an enclosure that cannot be accessed by the ewes. The enclosure has vertical bars at spacings that allow lambs in, but are too narrow for the ewes (approximately 20 cm). Further security can be provided by placing a horizontal bar at a height taller than the lambs, but shorter than the ewes (approximately 50 cm). It may take time for lambs to find the feed and therefore the energy required by ewes will need to be maintained. Creep feeding offers less management flexibility than with early weaning. However, the technique can be used to prepare lambs for early weaning, and might be particularly useful if the lambs cover a wide range of ages.

Time of shearing

Sheep deaths after shearing in cold, wet, windy conditions are likely to be higher during droughts. Losses from exposure are related to the rate of liveweight loss prior to shearing rather than actual liveweight.

Feed extra hay to sheep before and after shearing as the feed requirement for freshly shorn sheep in cold weather will double. Sheep should be returned to the same paddock offshears so they are familiar with the shelter. Paddocks will need to be planned in advance to provide adequate shelter and feed. Large round bales may be used for both shelter and feed.

Mob size

Although it may make management and handfeeding more time consuming, in a drought sheep perform best when run in small mobs. Large mobs waste feed and energy by excessive walking and tailenders may not have access to adequate food or water. The risk of erosion is also greater with larger mobs.

Sheep nutrition

Principles of sheep nutrition

Nutrition is perhaps the least understood area of feeding sheep. However, getting the nutrition right is vital, especially during dry periods and in confinement feeding situations.

Energy

Energy is the most important nutrient for a sheep. When feeding during dry seasons or droughts, provision of adequate energy to maintain liveweight and to ensure survival is the most important need.

Energy in feed is measured as megajoules of metabolisable energy (MJ of ME). ME is the energy that is available in feed for use by the sheep. The energy requirement for maintenance or survival varies for different classes of sheep.

Once you know the requirement of the animal and the energy provided by each kilogram of feed, you can work out how many kilograms of feed are needed by the sheep.

Estimates of daily energy requirements for medium frame sheep (50 kg) can be found in Table 1.3 and 1.4, (for example, a 50 kg wether at CS 2 requires 7MJ of ME/day).

Digestibility

If a feed is described as being 50 per cent digestible then only half of the feed eaten can actually be used by the sheep, the other half will be excreted.

Digestibility is an indicator of the quality of a feed and how much energy the feed contains. Grain has a digestibility of around 80 per cent and is high in energy whereas straw has a digestibility of only 50 per cent and provides much less energy.

Protein

Protein in feed is made up of amino acids. These amino acids are the building blocks for growth, pregnancy and milk production. The need for protein is greatest during pregnancy (particularly late pregnancy), lactation, and for rapidly growing and young sheep.

A crude protein percentage in a feed is obtained by measuring the amount of nitrogen in that feed. Nitrogen can be found in protein (true protein) or in other sources such as urea or sulphate of ammonia. These other sources of nitrogen are known as “non-protein nitrogen” (NPN). The microbes in the rumen have the ability to convert NPN into true protein if sufficient energy is available. NPN sources can be added to low protein rations to improve the protein available to the sheep.

While NPN can be used to boost the protein content of the diet, rumen microbes still require some true protein. Adult sheep require a minimum of 7 per cent true protein to maintain a healthy rumen.

Minerals

There are 19 naturally occurring minerals that are known to be essential for the normal function of a sheep. Macro minerals are those needed in relatively large amounts (grams per kilogram) and include calcium, phosphorus and sodium. Trace minerals, such as selenium, copper and cobalt, are needed in much smaller amounts (milligrams per kilogram). Mineral deficiencies can cause noticeable disorders but can also go undetected (subclinical) and cause significant production losses.

Ill-thrift is the most common sign of a mineral deficiency. Many mineral deficiencies cause a reduction in feed intake and reduce the efficiency of digestion and utilisation of feed. The best way to diagnose a mineral deficiency is by a blood test.

When sheep are fed a grain-based diet for more than a month, mineral reserves can become depleted. Grains are low in calcium and have relatively high

levels of phosphorous. This can lead to an imbalance in the calcium to phosphorous ratio, which is ideally at 2:1. Add 1.0 to 1.5 per cent stocklime to all grain based rations fed for longer than a month. See page 39 on addition of lime to rations. Grains are also low in sodium so add 1 per cent salt mixed with the lime.

Vitamins

Vitamins are organic compounds required by sheep in very small amounts. See page 48 for more detail on vitamins.

Fibre

Fibre is essential for normal rumen function. It ensures mechanical and chemical breakdown of the feed and that this feed is mixed with the rumen microbes.

Feeds that are high in fibre are termed roughage, these include hay, straw and mature pasture stands. In the paddock sheep will normally obtain enough roughage from pasture and stubble. In confinement feeding situations it is important to provide sheep with at least 10 per cent roughage.

Dry Matter versus 'As Fed'

Feed analysis tables and test results from laboratories usually give figures in dry matter (DM) terms. For example, MJ of energy per kg DM. All feed contains some moisture and the moisture content varies considerably between feeds.

For example;

- most grains and hay are 90 per cent DM (that is, 10 per cent moisture);
- silage can be up to 35 per cent DM (65 per cent moisture); and
- onions are around 10 per cent DM (90 per cent moisture).

Since you always weigh, and pay for, the feed 'as-fed' (or by fresh weight) it is very important to take moisture into account. This is done by quoting feed values as DM/kg.

For example, a feed test of barley has 12.6 MJ of energy per kg of DM and 90 per cent DM. On a 'fresh weight' or 'as fed' basis, this is 11.3 MJ of energy per kg.

That is, 12.6 x 90/100 = 11.3 MJ of energy per kg 'fresh weight'.

Feeding methods

Feeding sheep for maintenance can be carried out in the paddock as a supplement to pastures or stubbles, or as a complete ration in the paddock or a confined area. Rations are usually in the form of whole grain, hay, pellets or a mix of these feeds. The grain and roughage portions of a ration can be offered together in a trough, or the grain in troughs or on the ground, and the hay either on the ground, or preferably, in a hayrack.

Feeding frequency

Sheep should be fed every day whilst being introduced to a new ration. After this initial introductory period, the ration can gradually be fed out less frequently (see guidelines below). If sheep are fed daily each feed amount is small and dominant animals will eat more than their share at the expense of smaller, weaker animals. Research has shown that there will be a more uniform liveweight across a mob, and fewer losses, if sheep are fed less often.

After the introduction program leading up to a survival or maintenance ration, sheep should be fed at these intervals:

Dry sheep – twice weekly or weekly;

Ewes in late pregnancy or lambing – every second day;

Lactating ewes (after lambing has finished) – twice weekly;

Early weaned lambs – feed *ad lib* until they reach 20 kg liveweight, then feed every second day.

If possible, feed the roughage before the grain so that all sheep get some roughage. This also reduces the risk of hungry sheep overeating grain resulting in acidosis.

Types of feeds

Grains are the most readily available, and usually the best value, feed in broadacre farming districts. They are high in energy or protein, or both and some grains also have good fibre content. However, the nutritive value of grains varies from paddock to paddock and from year to year. Therefore, when formulating feed rations it is recommended that each feed be tested to determine its nutritional value. You can then formulate a ration that meets the requirements of your sheep. Table 3.3 shows the range in nutritive values of common feed grains. These values should only be treated as a guide.

To test a feed, take a representative sample of about half a kilogram of grain, or half a bucket of hay. Using a core sampler for hay is preferable. Send this to a feed testing laboratory to be tested for energy, protein, fibre and dry matter content. Laboratories are listed in the yellow pages. Contact your local consultant or Department of Agriculture office for further details on testing laboratories.

Cereal grains

Cereal grains generally form the basis of a ration or supplement as they are high in energy and are usually readily available. Most cereal grains have an energy level of between 10 to 13 MJ/kg DM and contain around 5 to 15 per cent crude protein.

Introducing sheep to grain

Due to their high starch content cereal grains pose an acidosis risk. Cereal based diets or supplements should be introduced gradually over 10 to 20 days (depending on the feed and situation) to allow the rumen time to adapt. Refer to Table 3.1 for an example introductory schedule for a maintenance ration. The descending order of risk of acidosis is wheat, triticale, barley then oats, where oats are the safest grain to feed. When introducing maintenance rations, allow at least 10 days for oats and low energy pellets, and 14 days for wheat, barley and triticale. Even changing from one grain to another, should be carried out slowly – over 7 days. Sheep can be introduced to oats or sheep pellets (depending on their cereal grain or energy content) five days faster than recommended in Table 3.1. If sheep have been grazing stubbles with grain on the ground, introduction can be three days shorter at the early stages.

Table 3.1. Example daily rations of wheat, barley or triticale per sheep (grams/day) when introducing sheep to cereal grains.

Day	Dry sheep	Lactating ewe
1-2	50	50
3-4	100	100
5-6	200	200
7-8	300	300
9-11	350	350
12-15	430	450
16-19	430	550
20	860*	700
21	0	700
22	860	700
23	0	700
24	860	1400*
25	0	0
26	1300	1400
27	0	0
28	0	1400
29	1300	0

*Note: Especially watch out for acidosis at this stage.

Sheep on high starch diets are also prone to pulpy kidney disease, so ensure they are fully vaccinated. See page 47.

Seconds grain (screenings)

Seconds grains can be a useful inclusion in mixed rations as they are generally higher in crude protein and have less starch than fully formed grains. This may mean that you can reduce the amount of lupins included in the diet, particularly if you are feeding lambs. It is very important to have the protein and energy level tested as they are likely to have a variable nutrient content due to the degree of pinching and the presence of weed seeds.

Seconds grain should be introduced gradually as they still pose an acidosis risk.

Lupins

Lupins are a good source of protein and have the advantages of high energy content, a very low level of starch and a high level of fibre. This means that lupins pose a lower acidosis risk than cereal grains. It is still important to gradually introduce lupins to sheep, as the sudden introduction of high amounts of lupins to hungry stock may result in the occurrence of ammonia toxicity.

Lupins are low in sulphur which can upset the ratio of nitrogen to sulphur. To overcome the imbalance a mineral supplement containing sulphate or sulphur (for example, gypsum) can be added to the diet. See page 39 for sulphate/sulphur additives.

Beans, peas and vetches

Beans, peas and vetches contain a high level of both energy and protein. They also have a high level of starch, which means they pose an acidosis risk. They need to be introduced slowly and fed at least twice a week to prevent acidosis. Sheep may take some time to adapt to these feeds if they have not been exposed to them before.

Canola

Canola seed is also high in both energy and protein. However, there are two problems associated with canola in a ration. Due to its small seed size and lignified seed coat, most seed will tend to pass through the sheep undigested. The other problem is that the oil in whole canola seed, when released in the rumen, can coat the fibre in the gut and reduce the efficiency of digestion. Canola can, however, be utilised quite well by sheep if it is coarsely cracked or milled. Canola seconds are generally of lower oil content and contain more protein.

Pellets

The use of pellets can be convenient. In most cases, pellets provide a complete ration, ensuring that all sheep receive a balanced diet as they cannot select the individual components.

There are a few simple rules to remember when buying and feeding out pellets.

- Pellets are designed for a range of purposes from maintenance through to production. Obtain the nutritional analysis from the supplier and decide whether the pellets are appropriate and good value.
- Some pellets are high in energy and pose an acidosis risk just as grain does. Other pellets are lower in energy and have a lower risk.
- Check the level of fibre in the pellets and ask the manufacturer whether the pellets should be fed with additional roughage.
- Calculate the cost per unit of energy (see page 43) including other costs such as transport;
- Ask the manufacturer the best way to store the pellets to give them the longest life possible. If the pellets are hot when stored they can go mouldy. Clean out the silo and ensure there are no grain pests present.

Roughage

Sheep being fed in a confined area need at least 10 per cent roughage in the diet to keep the rumen working effectively and to reduce the risk of acidosis. Lactating ewes require at least 15 per cent roughage to ensure that they can produce sufficient milk for their lambs. Use higher rates of roughage at the start of feeding, when changing a ration, or at other times of risk (such as, at times when intake may be low) e.g. cold spell.

Roughage alone may not provide the nutrients required by all classes of stock and may be more expensive per unit of energy or protein compared to grain based rations. The nutritive value of different roughage sources is highly variable and difficult to estimate, so it is recommended that the energy and protein be tested before planning a feeding program. Table 3.3 shows the range in feed analyses values for roughage sources. When making a decision on the best feed to buy, calculate the cost of the feed based on an energy basis (that is c/MJ) so that the costs of different feed sources can be compared (see page 43).

Silage

Silage is generally of a greater nutritive value than hay (per kilogram of DM) because it is made at an earlier stage of plant growth when energy and protein are at higher levels. Silage made from pasture or cereal crops can range from 8.5 – 11 MJ ME/kg DM and 7 – 25 per cent crude protein. Grass-based silage will maintain sheep, but generally not provide an adequate diet for animal production. Silage made from a mixture of cereal and legume crops will contain more nutrients and so may support production (growth) without additional grain.

Hay

In general, the later the hay is cut, the higher the yield but the lower the nutritive value. This is due to energy and protein decreasing as plants mature. Although hay is an important source of roughage, it is bulky and expensive to transport so other feed options may offer better value. When you buy hay, purchase it by weight as bale weights can vary greatly.

Mixed cereal-legume hay is usually the most valuable hay because the nutritive value will be higher and it will be more palatable to sheep compared to grass-based hay. High protein hay is particularly valuable as the roughage component for lactating ewes and growing lambs because they have a higher protein requirement than dry adult sheep. Poor quality hay cannot supply enough energy, or protein, for sheep during late pregnancy and lactation and so sheep must be supplemented with grain or pellets.

It is recommended that any hay, or other feed that is purchased, be checked for weed seeds and the possibility of annual ryegrass toxicity (ARGT).

Hay freezing

Hay freezing is the spraying of green pasture, or crop, with a herbicide which stops further growth of the plant, prevents seed set and conserves the nutritive value of the standing plants for later grazing. It is also of benefit for cleaning up weeds to prepare the paddock for cropping. The nutritive value of hay frozen fodder can be high, depending on its components at the time of spraying. Time and labour can also be saved compared with conventional haymaking but there is a risk of nutrients leaching if there is rain.

Failed crops

During a drought, feeding sheep on failed cereal crops may be an option for providing additional feed. The food on offer (FOO) should be estimated first to ensure it meets the requirements of the animals, and to determine whether a supplement will also be required. It is also worth considering that the grazing of standing crops may lead to erosion. If the crop is grazed in spring, the paddock could have up to 9 months before the soil is anchored with green growth again and so it is important to monitor the paddock closely. In areas susceptible to erosion, it is much better to graze the crop in late autumn so that the soil is protected over summer.

Mature crops

Allowing a crop to go to head and letting the sheep graze the standing crop during summer is also an option during drought. This allows sheep to graze the grains from the heads of the plants, rather than having to eat them off the ground. The nutritional value in grazing a crop is in the grain, followed by leaf material (which is what sheep will preferentially graze), there is minimal feed value from the crop stems. Grazing standing crops can pose an acidosis risk if the sheep are not accessing enough roughage and are consuming high-starch grain without an adequate introductory phase.

A hayed off unharvested cereal crop (commonly oats or oats/lupins) as a feed source for summer is a good tactic in farming systems that have optimum winter stocking rates, summer shearing and a low percentage (< 20 per cent) of farm in crop. The crop is generally provided as fodder to weaner sheep stocked at 30 to 40 head per hectare.

Stubble

The main feed value of stubbles is in the spilt or unharvested grain and the weeds they contain. However, the efficiency of harvesting and general weed control in crops have improved in the past decade and this results in stubbles with less grain and weeds.

It is difficult to predict the grazing potential of a stubble. Therefore it is important to weigh, or at least condition score, sheep on stubbles regularly - preferably every three weeks. Regular monitoring of sheep can aid in deciding when sheep need to be moved to a new paddock or be fed a supplement.

Stubble paddocks should be assessed for the amount of residual grain available before they are grazed. Some stubble paddocks do not contain sufficient feed to maintain sheep, even immediately after harvest.

A simple method to measure the grain available in stubble is to use a 0.1 m^2 quadrat (such as a Hoegrass® square), and perform at least 20 counts on a line across each paddock at right angles to the harvest runs. This will provide an indication of the average levels of residual grain in the stubble.

One hundred kilograms of grain per hectare on average equals:

Wheat* and oats	28 grains per square
Barley*	25 grains per square
Lupins	8 grains per square
Field Peas*	5 grains per square
Chick Peas*	5 grains per square
Faba Beans*	2 grains per square

*The risk of acidosis is high in these crops.

