



NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Managing drought, sixth edition 2006 - Readers' Note

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<http://www.dpi.nsw.gov.au/aboutus/resources/majorpubs/guides/managing-drought>

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NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Section 2

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Drought increases residue risks

INTRODUCTION

Maintaining the 'clean' reputation of our animal products in the domestic and export marketplace is of paramount importance to the future of Australia's livestock industries. Chemical residues are a direct threat to the sales of meat and animal products to overseas and domestic markets.

Every livestock producer must ensure that slaughter stock and stock producing milk for human consumption do not have unacceptable levels of chemical residues.

During drought times, a range of factors can lead to a higher risk of chemical residues in livestock:

- an increased reliance on purchased fodder;
- the temptation to feed unusual materials;
- the loss of pasture cover, which can increase animals' soil intake;
- when livestock lose condition, residue levels of fat-soluble chemicals can increase.

Key points in managing these risk factors include:

- ensuring that purchased stockfeeds do not contain unacceptable residues;
- exercising extreme care over any decision to use unconventional stockfeeds;
- using chemicals strictly in accordance with label directions;
- adding a safety margin to withholding periods (WHPs) and export slaughter intervals (ESIs) for lean stock and those that are losing weight;
- keeping stock away from farm buildings or other sites where chemicals, particularly organochlorine (OC) chemicals, may have been used or stored;
- avoiding the grazing or feeding of stock on areas contaminated with OC chemicals;
- clarifying the residue status of suspect stockfeeds or livestock by appropriate testing;
- seeking professional advice about residue risk management;
- fully and accurately completing National Vendor Declarations (NVDs) for sale stock.

MAXIMUM RESIDUE LIMITS

Maximum residue limits (MRLs) are set for various chemicals in food commodities and in animal feeds. Food products found to contain a residue level exceeding the MRL may be condemned without payment to the producer. Where no MRL is set, the food product may be condemned if any residue is found.

Many of our trading partners have not set MRLs for chemicals commonly used in Australian agriculture, or may have set MRLs which are lower than those that apply in Australia. This is due to their different chemical use patterns. Where trading partners have no set MRL for a particular chemical, there must be no detectable residue of that chemical in exported products.

WITHHOLDING PERIODS

Withholding periods (WHPs) aim to ensure that, when agricultural and veterinary chemicals are used in accordance with label directions, the treated animal or crop will not have residue levels that exceed Australian MRLs. Withholding periods are legally enforceable.

For animal treatments, the withholding period on the product label is the minimum time that must elapse between treatment and the slaughter of the animal, or the collection of its milk, for human consumption.

Crop chemicals may have different withholding periods for harvest and for grazing/fodder purposes. Some older chemicals may not have a specific grazing/fodder withholding period on the label. If so consult the chemical manufacturer to determine if and when it is safe to graze the treated crop or crop stubble or cut them for fodder.

EXPORT SLAUGHTER INTERVALS

As noted above, overseas markets often have lower MRLs (or no MRL) for chemicals used in Australian agriculture. Export products must meet the importing country's MRLs. Any overseas detection of an unacceptable residue puts our export markets at serious risk.

Australian livestock industries have established export slaughter intervals (ESIs) for a range of veterinary drugs and pesticides used on livestock. These ESIs are simply longer withholding periods which aim to ensure that animal products comply with our trading partners' MRLs. ESIs must be observed unless the stock are consigned direct to a domestic abattoir.

Information on ESIs is included on NVDs for Cattle and Sheep. The most up-to-date list of ESIs is available from the Australian Pesticides and Veterinary Medicines Authority (APVMA) website.

CONVENTIONAL STOCKFEEDS

Before buying feed, ask for a Commodity Vendor Declaration (CVD). These declarations detail the chemical treatments applied to the feed and allow you to identify potential residue risks.

If you **cannot** obtain a CVD:

- inform the seller of the intended use of the feed;
- ask the seller if the feed is suitable for that purpose;
- ask if any chemicals have been applied to the feed or if the feed has been tested for residues.

If the feed has been raked and baled in the field, or if it may contain soil, seek an assurance that it was harvested from land free of persistent organochlorine (OC) chemicals such as DDT, dieldrin, heptachlor etc. Storing grain and hay in areas previously treated with OCs can also contaminate that feed and result in residues being present in livestock.

Unless a satisfactory CVD is provided or the feeds have been appropriately tested for residues, assume that chemical residues may be present.

Seek professional advice on potential chemical residue problems, their management and whether any reported residue tests are appropriate and/or comprehensive.

For further information see Agnote DAI-265 *Buying stock feeds: minimising chemical residue risks.*

UNCONVENTIONAL STOCKFEEDS

Be extremely cautious about any decision to use unconventional stockfeeds. Before purchasing such stockfeeds, obtain a completed By-product Vendor Declaration (BVD) from the supplier as part of your risk assessment of the suitability of feeding these materials to your stock. The BVDs intended to cover materials that have not been produced specifically for use as stockfeed including fruit and vegetable wastes and crop processing by-products such as peel, pulp, pressings and leaf material. (Question 4 and the explanatory notes for the NVD (Cattle) define 'by-product stockfeeds'.)

Crop wastes and plant-processing by-products may seem like useful roughage sources in hard times. However, such unconventional stockfeeds may contain chemical residues that could cause residue levels in livestock to exceed domestic or export standard limits. The crops from which the wastes or by-products are derived may have been treated with chemicals whose label directions prohibiting the feeding of wastes from treated crops.

Detailed advice on the use of waste materials as stockfeed is contained in Agnote DAI-181 *Dangers in feeding waste materials to livestock.* Producers should consult this publication before sourcing waste materials for use as drought feed.

CURRENT CHEMICAL USE

All chemicals must be used according to label directions, and the recommended withholding period must be observed. Check if the product also has an export slaughter interval and, if so, ensure that this is observed unless the stock are consigned direct to a domestic abattoir.

It is wise to add a safety margin to WHPs and ESIs when treating poor stock or those losing condition. Because these stock have low or falling levels of body fat, they tend to develop higher-than-normal residue levels of fat-soluble chemicals such as the chemicals contained in tick and lice treatments.

PAST CHEMICAL USE

Organochlorine (OC) pesticides, such as dieldrin, heptachlor and DDT, were banned from use on New South Wales pastures in 1982 and from all other agricultural uses in 1987. Their last registered use, for termite control, ceased in 1995. However, OCs persist for decades in the environment. In some situations they are a potential source of livestock residues.

Drought can increase that risk. Reduced pasture cover means that stock consume more soil, particularly if they are fed off the ground. Any traces of OCs in the soil will build up in the animal's body fat. During drought times stock are more likely to force their way into potentially contaminated areas where there is remnant feed, such as rubbish dumps and around farm buildings. The levels of any existing OC residues in animals will increase as they lose weight (body fat).

OC residues can be a problem if stock:

- graze paddocks where OCs have been used in the past, such as on old maize, potato, horticultural, cotton or sugar cane fields;
- access areas or buildings that have been treated with OCs to control white ants or other pests;
- access old chemical containers in sheds or rubbish dumps – just a few minutes' access can result in high residue levels;
- are fed hay or grain stored in areas previously treated with OCs;
- are held on and/or feed on OC-contaminated areas such as old dip sites, house areas or farm buildings;

- are fed materials, particularly unconventional feeds such as sugar cane tops, cut from OC-contaminated land and which include a significant amount of contaminated soil.

For detailed information on the identification and management of OC residue risks on your property, refer to Agnote DAI-29 *Management of organochlorine and related residues*.

RESTRICTING LIVESTOCK ACCESS TO 'NO-GO' AREAS

During a drought, livestock are more likely to force their way into restricted areas such as farm rubbish tips, farm buildings, old dip sites, old yard sites, pickled grain silos and old house sites. Hungry stock will eat or lick things not normally consumed so there is a risk of these stock eating soil, lino, wire and other rubbish, and licking old batteries.

- Often the first sign of lead poisoning is dead cattle. Affected live animals are often very docile, appear blind and walk aimlessly – including through fences. In rare cases they may become aggressive or manic.
- Organochlorines, arsenic and lead can all cause residues in livestock for a significant time after ingestion, even if they don't kill the animal.
- Eating wire and other foreign bodies can lead to extensive (and expensive) surgery and infection can cause death.