The yield of grain harvested does not provide a reliable indicator of the value of the stubble for sheep feed. In addition, following harvest, the digestibility of the stubble declines by about 1 per cent per week and decreases more rapidly when nutrients are leached from the stubble by rainfall.

Strategies when grazing stubbles and standing crops include:

- grazing stubbles which provide the most feed value first. The stubble grazing sequence is (most valuable to least valuable) canola, lupins, field peas/chick peas/faba beans, cereals;
- to avoid a setback, train lambs to recognise the grain they are to consume if they have not previously been fed grain. This is best done by trail feeding grain while the lambs are still on their mother;

- grazing early – lupin crops/stubbles should be grazed first to decrease the risk of lupinosis. The phomopsis fungus that causes the toxins, which cause lupinosis, are generally found on the stem of the plant. Therefore the risk of lupinosis increases as sheep consume pod and leaf material, leaving only stem. Young sheep should be trained to eat lupin grain. This may involve feeding lupins prior to weaning or chaining a section of a failed lupin crop to release grain onto the ground. Grazing of cereal crops can be delayed, though summer rains will reduce their nutritive value;
- checking sheep regularly to ensure the sheep are maintaining weight;
- checking paddocks regularly to minimise the risk of erosion (see guidelines on page 23);
- fully vaccinate sheep against pulpy kidney with both an initial and booster vaccination.

Straw

In a drought year straw is a particularly useful and inexpensive source of roughage for sheep. It is low in protein and energy and up to 50 per cent digestible. Because the digestibility of straw is low, the animal cannot eat enough to obtain sufficient energy so even when given *ad lib* access, they will slowly lose condition. Straw should never be the sole diet of a sheep.

Straw is valuable where it complements a cereal grain diet - where the grain provides most of the energy and protein, and the straw provides most of the roughage. A straw and cereal grain ration is suitable for maintenance feeding of adult sheep. However, for young growing sheep or lactating ewes, good quality roughage is preferable.

Straw quality can vary greatly. Straws low in protein and energy are generally unpalatable, and the levels of dust and odour may affect palatability. Barley straw is highest in energy, followed by oats then wheat. Cereal straw is low in crude protein, with most levels between 2 – 7 per cent. Grain legume straws are higher in protein but lower in energy than barley straw. Energy is the most important nutrient to consider as it is generally the most limiting during a drought.

There are several benefits to baling straw. In addition to providing an inexpensive feed for stock, it enables easier trash handling if the paddock is to be re-cropped. Pasture establishment in the following year may also be improved by stubble removal. Baling straw from harvester trails will still allow enough standing stubble in the paddock for trash retention and erosion protection, however assess the amount of stubble present and ensure the risk of erosion is minimal. It is worth noting also that removing stubble from paddocks exports nutrients with it, particularly potassium and lime.

Straw should be baled as soon after harvest as possible to reduce the loss of the fine leaf material. The proportion of fine to coarse material has a large influence on quality. If the baling method loses much of the fine material, and includes the coarse stem, the quality of the straw will be low.

Baling straw is best done at night or early in the morning before it becomes too brittle. However, straw baled too moist can become mouldy.

If the straw is unpalatable to stock, treatment with molasses may improve its palatability. The poor protein value of straw can be improved with the addition of urea based products (see page 38 for further information).

Chaff cart residues

Improved cart collection systems for chaff residues have increased the availability of the higher quality components of cereal, pulse and canola crop residues by allowing separation of harvested material into leaf-rich and stem-rich components. Chaff heaps from the collection process can provide an accessible source of feed at specific locations in the paddock. Alternatively, they can be collected and used as part of a ration in confinement feeding systems.

Chaff cart residues are generally capable of maintaining adult sheep as the average energy

A sample of wheat chaff being used as a roughage source in a confinement feeding system.

content of collected material (around 7.5 MJ ME/kg DM) is close to the sheep requirement for maintenance. Chaff cart residues may require supplementation with additional protein (such as lupins) if the protein content of the diet falls below 7 per cent. Young sheep will begin to lose condition on chaff cart residues if the energy is below 8 MJ ME/kg DM. See Table 3.3 for nutritive value ranges of chaff cart residues for different grain crops. The nutritional value of chaff cart residues varies depending on the proportion of weed seeds, cereal grain and fine leaf material in them.

In large stubble paddocks, the provision of strategically placed chaff heaps may improve the utilisation of stubble across the whole paddock, increase the number of grazing days and reduce the amount of supplementation required if deferring grazing to autumn. However, it must be noted that in drought conditions, these stubbles may not be available for long and the risk of erosion may be greater if sheep are left to actively search for food. Sheep may also begin to lose condition if expending energy to find food, so confining them and feeding the chaff residues within a small area may be a better option.

The risk of ARGT and lupinosis is higher if chaff is heaped.

Alternative feeds

There is a wide range of alternative feeds that may be considered for use by sheep during dry times. However, some of these feeds may have risks associated with them.

Summer fodder crops

In seasons with significant spring or early summer rainfall, fodder crops may provide an extra feed source for sheep and ground cover for bare paddocks.

Summer fodder crops include different hybrid types of forage sorghum, multi-purpose millet and maize.

The quality of summer fodder crops will vary with soil moisture, soil fertility and grazing management. Crude protein can vary from 9 to 25 per cent, metabolisable energy from 9 to 11 MJ/kg DM, and digestibility from 55 to 70 per cent. Feed quality will decline as the stand matures over summer and with increasing height of regrowth. The grazing of summer fodder crops should be delayed until the stand is well established because grazing too early will decrease the longevity of the crop. Once the stand is established, regular grazing helps delay flowering and maintains the quality and growth rate.

Forage sorghum

Key points to note for forage sorghum include:

- produces excellent yield (bulk);
- some hybrids are good for silage;
- can provide reasonable quality feed over summer;
- grain feeding, or access to high quality forage (eg. lucerne) is required if feeding for growth or production;
- do not graze sorghum below 15 cm as re-growth will be reduced, or allow the crop to get higher than 100 cm because feed value will decline.

Prussic acid poisoning

Sorghum contains hydrogen cyanide which may lead to prussic acid poisoning if plants are consumed while concentrations are high. Prussic acid levels vary between variety, growth stage and with seasonal stresses. To avoid poisoning, choose a variety that is low in prussic acid and wait until the crop reaches a height of 80 cm, or until plants start to mature before grazing. Provide an alternative feed source such as hay, or an adjoining pasture paddock, until the animals have adapted to the sorghum. Place a sulphur lick at watering points. Do not introduce hungry sheep to the crop.

Symptoms of prussic acid poisoning include muscle trembling, staggers, deep and rapid breathing, frothing at the mouth and gasping. Affected animals can be treated with a sodium thiosulphate solution.

Forage millet

Key points to note for forage millet include:

- feed quality of forage millet is higher than forage sorghum but the yield is less;
- no risk of prussic acid poisoning;
- rotational grazing will result in the best yield and quality;
- millet should be grazed early while the feed value is high. As the crop grows taller, and begins to form seed, it becomes rank and the feed value declines;
- temperate millets should be grazed when they reach 25 cm in height and down to no less than 10 cm.

Sheep grazing tagasaste

Sheep grazing saltbush

Maize

Key point to note for maize:

- Choose a variety that has good drought tolerance for dryland farming and is suited to fodder or grazing purposes.

Hydroponic fodder

Hydroponically grown feed is a fodder production system that provides green feed in the form of young cereal grass from sprouting grain. The feed produced is high in protein and energy, however it is low in dry matter, that is, it is about 85 per cent water (1 tonne of fodder contains only 150 kg of DM). Hydroponic fodder is not normally considered practical or economic.

Tagasaste

During a dry season or drought, an established stand of tagasaste may provide grazing management benefits that include:

- an additional feed source for maintaining sheep;
- shelter for stock;
- prevention of soil erosion by reducing overstocking on bare paddocks.

Saltland pastures

Saltland pastures present an opportunity to increase feed supply to sheep when other pasture sources are limited, particularly during autumn.

The benefits of saltland pastures include:

- providing additional feed which may maintain stock at critical times of feed shortage;
- minimising the overstocking of annual pasture paddocks (hence reducing erosion risks) by moving sheep onto saltland pastures;
- saltland pastures may protect sheep from wind and storm events.

Native vegetation (WA & SA only)

Grazing native vegetation is generally discouraged. It is illegal to graze in reserves or on Crown Land, and against many funding and covenanting agreements on private property.

Advantages

- Some native plants can provide a low value feed to sheep.
- It provides a source of roughage.
- It provides shelter.

Sheep grazing under a bluegum plantation in Western Australia

Disadvantages

- Grazing will lead to an increase in weed species.
- Some species are high in tannins and are unpalatable. Most species have very low digestibility.
- The nutritional value of the bush is often very low. Sheep can use more energy to find the feed, and digest it, than they can obtain from the feed.
- Damage to the environment can be high and long term.
- Grazing may be illegal or against contract agreements.
- There is the risk of poisoning from some native plants.

Native vegetation may a have higher feed value where there are dense areas of Acacia saligna, large areas of native grasses and where weeds have invaded the area.

Plantations and revegetation areas

The grazing value under young plantations may be high because soil nutrition levels are higher and improved pasture species may have established between tree rows. The total feed value will depend largely on the quantity and quality of the pasture species and the weeds present.

Advantages

- Plantations may provide shelter for sheep.
- The removal of sheep from bare paddocks will reduce the risk of erosion.
- Increased pasture availability between trees.
- Improved pasture species in tree rows may have a higher grazing value.
- Reduced fuel load which can reduce the fire risk.

Disadvantages

- Trees, shrubs and ground covers are often damaged by sheep.
- Grazing can increase weediness in the following years.
- Sheep may preferentially graze some species.
- Sheep can be hard to muster.

Novel feedstuffs

A wide range of by-products and novel feedstuffs have been fed to sheep. The nutritional value of some by-products can vary greatly so before using any unusual feedstuff, have it tested for energy and protein. If appropriate, these feedstuffs can be effectively incorporated into mixed rations. It is also important to ensure that the by-product is free from any chemical residues or meat products. Be sure of the continuity of supply of the feedstuff before including it in sheep rations.

The introductory period for novel feedstuffs is usually when problems will occur. As with any change in feed, novel feedstuffs should be introduced gradually over a period of 10 to 20 days. Ensure stock have spent a day consuming roughage before the introduction of any novel feed. Introduce a small amount to begin with, gradually increasing over time.

It is highly recommended that contact be made with a nutritionist, or livestock consultant, for further information on ration formulations.

These are unusual feedstuffs and careful consideration should be made. For example, onions have been successfully fed, however they are only 10 per cent DM and therefore of low feed value. They have also caused deaths in cattle but not in sheep. Some products such as sawdust and paper are extremely low in feed value, and sheep would require more energy to eat and digest it than they would receive from the feed. Their only role is mixed with grain if no other source of roughage is available.

Urea

Urea can be used to boost the protein content of low protein feeds, but in a drought the major deficiency is energy. Urea will only be of benefit, if the ration is deficient in protein but contains enough energy. For each addition of urea, crude protein increases by nearly three times (that is, 1 per cent added urea boosts crude protein by 2.75 – 3 per cent). Urea does not supply true protein so it cannot be used as the sole source, or to supply the protein needs of very young stock. See page 27.

Feeding urea with low energy roughage, such as straw, without an energy supplement, has little value. The diet will still lack energy.

Treating grain with urea

Cereal grains are often too low in protein to meet the requirements of growing or lactating sheep. When grain legumes or high protein hay are not available or are too expensive, the addition of urea can be used to increase the protein equivalent of cereal grain. Urea can safely increase the protein level of grain by up to 3.5 per cent.

Table 3.2. Some examples of novel feeds.		
Energy concentrates	**Protein concentrates**	**Roughage**
Almond hulls	Coconut meal (copra)	Rice hulls
Apple pomace	Cottonseed meal	Oat hulls
Brewer's grain	Linseed meal	Lupin hulls
Malt combings	Safflower meal	Sawdust
Citrus peel	Soybean meal	Kelp
Tallow	Canola meal	Waste paper
Grape pomace	Sunflower meal	
Bread		
Bakery waste		
Potatoes		
Rice bran		
Wheat bran and other wheat by-products		
Onions		

How to add urea to grain

A urea solution is made by adding urea to water. Normal fertiliser grade urea can be used. For example, dissolve 100 kg of urea in 200 L of water. The solution will become very cold during mixing and this reduces its ability to dissolve the entire quantity of urea. Stir the solution several times over a day or more. Starting with warm water will speed up the process. After the urea has dissolved, add 20L of this solution to every tonne of grain. This adds 10 kg of urea per tonne (or 1 per cent) and will increase the protein by nearly 3 per cent.

The addition of 20 L of solution to a tonne of grain, particularly oats, will not cause any augering problems. However, it may take up to two hours for the grain to dry. Other grains can not absorb as much water. Start at half the rate of water and increase only if needed. A practical method of applying the solution to the grain is to drill a hole in the auger wall and drip the solution onto the grain as it flows past. As dampened grain significantly slows the rate of flow of grain, the rate of application of the solution needs to be adjusted accordingly. Record the time it takes one tonne of grain to go up the auger. Adjust the flow rate so that 20 L of solution flows in over this time.

An alternative method is to use a sprayer to mist the solution onto the grain as it leaves the top of the auger, or as it goes into a feed bin. The solution can also be added to the grain while it is mixing in a mixing wagon. The solution can be evenly poured over the grain in the feed trough using a watering can. Stir it in well before the sheep have access to it. This method of adding urea is very safe.

Urea can be added to drinking water, but this is not as effective as treating grain.

Sheep fed urea may need extra sulphur to fully utilise the urea. The easiest way is to add sulphur dust at 5 to 10 per cent of the rate of urea. Sulphur dust is cheap and available from fertiliser outlets or garden shops. Alternatively, sulphur can be added by replacing 20 per cent of the urea with sulphate of ammonia, this mixture however is more corrosive. Gypsum can also be used as a sulphur source, see page 39.

Use of urea treated grain

If properly stored in a silo, the treated grain can be retained for at least six months without any significant loss of quality. To avoid accidental feeding to non-ruminants, silos containing treated grain should be clearly identified.

The microbes in the rumen take two weeks to adjust and to fully utilise the urea. For this reason, build up to the full rate over two weeks. If necessary, once the stock have adapted to the treated grain, the rate of urea can be increased to 1.5 per cent. To do this, add 150 kg of urea to 200 L of water and still use 20 L of water per tonne of grain. The grain becomes unpalatable with over 2 per cent urea.

Once using treated grain, the stock should be fed at least three times a week to keep the microbes in the rumen fully using the urea.

Warning

- Urea is toxic to non-ruminants such as pigs, horses and poultry.
- Urea can also be toxic to ruminants if they consume high doses.
- Apart from urea blocks, never feed solid urea to ruminants.
- Feed carts should be emptied before making new batches of treated grain as the run-off from the new batch can increase the urea concentration in the remaining grain.
- Do not feed other urea supplements to stock while they are being fed with treated grain.
- The combination of urea and water is corrosive on metal surfaces such as augers, metal containers and feed carts. Hose feeding equipment out with water after using urea.

Treating straw with urea

Many methods of straw treatment have been tried to improve its feed value. Unfortunately, most of these treatments have proved uneconomical or impractical and many researchers have concluded that it is best to simply use cereal grain, or a grain legume, to supply the additional energy and protein. If straw treatment is required, adding urea is the most practical solution.

Urea can be added directly to straw to increase its protein equivalent. Dissolve 10 kg of urea and 2 kg of sulphate of ammonia, in 200 L of water.

Weigh a few bales so that you can calculate the correct volume of urea solution per bale. The weight of straw bales is about half the weight of similar sized hay bales. A large round bale will weigh around 300 kg and a large square bale will weigh around 400 kg. Lay the bales on their side and pour the mixture over them at 45 L/100 kg of straw.

The treatment will increase a 3 per cent protein straw to a 6 or 7 per cent protein equivalent. Treated bales can be stored for months and they do not go mouldy because the ammonia acts as a preservative. The action of the ammonia on the straw could slightly increase the digestibility of the straw if the bales are covered to be airtight and left for at least three weeks before use.

Adding liquid nitrogen to grain or straw

Liquid nitrogen is a relatively new product to the market and experience using it in animal feeds is limited. It is therefore recommended that advice be sought before using it.

The use of liquid nitrogen can simplify the application of nitrogen to grain or straw compared with a urea solution. Liquid nitrogen such as Flexi-N® (urea, ammonium nitrate) or Maxamflow® (urea, ammonium sulphate) is a novel approach to applying nitrogen to low protein feed. These products are a solution of urea, and ammonium nitrate or ammonium sulphate in water. For example, the product Flexi-N® added to a feed at a rate of 1 per cent, will add 2 per cent crude protein to that feed. This will vary according to the liquid nitrogen product. To avoid nitrite toxicity from ammonium nitrate (nitrate converts to nitrite) in Flexi-N®, do not add more than 1.5 per cent Flexi-N® to a feed.

Maxamflow® contains sulphur as well as nitrogen so there is no need to add sulphur to the ration. Adding Maxamflow® at a feed rate of 1 per cent will add 1.4 per cent crude protein.

Adding 1.5 per cent Flexi-N®, or 2 per cent Maxamflow® to:

- straw will increase the crude protein from 4 to 5 per cent to around 7 to 8 per cent;
- hay will increase the crude protein from 6 to 8 per cent to around 9 to 11 per cent; and
- oats will increase the crude protein from 8 to 10 per cent to around 11 to 13 per cent.

Molasses

Molasses can be used to improve the palatability and energy value of straw. However, adding sufficient molasses to noticeably improve palatability and energy levels will be expensive. A 200 L drum of molasses costs about $190 and weighs 250 kg (therefore $760/t). Molasses has 13.3 MJ ME/kg DM and contains 75 per cent DM, therefore each MJ costs 7.6 cents. In comparison, feed barley grain at 12 MJ ME/kg DM and 90 per cent DM at $170/t costs only 1.6 c/MJ

Molasses should only be considered an option as an energy supplement when unpalatable straw is the sole source of roughage available to sheep. However, it

may be useful in small quantities in total mixed rations to bind ingredients together and stop fine particles from separating in the mix.

If straw is the only feed source, and is particularly unpalatable due to dust or a bad odour, dissolve 60 L of molasses in 200 L of water when treating straw with urea (see page 38). This may help to increase palatability of the straw. If lupins are available, then adding molasses to unpalatable straw will encourage roughage consumption.

Mineral supplements

Cereal grain diets are deficient in sodium and calcium and the following is a suitable mineral mix that can be supplied with the grain.

Salt	1 per cent
Lime	1 to 1.5 per cent
Trace mineral mix	as per manufacturer's instructions

The lime used should be agricultural lime/stock lime (calcium carbonate which is around 37 – 40 per cent calcium), limestone or limesand, but not burnt lime. Burnt lime reacts with moisture and may burn the lips and mucous membranes of stock.

Gypsum (calcium sulphate) can also be included as a mineral supplement to grain rations to supply calcium and sulphur. Use gypsum which contains more than 17 per cent sulphur, this can be added at 5 to 7 kilograms per tonne of grain.

Add minerals to a trail feeder with the last 75 per cent of the grain as the minerals are likely to move down through the grain while the trail feeder is being taken to the sheep. It is best to incorporate the minerals as the grain is being augured into the feed trailer.

Commercial mineral blocks can be an expensive option compared to other methods and there is no guarantee that all sheep will use them.

Buffers

The purpose of adding a buffer to a feed ration is to reduce the formation of acids in the rumen when introducing grain or feeding high levels of grain.

Sodium bicarbonate has been added to help reduce the possibility of acidosis at 0.5 – 1 per cent of the ration, however reports indicate that it can cause bloat. Sodium bentonite, a clay, can be added at 2 per cent during the grain introductory phase, then reduced to 1 per cent and removed completely after another week. These buffers are not effective in reducing acute acidosis and are not a substitute for good grain introduction or including sufficient roughage in the ration. Virginiamycin, an antibiotic, is very effective at reducing the risk of acidosis, but its use may not be appropriate.

Meat meal and other restricted animal material

Australia continues to be free of Bovine Spongiform Encephalopathy (BSE or Mad Cow Disease). One of the control measures to maintain this status is a ban on the feeding of restricted animal material to ruminants. Examples of restricted animal material include meat meal, meat and bone meal, blood meal, fish meal and poultry meal. Feeding these materials to ruminants is illegal.

Medications

Often ingredients are added to pellets to improve feed conversion rates or to reduce the likelihood of acidosis. These additives include antibiotics, antiprotozoals or ionophores. Products containing any medications are required by law to be labelled as such. Information on medications added to manufactured feeds will appear on labels, sales orders or invoices. It is important that you check in advance that your market will accept animals that have been fed antibiotics.

Virginiamycin is an antibiotic that greatly reduces the risk of acidosis. At the time of printing, Virginiamycin for use in sheep is permitted under veterinary prescription (that is, it is registered as an S4). Contact your veterinarian for further details.

Ration formulations

When calculating a ration, several pieces of information are required.

Feed analysis

See Table 3.3 for the average nutritive composition of feeds. Use it as a guide only, as a test of your feed is more accurate. Tests and tables give you dry matter (%), metabolisable energy (MJ/kg), crude protein (%), fibre (%) and possibly calcium and phosphorous levels (%). These figures are given on a dry matter basis, that is, they do not allow for moisture in the feed.

Table 3.3. Feed analysis for common sheep feeds showing dry matter, energy, protein and fibre content (dry matter basis). The average across the range of values is shown in brackets.

Feed type	Dry Matter (%)	Metabolisable energy (MJ/kg of DM)	Crude Protein (% of DM)	Acid detergent fibre (% of DM)
Grains				
Cereals and pulses				
Wheat	91	12.4-13.3(12.9)	7.5-15.0(11.5)	2.5-4.5(3.0)
Barley	91	11.6-12.2(11.9)	7.0-13.0(11.0)	7.0-9.5(8.0)
Triticale	90	12.0-13.0(12.5)	7.5-14.0(11.0)	3.5-5.0(4.0)
Oats	92	10.4-11.3(10.7)	5.5-13.5(9.0)	16.0-21.5(18.5)
Narrow leaf lupins	92	13.1-14.1(13.7)	27.0-42.0(34.0)	17.5-23.0(20.0)
Albus lupins	92	13.4-15.0(14.0)	34.0-44.0(38.0)	17.0-21.0(19.0)
Peas	91	12.5-13.5(13.0)	21.5-30.0(25.5)	6.0-10.5(9.0)
Vetch	91	12.4-13.2(12.8)	26.0-34.5(29.0)	7.5-9.5(8.5)
Chick Peas	91	12.0-13.0(12.4)	18.0-24.0(21.0)	12.0-16.0(14.0)
Faba beans	90	12.4-13.2(12.9)	22.0-30.0(26.0)	7.5-9.5(8.5)
Canola (>35% oil)	95	15.0-17.0(16.0)	20.0-25.0(22.0)	22.5-26.5(24.0)
Cereal seconds				
Wheat	92	11.8-12.4(12.1)	12.5-17.0(13.5)	3.5-5.5(4.5)
Barley	93	11.1-11.8(11.4)	11.0-14.5(12.5)	9.5-12.5(10.0)
Triticale	92	11.3-12.1(11.7)	10.5-15.5(13.0)	4.5-6.5(5.5)
Oats	93	9.8-10.5(10.3)	4.5-16.0(12.5)	21.0-26.0(23.5)
Sheep pellets				
Maintenance	90	8.0-9.0(8.5)	8.5-9.5(9.0)	29.5-32.0(31.0)
Production	91	10.6-11.4(11.0)	13.5-16.0(15.0)	20.0-25.0(23.0)
Green fodders				
Cereals				
Early growth	12-22(17)	9.5-11.0(10.5)	14-24(18.0)	23-27(25.0)
Before heading	18-30(25)	9.0-10.2(9.5)	9-15(12.0)	28-32(30.0)
Pasture (early)				
Grass – dominant	10-20(15)	10.0-11.8(10.5)	20-27(23.0)	22-26(24.0)
Clover – dominant	10-20(15)	10-12(10.8)	24-32(27.0)	21-25(23.0)
Pasture (flowering)				
Grass – dominant	20-30(25)	9.5-10.5(10.0)	10-15(12.0)	28-33(31.0)
Clover – dominant	20-30(25)	9.8-10.8(10.3)	13-18(15.0)	26-31(29.0)
Millet for grazing	15-30(22)	9-11(10.5)	9-24(17.0)	24-32(29.0)
Sorghum hybrids				
Immature	12-20(17)	9.5-10.5(10.0)	15-22(17.0)	24-29(27.0)
Heading	25-35(30)	9-10(9.5)	7-14(10.5)	28-34(32.0)
Lucerne				
Immature	12-20(17)	9.8-11.2(10.5)	22-33(26.0)	24.0-27.5(25.5)
10% flowering	20-30(25)	9.2-10.2(9.6)	15-22(18.0)	28-34(30.0)
Annual ryegrass	10-30(22)	8.5-11.5(10.0)	10-30(14.0)	21-30(28.0)
Perennial ryegrass	12-30(22)	8.5-11.5(10.0)	10-30(14.0)	21-30(26.5)
Phalaris				
closely grazed	12-27(20)	9-11(10.0)	14-28(17.0)	21-28(26.0)

Note: These figures have been extracted from data collected by Independent Lab Services, Perth, Western Australia.

Table 3.3 Continued. Feed analysis for common sheep feeds showing dry matter, energy, protein and fibre content (dry matter basis). The average across the range of values is shown in brackets.

Feed type	Dry Matter (%)	Metabolisable energy (MJ/kg of DM)	Crude Protein (% of DM)	Acid detergent fibre (% of DM)
Hays				
Oaten				
Early-cut	90	8.8-10.2(9.1)	7.0-12.5(8.5)	25-32(30.0)
Late-cut	90	8-9(8.5)	4.0-7.5(6.0)	30.0-37.5(32.5)
Wheaten				
Early-cut	90	9-10(9.4)	8.0-11.5(9.5)	25-31(29.0)
Late-cut	90	8-9(8.6)	4.5-7.5(6.5)	30-36(32.0)
Barley				
Early-cut	90	9-10(9.4)	8-11(9.2)	25-31(29.0)
Late-cut	90	8-9(8.6)	4.5-7.5(6.5)	30-36(32.0)
Pasture (grass dominant)				
Early-cut	88	9.0-10.8(10.0)	12-18(14.5)	24-30(28.0)
Late-cut	88	8.0-9.5(9.0)	8-12(10.0)	30.0-34.5(32.5)
Pasture *(clover dominant)*				
Early-cut	88	9.5-11.2(10.2)	15-23(17.0)	23-29(27.5)
Late-cut	89	8.5-9.8(9.5)	11-15(12.5)	30-33(32.0)
CLIMA legume	89	9.3-11.1(10.2)	14-20(16.0)	27-32(29.5)
Cereal/vetch	88	9-10(9.5)	10.5-15.5(13.0)	29.5-32(31.0)
Pea	88	9-10(9.5)	13-17(15.5)	30-33(31.5)
Lucerne				
Early-cut	88	9.8-10.5(10.0)	20-30(26.0)	27-29(28.0)
Late-cut	89	9.0-9.8(9.5)	13-20(15.0)	30.0-33.5(32.0)
Silage				
Pasture				
Direct-cut				
(chop) wilted	21-33(25)	8.5-10.5(9.5)	12-22(16.0)	28-35(33.0)
(chop and bale)	35-55(45)	8.8-10.8(9.8)	12-25(17.0)	28-33(32.0)
Sorghum hybrid	25-35(30)	8-9(8.5)	6-10(8.0)	32-35(34.0)
Cereal crops (bale)	35-45(40)	8.5-9.8(9.1)	7.0-13.5(9.5)	29-35(32.5)
Cereal/vetch	35-45(40)	8.8-10.0(9.7)	10.5-16.0(13.0)	30-33(31.0)
Lucerne (bale)	45-55(50)	9.1-10.7(9.5)	15-28(22.0)	29.0-33.5(30.5)
Straws/stubble				
Oat	89	6.0-7.7(6.8)	4.0-6.5(5.0)	38-45(43.0)
Barley	89	6.0-7.5(6.7)	4.0-6.5(5.0)	38-47(44.0)
Wheat	91	5.8-7.0(6.5)	2.5-6.5(3.5)	43-52(47.0)
Triticale	89	5.5-7.0(6.3)	2.5-6.0(3.5)	44-52(48.0)
Lupin	92	5.5-9.5(8.0)	6-10(8.0)	36-44(42.0)
Pea	90	6.5-7.8(7.2)	6.0-8.5(7.5)	38-44(42.5)
Canola	92	5.5-7.5(6.5)	4.0-7.5(6.0)	42-50(47.0)
Sorghum	88	5.5-7.0(6.5)	3.5-6.0(4.5)	45-54(48.0)
Chaff-cart residues				
Oat	90	6.5-8.0(7.2)	5-7(6.0)	36-44(41.0)
Barley	90	6.5-8.2(7.5)	5.0-7.5(6.5)	37-45(42.0)
Wheat	90	6.2-8.5(7.5)	4.5-8.0(6.5)	39-50(45.0)
Canola	92	6.0-8.5(7.5)	5.0-9.5(7.5)	42-50(45.0)
Lupin	92	7.5-9.5(8.5)	7.5-11.5(9.5)	35-43(41.0)

Note: These figures have been extracted from data collected by Independent Lab Services, Perth, Western Australia.

Nutrient requirements

Determine the nutrients (energy, protein, fibre and minerals) the animal requires to meet your objective (for example, to maintain weight, to produce a lamb, or to put on weight). The nutrient requirements of some different classes of sheep are listed in Table 3.4.

Ration formulation

Ration formulation is simply a matter of matching the nutrient requirements of the sheep with nutrients supplied in available feeds.

For example;

In a ration to maintain adult sheep during a dry season in a confined area, energy is the most important, and most limiting, nutrient. So, the energy requirement is the first thing to calculate.

The energy required for an adult dry sheep to maintain weight at 50 kg (CS 2) is 7 MJ ME/day (see page 27). If the feeds available are late cut oaten hay and barley, then how much of each feed should be given?

Adult sheep need at least 10 per cent roughage in their ration. However, because the grain to be fed is barley and the risk of acidosis is high, the farmer chooses to feed 20 per cent hay. This means that the remaining 80 per cent of the ration will be made up of barley. Feed test results for this example are given in Table 3.5.

Step 1

Energy of the ration = hay (20 % x 8.5 MJ/kg) + barley (80 % x 11.9 MJ/kg)
= 1.7 + 9.5
= 11.2 MJ/kg DM

Step 2

Energy required = 7 MJ/day
Divide by the energy level of the feed
= 7 MJ ÷ 11.2 MJ/kg
Kilograms of feed required = 0.63 kg/day

Step 3

Amount of hay = 20 % x 0.63
= 0.13 kg/h/day
Amount of barley = 80 % x 0.63
= 0.5 kg/h/day

Note; so far this is calculated on a dry matter basis.

Step 4

To adjust to an "as fed" basis (which is how the farmer weighs it) divide by the dry matter content.

Hay = 0.13 ÷ 90 %
= 0.14 kg/h/day or 1.0 kg a week
Barley = 0.5 ÷ 91 %
= 0.55 kg/h/day or 3.8 kg a week

Table 3.4. Energy and protein requirements for medium frame sheep (50kg adult) on dry paddock conditions.

	Energy Requirement (MJ/day)	Protein Requirement (%)
Survival feeding for dry or early pregnant ewes* (losing 100g/h/d until CS 2)	5.0	8
Maintaining dry sheep at CS 2	7.0	8
Maintaining dry sheep at CS 3	8.5	8
Pregnant ewes # (last month @ CS 2.5)	12	12
Ewes with lamb at foot (1st month)	20	12
Ewes with lamb at foot (3rd month)	8.5	12
Early weaned lambs	10	15-16

* Sheep must be monitored regularly and ration increased before mob average reaches CS 2.
\# Late pregnancy ewes less than CS 2.3 should be removed and managed separately.

Table 3.5. Feed test results of available feeds.

	Oaten hay	Barley
Metabolisable Energy (MJ/kg DM)	8.5	11.9
Crude protein (% of DM)	6.0	11
Dry Matter (%)	90	91

Step 5

This ration will meet the energy requirement. Now check the protein to ensure it is adequate.

Crude protein of ration = hay (20 % x 6.0) + barley (80 % x 11)
= 1.2 + 8.8
= 10 % on a dry matter basis

This ration is in excess of the protein requirement of 8 per cent for maintenance.

Step 6

Check that the ration has sufficient fibre and minerals.

It is important to remember that not all animals, or conditions, are the same. While rations calculated give you an indication of the amounts to feed, you must monitor the sheep and adjust the ration if needed.

Using "Pearson square"

"Pearson square" is a mathematical tool that can be used to calculate the proportion of two ingredients that will result in the desired mixture. It can be used to calculate the proportion of two feeds to meet energy, protein or fibre requirements. For this method to work, one feed must be above the desired level and the other below.

For example

To calculate the proportion of two grains needed to make a 13.5 per cent protein mix.