Prevention is the best cure.

- If possible, remove old batteries and other potential hazards from your property, making sure that you also clean up any broken battery cases or spilled contents.
- Also look at other potential stock poisoning risks, including chemical stores, chemical handling areas and stored treated seed.
- If you cannot remove a hazard, make sure that the area is very well fenced. Remember that stock may be desperate to get into areas with ungrazed feed.

For additional information on lead poisoning see Primefact 413 *Lead poisoning of cattle*.

NATIONAL VENDOR DECLARATION AND WAYBILL

The livestock industries require producers to supply National Vendor Declarations (NVDs) to confirm the chemical exposure history of livestock and to identify those that may be a chemical residues risk. The National Vendor Declaration also functions as a waybill (transported stock statement) when stock are transported, whether or not they are being sold.

NVDs ask questions about the feeding and chemical treatment history of stock offered for sale or slaughter. Read the explanatory notes carefully before fully and accurately completing NVDs. False or misleading answers on NVDs may result in prosecution or civil liability.

The sheep and cattle NVDs include questions about the feeding of any pasture, crop, stubble, grain or fodder treated with an agricultural chemical in the 60 days prior to harvest or first grazing. Producers selling stock within 60 days of feeding materials with an unknown chemical treatment history should check the explanatory notes before completing their answer to question 7 on the Cattle NVD or question 5 on the Sheep NVD.

Question 4 on the cattle NVD also asks if by-product stockfeeds have been fed within the 60 days prior to sale. Producers who have fed materials not produced primarily for livestock consumption to stock in the 60 days prior to sale must answer 'yes' to this question. The by-products covered by this question include waste fruit, vegetable and fibre crops, which can be in the form of peel, pulp, pressings, stem and leaf material.

OTHER ISSUES

Many factors affect the risk of unacceptable residues being present in slaughter stock that have been fed materials containing chemical residues. They include:

- the level of the residue(s)
- the chemical(s) involved
- the condition of the stock
- the proportion of affected feed in the overall diet
- the time between last feeding the material and slaughter.

Keeping the animals on clean, uncontaminated feed for 2 months before slaughter may allow the residues of most currently registered chemicals to decline to acceptable levels. However, there are no guarantees, particularly under drought conditions. With residues of persistent OCs it may take many months or even years on residue-free feed and uncontaminated land before stock meet market standards.

The only definitive way to determine if unacceptable chemical residues are present in feed or stock is to have appropriate tests done.

FURTHER INFORMATION

For further information on managing chemical residue risks during drought, contact your livestock or veterinary adviser or the District Veterinarian at your local RLPB.

The NSW DPI website has a wealth of information available at

www.dpi.nsw.gov.au/drought

Supplementary feeding of cattle

INTRODUCTION

Early in a drought there is usually plenty of poor quality dry feed, which animals cannot use efficiently. Supplementary feeding at this stage aims to make better use of this feed by supplying those nutrients that the pasture is deficient in, so that animals can be cheaply maintained while decisions are being made.

Supplementary feeding is an option **only** when there is paddock feed available. When availability of paddock feed becomes limited, survival feeding or production feeding must be implemented. 'Survival feeding' means providing an animal with the minimum feed it needs to stay alive; 'Production feeding' means, for adult stock, sufficient food for successful breeding or, for younger animals, sufficient food to meet growth and/or market targets.

SUPPLEMENTARY FEEDING PRINCIPLES

To be effective, the supplement you choose must make up for the main nutrient deficiencies in the paddock feed. Dry feed is often deficient in protein and sulphur. In cases where the feed is green but very short, it is the low energy intake which limits production.

The following principles for efficient use of supplements should be followed:

- Identify the most limiting components, usually protein, sulphur and/or metabolisable energy.
- Select supplements containing high levels of the identified limiting components.
- Balance the supplement to ensure efficient rumen function (contact your local NSW Department of Primary Industries Livestock Officer or Veterinary Officer for information on appropriate supplements for particular circumstances).
- Young and lactating animals have a greater need for protein.
- Choose feeding techniques which minimise disruption to the animals' digestive system.

- Cost out the program, taking into account alternative measures.
- Start feeding those animals with the greatest needs, for example pregnant cows of low fat score, or weaners below critical liveweights.
- Monitor feed consumption, liveweight and condition, so that you can confirm that your strategy is working.

OUTCOMES OF FEEDING SUPPLEMENTS TO STOCK

When supplements are fed to stock, there are three possible outcomes, depending on whether energy supplements or protein supplements are used and on how the pasture and supplement interact during digestion:

- **Supplementation.** The supplement is eaten and pasture intake is unchanged. This is a rare event.
- **Substitution.** The supplement eaten causes reduced pasture intake. This usually occurs when pasture is supplemented with a high-energy feed.
- **Complementation.** The supplement is eaten and pasture intake increases. This occurs when stock are grazing on dry pasture or crop stubble and the supplement improves the animal's ability to utilise the feed.

SUPPLEMENTARY FEEDING

Table 1 provides supplementary feeding recommendations for various stock classes of beef cattle.

FREQUENCY OF FEEDING

Non-protein nitrogen sources – such as urea and sulfate of ammonia – dissolve quickly in the rumen, and any surplus nitrogen is wastefully excreted. To be effective, the non-protein supplements must be fed little and often.

Protein meals, such as cottonseed meal or linseed meal, release their protein differently, allowing cattle to use the protein efficiently over a longer period. Twice-weekly feeding is as effective as daily feeding.

High-protein grains (e.g. lupins or peas) are more degradable, with a higher protein release rate, and should be fed every second or third day.

PROTEIN MEALS AND SEEDS

Protein meals and high-protein seeds are excellent supplements when pasture digestibility is falling. Protein meals are oilseed crop by-products. The most common high-protein seeds are white ('fuzzy') cottonseed and lupins.

Both protein meals and seeds can be fed twice weekly in daily amount multiples (see Table 1). They are safe feeds and do not cause acidosis (grain poisoning).

BLOCK LICKS

Although commercial urea and protein blocks are convenient and can be used with moderate success as supplements to abundant dry feed (over 2500 kg dry matter/ha), they cost three to four times as much as high quality protein feed. Better results can be achieved at a fraction of the cost by using legume grains or protein meals.

Block licks are best used in the early drought phase.

If you wish to try the convenience of blocks, you can make your own much more cheaply by following the recipes given in Table 2b.

ROLLER DRUMS

Roller drums supply nitrogen from the urea in a molasses, urea and water mix. They are useful only when dry standing feed exists, and they are an alternative choice to protein block licks. Their 'window of usefulness' is when you want to maintain liveweight in a dry spell, and dry feed is plentiful. They work best with 'dry' cattle. Table 2a provides the recipes that must be followed.

Table 1. Supplementary feeding recommendations

Available feed	Class of stock	Supplement	Frequency
Plentiful dry feed – Digestibility of pasture limits intake – Protein supplements increase pasture intake	Cows and calves, dry adult stock	Urea/molasses, mix 60 g urea/head/day OR High-protein grains, 0.5–1.0 kg/head/day OR Protein meals, 0.3–0.7 kg/head/day	Continuous access Feed every second day Feed twice weekly
	Weaners	Supplement and frequency as for other classes of stock, but high-protein grains or meals preferred.	
Short green feed – Quantity of pasture limits intake – Feed energy supplements	Cows and calves	Good quality hay, 3–4 kg/head/day OR Cereal grains, 1–2 kg/head/day	Feed 2–3 times/week Feed 2–3 times/week
	All dry cattle	Hay, 2–3 kg/head/day OR Cereal grain, 1–2 kg/head/day	
Deteriorating dry feed – Quantity and digestibility restrict intake – Feed energy/protein supplement mixes – Full hand feeding follows	Cows and calves	Molasses/urea/protein meal OR Grain/protein meal	Continuous access Feed daily or 3 times/week
	Dry stock	Grain/protein seeds or meals	Feed daily or 3 times/week

WARNING: Cereal grains and urea can be poisonous if fed in large amounts before cattle are used to them. Be sure to introduce them gradually to reduce this risk. Rations consisting wholly of grain are not recommended for lactating cows; instead, feed a mixture of 80% grain and 20% hay.