Step 1

Draw a square and insert the desired crude protein (that is, 13.5 per cent) in the middle of the square.

Step 2

Place the two grains and their respective crude protein contents on the left hand corners of the square.

Step 3

Calculate the difference between the middle value and the value in the top left corner and place the result (20.5) on the corner diagonally opposite. This is the barley proportion.

Step 4

Calculate the difference between the middle value and the value in the bottom left corner and place the result (2.5) on the corner diagonally opposite. This is the lupin proportion.

Step 5

These values represent the proportion of each grain required to produce a grain mix with a protein level of 13.5 per cent. Then calculate the percentage of each grain. Add the two proportions to give the total (2.5 + 20.5 = 23). Calculate each feed as a percent of the total as shown in the diagram below.

The Pearson's square method can also allow for the hay in a ration.

For example;

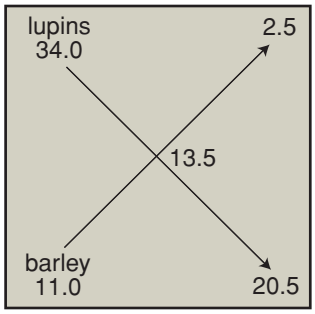
Sheep requirement = 12 % crude protein

Oaten hay, of 6 % protein, will be fed at 20 % of the ration

Protein supplied by the hay = 20 % x 6 = 1.2 %

Protein needed from grain mix = 12 % – 1.2 % = 10.8 %

Pearson's square can then be used to calculate the mix of grain needed to give 10.8 % protein.



$\frac{2.5}{23.0}$ x 100 = 11.0% lupins

$\frac{20.5}{23.0}$ x 100 = 89.0% barley

Diagram 3.1. Pearson square example

Calculating the cost of a feed on an energy basis

The cheapest feed in cents per MJ of ME usually provides the most economical ration. The cost of a feed per MJ can be calculated and this can be used to compare alternative feeds.

For example

A farmer can buy barley at $180/t with 11.9 MJ /kg DM and 91 % DM.

Cost of grain "as fed"= $180/t

Cost of grain on a DM basis = $180 ÷ 91/100

= $198/t DM

= 19.8 c/kg DM

That is, each kilogram of grain dry matter cost the farmer 19.8 cents.

Cost per unit of energy

Cost of grain per kg ÷ energy level per kg

= 19.8 c/kg÷11.9 MJ/kg

= 1.7 c/MJ of energy

The farmer can also buy silage at $80/t with 9.4 MJ /kg DM and 35 % DM.

Cost of silage "as fed" = $80

Cost of silage on a DM basis = $80 ÷ 35/100

= $229/t DM

= 22.9 c/kg DM

That is, each kilogram of silage dry matter cost the farmer 22.9 cents

Cost per unit of energy

Cost of silage per kg ÷ energy level per kg

= 22.9 c/kg ÷ 9.8 MJ/kg

= 2.3 c/MJ of energy

This example shows the importance of calculating the cost of the energy in the ration and allowing for the moisture in the feed (silage is high in moisture).

Computer programs are available to aid in formulating rations. They can provide least cost rations for all scenarios, using many and varied ingredients (an example is 'Ready Rations', available from Primary Industries and Resources SA). Other useful tools are available at www.agric.wa.gov.au/sheep or www.agric.nsw.gov.au. Another alternative is to ask a consultant to formulate a ration for you.

Table 3.6. An example of feed costs per MJ of energy.

Feed	Price ($/t)	Energy (MJ/kg of DM)	DM	Energy cost (cents/MJ)
Wheat	220	12.9	91	1.9
Oats	150	10.7	92	1.5
Barley	180	11.9	91	1.7
Lupins	260	13.7	92	2.1
Cereal hay	150	8.5	90	2.0
Cereal straw	70	6.5	90	1.2
Sheep pellets (for lambs & weaners)	250	11.0	91	2.5
Sheep pellets (for maintenance)	215	8.5	90	2.8

Example rations

When feeding sheep during a drought, or in dry seasons, it is helpful to know how much you may need to feed.

The following pages give some examples of full rations, using common feedstuffs, assuming the sheep are in a contained area or bare paddock in mild weather. The rations are a guide only because the requirements of the animal and the nutritive value of feeds will vary.

If you start feeding in the paddock it is normal to start feeding well before the paddock is bare. For example, start feeding a third of the full ration and gradually increase the ration as the sheep need it, or as the paddock becomes eaten out. Once almost a full ration is being fed, or the paddock is at risk of erosion, it is best to confine the sheep and feed a full ration. Continue to monitor the sheep.

During a dry season, or drought, two rations can be given to adult dry sheep or ewes in early pregnancy. That is, a maintenance or a survival (drought) ration.

Table 3.7. Examples of full rations (when grazing very poor feed or bare paddocks) for medium frame sheep. Adjust the rations for larger (or smaller) frame sheep, rams, cold weather etc.

Class of sheep	Energy required MJ/week	Example weekly rations	Comments
Survival feeding for dry or early pregnant ewes (losing 100g/h/d until CS 2*)	35	0.5 kg straw + 2.7 kg wheat or 0.5 kg straw + 3.3 kg oats or 0.5 kg straw + 2.9 kg barley or 4.1 kg of cereal hay	Minimum rations Marginal protein**
Maintaining dry sheep at CS 2	49	0.5 kg straw + 3.8 kg wheat or 0.5 kg straw + 4.6 kg oats or 0.5 kg straw + 4.1 kg barley or 5.8 kg of cereal hay	Minimum ration for CS 2 Marginal protein
Maintaining dry sheep at CS 3	60	0.5 kg straw + 4.6 kg wheat or 0.5 kg straw + 5.6 kg oats or 0.5 kg straw + 5 kg barley or 7 kg of cereal hay	These rations allow for exercise, poor weather, etc. Marginal protein
Pregnant ewes (last month @ CS 2.5)	84	0.6 kg hay + 6.1 kg wheat or 0.6 kg hay + 6.6 kg barley or 0.6 kg hay + 6 kg barley + 0.5 kg lupins	Start building up the ration up to 6 weeks before lambing
Ewes with lamb at foot (1st month)	140	1.8 kg hay + 8.7 kg wheat or 1.6 kg hay + 8.2 kg barley or 1.6 kg hay + 7.6 kg barley + 0.8 kg lupins	Marginal protein Marginal protein (urea could be added)
Ewes with lamb at foot (2nd month)	105	2.3 kg hay + 7.8 kg wheat or 2 kg hay + 7.5 kg barley or 2.1 kg hay + 6.6 kg barley + 1 kg lupins	Marginal protein Marginal protein
Early weaned lambs	70	2.0 kg barley + 0.75 kg lupins + pasture hay fed ad lib	Ration level depends on the size of the lambs

* Sheep must be monitored regularly and ration increased before mob average reaches CS 2.

** Production likely to be compromised due to low protein in the diet. See page 36 for details on increasing dietary protein.

Table 3.8. Survival and maintenance ration examples (for use in confined area or bare paddock) for adult dry sheep, or ewes in early pregnancy.

Ration	Price / t	Survival ration (Maintain at CS 2)		Maintenance ration (Maintain at CS 3)		Comments
		Amount fed a week	Cost of each feed	Amount fed a week	Cost of each feed	
Barley Cereal hay Salt Stocklime	$180 $150 $300 $350	2.6 kg 0.5 kg 26 g 26 g	47 c 7.5 c 0.8 c 0.9 c **56 c total**	4.6 kg 0.6 kg 46 g 46 g	83 c 9 c 1.4 c 1.6 c **95 c total**	A good ration
Barley Straw Salt Stocklime	$180 $70 $300 $350	4.1 kg 0.5 kg 41 g 41 g	74 c 3.5 c 1.2 c 1.4 c **80 c total**	5 kg 0.5 kg 50 g 50 g	90 c 3.5 c 1.5 c 1.8 c **97 c total**	A good ration
Triticale Hay Salt Stocklime	$185 $150 $300 $300	3.5 kg 0.6 kg 35 g 35 g	63 c 9 c 1.0 c 1.2 c **74 c total**	4.4 kg 0.6 kg 44 g 44 g	81 c 9 c 1.3 c 1.5 c **93 c total**	A good ration
Oats Hay Salt Stocklime	$150 $150 $300 $350	4.1 kg 0.6 kg 41 g 41 g	61.5 c 9 c 1.2 c 1.4 c **73 c total**	5.1 kg 0.6 kg 51 g 51 g	76.5 c 9 c 1.5 c 1.8 c **89 c total**	A good ration
Oats Salt Stocklime	$150 $300 $350	4.6 kg 46 g 46 g	69 c 1.4 c 1.6 c **72 c total**	5.6 kg 56 g 56 g	84 c 1.7 c 1.9 c **88 c total**	Low in roughage
Cereal Hay	$150	5.8 kg	87 c	7 kg	105 c	Possibly low in protein
Barley Salt Stocklime	$180 $300 $350	4.1 kg 41 g 41 g	74 c 1.2 c 1.4 c	5 kg 50 g 50 g	90 c 1.5 c 1.8 c	Not a good ration – no roughage

Note: the quality of hay and straw varies greatly. The more roughage used in the ration the greater the need to test it, and to monitor stock carefully.

Maintenance rations

These rations are designed to keep the sheep in reasonable condition, at about score three. Choose these rations when the feed is not expensive, or when feeding valuable sheep.

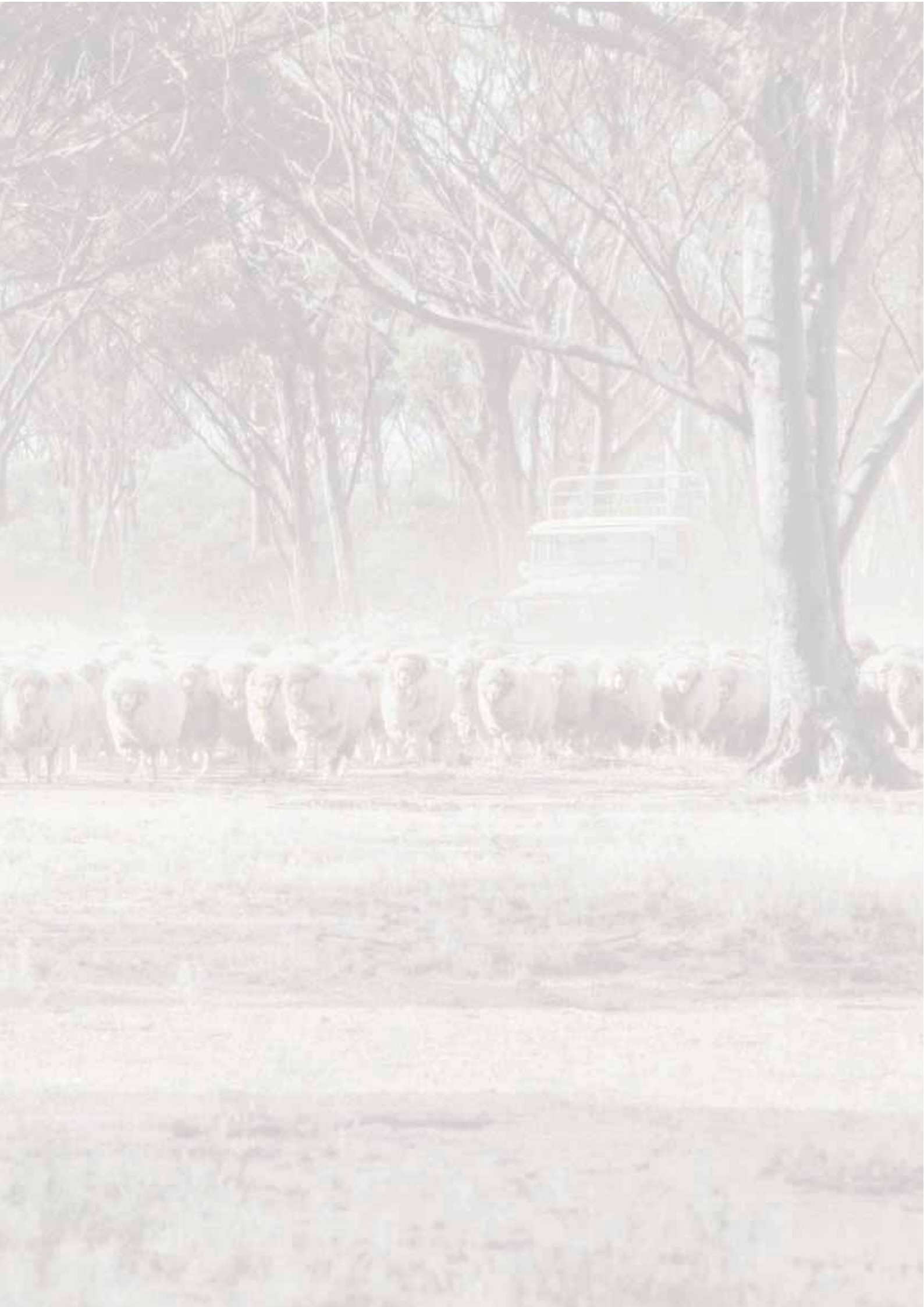
Survival rations

These rations, also called 'drought' rations, are designed to allow the sheep to lose weight (100 g/day maximum) from condition score 3 to condition score two. The sheep will remain strong and healthy however, compared to sheep at CS 3 they will have less body reserves. Sheep fed survival rations should not suffer higher incidences of deaths or tender wool than those sheep fed maintenance rations provided, the length of feeding the lower rates does not exceed 90 days. However, sheep fed survival rations will have a lower tolerance to excessive exercise, bad weather, disease or other adverse conditions. Sheep on survival rations will cut less wool and experience a lower lambing percentage than those at condition score 3.

At times it may be tempting to feed what could be called a 'starvation' ration. On these rations individual sheep fall to very lean, or condition score one, and the sheep suffer. This is not acceptable. Sheep fed starvation rations will have limited energy reserves making them more susceptible to adverse conditions. For example, in droughts last century it was common for a third of a mob to die at the end of the drought when it came in cold and wet. Wool production and lambing percentage was also greatly affected. It is far better to feed less sheep an adequate ration.

Creating your own rations

As shown, many different rations can be used – as long as they provide sufficient energy, protein, fibre and minerals.



Animal health

The following section covers health problems that can occur when feeding sheep in a paddock or in a confined feeding situation. If unsure about any health issues contact your local veterinarian.

Confinement feeding is a safe and practical method of feeding sheep. It is, however, a change from the normal grazing and social behaviour of sheep and requires a high standard of management.

Grain poisoning (acidosis)

Introducing sheep too quickly to diets high in starch causes acidosis. Most grains and some pellets are high in starch. It is also seen when self-feeders have run out of grain for several days and are then refilled, with consequent engorgement by sheep. Alternatively, it may occur when the supply of hay or other roughage runs out when sheep are being fed grain.

Symptoms

- Not eating, appearing dull and standing alone.
- Scouring, panting, and a loss of appetite.
- Occasionally, lameness and bloating.
- Yoghurt-like odour of lactic acid may be smelt in the vicinity of affected sheep.
- In severe cases, death.

Treatment

- Remove affected sheep, then provide with roughage such as hay until recovered.
- With valuable animals, and if practical, drench the sheep with at least 4 litres of rumen fluid which can be obtained from an abattoir or a sacrificed animal.
- Drench with sodium bicarbonate, 15 g in 250 ml of water, three times a day until recovery.
- Seek veterinary assistance if the animals are valuable as antihistamine and antibiotic treatments will help.

Control and prevention

- Introduce sheep gradually to grain and any ration changes should be made over a two-week period.
- Ensure adequate palatable roughage is available.

Pulpy kidney (enterotoxaemia)

Changing diets from low to high quality feed may lead to pulpy kidney. It can occur when sheep graze highly digestible spring pasture or when they are fed grains. It is most often seen in lambs and weaners but can affect sheep of any age.

Symptoms

- Sudden death without any symptoms.
- Head may be thrown back, signs of staggering, twitching and convulsions.
- Can be frothing at the mouth and scouring (thin, green and pasty).
- Carcase decomposes quickly.

Treatment

- Due to the short course of the disease, treatment is generally not possible or practical.
- Exercising the sheep and feeding hay may help to control an outbreak. Gradually re-introduce grain after the outbreak has ceased.

Control and prevention

- A vaccine given at marking and weaning and annually thereafter will protect sheep. Ewes given an annual booster four weeks before lambing will protect the lamb until marking.
- All sheep that are fed grain in confinement should be vaccinated for pulpy kidney. Previously unvaccinated sheep take 10 days to develop immunity.