Table 2. Mixes for supplementary feeding
a. Urea/molasses (roller drums)

	First week	Second week	Third week
Water (litres)	100	100	100
Molasses (litres)	100	50	30
Urea (kg) – Prilled	15	15	15

Each mix should last about 30 head for 10 days. To decrease the rate of consumption, reduce the proportion of molasses.

WARNING: Urea can be poisonous to stock.

b. Home-made protein blocks

	Per cent by weight
Molasses	40
Protein meal	30–40
Coarse salt	5–10
Urea	0–10
Slaked lime	5
Cement	10
Kynofos 21*, DCP or Biofos*	2

Weigh all ingredients, combine in a concrete mixer, and pour into moulds (cardboard boxes, timber frames and fertiliser bags will all serve this purpose). Blocks harden gradually over a week or two.

GRAIN AND HAY

In the early drought phase (dry standing feed), grains and hays tend to act as a substitute for paddock feed rather than a supplement. Supplements encourage the use of standing dry feed.

Cereal grains (such as oats or wheat) are not efficient supplements when paddock feed is dry. They produce lactic acid in the rumen, which slows down the digestion and consumption of fibrous paddock feed. You can reduce this effect by feeding small amounts every 3 days and by adding protein meals, grain legumes or white cottonseed. This will fill the gap between the protein level in the grain and the animal's need for 15% protein. In practice the high-protein alternatives, such as lupins, peas, or cottonseed meal, will give better results while paddock feed lasts.

Grains are more useful when feed is short and green. This is particularly so for dry cattle, which need less roughage. Hay is best for lactating cows on short green feed, particularly in the colder months. The main role of grains is in full feeding when available pasture is low, and cattle should be removed from paddocks to reduce the

likelihood of erosion (see the following sections on full feeding).

WHITE COTTONSEED

Warning

White cottonseed (WCS) and de-linted cottonseed (black cottonseed) may contain residue of chemicals applied to the cotton crop during the growing season. The Australian Pesticides & Veterinary Medicines Authority (APVMA) calculates maximum residue levels on the basis of a 30% maximum dry matter (DM) intake of cottonseed (WCS and black cottonseed) in the diet. This means that using WCS at levels above 30% of the total dry matter intake could result in excessive residues in cattle. This is particularly true for cattle destined for export markets, where the 30% limit set to comply with domestic MRLs may not apply. If you have fed WCS from crops treated with chemicals within 60 days of harvest (all cottonseed would be in this category) to cattle within 60 days of sending them for sale/slaughter, then you must disclose this at Question 7 of the National Vendor Declaration (Cattle). NSW Department of Primary Industries does not recommend the use of cottonseed at more than 30% of the total dry matter intake, even in severe droughts.

NSW Department of Primary Industries and the cattle and cotton industries recommend that cotton trash not be fed to livestock due to residue concerns.

White cottonseed is an excellent supplementary feed for all cattle except calves under 4 months of age.

White cottonseed mixes well with grain and protein meals. It is high in energy and protein, but because its high oil content may cause digestive upsets, it should make up no more than a third of maximum potential feed intake (i.e. two-thirds of intake should be from pasture).

- White cottonseed fed as a supplement to pasture is an excellent complete supplement.
- It can be fed whole, in dumps in the paddock, twice a week.
- Intake should be kept to a safe 2.5 kg/day for adult cattle.
- Do not feed where no roughage is available.

Molasses

Cattle can be fed molasses-based diets fortified with protein meal and urea, provided there is roughage in the paddocks.

Molasses-based diets are versatile and can be used in the early drought stage as a production feed as well as being used in full feeding. Table 3 shows recommended molasses rations, which assume adequate roughage is available.

These fortified molasses mixes are distinct from roller drum mixes. Fortified molasses mixes give cattle performance that is superior (particularly in lactating cows) to that given by roller drum mixes.

Sources of phosphorus

Traditional sources of phosphorus – MAP fertilisers (e.g. Starter 12®) and DAP fertilisers – are not recommended for use as stockfeed sources of phosphorus. These products now contain fluorine at levels that can cause fluorosis if fed for an extended period.

The new sources of phosphorus are monocalcium and dicalcium phosphates that are low in fluorine and cadmium (see Table 4).

FURTHER INFORMATION

The NSW Department of Primary Industries website has a wealth of information available at

www.dpi.nsw.gov.au/drought

Table 3. Recommended molasses rations (calculated assuming adequate roughage is available)

Class of stock	Molasses	Cottonseed meal	Urea	Monocalcium or dicalcium phosphate*
30 cows with calves at foot. – For lactation and successful rejoining. – Feed the mix twice weekly.	250 kg (1 drum)	50 kg	8 kg	3 kg
30 cows with calves at foot. – For scrub feeding. – Feed mix twice weekly.	250 kg	25 kg	8 kg	3 kg
30 weaners (200 kg). – For normal growth. – Feed mix twice weekly.	125 kg	50 kg	2 kg	2 kg
30 head of dry stock. – For maintenance of weight and condition. Also for scrub feeding dry cattle. – Feed mix twice weekly.	250 kg	–	8 kg	2 kg

* Monophosphate or dicalcium phosphate should be included in phosphorus-deficient country.

Table 4. Suitable sources of phosphorus

Product	Ingredient	Phosphorus content
Kynofos 21 [®]	Monocalcium and dicalcium phosphate (50:50)	21%
Biofos [®]	Monocalcium and dicalcium phosphate (67:33)	21%
Palaphos [®]	Dicalcium phosphate	15.5%
DCP [®]	Dicalcium phosphate	18%

Full hand feeding of beef cattle – management

INTRODUCTION

When there is not enough pasture for livestock maintenance, or further grazing of pastures may be detrimental to pasture management or survival, the animals' nutritional requirements must be met by full hand feeding. When initiating a full feeding program, it is necessary to plan well before starting to feed.

Feed in a confined area

All stock in a full feeding situation should be confined to a small area or a small paddock for the following reasons.

- The extent of pasture and soil degradation will be limited.
- A close eye can be kept on stock for assessing their health.
- Stock do not have to expend energy walking around the paddock looking for food or water, and so the amount of feed required is reduced.

Choose an area where the pasture can be regenerated without any inconvenience after the drought breaks and any soil erosion will be minimised.

Weeds

Weeds introduced in drought feed can become an ongoing liability for a farm. The following strategies will facilitate weed management:

- Try to find out about the source of grain or fodder so that potential problems can be anticipated.
- Restrict the area over which imported grain or fodder is fed out and keep a record of the area.
- After the drought breaks, observe the area periodically for the next few years, note any new weed species and have them identified.
- Contamination of fodder and grain with herbicide-resistant weed seeds, mainly annual ryegrass, is the quickest means of introducing herbicide resistant weeds onto

farms. Good farm hygiene and the controlled feeding of introduced fodder and grains are the best avoidance procedures.

Parasites

Parasite burdens can be greater when stock have lower resistance because of poor nutrition and when they are concentrated in small areas. Bulls are highly susceptible to ostertagia (small brown worm) infestations.

Do not overlook the need to treat for fluke in areas at risk from this parasite. Treat all stock for lice and worms.

Vaccinations

A 5-in-1 (or 7-in-1) vaccination given to all stock (including bulls) before grain feeding provides cheap insurance against losses from clostridial diseases.

Vitamin A, D, E injection (intramuscular) is essential for all classes of cattle.

STOCK MANAGEMENT

Heifers

If you decide not to sell maiden heifers, they are best withheld from joining. If joined then you must feed them to ensure they will develop adequately before calving.

Cows

Pregnancy-test all cows that have been joined and sell any that are not in calf. Cows that are in calf need close supervision.

Problems may develop during calving because drought conditions lead to a higher proportion of calving difficulties and retained afterbirths. Metabolic disorders (such as milk fever) are also more likely to occur. Cows will do better if fed separately from their calves. They need less feed and feed quality is less important.

Calves

It may be better to dispose of calves shortly after birth, particularly those from first and second-calvers. Those you keep should be weaned at as young an age as possible – see the later sections 'Weaning management' and 'Calf feeding management'.

Dehorning

Ideally, stock should have been dehorned as part of normal management. In a drought, polled or

dehorned cattle are less aggressive at the feed trough, so less troughing is required.

If beasts have not been dehorned by the start of the drought, they are better left alone than being subjected to the extra stress of dehorning.

Water

Beware of cattle bogging in dams, soaks and waterholes. Fence off these areas and provide water in troughs. The inflow to the trough is as important as trough capacity. Under drought conditions cattle will drink about 10 L of water per 100 kg of bodyweight per day, and more in hot weather. Cattle water intake doubles when the daily temperatures increase from 21°C to 32°C.

When water becomes a problem, sell stock to reduce the need to cart water.

Preparing for full feeding

Where necessary, draft stock into management groups based on weight and body condition. Stock are best confined to small paddocks close to feed supplies so that they can be better supervised and managed.

GRAIN FEEDING

Starting cattle on grain

Take care when introducing cattle to grain and pelleted diets as there is the risk of grain poisoning. The high starch content of most grains can cause grain poisoning. Lupin is the exception because it is low in starch.

Good security of grain stores and standing crops is essential in order to prevent accidental poisoning. If it is intended to turn stock onto stubble, it may be a wise precaution to feed some grain beforehand, so that the rumen bacterial population becomes adapted to grain.

When stock are fed grain or any feed that has a high carbohydrate content, the feed must be introduced gradually so that the animal's rumen has time to adapt to the increasing levels. There

should also be a minimum of 10–20% roughage in any ration.

During the introductory phase to grain feeding, animals should be closely monitored. Diarrhoea is often the first sign of mild grain poisoning, and if this is seen in a number of animals, the proportion of hay in the ration should be further increased.

Some grains, for example lupins, are safer to feed than others. Similarly, it is safer to feed oats, which have a higher ratio of fibre to starch than does wheat.

When changing between different types, or even batches, of grains, and especially when changing between batches of pellets, the new feed should be introduced by 'shandyng' it with the old and gradually increasing the proportion of the new feed over about 7 days.

Paddock situation

A typical introductory regime to grain feeding in a paddock situation for cattle is given in Table 5.

Complete grain and roughage ration

When animals are introduced to a high-grain diet, they should be started on a ration consisting primarily of hay, with the percentage of grain being gradually increased over 2–3 weeks.

A typical introductory regime for introducing sheep or cattle to a complete diet of grain and roughage is given in Table 6.

Including lupins in the ration

Alternatively, lupins may be used to introduce sheep or cattle to a complete ration with high levels of grain. The high fibre content and low starch levels in lupins make them extremely safe to feed to ruminants without the risk of acidosis. **The lupins must be fed whole or cracked, but not ground, as grinding will increase the risk of grain poisoning.** The high protein and energy levels in lupins also make them an ideal feed for inclusion in any ration. A typical introduction to a feedlot ration using lupins is given in Table 7.

Table 5. A typical introductory regime for increasing grain content in the rations of cattle in a paddock feeding situation

Day	Amount of hay	Cereal grain (kg/hd/day) for cattle
1–2	To requirements, then grain	1
3–4	Decrease hay fed	1.5
Day 5 onwards	Decrease hay fed	Increase by 500 g/day – until required feeding level is reached

Table 6. A typical introductory regime for increasing grain content in a complete ration for cattle

Day	% in ration	
	Cereal grain	Hay
1–5	20	80
6–10	40	60
11–15	60	40
16–20	70	30
Final ration	80	20

Table 7. A typical introductory regime for increasing grain content using lupins in a complete ration for cattle

Day	% in ration		
	Lupins	Cereal grain	Hay
1–5	80	0	20
6–10	60	20	20
11–15	40	40	20
16–20	20	60	20
Final ration	0	80	20

Frequency of feeding

When cattle are on full drought grain rations, it is safest to feed daily. If you can feed only two or three times a week because labour is scarce or needed elsewhere, be alert to the increased risk of grain poisoning.

Where possible, feed at a regular time of the day to reduce digestive upsets.

Digestibility of grains

Grains are more digestible if coarsely crushed, but the benefits of crushing the grain are questionable when drought feeding for survival. More digestive upsets occur due to gorging.

Most grains give satisfactory results if fed whole. Some whole grain will pass through in the dung, but the proportion lost will decrease the longer cattle are being fed whole grain. Grain that is processed too finely may cause digestive upsets and surges in intake.

Digestive losses will vary, depending on a number of factors, including the amount and type of grain fed and the length of time animals have been on that feed. The amount passed through by cattle eating whole grain compared

with crushed grain varies from about 5% in oats up to about 25% in sorghum.

Addition of calcium

Grains are low in calcium, so feed finely ground limestone with the grain at the rate of 1.5 kg limestone per 100 kg grain. This will avoid the poor bone and teeth development that are the long-term effects of calcium deficiency.

Changing grains

Changing from one type of grain to another (e.g. from oats to wheat) increases the risk of grain poisoning and deaths. The approach here is to introduce the new grain slowly by mixing it with the original grain and, over 7–10 days, gradually increasing the proportion until the substitution is complete.

Depraved appetite

Bark chewing, hair licking and dung eating can occur when cattle are on grain survival rations. These habits are no real problem. However, bone chewing is more serious, and calcium-based supplements should be given to reduce this behaviour and avoid deaths from botulism.

Lactating cows

Cows have low milk yields on all-grain diets and calves suffer accordingly. To help calves survive, feed lactating cows 1–2 kg of hay or straw / stubble in addition to grain.

Shy feeders

About 10–15% of stock will not settle down to grain feeding. Such shy feeders are best removed from the mob and should either be fed diets containing some roughage or be sold.

WEANING MANAGEMENT

Calves are the most difficult stock to feed in a drought. There is no point in feeding them for survival; they need a ration that allows them to grow. Calves need more protein than do older stock, thus adding to costs. They also take longer to finish.

If you decide to wean and feed calves, the guidelines below will help. See also Agnote DAI-15 *Feeding calves in drought*.

Calves over 5 months

Wean and feed calves aged over 5 months according to Table 9 in the chapter 'Full hand feeding of beef cattle – quantities'.

Backward calves, and heifers intended for future breeding, will benefit from adding 75–100 g per head per day of a high-protein feed (such as a meal or legume grain) to normal rations.

Calves 2–5 months

Calves 2–5 months will wean satisfactorily as long as they are fed a balanced diet. Calf pellets available commercially are suitable, or one of the following feed mixes:

- **Mix 1:** 100 kg lucerne chaff with 100 kg crushed grain.
- **Mix 2:** 100 kg crushed grain, 15 kg protein meal and 10 kg roughage (Optional: add 1 kg urea).

A ration of 1.5–2 kg per head per day is adequate for maintenance, but 2–2.5 kg per head per day is preferable as it will ensure some growth.

Treat these calves against coccidiosis.

Calves under 2 months

Leave calves under 2 months with the cows. They should be weaned only if the survival of the cow is at stake. If calves must be weaned earlier, feed them a milk replacer to minimise losses. Milk replacers are best fed in liquid form or as the manufacturer recommends. Observe strict hygiene to prevent scouring.

Calf feeding management

Provide fresh, clean water, preferably in troughs, at all times. Provide shelter from cold winds.

Inject the calves with one million international units of vitamin A at weaning, and thereafter at 3-monthly intervals.

Draft off strong calves and feed them away from weak ones. Remove sick and scouring calves from the group, and treat them immediately.

Treat calves regularly for lice and internal parasites.

Troughing

If possible, put grain in a trough to prevent wastage. Troughing does not need to be elaborate. Many cheap, temporary methods are satisfactory, for example:

- bush timber or railway sleepers placed on the ground 30 cm apart, along a fence line;
- 200-litre drums split down the middle;
- tractor tyres cut in half with a chainsaw.

Provide sufficient length of trough so that all stock can eat together. Allow 30 cm of trough length per head for weaners, 45 cm for yearlings and 60 cm for adult stock. To reduce bullying, several troughs spread apart are better than one long trough.

Where no troughing is available, place the grain in dumps of about 20 kg each, rather than trailing as for sheep. Dumps are not as efficient as troughs; a wastage of 6–8% can be expected, and there is a higher risk of sand impaction.

THE BEST BUY IN FEEDS

Energy requirements for maintenance

Energy is needed by animals for all body functions. Energy is measured in megajoules (MJ). Animal requirements are assessed as megajoules of metabolisable energy (MJ.ME). Energy in feed is assessed as megajoules of metabolisable energy per kilogram of dry matter (MJ.ME/kg feed dry matter or simply M/D).