White muscle disease

White muscle disease is due to vitamin E deficiency (in summer autumn) or selenium deficiency (in winter). It is most common in lambs that have not grazed green feed for three months or more. Selenium deficiency is most likely in areas with acid soils, receiving 400mm of rainfall or more.

Symptoms

- Lambs appear weak, have a stiff gait, and may be unable to rise.
- Can die suddenly particularly after being mustered.

Treatment

- If due to vitamin E deficiency, see page 49.
- If due to selenium deficiency, a selenium drench, injection or bullet can be used. Sheep must be yarded, and treated with care as stress may precipitate more cases.

Control and prevention

- Selenium may be topdressed with fertiliser, given as a bullet or as a long acting injection.

Mineral and vitamin deficiencies

The most common macro-mineral deficiency associated with prolonged grain feeding is calcium, while the most likely trace mineral deficiencies in southern Australia are selenium, cobalt and copper.

Calcium

Deficiency usually occurs with prolonged grain feeding.

Symptoms

- Poor growth.
- Milk fever in ewes.
- Calcium deficiency can result in the formation of urinary stones leading to water belly.
- An imbalance of calcium and phosphorus can lead to reduced appetite, soft bones and fractures.

Control and prevention

- Add 1.0 – 1.5 per cent limestone to the ration (see page 39 on addition of calcium).

Copper

Deficiencies usually occur in spring, particularly in years with rapid pasture growth after good winter rains.

Symptoms

- Failure of the animal to coordinate its legs, inability of lambs to stand after birth or born dead. Other lambs will appear normal at birth and develop an uncoordinated gait or swayback.
- Wool goes steely (reduced lustre) and black wool will go gingery-brown.

Treatment

- Copper sulphate drench or a copper pellet.

Control and prevention

- Copper pellet.
- Top dressing with a copper containing fertiliser to paddocks.

Vitamin A deficiency

This can occur in lambs born to grain-fed ewes that have had no green feed for four months, or lambs that have not had access to green feed for at least 4 months. Grain and most hays are low in Vitamin A.

Symptoms

- Night blindness.
- Eye discharges and ill-thrift.

Treatment

- Vitamin A drench or a Vitamin A, D & E injection.
- Provision of green feed (sheep which eat green feed on only one day will obtain sufficient Vitamin A for three months).

Control and prevention

- A single vitamin A drench should give six months protection.

Vitamin B1 (thiamine) deficiency

This can occur with prolonged grain feeding, possibly associated with inadequate amounts of roughage. It can also cause a neurological disease called Polio (polio encephalomalacia).

Symptoms

- Affected sheep will stand alone.
- Show signs of blindness, ‘star gazing’, and head pressing.

Treatment

- Early treatment with a vitamin B1 injection may save affected animals.

Vitamin B12 (cobalt) deficiency

Vitamin B12 deficiency occurs irregularly on well drained soils, alkaline soils, in seasons of good spring pasture growth and on grass dominant pastures.

Symptoms

- Loss of appetite.
- Wasting.
- Anaemia.
- Lethargy.
- Occasionally weepy eyes.

Treatment

- Inject with vitamin B12 or give cobalt bullets.

Control

- Pasture topdressing with a cobalt containing fertiliser.
- Cobalt bullets or vitamin B12 injections administered to sheep.
- Pasture manipulation to increase the clover content.

Vitamin E (see also white muscle disease)

Vitamin E deficiency is often associated with feeding weaners on dry feed, hay and grain over extended periods. Young animals that have had limited access to green feed, or have been off green feed for more than three months are more likely to have low reserves.

Symptoms

- Animals go down.
- Appear bright and alert but reluctant to stand.
- Sudden deaths.
- Signs may be precipitated by driving or yarding.

Treatment

- Drench with vitamin E.

Control and prevention

- Watch weaners and young sheep for signs suggesting deficiency and seek advice.

Vitamin D

Vitamin D is synthesised in the skin provided sheep are exposed to sunlight. This is only an issue in sheds.

Urea poisoning (ammonia toxicity)

The recommended methods of adding urea to a ration are safe, however, accidents or miscalculations can happen. Sheep can be poisoned if they eat more than 15 g in one feed, or if urea constitutes more than 3 per cent of the ration. Tolerance of urea is increased if it is mixed with molasses, and reduced if sheep have been fasted for more than 24 hours. Hungry sheep that gorge on lupins may also suffer from ammonia toxicity. See page 37 on how to safely add urea to feeds.

Symptoms

- Trembling, walk with proppy gait, appear bloated.
- May have grey scour.
- Laboured breathing.
- Membranes inside mouth and tongue become blue.
- Collapse and regurgitation of stomach contents.

Treatment

- Needs to be quick.
- Drench with 120 ml vinegar diluted in equal parts of water. Repeat every two hours until the animal improves.
- Drenching with large amounts of cold water also helps dilute the ammonia.

Control and prevention

- Start by adding 1 per cent urea to a ration and do not exceed 2 per cent.
- Ensure there is thorough mixing of urea in the ration.
- Do not allow stock block/licks containing urea to become wet and soft.

Salmonellosis

Salmonellosis is a bacterial disease which causes severe scouring, abortions and death. It is most common when sheep are stressed and confined to a small area. Some sheep carry salmonella in their intestine and shed the infection in their dung when under stress. It is spread by faecal contamination of feed and water supplies. Trail feeding grain in the

same area can lead to a build up of faeces and result in the disease. Outbreaks of salmonellosis may also occur following summer storms when large amounts of organic matter are washed into dams.

Note: humans can contract Salmonellosis. Take care of personal hygiene when handling live and dead sheep or aborted lambs.

Symptoms

- Loss of appetite and rapid loss of condition are the first signs.
- Sheep appear depressed.
- Abortion in pregnant ewes.
- Severe, foul smelling diarrhoea (often with blood and mucus).

Treatment

- Affected sheep need to be removed from the confined feeding system and the cause identified and corrected.
- Veterinary treatment is required.

Control and prevention

- Prevent faecal contamination of feed and water.
- Withhold affected sheep from the rest of the mob until the outbreak is over.
- Change trail feeding sites regularly.
- Ensure sheep are not stressed.
- Provide an adequate area for the number of sheep.

E.Coli

E.Coli infection and salmonellosis share similar symptoms, treatment and prevention regimes. In both cases veterinary help should be called to determine the disease and its treatment.

Pneumonia

Cold, wet, overcrowded, or very dusty conditions, can trigger an outbreak of pneumonia. It may also be caused by lungworm infestations and a variety of organisms, including bacteria. It is most commonly seen in young sheep on dry, dusty feeds.

Symptoms

- Nasal discharge, coughing, high temperature and lethargy.
- Ill-thrift and sudden death.

Treatment

- Clinical cases may require antibiotic treatment as advised by a veterinarian, with strict adherence to withholding times.

Control and prevention

- Avoid finely hammer-milled feeds. Otherwise dampen feed or add a dust suppressant.
- Avoid cold, wet, overcrowded conditions.

Coccidiosis

Coccidiosis is caused by a small gut parasite and usually only affects young sheep. It is most commonly caused when lactating ewes are under nutritional stress and their milk supply is low. It also occurs in crowded conditions, in cold weather, or when feed is heavily contaminated with dung.

Symptoms

- A dark profuse scour, sometimes containing blood.
- Weight loss and ill-thrift.
- The disease cannot be diagnosed solely on symptoms or on the presence of coccidia in the faeces. An autopsy is necessary to confirm the diagnosis.

Treatment

- Isolate affected sheep.
- Consult a veterinarian.

Control and prevention

- Supplementary feeding of ewes.
- Change trail-feeding sites regularly.
- In wet, overcrowded conditions release sheep into a small paddock.
- Avoid faecal contamination of feed and water supplies.

Worms

Worms of sheep are a major cause of economic loss. Before putting sheep into a confined area the worm status should be assessed with a faecal worm egg count and, if required, drench the sheep with an effective drench.

Symptoms

- Can be various combinations of ill-thrift, anaemia, scouring, and in severe cases death.
- There may be no obvious signs.

Drenching to control worms in sheep

Treatment

- A worm egg count test assists in diagnosing the number and types of worms and whether a drench is required.
- Administer an effective drench.

Control and prevention

- Use a control program that incorporates paddock and stock management, worm egg count monitoring and drench rotation.
- Test for drench resistance.

Pinkeye

Pinkeye can be a major problem in confinement systems, as it spreads quickly and is a particular problem in dusty conditions or when flies are present.

Symptoms

- Reduced feed intake, lowered growth rates.
- Cloudy film over the eye.
- Severely affected sheep can go blind (which can last for weeks).

Treatment

- Remove sheep immediately into a hospital pen (this is necessary because transmission is mainly through dust and flies).
- Treat with pinkeye ointment , spray or powder.

Control and prevention

- Remove any sheep with pinkeye before feeding in confinement and monitor the sheep on a regular basis.

Scabby mouth

Scabby mouth is a highly contagious disease of sheep that can affect humans. It has little effect on general health, however the painful lesions around the mouth can result in animals eating less. It infects sheep through abrasions to the skin such as from grazing thistles, stubbles or harsh feed. Sheep in long wet pastures are most likely to get the lower leg form of the disease.

Symptoms

- Mouth, and skin just above the hoofs are most commonly affected.

A sheep with scabby mouth

- At first, small reddened areas appear and weep clear fluid. Usually affects corners of lips and muzzle. Severe cases spread to mouth and nostrils.
- Clear fluid hardens into a thick brown scab.
- After two to four weeks the scab dries up and drops off.

Treatment

- Let disease run its course.
- Do not remove scabs as this may prolong recovery.
- Provide soft palatable feed.

Control and prevention

- A single vaccination (skin scratch with Scabigard®) at least two weeks before entry to a confinement feeding system will prevent the disease.

Heat stress

Health problems caused by high temperatures are rare. However, heat stress at mating can reduce lambing percentage. In hot weather (above 30 degrees Celsius) growth rates in production feedlots can be reduced.

Control and prevention

- Provide shade in permanent confinement feeding systems.

Accidental deaths

The causes of accidental deaths in confined feeding systems are many and varied. They range from collapsing round bales, to sheep getting caught in mesh. Some serious sheep losses have occurred when sheep have suffocated each other when feeding around bales or self-feeders. Ensure the sheep are not excessively hungry and watch them carefully when first feeding.

Water belly (urinary calculi, bladder stones)

The common predisposing cause is a limited water intake. This can occur as a result of contaminated, stagnant or brackish water, or a high mineral or salt content in the diet and/or water. Losses can also occur when sheep are fed on grain rations without calcium supplements, and where straw (mainly wheat and oats) is high in silica.

Symptoms

- Straining to urinate, dribbling urine.
- Distended abdomen or doughy swelling under the skin under the belly.
- Sudden death.

Treatment

- Not practical and rarely successful.

Control and prevention

- Add calcium to any grain ration.
- Ensure sheep have access to good quality water at all times.

Salt poisoning

Sheep will be affected by salt poisoning if the water supply is high in salt, (see page 61) or salt has been added to the ration at too high a rate or is it has been inadequately mixed. When salt is added to a diet, it should be added at 1 per cent of the total ration, however be sure to check salt levels in the drinking water first.

Symptoms

Moving sheep suddenly from good quality water onto even moderately salty water can result in:

- loss of appetite;
- ill-thrift;
- scouring;
- some deaths;
- apparent blindness; or
- lack of co-ordination.

Treatment

- Provide fresh water in small quantities at first. Weak animals may need to be drenched, or dosed by stomach tube.

Control and prevention

- Regularly monitor the salinity level of water supplies.
- Clean troughs regularly.

Pregnancy toxaemia (twin lamb disease)

Pregnancy toxaemia is caused by an inadequate energy intake in the last 6 weeks of pregnancy. It mainly occurs in fat ewes and those carrying twins. An outbreak can be triggered by:

- mustering for shearing or crutching;
- holding ewes off feed for periods of time;
- severe weather conditions; or
- sudden changes in diet.

Early signs

- Separation from flock.
- Appear dopey and blind, blunders into objects when forced to move.
- Stands still when approached.
- May stand in water all day lapping water.

Later signs

- Marked drowsiness.
- Abnormal postures, tremors and spasms of the head, muscle tremors of legs and convulsions.
- May be thick, often yellowish and candlewax-like discharge from nose.

Treatment

Whichever the treatment used, ewe survival rate is usually below 50 per cent.

- An energy solution, eg. a glycerine/glucose drench can be successful, followed by a subcutaneous injection of a commercial calcium plus dextrose solution. Dose according to instructions on label. Follow up treatment maybe required.
- If treated soon after the earliest signs are seen and while the ewe is reasonably alert, she is more likely to recover. Poor responses result from treatment once ewes become drowsy or go down.
- Once ewes start exhibiting signs, energy supplements such as cereal grain should be provided to the mob to minimise the chance of further cases.

Control and prevention

- Prevention is far better than curing the disease.
- Start increasing the ration six weeks before the start of lambing so that at four weeks before lambing the full late pregnancy ration is being fed.
- The late pregnancy ration is 50 – 70 per cent more than the minimum ration for early pregnancy depending on if the ewe is having twins or singles.

Milk fever (hypocalcaemia)

Milk fever is caused by calcium deficiency in the bloodstream. It is most common in heavily pregnant or lambing ewes, however it can occur in weaners and wethers. Stress, or periods off-feed, can bring on the disease. Ewes feeding on early cereal crops, grassy pastures or grain diets without added calcium are the most susceptible.

Symptoms (early signs)

- Stilted proppy gait.
- Muscle tremors, particularly shoulders.
- Alert and struggles when approached.
- Appear weak, staggers and collapses.

Symptoms (later stages)

- Rapid progression to laying down (3 to 4 hours).
- May lie with their hind legs stretched out behind them.
- Watery discharge from nose may occur.
- Vaginal prolapse may occur.
- Drowsy appearance rapidly gives way to severe depression and coma.
- Death is usually rapid (6 to 24 hours), however some cases may linger up to three days.

Treatment

- Affected sheep which are treated early generally respond quickly to an injection of commercial calcium solution.

Control and prevention

- Minimise stress and periods off feed.
- When feeding grain, add 1.5 per cent lime (calcium carbonate).
- Pregnant and lactating ewes released from confinement feeding onto lush pasture should have access to a 50:50 salt:lime mixture.

Sand impaction

Sand impaction can occur in confinement systems and in paddocks. It is the result of sheep picking up excessive sand or soil while feeding off the ground. The sand collects in the rumen, or large intestine, sets firm and is difficult to remove.

Symptoms

- Loss of appetite and ill-thrift.
- Can be significant amounts of sand in the droppings.

Treatment

- Increase roughage to the mob.
- Treat individual sheep by drenching with 40 mL of warm paraffin oil and follow this with a course of Epsom salts dissolved in water administered over four days. The dose being 120g first the day, 90g on the second, then 60g and finally 30g on fourth day.

Control and prevention

- Feed grains in troughs or self-feeders.
- Ensure adequate roughage is provided (this can be fed on the ground).

Botulism

Deaths through botulism can occur if carcases are left in the confinement feeding system. Remove and dispose of them appropriately.

Production feeding

Production feeding is where sheep are fed to put on condition or liveweight. Usually this is to finish lambs to meet the weight requirements of a particular market.

Successful production feeding is much more difficult than feeding for maintenance. Many aspects of production feeding need to be correct for the system to be profitable. For this reason we strongly advise that you speak to a nutritionist, or consultant, before you start feeding. There are also a number of publications specifically on this topic.

This is a brief overview of production feeding aimed at pointing out the differences to feeding for maintenance.

The principals of production feeding

The aim of production feeding is to grow the animals as quickly as possible as this leads to the best conversion ratio of feed to meat and the best use of time. To grow quickly, the sheep need a high energy, high protein, balanced ration and to be in a stress free situation. In short, everything needs to be favourable.

The economics

Some production systems have been successful at finishing lambs to a required weight but have still been uneconomic.

Do a careful budget before committing to feeding and recalculate as you go to ensure the outcome is close to the budget predictions. The budget is the most important activity of a production feeding exercise. See Table 5.2 for an example budget.

An economic production feeding unit has;

- a favourable “buy-in” price of the lambs;
- clear target weights and condition scores, with a good indication that most lambs will reach the target;
- a favourable ratio of feed cost to lamb sale price (for example, a grain:live weight price ratio of 1:10);
- a good food conversion ratio (feed:liveweight gain). Budget on a FCR of 6:1 for crossbred lambs and 7:1 for Merino lambs. To achieve these a high growth rate is essential, which requires a good ration and good management;
- maximum skin value;
- overhead and labour costs per lamb kept to a minimum.