Table 8 gives a suggested method of comparing value for money in different types of feeds that may be available for drought feeding. Read downwards to compare relative costs; figures in the same vertical column represent matching cost per unit of energy.

Table 8 is best used to work out value for money when purchasing your main feed source. The energy value is expressed on a weight basis and all cost calculations must be done on weight, not volume.

When calculating the cost of a feeding program, it is important to cost the feed in terms of units of energy provided, because feed that has the lowest price per tonne may not be the cheapest source of energy. To use Table 8, select a feed from the right-hand column (e.g. wheat). Then select the price per tonne you can buy it for (e.g. \$140). Look down that column to see how much you must pay for other feeds and compare on a 'cost per unit of energy' basis. For example, if barley is more than \$129 per tonne, then wheat at \$140 is a better buy. The cost per unit of energy is the same where wheat is \$140, barley \$129, medium quality oats \$118, and so on.

Remember to consider:

- wastage levels and the practicalities of handling and feeding out;
- the amount of hay needed for cold weather, for lactating stock, when introducing full grain rations, and for shy feeders;

- suitability of the feed – low-energy feeds (ME 7 or lower) may not be suitable for feeding to young stock over a prolonged period;
- grains fed whole are lower in feed value than the same grains cracked or rolled;
- supplements may be needed with some types of feed – this could mean the addition of extra protein or minerals such as limestone, salt, urea.

For assistance in calculating relative feed costs, see the Feed Cost Calculator at www.agric.nsw.gov.au/reader/4439. This online tool can be used to select the best mix of feed for your situation.

WHEN THE DROUGHT BREAKS

Many properties have experienced their heaviest losses during the period immediately after drought-breaking rain. Prolonged wet conditions turn animals off their feed. Problems exist under these circumstances if grain is being fed on the

ground. As soon as the first green pick emerges, cattle may chase this, expending more energy.

It is essential that cattle are kept confined to the restricted feeding areas until adequate pasture is available. At that point, allow increased grazing time each day until full grazing is provided after 6–7 days. Allowing immediate full grazing will lead to digestive disorders.

Weeds already present can increase in importance after a drought since they recover faster than desirable species. Observe how the pasture is recovering and decide on a management strategy if weeds show signs of dominating.

FURTHER INFORMATION

The NSW Department of Primary Industries website has a wealth of information available at

www.dpi.nsw.gov.au/drought

Table 8. Feed price equivalents for drought feeding, based on energy values of feed

ME* (MJ/kg DM)	\$ per tonne									Examples of feeds
	100	140	180	220	260	300	340	380	420	
13	100	140	180	220	260	300	340	380	420	Maize, wheat, triticale, sorghum, lupins, peas.
12	92	129	166	203	240	277	314	351	388	Barley, good quality oats.
11	85	118	152	186	220	254	288	322	355	Medium quality oats, most nuts.
10	77	108	138	169	200	231	262	292	323	Poor quality oats, good legume hay.
9	69	97	125	152	180	208	235	263	291	Good pasture and cereal hay.
8	62	86	111	135	160	185	209	234	258	Medium quality hays.
7	54	75	97	118	140	162	183	205	226	Poor quality hay.
6	46	65	83	102	120	138	157	175	194	Stubbles, cottonseed hulls.
5	38	54	69	85	100	115	131	146	162	Rice hulls, sunflower hulls, rice straw.

* This is the energy value of feed (ME = metabolisable energy; MJ/kg DM= megajoules per kilogram of dry matter). Most grains and hays contain about 10% moisture, a component which has no feed value. When buying feeds with a higher moisture content than this, for example molasses, silage or turnips, try to ensure that the price is discounted to relate to dry matter content only.

Full hand feeding of beef cattle – quantities

ASSESSING THE SITUATION

The full drought phase begins when your cattle have reached the point where they should not lose any more weight, and supplements are insufficient to maintain weight. Now is the time for a major reassessment. Consider the following:

- the probability of useful feed growing if the drought breaks in the near future;
- the quantity of feed required for full feeding;
- the resources required (including finance for buying feed, paying for labour and other continuing costs), and the facilities or equipment required;
- the potential benefit of continuing to feed certain classes of stock.

Cost your program on a monthly basis. You can reassess the stock you are going to feed, and perhaps reduce numbers again, to make available funds go further.

From here on, the cost of a feeding program will increase, particularly during periods of production stress such as calving and lactation. So it may be necessary to cull more heavily.

ENERGY REQUIREMENTS FOR MAINTENANCE

Energy is needed by animals for all body functions. Energy is measured in megajoules (MJ). Animal requirements are assessed as 'megajoules of metabolisable energy' (MJ ME). Energy in feed is assessed as 'megajoules of metabolisable energy per kilogram of dry matter' (MJ ME/kg DM, or simply M/D).

In drought, it will be the energy component of feed that will be the most limiting. Addressing this need is the first requirement in a drought feeding program. The energy requirements of cattle depend on:

- liveweight

- energy concentration of the feed (M/D)
- pregnancy
- lactation
- growth
- weather conditions.

CALCULATING THE FEED REQUIREMENT FOR MAINTENANCE

The first step in finding the energy needs of adult cattle is to calculate the amount of feed needed to provide sufficient energy to maintain liveweight. (If cows are pregnant or lactating, adjustments to the maintenance value need to be made, and these are discussed in Step 2 of the next section 'Adjusting the ration'.)

To calculate the feed requirement for maintenance, you need to know the energy content of the feed or feeds to be used. A guide to the energy contained in various feeds can be found in Appendix 1. The values given are average values. Whenever possible, a feed analysis is recommended, as there can be considerable variation. Information on testing laboratories can be obtained from your local NSW Department of Primary Industries office.

Once the energy content of the feed is known, use Figure 1 to predict the amount of feed needed to meet maintenance requirements. Where more than one feed is being fed, the following procedure is used to calculate the energy content of the mixed ration. It is this number which is then used in Figure 1.

Example

A ration contains 80% wheat (12.9 M/D) and 20% clover hay (8.9 M/D). The calculation is as follows:

$$\text{Energy content} = \frac{(80 \times 12.9) + (20 \times 8.9)}{100} = 12.1 \text{ M/D}$$

To use Figure 1, place a ruler on the appropriate point which represents the liveweight of the animal under assessment (left-hand vertical line of the figure), then run the ruler through the energy content of the feed (centre angled line). The point where the ruler cuts the right-hand line indicates how much feed (in kilograms per day) needs to be fed to maintain liveweight.

CALCULATING THE 'AS FED' AMOUNT

The calculation in the previous section assumes the feed is 100% dry matter. All feeds will contain some moisture, and this needs to be compensated for when determining how much of the fodder to feed.

Dry matter percentages for various feeds are also found in Appendix 1. To determine the amount of a particular fodder or ration to feed, take the

calculated amount from Figure 1, multiply it by 100, and then divide this by the dry matter percentage. This is commonly known as the 'as fed' amount.

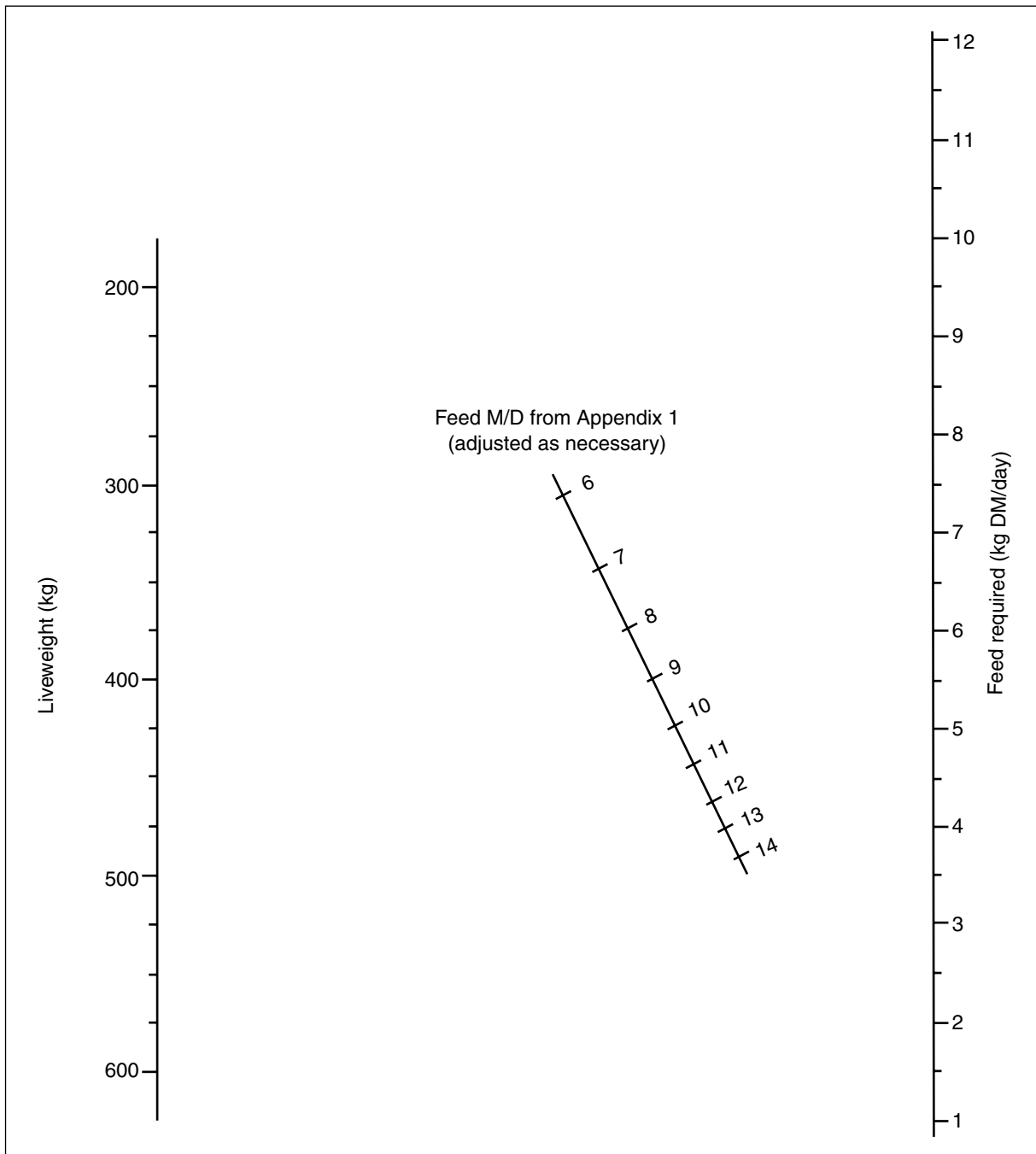
Example

6.5 kg DM/day, where the dry matter percentage is 90%:

$$\text{'As fed' amount} = 6.5 \times 100 \div 90 = 7.2 \text{ kg}$$

As a general rule, to adjust the amount of feed to an 'as fed' weight:

Figure 1. Cattle maintenance requirements



For grains/hay:

'As fed' amount =
feed required (kg DM /day) × 100 ÷ 90

For silages:

'As fed' amount =
feed required (kg DM /day) × 100 ÷ 30

ADJUSTING THE RATION

Step 1. Ration for dry beast

As described in the previous section, use Appendix 1 to get the energy (M/D) value of the feed. Then place a ruler on Figure 1 at your values for 'Liveweight (kg)' and 'Feed M/D', and read off the 'Feed required' from the right-hand side. Then adjust for dry matter content to calculate the 'as fed' quantity.

Step 2. Allowance for pregnant and lactating cows

Using Figure 1, first calculate the feed requirements for maintaining a non-pregnant cow. Then increase this amount of feed by the percentage factor given below to determine the corrected amount of feed required by a pregnant or lactating cow:

Cow 6 months pregnant:	add 20%
Cow 8 months pregnant:	add 40%
Cow with calf at foot:	add 60%

Step 3. Allowance for cold stress

During cold, bleak weather, increase the rations for all classes of stock by 20%. The extra feed should be provided as hay.

Wet feeds such as silage or vegetables should be fed in greater quantity in proportion to their moisture content. See the section 'Calculating the "as fed" amount'.

FEEDING FOR SURVIVAL

Feeding grain for survival involves a certain amount of stock training and gradual introduction of grain, otherwise deaths will occur. The success of grain feeding depends largely on starting well before cattle weights fall to their critical level.

Critical survival weight

When body weight falls to a critical point, called the critical survival weight, the body reserves are almost depleted, and you must be prepared to increase feed substantially to prevent stock losses.

The critical survival weights for medium-maturity British Breed cattle are as follows:

Weaners	150 kg
Yearlings	225 kg
Adult dry stock	300 kg
Breeders	350 kg

Table 9. Maintenance^(a) feed requirements ('as fed') for full hand feeding of cattle

Feed options: minimum weight (kg) per day 'as fed'						
Class of stock + bodyweight	Grain (12 ME) OR	Hay (8.5 ME) OR	50:50 grain: hay mix OR	80:20 grain: hay mix OR	Silage (30% dry matter and 9 ME)	Expected weight gain/day
Weaners (200 kg)	2.5	3.5	3.0	2.5	12.0	0.2 kg ^(b)
Yearlings (250 kg)	3.0	4.0	3.5	3.0	15.0	0.1 kg ^(b)
Adult dry stock (400 kg)	4.0	6.0	5.0	4.5	20.0	nil
Breeders, late pregnancy (425 kg)	5.0	8.5	7.0	6.5	27.0	nil
Breeders, lactating (425 kg)	–	10.5	9.0	8.0 ^(c)	30.0	nil

^(a) During periods of cold weather, these levels should be increased by 20% using hay if possible (3 kg hay is equivalent to 2 kg grain).

^(b) For young stock, protein levels should be at least 9% for them to continue growing. It would be better to lot feed these cattle for production.

^(c) High levels of grain cause cows to milk poorly. Feed at least 1.5 kg hay/hd/day with 6.5 kg grain/hd/day.

It is recommended that cattle be maintained above these weights by feeding according to the requirements given in Table 9. Extended feeding of cattle that are at critical survival weights does not allow for unexpected problems.

Adjustments should be made for larger framed or higher producing cattle. Note that individuals in the herd may be below these weights and still be in satisfactory condition.

SUITABILITY OF VARIOUS FEEDS

Grains

Grain is usually the most economical type of feed to use during drought. Wheat, barley, oats, rice, maize and sorghum are energy-rich feeds of similar nutritive value. They contain sufficient protein to meet the requirements of adult stock, and all are suitable for drought feeding. Grains are low in calcium, so 1.5% limestone (superfine grade) by weight must be fed with all-grain diets. Grain consumed to excess or introduced too rapidly can cause sickness or even death.

For more information on grain introduction and the use of feed additives to reduce the risk of grain poisoning, see Agfact A0.9.53 *Grain poisoning of cattle and sheep*.

Molasses

Molasses is highly suitable for supplementing paddock feed because it can be used as a carrier for other components such as protein or minerals. Molasses has about 70% of the energy value of grains. Because the protein content is negligible, molasses is usually fed with a high quality protein meal or with urea. Note that if urea is fed to excess or introduced too rapidly, it can be toxic and cause stock death. Sixty grams of urea per head per day is the maximum intake recommended. Molasses can be safely fed undiluted in troughs. Where molasses is the main feed, cattle usually regulate themselves to about 1 kg per 100 kg of bodyweight per day. Some roughage should be available to avoid molasses toxicity.

Protein-rich meals

Cottonseed (see warning box, right), linseed and sunflower meals, and others, are rich in protein and can be used as special-purpose supplements for young stock in association with energy feeds. They are too expensive to be fed in large quantities.

Warning

White cottonseed (WCS) and de-linted cottonseed (black cottonseed) may contain residues of chemicals applied to the cotton crop during the growing season. See the boxed panel on page 21.

Prepared feeds

Cattle and sheep nuts vary in quality between manufacturers and even between batches. Their energy value is slightly lower than that of grain. They are a convenient but expensive form of energy, and can cause digestive upsets similar to those caused by grain. When introducing and using prepared feeds, adopt the same precautions as for grain.

Protein nuts/pellets are now available and have proved to be efficient in supplying protein to cattle. Use them as you would protein meals.

Hay

Hay is a necessary drought fodder in the following circumstances:

- introducing stock to grain
- feeding during periods of cold stress
- production feeding.