Since there are major costs and risks associated with production feeding, marketing of the lambs is important. Marketing over-the-hook, via an alliance, or under a contract, will be vital options. Contracting at least half the lambs will reduce the risk of losing money, however monitor growth rates to be sure the lambs will reach the target weights in time. Keep in touch with your agent during feeding to ensure the marketing is under control.

Confinement feeding versus paddock feeding

Production feeding in the paddock can be quite successful and a confinement feeding system is not essential. A small paddock can work well if there is good quality dry feed available and the paddock has good shelter. A paddock has the advantage that lambs may adapt more quickly, dry feed can be utilised so less hay is needed, and in wet weather the area does not get boggy.

Paddock feeding may be a disadvantage if there is a slight germination and the lambs ‘chase’ the green and stop eating the ration. It can be a problem if the paddock has grass seeds that contaminate the skin, or if bought feed contains weed seeds that could be spread around the farm. Paddock feeding can also be a problem at the introductory phase if not all lambs come in and eat the feed together. This could result in some lambs getting acidosis at a later date.

Confinement feeding system

The confinement feeding system for production can be very similar to a maintenance system. It does not need to be elaborate.

However, for a production feeding system also consider;

- if planning approval is required from your local council;
- if there is adequate drainage and shelter. If the site does become boggy, have a nearby area to run the lambs into.

Self-feeders are usually preferred to troughs only because they are less work. Two feeding points are better than one to assist shy feeders. If troughs are used ensure the lambs can't lie in, or foul them. A trough width of 30 cm and a depth of 20–25 cm is ideal. This allows filling without wastage and provides enough space for a daily ration. The ground around the base of the trough may need to be hardened with gravel or concrete as sheep will wear a hollow where they feed.

Locate feeders away from water troughs so they are less likely to be contaminated with feed.

Types of sheep to feed

The profits from production feeding come from increasing the weight (converting feed into meat) and also from increasing the price per kg. Feeding lambs may push them into a higher price bracket and this is where a lot of the profit can come from. Therefore, selection of the right sheep is crucial. Lambs from ewes and rams with good genes for growth rate, muscle and fat will be more profitable. Sheep Genetics Australia can calculate this information for breeders.

On weighing a mob of lambs a farmer may find;

- some lambs are heavy enough to meet the higher price market category – these can be sold immediately;
- some may be too small, for example, less than 35 kg live weight. It will take too much feed, and time, to get them to target weight. These need to be grown out further in the paddock;
- some may be ideal for production feeding.

Don't feed unhealthy sheep (for example, sheep with pink eye), poor-doers, or sheep that will not reach the market you are aiming for.

Introduction to grain or pellets

As with maintenance feeding, introduction is a crucial process. The difference to maintenance feeding is that it will take longer as you are building up to an ad lib ration. Plan an introductory period of three weeks for wheat, triticale or barley and two weeks for oats.

The easiest method is to introduce grain in the paddock until the sheep leave some grain in the trough all the time. Then put them into the confinement feeding area and feed only good hay on the first day (at least 1 kilogram per head). Introduce the grain again when they have a full stomach of hay. Make any changes to the ration slowly and, preferably, when the sheep have a full stomach of hay.

A self-feeder can then be introduced, but still use the troughs for a week until they are used to the self-feeder.

Grain introduction can be quicker in some situations. If a mixed ration is being used (roughage hammer-milled and mixed with the grain) it is possible to gradually increase the grain portion over 14 days. Alternatively, you can start with a high proportion of lupins (that do not cause acidosis) and slowly change to a high proportion of cereal grain.

High energy pellets can also cause acidosis and should be introduced slowly. Seek advice from your manufacturer.

Careful grain introduction is critical because it can take five weeks for sheep to recover from acidosis and the feeding will then be uneconomic. The most useful early sign of acidosis is loose dung or scouring.

Mixing wagon used to produce a mixed ration

Weighing lambs before going to market

Management

Production feeding requires good management and a daily commitment for the period of feeding. Aim to have the lambs in stress-free conditions with minimal use of dogs and disturbance. Have shade, shelter and the environment as comfortable as possible. Over crowding can cause stress so allow about 4 square meters per lamb.

When bringing in lambs from another district or from distant sale yards they can be stressed when they arrive. It is important to have them settle quickly, perhaps by feeding good hay in a paddock, before starting to production feed them.

Ration formulation for production feeding

The best ration will depend on the cost and quality of available feeds. Balancing the ration is a lot more critical than when feeding for maintenance. There are computer programs that can calculate the best "least cost" ration. It is worth having the feed tested for energy and protein so you can provide the test results to your consultant.

A good ration for production feeding is;

- high in energy - higher energy leads to faster growth but increases the risk of acidosis. At least 10.5 MJ of ME per kg of DM is needed;
- sufficient protein - unlike maintenance rations, protein is just as important as energy. Lambs need 14 to 16 percent (younger lambs and higher energy rations, require higher protein);
- fibre - roughage is needed to prevent acidosis and aid rumen function (20 to 25 percent hay is a guide);
- minerals – in addition to stocklime and salt, add a mineral mix.

There is no benefit in crushing the grain. Hammer-milling can increase the risk of acidosis and, if the ration is finely powdered, can cause pneumonia.

Hay can be fed separately to the grain. It can be spread on the ground every second day. This ensures all lambs get an equal chance and they all eat the correct amount. Hay can also be made available all the time in a hay-rack. Some lambs may not eat enough if the roughage is poor quality, or too much (and not enough grain) if it is very palatable. Monitor their hay consumption rate.

Milling the hay and mixing it with the grain has the advantage that you have control over the proportion of roughage they eat. Lower quality roughage (such as straw) and a lower percent of roughage can then be used. However, it adds to the cost and the mixed ration may be impossible to auger or use in self-feeders (because "bridging" can occur). With legume hay some of the high quality leaf may be lost as dust when it is hammer-milled.

Using a mixing wagon (that is, a "mixall") to mix the ingredients allows for an even distribution of all ingredients through the ration, especially the minerals which have the tendency to settle in the bottom of the feeder. The mixed feed is then fed daily in troughs.

Monitor feed consumption and growth rate

The rate at which the ration is eaten is crucial. If sheep are not eating enough, something is wrong. The ration may be unpalatable, the lambs under stress, or the ration unbalanced. Lambs should eat 3 to 4 percent of their liveweight each day.

Growth rate is also crucial. Weigh a sample of lambs every two or three weeks. Give some lambs a large numbered ear tag so you can weigh and monitor them. Handle lambs carefully to minimise stress. Weigh at the same time each day so they have a similar gut-fill (which can be 4 kg). Often the weight taken when lambs go into the confinement feeding system is an "empty" weight and cannot be compared to other weights (it's best to take the first weight a week later - after they reach full feed consumption).

It is important to monitor feed intake and growth rates or you could find that at the end of the exercise you have lost money – even if the lambs look to do well.

Budget on the following growth rates until you have your own records (see Table 5.1). If these rates are not achieved there may be something wrong with the lambs, the ration, or the management. If the feed is high in energy, and the lambs are genetically superior for growth rate, rates of up to 50 grams a day faster may be achieved.

Table 5.1. Expected growth rates for different sheep.

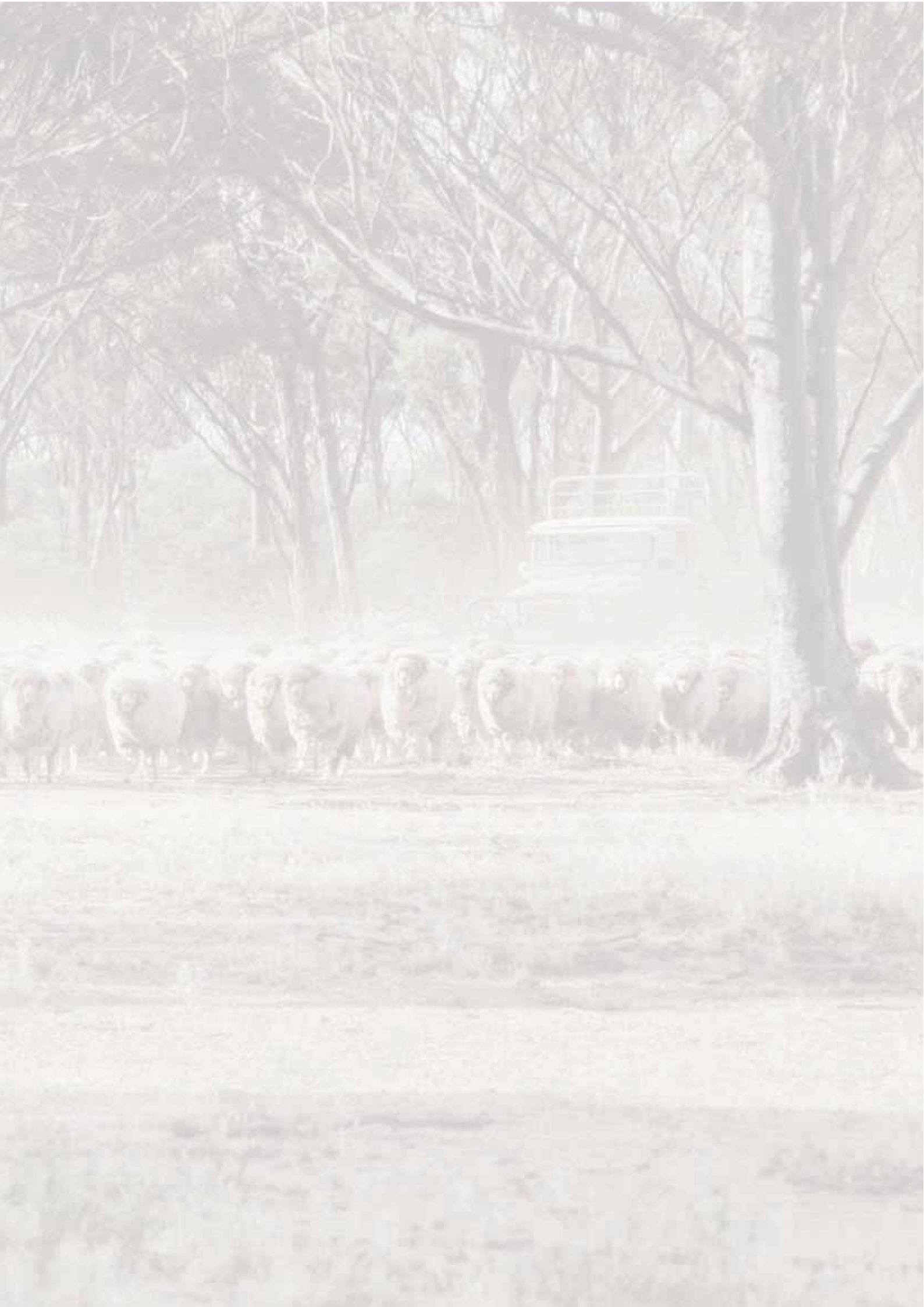
	Grams per head per day
Merino	120 to 150
First cross	200 to 250
Second cross	250 to 300

Health issues

The same issues can occur as with maintenance feeding but they can be more costly. A disease in the mob can cause a setback and a reduction in growth rate. This may mean the lambs don't reach the weight required to meet a forward contract. If the lambs get scabby mouth, or pink eye, just before they reach a target weight marketing can be difficult.

Table 5.2. Example budget for finishing lambs.			
Example		Your estimate	
Costs	($/head)	Costs	($/head)
Average purchase price (or value of your own stock)	50.00		
Transport to property	3.00		
Interest on:			
Stock - $50 @ 10% p.a. for 10 weeks	1.00		
Feed - $11.41 @ 10% p.a. for 10 weeks	0.22		
Drench	0.20		
Vaccination	0.15		
Crutching	0.57		
Introductory feed			
7 kg barley	0.91		
2 kg lupins	0.40		
4 kg hay	0.40		
Production feed			
40 kg barley	5.20		
11 kg lupins	2.20		
23 kg hay	2.30		
Mineral supplement			
1.2 kg @ $0.25/kg	0.30		
Fuel, oil, repairs, etc	0.70		
Transport to market	5.00		
Commission (@ 5.5%)	4.80		
Transaction levy	1.50		
Yard fees (if applicable)			
Total costs/head	**$78.85**		
Returns	**($/head)**	**Returns**	**($/head)**
Return per finished lamb	92.50		
Carcase - 23kg @ $3.50/kg			
Skin - $12.00			
Less 10% not finished	(9.25)		
Add 8% sold as stores			
$50.00 x 8%	4.00		
(2% deaths)			
Average return per lamb bought	**$87.25**		
Gross margin	$8.40	Gross margin	$.....

Note. Costs for capital items and labour are not included.



Water for sheep

Sheep need to drink sufficient water of suitable quality, otherwise their feed consumption will decline, along with their productivity and health.

Water quantity

Water needs vary greatly depending on weather conditions, distance to feed, type and moisture content of feed, and quality of water.

Stock eating more dry feed will need to drink more. This means that sheep fed for production will drink more than twice as much as sheep fed for maintenance. Lactating animals need to drink up to twice as much as dry animals. British breed sheep need more water in hot weather than Merinos.

Table 6.1. Water reqirements for sheep over summer.

Dry feed	1.8-3.7 litres per day
Saltbush	Up to 14 litres per day
Lucerne hay	9 litres per day
High protein stubbles (eg. lupin)	50% more than on other dry feed

At Minnipa, South Australia, a trial showed that sheep drank an average of 1.6 litres per day over 3 years. In December and January they drank 3.7 litres per day whilst in August and September they only drank 0.1 litres per day. The maximum rate they drank over one week was 6.1 litres per day which shows there must be enough water available for peak demand, not just the average.

Allow for evaporation from dams, which over a year can be 50 per cent of the dam capacity.

Water quality

Water quality is affected by soluble salts, algae, the presence of animal carcasses, bird faeces, pH and clay in suspension. If water quality is not acceptable sheep may drink less than required or, stop drinking altogether. Therefore, poor water quality may cause sheep to go off their feed, lose condition, stop lactating or die from thirst, disease or toxicity.

Sheep kept in confinement are more sensitive to lower quality water or changes in water quality and so it is important to closely monitor water supplies in confinement systems. Daily cleaning of water troughs is recommended to remove faecal and food contaminants.

Salinity

Salinity is the sum of all salt ions dissolved in water. It is usually measured using an electrical conductivity (EC) meter. The units of electrical conductivity are deci-Siemens per metre (dS/m), milli-Siemens per centimetre (mS/cm), milli-Siemens per metre (mS/m) or micro-Siemens per centimetre (mS/cm).

Total dissolved solids (TDS) is the sum of all the ions dissolved in water plus dissolved organic molecules. Because salts usually dominate, salinity and TDS are usually highly correlated and TDS is often used in defining water quality. TDS is expressed in milligrams per litre (mg/L), parts per million (ppm) and grains per gallon (gpg). The relationship between these units is shown below.

Water quality conversions.

1 dS/m = 1 mS/cm or 100 mS/m
1 dS/m = ~640 mg/L (depending on type of salt present)
1 mg/L = 1 ppm
1 gpg = 14.25 mg/L

Salinity becomes increasingly important as animals need to drink more, as they do on dry feed in summer. As the salt concentration rises, sheep drink progressively more water to flush the salt from their bodies but will eventually refuse to drink highly saline water.

A sudden change to more saline water may cause problems as sheep may refuse to drink it, or they may drink but become ill or die. Carting fresh water for a few days to mix with the salty water can help sheep to adapt.

Stock grazing salt bush, or other salty feeds, are less tolerant to saline water. Sheep in Western Australia fed all salt bush diets drank 5.7 litres per day (and lost weight) while sheep fed hay drank 1.8 litres per day. Sheep entirely dependent on salt bush, or blue bush, can only tolerate water up to 8000ppm (1250mS/m). However, in more productive years sheep may be eating mainly grass between the salt bush plants and may be less affected by the salt.

Pregnant, lactating or young sheep are less tolerant of saline water than dry mature stock. Table 6.2 provides the recommended upper salinity levels for sheep drinking water.

Salinity levels can be kept as low as possible by cleaning tanks before each summer and scrubbing and flushing water troughs frequently, even up to twice a week, as evaporation increases salinity. An investigation into sheep deaths showed evaporation in a trough had increased the salinity from 3900 to 8400ppm (600-1300mS/m) in just two days.

Salinity levels of dams, creeks and water holes should be checked during summer. Water testing is available.

Most salinity is due to common salt, but magnesium salt levels above 600ppm (94mS/m) can cause scouring. However, because magnesium levels and TDS are highly correlated, water with high magnesium levels will generally be unsuitable for stock because of high TDS. A farm water survey conducted in Western Australia in summer autumn 2003, found approximately 15 per cent of water samples submitted for testing exceeded 600mg/L of magnesium.

If sheep become very thirsty and are then allowed to drink *ad lib* they may show all the signs of salt poisoning, including deaths, even though their feed or water may not be unusually salty. This is termed chronic salt poisoning. To avoid this condition, very thirsty sheep should be watered, initially in small quantities.

Table 6.2. Sheep drinking water-recommended upper salinity levels.

Sheep	EC (mS/m)	ppm
Lambs, weaners, lactating ewes	930	6000
Adult dry sheep	2030	13000
Saltbush or bluebush diet	1250	8000

Algae

Build-up of algae in tanks and dams can block outlets and taint the water. Some species of blue green algae produce toxins that can kill stock.

If you suspect blue green algae poisoning of stock, or are concerned about algae in a dam, a water sample can be submitted to a laboratory for algal identification. Collect at least half a cup of water in a container, leaving a third of the container as an air gap, and cool the sample. In South Australia contact the Australian Water Quality Centre and in Western Australia, the Department of Agriculture.

Algae can be controlled with several chemicals, including simazine, copper sulphate, calcium hypochlorite and ferric alum.

Simazine is marketed under a variety of commercial product names and can kill algae. You should only use simazine containing products that are registered for algal control and then follow label instructions. Premix simazine in a drum, or a small tank of water before adding it to the dam. Do not use simazine treated water for irrigation, or livestock, for two weeks. Simazine is safe to use where fish or crustaceans are present.

Calcium hypochlorite (from swimming pool suppliers) can be used at the rate of 12 grams of 70 per cent material in 1000 litres of water. Chlorination on a large scale, such as a farm dam, is not practical however because large amounts of organic matter interfere with the disinfectant. This treatment may also kill fish and crustaceans.

Ferric alum reduces algal blooms by removing phosphorus from the water as a precipitate. Place a block of it in a porous bag attached to a float in the dam. A rate of 50 grams per 1000 litres is used. Ferric alum is best used as a preventive, to treat dams before likely growth of algae.

Copper sulphate treatment is no longer recommended as it can kill crustaceans, fish and other aquatic life. It can also be dangerous for stock suffering liver damage (for example from lupinosis or caltrop poisoning) or receiving copper from other sources, such as copper pellets.

Barley straw inhibits the growth of algae. This was discovered by accident and the mechanism of action is unknown. Barley straw is most useful when applied to dams as a preventative as it is slow acting, taking at least a month to start working. Its effect lasts about six months. Only 100 grams of straw spread on the surface per 1000 litres of water is required.

Dead algae can settle in a dam and rot, causing putrid water or blocked pipes and may release toxins as they decompose. Therefore, it is best to remove as much algae as possible before treatment. Dams or tanks may need to be retreated. A cover on tanks will reduce algal growth.

If the volume of a dam is needed so that water can be treated for algal growth, the dam volume calculator on the Department of Agriculture Western Australia website (www.agric.wa.gov.au) is useful.

Pollution by debris or animals

Contamination of water by birds, animal droppings, animal carcases or contaminated storm run-off, can result in low animal production, disease or deaths. Water polluted with bacteria can be treated with chlorine, although chlorination does not kill all disease causing bacteria, nor does it affect toxins already present, such as botulinum toxin. Add calcium hypochlorite (70 per cent), 14 grams per 1000 litres in slightly affected water, to 140 grams per 1000 litres in badly fouled water. This is best done in holding tanks in the evening. Chlorination is not suitable for farm dams.

Sound water management includes regular inspection of dams, tanks and water troughs and cleaning them as needed.

Objectionable odours caused by dissolved gases can often be dispelled through aeration, such as by splashing the water from the delivery pipe on to a board before it enters the trough or tank. Aeration may also reduce acidity.

Cloudy or muddy water

Cloudy or muddy water can be a nuisance in water for domestic use and may block irrigation spray nozzles, but it rarely harms livestock.

Sheep require access to good quality water, particularly when grazing dry feed.

Cloudy water is best treated in a tank, as wind can stir up more particles of clay in a dam and undo any treatment carried out. Ideally, two tanks should be used so that one can be settling while the other is being drawn on.

To settle muddy water, add alum at the rate of 50 to 75 grams per 1000 litres. Dissolve the alum in a bucket first. Be careful, as alum is corrosive. Spray it over the entire surface and stir the water as much as possible. If the water is acid, agricultural lime may need to be added

before the alum. Add lime at half the rate at which the alum is to be used. Lime will also reduce the corrosive effect of the alum-treated water.

If alum and lime do not work, try 'Plaster of Paris' at 370 grams per 1000 litres, or salt at 1000 grams per 1000 litres (only if the water is not already salty), or ferric chloride at 10 grams per 1000 litres. Gypsum at 400 grams per 1000 litres may also be used, but avoid using it in greater amounts than this in dams as it may cause them to leak.

It is recommended that, before treating water in a dam or tank, you experiment with a 200 litres drum full of the water to establish the preferred rate of alum, or to establish which chemical is most effective.

Miscellaneous sheep water issues

When feed is dry and paddocks are large (greater than 100 hectares), two watering points or a moveable trough will allow better utilisation of the entire paddock, reduce erosion risk and allow better animal performance.

In hot weather stock avoid warm water, so deeper or shaded water sources will be preferred.

Weaners on lupin stubbles will not travel more than 500 to 600 metres from a water source, thus increasing the risks of soil erosion and lupinosis from grazing continuously around the water point.

With large mobs of sheep (more than 600), the tail end sheep may not drink enough water before the mob moves away. The flow rate needs to be sufficient to keep water in the trough while the sheep drink. A minimum trough length of 30 cm plus 1.5 cm per sheep (with one-sided trough access) is recommended for mobs of up to 500 sheep. Sheep not used to water troughs may take time to learn to drink from them. Young sheep are less adept at finding water so always push them onto water in a new paddock. Many farmers believe that weaner sheep do better in summer autumn on dams rather than troughs.

Agistment guidelines

Agistment is an arrangement where feed is made available on someone else's property for the short-term use by stock. This is generally carried out for an agreed fee between the livestock owner and the property owner (agistor). The following information provides some guidelines and checklists that should be considered prior to sending, or accepting animals for agistment.

The benefits of agistment

During poor years, when rainfall has been inadequate for required pasture growth, agistment may be considered as an option to:

- reduce the risk of soil erosion on susceptible paddocks;
- maintain breeding lines developed over many years;
- avoid having to sell sheep and then buying them back later;
- avoid putting sheep into a confinement feeding situation;
- spell paddocks recovering from a poor season so that pastures can recover;
- provide stock with good quality feed for weight gain, improved fertility or improved lamb survival.

The costs of agistment

The costs of agistment can be thought of in monetary terms as well other costs. These other costs need to be considered when agistment is being compared to other options (such as confinement feeding).

These other costs include:

- biosecurity (the risk of importing pests, disease and weeds);
- risk of theft (where the property is isolated);
- loss (where fencing is poor, or in bushland or tree plantations);
- death (disease or predator attacks);
- inconvenience (travel time to monitor the flock, or mustering difficulties in forested properties).

The monetary costs include:

- agistment fees (usually quoted as c/hd/wk);
- transportation costs to and from the property;
- inspection costs by the livestock owner;
- quarantine drench (on leaving to, and returning from agistment);
- interest paid on agistment fees.

See page 18 for a guide to comparing the monetary costs of the different options of managing sheep (including agistment) through a drought or dry season.

Calculating the break-even period

On comparing the different feeding options, it may be useful to calculate the break-even period of agistment compared to other options. If you compare hand feeding costs with agistment, how long would it take for the agistment costs to break even using the following formula?

Number of weeks for agistment to break even =

$$\frac{\text{Transport cost to and from agistment (\$/hd)}}{\text{cost of hand feeding (\$/hd/wk)} - (\text{Cost of agistment (\$/hd/wk)} + \text{Inspection cost (\$/hd/wk)})}$$

For example

A mob of 200 dry ewes, agisted 100km away

Hand feeding costs at home

Feed mix @ $0.65/hd/wk.

Fuel cost @ $0.10/hd/wk.

Total costs = $0.75/hd/wk.

Agistment costs

Transport cost to and from agistment @ $4.00/hd.

Agistment fees @$0.50/hd/wk.

Inspection costs @ $0.06/hd/wk.

Total costs = $0.56/hd/wk.

$$\text{Break even period} = \frac{\$4.00}{\$0.75 - (0.50 + 0.06)}$$

$$= \frac{\$4.00}{\$0.19}$$

$$= 21 \text{ weeks}$$

Therefore, in this example, it is cheaper to hand feed at home for up to 21 weeks. For more than 21 weeks agistment will be the cheaper option.

Agreeing on an agistment price, terms and conditions

Whilst it is common practise for farmers to enter agistment agreements by a brief conversation and verbal agreement, this is not a desirable practise. Each situation will be different and to be fair to both parties, the agistment price, and terms and conditions, should be agreed upon to suit that particular situation. Agistment issues which have arisen in the past include, not being clear on who is responsible for monitoring stock, what resources were available to the livestock owner, stocking rates and biosecurity risks. These points should be clear in the agistment agreement (see page 68).

Agistment fees tend to closely follow the law of supply and demand. In years where a dry season is extensive, agistment can be hard to come by and expensive. During the drought of 2002, prices in Western Australia varied from 30c/hd/wk to $1.70/hd/wk. In contrast, during good seasons the price of agistment may be much less (or even nothing) because both parties may gain from having sheep graze a property.

As a livestock owner, before agreeing on an agistment price it is worth doing some homework to ensure you are paying a reasonable price and you know what is included in the price.

Details to investigate include:

- what other farmers are paying for agistment in the area, or what price agistors are asking;
- checking with local stock agents on agistment availability and going rates;
- what is the quality and quantity of feed on offer, how long it will last;
- what is the length of time the agistment is available for;
- what is the condition and availability of infrastructure such as watering points, fencing, and handling facilities;
- water quality, quantity and reliability;
- investigating the presence of poisonous weeds or scrub;
- inquiring into biosecurity risks;
- determining who is responsible for monitoring stock.

In order to satisfy the above details an inspection of the agistment property is essential.

The agistment agreement should describe the responsibilities of the livestock owner and the agistor. The following provides a basic guideline of responsibilities.

Livestock owners are normally responsible for:

- paying all costs for care and transportation of their stock;
- informing agistors of diseases affecting their stock, and treatment required;
- insurance for their stock, and against any damage they may cause whilst on agistment;
- checking stock routinely to ensure conditions of the agreement are being met;
- ensuring that the agistor can contact the owner or owner's representative in an emergency.

Agistors are normally responsible for:

- advising owners if the site becomes unsuitable for agistment;
- advising owners of disease, accident or injury to stock (but would not be liable unless this was due to negligence).

Checklist for sheep leaving for agistment

The welfare of sheep are the shared responsibility of both the livestock owner and the agistor, once the sheep arrive at the agisted property (unless the agreement states otherwise).

Other points to consider include:

- ensure the sheep are fit to travel, see page 70 for guidelines;
- insure against diseases or pests (or make certain you don't carry them to the agistors property) by jetting, drenching, lice treating and vaccinating where there is a potential risk;
- do not let hungry sheep out onto paddocks containing lush feed or substantial amounts of grain. If possible feed hay to sheep before leaving and on arrival.

Checklist for sheep returning from agistment

When sheep return from agistment, it is important that no undesirable pests, diseases or weeds are introduced to the home property.

Lice transfer from infested sheep to 'clean' sheep is by direct contact. If possible, determine the lice status and treatment history of other sheep agisted on the property, of the neighbours sheep, and if there has been any mixing of sheep whilst they were on agistment. Check the sheep for lice, if you are unsure if lice are present, isolate and monitor that mob monthly.

Resistant worms can travel with sheep returning from agistment. Sheep should be quarantine drenched on returning home then left for 6 hours in sheds or yards with water. Treatment with a combination drench from at least three different chemical groups is recommended. After drenching, put the sheep onto the wormiest pasture paddock on the farm.

Sheep can introduce weeds following ingestion of small weed seeds, or seeds may be attached to their wool or hooves. Check fleeces for seeds and consider shearing if weed seeds are found. Confine sheep to a small paddock or a confined area on a full hay ration for a week to allow weed seeds to pass through the gut. This area can them be checked regularly for unusual plants which can then be sprayed. Check for germinating weeds in both autumn and summer.

Determine the footrot history on the agistment property and whether the agisted sheep have been in contact with any other sheep. If there is any risk of virulent footrot, keep these sheep isolated and seek further advice from your local Department of Agriculture or veterinarian.

Agistment agreement guidelines

It is recommended that a written agistment agreement be discussed and agreed upon to ensure both parties know what is expected of them. The following list outlines items that should be considered in agistment agreements.

Introduction

- Description of both parties, contact details, representative in case of an emergency.
- Agistment property name and location.
- Agistment paddock/s size and location.
- Stock number, class and method of identification.
- Who counts stock onto and off agistment?
- Who arranges for transportation?

Finance

- Duration of the agreement.
- Agistment fees and ability to re-negotiate.
- Timing and method of payment and other fees.
- Non payment.
- Insurance.

Termination

- Termination date or notice of termination.
- Ability to vary arrangement.

Livestock management

- Person in charge of stock (each persons responsibility for welfare of stock, who inspects and how often).
- Access to property by livestock owner.
- Presence of pests, disease and weeds and their management.
- Condition of facilities and their availability (handling facilities, sheds, watering points, fences and gates).
- Stocking rate limit, allowance for varying seasonal conditions.
- Quality of pasture, feed and supplements.
- Care of pasture (fertiliser, weed and pest control) and who pays.
- Availability and quality of water and who pays.
- Who is responsible for stock losses or theft?
- Arrangements if feed runs out, stock loose too much condition or the paddock starts to erode.
- Who covers stock losses in case of flood or fire?

Animal welfare guidelines

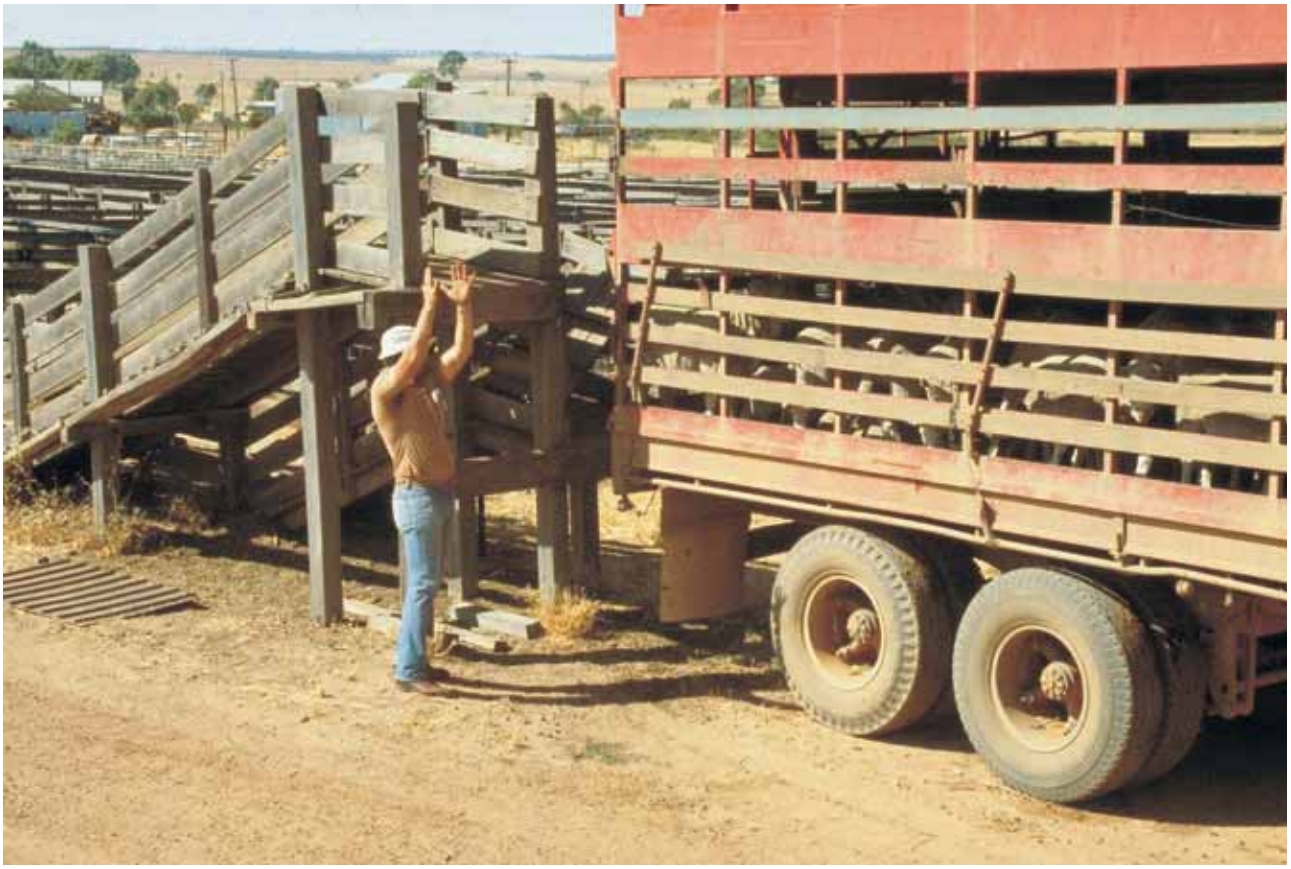
Animal welfare is a moral, and legal, responsibility of all livestock owners. This chapter goes through some of the minimum requirements for humane husbandry relevant to dry seasons and droughts. During these times farmers need to monitor the health and condition of their stock regularly. For further information contact your relevant State or Federal authority or refer to *The Australian Model Code of Practice for the Welfare of Animals – Sheep.*

Requirements for confinement feeding

The design, location and construction of a confinement system should take into account topography, climate, age and size of the sheep, space and feed requirements, and labour and management skills available. Adequate provision should also be made for cleaning, drainage and waste disposal from the site. See page 19 for further details.