Lucerne hay and good pasture and cereal hays are more than adequate for maintaining stock. The energy value of 3 kg of these hays is equivalent to the energy value of 2 kg of grain. Lucerne and clover hays are high in protein, calcium and vitamin A, and are particularly suited to young and lactating stock.

Maintenance feed for a 400 kg dry cow is as follows:

Grain	4 kg/hd/day
Good hay	6 kg/hd/day
Poor hay	8 kg/hd/day

Poorer quality hay and straw barely meet stock maintenance requirements, 2 kg being equivalent to 1 kg grain. The fibrous nature of these feeds will limit the amount a beast can eat. They are usually low in protein and are not suitable for young or lactating stock without the addition of either grain or a mixture of molasses and a high-protein feed.

Where lactating cows are being fed grain/hay (80:20), then using a good quality hay means 1.5 kg roughage/hd/day, and a low quality hay 2.5 – 3.0 kg/hd/day.

Silage

Silage is suitable for cattle and can be self-fed or fed daily as a restricted ration. If weekly feeding is practised, silage should be fed in dumps rather than trails. Most types of silage are comparable in energy value on a dry matter basis, but lucerne silage and clover silage have a higher level of protein.

The feed value of wet silage is variable because of differences in palatability and moisture content. The feed value is often less than it should be because of the low crude protein content of silage. The crude protein content should be determined by a feed analysis, and sufficient urea added to bring the protein content to 12%.

Dry matter content varies from 15% to 50%. A level of 30% is considered average and has been used for calculations here. Silage with more than 30% dry matter should be fed in smaller quantities.

To calculate the amount of silage to feed, see the section 'Calculating the 'as fed' amount'. High moisture content or low palatability can mean that stock won't always eat the required quantity of silage.

Irrigated feed

Stock may be given daily access to irrigated fodder crops, as follows (assuming no limit to availability and quality):

Weaners	2 hr/day
Yearlings	2 hr/day
Adult dry stock	1 hr/day
Breeders, late pregnancy	2 hr/day
Breeders, lactating	3 hr/day

By-products

By-products of the oilseed crushing industry (such as cottonseed meal, peanut meal and sunflower meal) are high in protein and energy. Seed hulls from these products are low in protein and energy but can help maintain grown cattle or serve as a source of roughage for lotfeeding.

Hull quality varies depending on the amount of kernel left after crushing. For example, cottonseed hulls are better than sunflower hulls, while rice hulls are hard to digest and can injure the gut lining. When used, rice hulls should make up only a small proportion of any ration.

At times, other materials may be available, for example citrus pulp and cannery waste. Have the feeding value of such by-products analysed before determining a feeding program.

If you are in any doubt about the pesticide status of any unusual feed, you can have it tested for residues at one of a number of commercial laboratories. A list of these is available from your nearest NSW Department of Primary Industries office.

FURTHER INFORMATION

The NSW Department of Primary Industries website has a wealth of information available at

www.dpi.nsw.gov.au/drought

Feed Cost Calculator:
www.agric.nsw.gov.au/reader/4439

The value of unusual feeds in drought

There is a wide range of unusual feedstuffs that can be safely and effectively fed to livestock during drought. However, livestock producers need to fully evaluate the feed value, risks, practicality and real cost before replacing more conventional feeds. Many of these products are low in nutritional value, bulky to transport, difficult to handle, may contain high levels of chemical residues and supply may be inconsistent.

Such products need to be evaluated on a dry matter and feed value basis as some very high moisture feeds may have a low cost per tonne but work out to be very expensive on a dry matter basis, particularly when freight is included.

Producers also need to assure themselves that the feedstuff does not include any restricted materials such as meat, fish or feather meal, bone or blood meal, poultry litter or pet foods. Spent mushroom compost is also unacceptable unless it can be proven to be free of any poultry waste.

The best policy is not to feed unusual feedstuffs to stock without first establishing that the material is suitable. Producers should ask the supplier to certify that the material that they are supplying is suitable for the purpose for which it will be used. If this assurance can not be given and the label or invoice/delivery docket does not clearly indicate that the feed is suitable for ruminants, do not buy or use it.

A By-product Commodity Vendor Declaration (BVD) is also available which covers materials that have not been produced specifically for use as stock feed, including fruit and vegetable wastes and crop processing by-products such as peel, pulp, stems, pressings and leaf material.

Use of by-product stockfeed needs to be disclosed accurately on any National Vendor Declaration you complete. By-product stock feeds include 'any plant material not produced primarily for livestock consumption, such as waste fruit, vegetables and fibre crops, including peel, pulp, pressings, stem and leaf material' but does not include grain and grain by-products, cotton seed, oilseed meals, tallow or molasses. A 'yes' answer is appropriate if the stock in question have been fed a by-product feed within 60 days prior to sale.

Ideally, unusual feedstuffs should be tested for chemical contamination by an accredited testing laboratory before being used as a drought feed. However, this alone does not provide a guarantee of freedom from residues as this screening typically only tests for a narrow range of chemicals.

Testing should also be carried out for nutrient value of unusual feeds and it should be remembered that composition may vary widely between samples of the same product from different sources. Factors to be considered include not only the energy value (MJ/kgDM), protein content and dry matter percentage but also the dry matter digestibility of the feed (Digestible Dry Matter – DDM%). Some alternative feeds may appear to have acceptable energy and protein levels but may be low in digestibility restricting both intake and the availability of nutrients.

To calculate the actual cost of nutrients in a feed:

$$\text{Energy: } \frac{\text{Cost per tonne (\$)}}{\text{Dry matter \%} \times \text{Energy content (MJ/kg)} \times 10}$$

For example, a feed costing \$120 per tonne and analysed at 55% dry matter and 6.3 MJ/kgDM

$$\frac{\$120/\text{t}}{0.55 \times 6.3 \times 10} = 3.46 \text{ c/MJ}$$

A feed cost calculator is available on the NSW Department of Primary Industries web site.

Most unusual feeds should be used with caution and introduced into rations gradually over a period of around 2 weeks. Generally it is recommended that these feeds comprise no more than around 30% of the total ration. It must be remembered that with low digestibility/low nutrient value feeds stock may not be able to eat enough to meet their energy needs and may die from starvation unless fed with higher digestible or more nutrient dense feeds.

Some unusual feedstuffs recently available include:

Bread: High in carbohydrates but low in fibre – risk of grain poisoning so introduce slowly.

Biscuit waste: Similar to bread but extremely variable in nutrient value.

Brewer's grain: High moisture content restricts delivery distance but a good energy and protein source. Storage requires care or can be ensiled.

Cane tops: Beware of residues. Low in nutritive value.

Citrus pulp: Composition varies depending on type of fruit and whether skins and seed included. High moisture content limits area of use due to freight cost. Limited storage life

but can be ensiled with other materials. Low in calcium. Must be introduced gradually – lemon is more acceptable than orange or grapefruit.

Cottonseed hulls: Palatable but low in feed value.

Grape marc: Generally low and variable in feed value and moisture content. Beware of residues.

Potatoes: High moisture content, low protein but good energy source. Palatable. Some risk of choking. Avoid sprouted potatoes or those that have turned green as a result of exposure to sun.

Pumpkins: Need to be chopped.

Rice hulls: Little feed value, abrasive and can cause impaction if fed at high levels.

Rice Straw: Beware of residues. Low in nutritive value. High silica and oxalate levels may cause problems.

Sawdust: Has no nutritive value at all but at levels up to 15% can be used as a roughage substitute to facilitate rumen function.

Hardwood is preferable to cypress pine.

Vegetable/Fruit wastes: e.g. cabbage, carrots, whole apples, oranges – beware of residues. Can have high moisture content.

Waste paper: Little feed value. May contain toxins if printed.

Table 10 gives a guide to average composition of some alternate feeds but producers are strongly urged to have products analysed before purchase.

Source: NSW Department of Primary Industries feeds database, and FeedTest®, Department of Primary Industries, Victoria.

Table 10. A guide to average composition of some alternate feeds.