Transportation

A farmer is responsible for sheep until they are on the transport vehicle. This includes the selection of those sheep fit to travel. Animals that go down after limited exercise are not fit to travel. They should be fed until they are strong enough to travel, or humanely destroyed. Weakened sheep should be transported to their destination by the quickest, least stressful route. They should be given special protection against exposure to the weather and they should not be mixed with strong animals.



A farmer is responsible for sheep until they are on the transport vehicle

Transportation guidelines.

- Those sheep most susceptible to disease, stress, or injury, during transport must be loaded last and unloaded first.
- For healthy adult sheep, any one journey should not exceed 24 hours, unless the entire journey can be completed in 36 hours.
- Ewes more than 4 months pregnant should not be transported unless it is unavoidable. These animals will be most susceptible to pregnancy toxaemia. They must be offered food and water on arrival.
- Lambs under 14 kg liveweight should not be transported unless unavoidable.
- Lambs and recently shorn sheep (up to 2 weeks off shears) are particularly susceptible to wind chill.

Drought periods

Sheep being fed for survival should be observed carefully at feeding times. Where minimum water or feed requirements cannot be met they should be agisted, sent for slaughter, or humanely destroyed on the property. Drought affected sheep are highly susceptible to stress and require careful handling. Weak animals may require segregation for special treatment.

Listed below are some fitness guidelines for weak sheep where adequate food requirements cannot be met.

- If they are unable to rise and walk - they should be humanely destroyed on site.
- If they go down after limited exercise - they are not fit to travel and should be humanely destroyed on the property.
- If they are still able to walk - they should be agisted or sent directly to the nearest abattoir. They should not be consigned through saleyards.

Humane destruction of sheep

One of the most disturbing outcomes of droughts coupled with low sheep prices, is the requirement to destroy sheep. Effective and humane methods of destruction which cause a quick and painless death include either shooting with a firearm, or stunning with a captive bolt stunner followed by bleeding. Other methods include clubbing of lambs with a heavy object followed by bleeding, or simply bleeding.

Firearms

A suitable firearm is a .22 magnum or larger rifle used at short range (30 to 60 cm) but not placed directly on the head. Disadvantages of the use of a firearm are hazards to human safety and the possibility of not being legal on public property.

Aim just below the poll in the direction of the animals muzzle (A in Figure 8.2), or aim at the point in the middle of the face at a point midway between eyes and ears (B). Alternatively, aim from the side of the head at a point midway between the eye and the base of the ear (C).

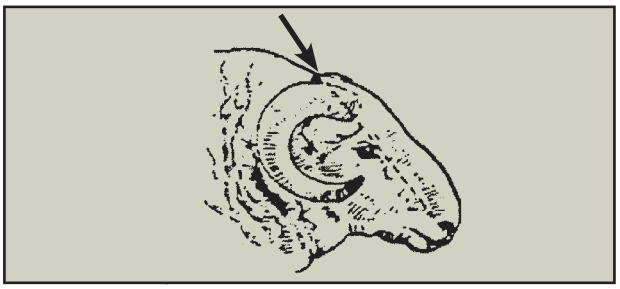


Figure 8.1 Recommended position and direction of fire for captive bolt stunners for horned and hornless sheep.

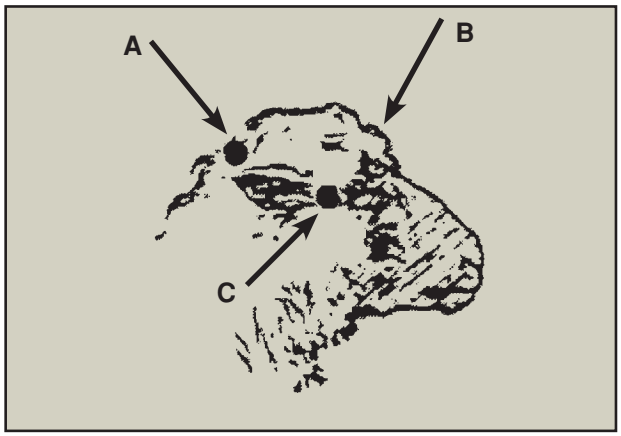


Figure 8.2 Recommended position and direction of fire – hornless sheep.

Captive bolt penetrating stunner

A penetrating captive bolt stunner uses blank cartridges, colour coded for the amount of power required for the species of animal being destroyed.

The stunner is placed firmly against the skull before firing (the frontal approach is preferred). Animals stunned must be bled out immediately. The main advantage of the captive bolt stunner is safety.

Place captive bold stunner on top of head aiming behind the poll in line with the animal's muzzle.

Bleeding out

Bleeding out by a skilled person using a sharp knife is an acceptable on-farm method of slaughter for individual animals. The method is to lay the animal on its side, draw the head back quickly and cut transversely to the spine just behind the jawbone.

Clubbing

Lambs (but not adults) may be stunned by a heavy blow to the back of the head to render them unconscious. This should be followed immediately by bleeding out.

Check that sheep are dead by looking for signs of breathing or eye movement after touching the eye surface.

Disposal of carcases

If large numbers of sheep need to be destroyed, burial is the preferred method of disposal.

Selecting a disposal site

To satisfy environmental concerns and to protect water resources, consult the local Department of Agriculture, or Departments responsible for the environment and water resources. The local council should also be consulted before selecting a site. Sites must be marked and a record kept to avoid future pollution concerns.

- Soils high in clay content are most suitable. Soils with high leaching properties (sands or gravely/ rocky soils) are to be avoided where possible. If these soils are unavoidable, lining the pit, or adding lime to the carcases to slow decomposition may be an option.
- A site away from defined depressions, or watercourses, is desirable. Surface water catchments (that is, streams, rivers, wetlands) should be at least 1km from the disposal sites.
- The highest annual groundwater should, where possible, be at least 5m below the bottom of the disposal trench.
- The nearest bore should be at least 1km from the site.
- Houses should be at least 1km from the site.
- The site must be free from underground services (pipelines, power and telephone lines) and should not interfere with access to roads.
- The site must be accessible to earthmoving plant, stock and operators.
- The zoning of land must be rural and used for agricultural purposes.

Calculating pit size

As a guide, one cubic metre holds 9 bare shorn sheep in store condition. The size of the pit can be calculated by the following formula:

$$\text{Length of trench} = \frac{\text{number of sheep}}{9 \times W \times (D-1)}$$

(Where W is average width in metres and D is depth in metres less one metre for earth fill)

For example

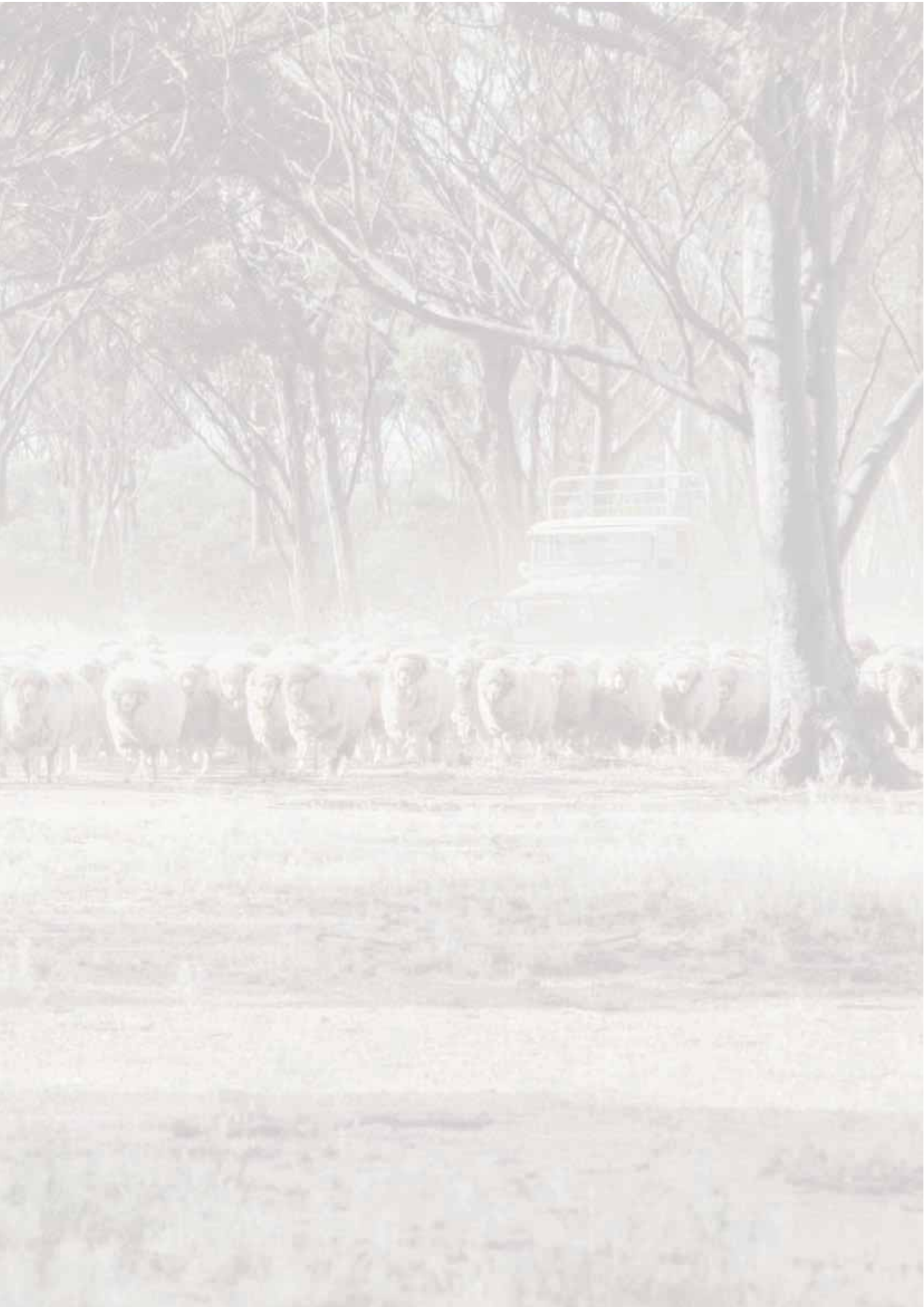
If you have 500 sheep and the average trench width is 3m and the total depth is 4m, then length needed

$$= \frac{500}{9 \times 3 \times (4-1)}$$

$$= 6.2\text{m}$$

Other factors to consider

- Rather than opening sheep's abdomens, soil should be piled on top of the carcasses to a height of at least half the depth of the pit to allow for decomposition.
- For safety reasons, the sides of the pit should be sloped. People should not work in pits over 1.5 metres deep unless the sides are battered (2:1) or shored.
- Maximum length of a pit for efficient bulldozer use is 65 metres. An access ramp of 1:4 slope must be allowed at both ends.
- It is easier to push sheep into a pit that is only 3 metres wide.
- Disposal pits should be inspected regularly during the month after closure.



Further information

Useful websites

Department of Agriculture and Food Western Australia

http://www.agric.wa.gov.au/sheep

Primary Industries and Resources South Australia

http://www.pir.sa.gov.au

NSW Department of Primary Industries

http://www.dpi.nsw.gov.au/agriculture

Department of Primary Industries, Victoria

http://www.dpi.vic.gov.au

Department of Primary Industries, Queensland

http://www.dpi.qld.gov.au

CSIRO

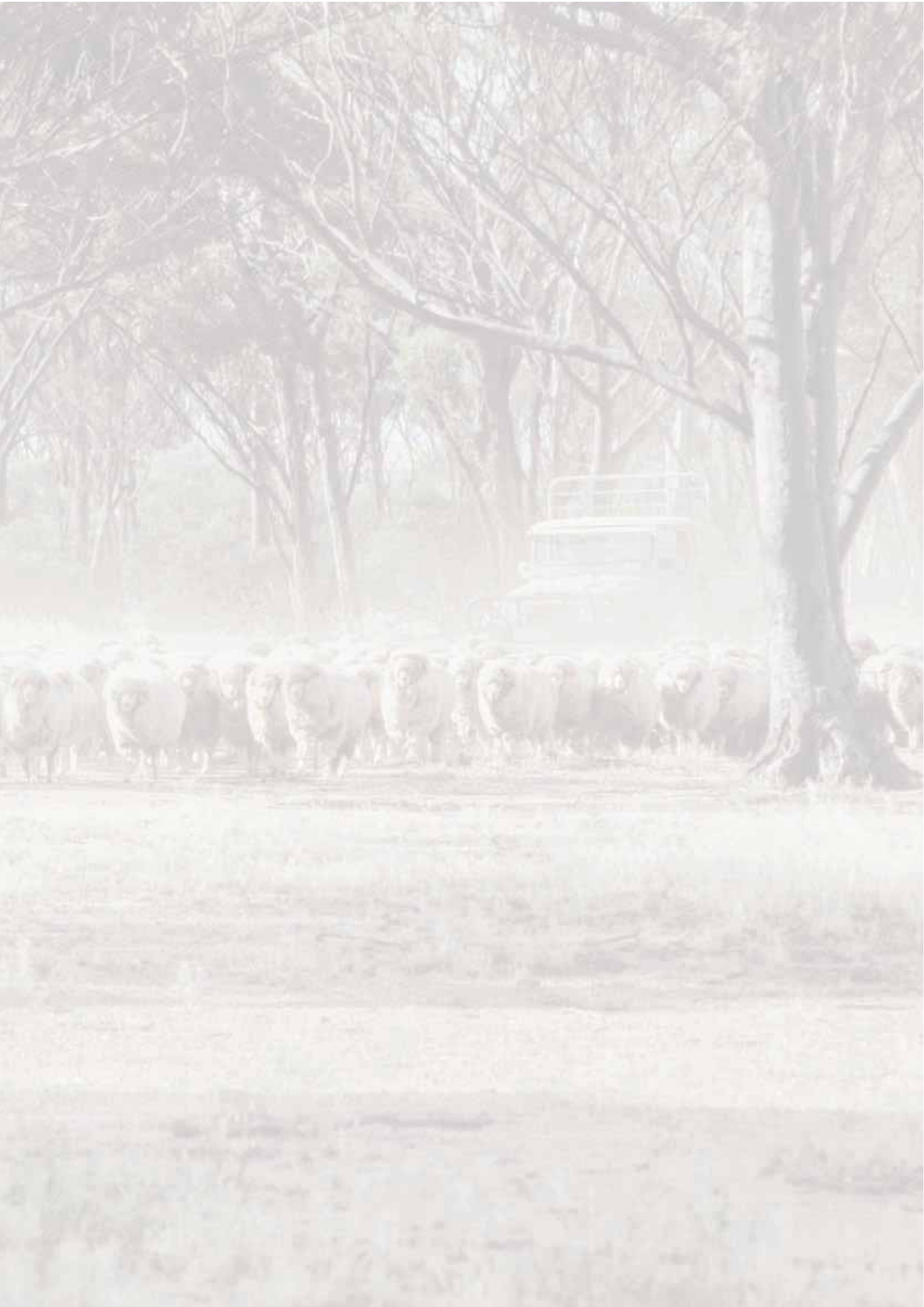
http://www.csiro.au

Australian Wool Innovation Limited

http://www.wool.com.au

Lifetime Wool

http://www.lifetimewool.com.au



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