Product	Dry Matter (%)	Crude protein (%)	DDM* (%)	Energy ME (MJ/kg DM)
Bread	62–85	13.5–18.2	85–89	12.8–13.4
Brewers grain	20–30	17–30	–	9.5–10.0
Cane tops	84.9	2.7–3.5	27.5	3.8–8.3
Citrus pulp	18.–25	7.5	–	10.4
Cottonseed hulls	93.4	4.0–11.5	35.5	2.9–6.3
Grape marc	49.1–51.6	11.2–16.1	25.1–48.8	3.8–7.3
Potatoes	16–25	7–14	84–86	10–12
Pumpkins	9	16	–	13
Rice hulls	92.3	2.0–3.1	23.3	2.4
Rice straw	52–93	2.2–9.0	30–55	3.1–7.5

* Digestible dry matter.

Managing dairy cattle

Herd numbers and feeding levels must be constantly assessed during feed shortages. Reducing stocking pressures by agistment or culling and selling are ways of coping with feed shortages. Whatever way you decide to manage your herd during feed shortages, grouping stock according to feed priorities is extremely important.

GROUPS OF STOCK

Early-to-mid lactation milkers are the main cash earners and require high intakes of good quality feed to maintain moderate to high levels of production. These stock are the most responsive to improved feeding levels.

Late lactation stock partition feed to body weight rather than milk. They should be maintained at a minimum condition score of 4.5 to 5.0 (on the 1 to 8 scale).

Forward springers should be treated the same as early milkers. It is essential to feed to prevent calving problems and to maintain a condition score of at least 5.0 to allow suitable levels of milk production, milk composition and fertility.

Backward springers in poor condition that are expected to calve within 2 months require supplementation to maintain weight or make some weight gains. Stock in moderate to good condition should be held at this condition while stock with long dry periods can be fed a maintenance ration.

Unmated heifers are the future milkers. If fed a maintenance ration they should be left unjoined. Actual numbers essential for a replacement program, should be determined to allow proper attention to a reduced and selected number of stock.

It is undesirable to feed weaners a maintenance ration for an extended period of time.

Selecting a small group that can be correctly fed to maintain growth is the best strategy.

Calves can be fed a milk replacer once they have received colostrum for the first 24 hours.

They may be weaned from milk onto dry feed at 4–6 weeks providing they are eating 0.5 kg to 0.75 kg of high protein concentrates a day.

SELECTIVE REDUCTION OF STOCK

Even if cattle prices are low, it is often more economical to sell sub-standard stock during feed shortages and droughts than to hold on to them. Early disposal of low producers, poor

quality replacements and problem cows in good condition reduces the total cost of feeding and increases the price received from their sale.

The availability and cost of agistment depends on the extent and duration of the dry spell. The reduction in stock numbers places less stress on your property, and time and cost of feeding surplus stock. Your property will also recover more rapidly at the end of the poor seasonal conditions.

AGISTMENT CONSIDERATIONS

- Supervision to prevent unwanted matings and to ensure safe calving of springers.
- Safe paddocks to prevent accidents (e.g. no drains, swamps or bogs) and to stop stock from straying.

STOCK HUSBANDRY

- When there is no paddock feed, confining stock to small paddocks allows better supervision and reduces the amount of energy spent walking.
- Shade in summer and shelter in winter reduce the amount of food used for thermal comfort.
- Ensure adequate water supplies.
- Separate stock into production groups or weight groups to improve feeding schedules. Young stock should be separated from older stock to prevent bullying and ensure adequate feed intake.
- Stock stressed by drought conditions have an increased susceptibility to internal and external parasites. If infected they require treatment, but care should be taken to avoid stress on weak, underfed stock.
- Ensure that all stock are also protected against clostridial diseases (e.g. blackleg, pulpy kidney).
- Cows calving in poor condition require close supervision to reduce problems associated with calving difficulties and metabolic disorders.

FURTHER INFORMATION

The NSW Department of Primary Industries website has a wealth of information available at

www.dpi.nsw.gov.au/drought

See Agnote DAI-281 *Dairying and Drought*.

Full hand feeding of sheep – management

Carefully consider the options available when coming into a drought. Keep in mind that the number of options available generally decreases as the drought progresses.

Making a decision about drought strategies will require assumptions to be made about drought length, stock prices and feed costs. Always use the best available information to support these assumptions and when new information becomes available use this to re-evaluate the current plan.

It is essential that a series of budgets be developed ranging from the best case to the worst case scenario so that the most cost effective strategy can be chosen. Keep in mind that under-estimating drought length will usually be a more costly mistake than an overestimate because of the different strategies that would be employed.

STOCK CULLING PRIORITIES

Reducing sheep numbers is the simplest way of making the available feed go further. If you are forced to sell stock because of drought, there are provisions to allow income, for tax purposes, to be carried forward into the next financial year. Contact the Tax Office or your accountant for details.

As the drought progresses, it is probably worth keeping only the most productive sheep (that is, those that you anticipate will contribute greatest to cash flow following the drought).

Following is a list of priorities for the disposal of sheep:

- all unthrifty sheep and sheep in poor health including those with conformation faults (for example, poor mouths and feet, and damaged udders) diseased sheep and cull weaners;
- wethers and aged ewes;
- dry ewes;
- weaners;
- quality breeding stock.

Good-quality breeding ewes and rams are the most valuable sheep at the end of the drought. This group will need special care if breeding programs are to be maintained.

Making hard decisions and selling stock while they are in good condition minimises the difference between selling price and buy-in price after the drought.

SUPPLEMENTARY FEEDING

Feeding in dry spells will often start well before it is clear that drought has arrived. During these periods, stock are fed as a supplement to the pasture still available. The types and quantities of supplement required will be many and varied and the best option requires many factors to be considered, including the current condition of the stock, the quantity and quality of pasture still available and the production target set for these animals. It is clear, though, that efficient supplementation requires that the balance between energy and protein intake be maintained.

Efficient formulation of appropriate supplements can be done using the GrazFeed™ computer decision support tool developed by CSIRO. This can be accessed directly from Horizon Technology at www.hzn.com.au. Your local livestock officer has a copy and can also respond to specific inquiries.

WHEN TO START FEEDING

Table 11 shows the minimum liveweight for various types of sheep (based on frame size) at which dry sheep should not be at risk. These weights should ensure that sheep are maintained at a fat score of 1. Note that if fat score 1 is set as the target, then the lightest, worst-conditioned animals in the mob may need to be separated and fed earlier than for the average.

Productive sheep (breeding ewes) should be maintained above these weights. Fat scores in the range of 2–3 (especially if sheep are pregnant or exposed to cold conditions) should be the minimum objective.

Start feeding when the sheep are at least 3–4 kg above the desired maintenance weight to allow for additional weight loss during grain introduction. In practice, feeding is likely to have started as part of a supplementary feeding phase as the property moves towards drought, ensuring sheep weights are well above those indicated in Table 11.

If a long period of cold weather is anticipated, set target weights 5 kg heavier to allow a greater safety margin.

Table 11. Minimum liveweight for shorn adult sheep in drought

Animal Class	Minimum liveweight (kg)
South Australian merino crossbreeds, British breeds (65 kg at 3 fat score)	50
Peppin-type merino and large frame fine wool merino (55 kg at 3 fat score)	40
Smaller framed fine and superfine wool merino (45 kg at 3 fat score)	35

NB. These minimum weights represent the weight of these animals in fat score 1.

TRAINING SHEEP TO FEED

It is good practice to include in the mob some sheep that have been fed previously. This encourages the inexperienced sheep to feed. Untrained sheep are best educated in small paddocks.

Start by scattering a highly palatable fodder such as lucerne or clover hay to encourage sheep to start feeding. Holding sheep near to the feed may also be necessary. Do not feed the sheep again until most of the hay is eaten. When the sheep are readily eating the hay, introduce a small quantity of grain (see Table 15 in 'Full hand feeding of sheep – feeding management').

A general policy of educating lambs to grain feeding prior to weaning (even in good years) will eliminate the often laborious and time-consuming task of starting sheep to feed. It has been shown that lambs who see their mothers eating from a grain trail will more readily adapt to hand feeding, even if some years pass before they are fed again. Just 3–4 feeds with their mothers with the grains most likely to be fed at some time in the future will be sufficient.

MONITORING THE FEEDING PROGRAM

Woolly sheep often look in much better condition than they really are. The weight of animals alone ignores the fact that sheep can be heavy because of large frame size but may carry little in the way of fat reserves. Manually assessing fat score helps to put the liveweight into the context of a fat score target. Changes in fat score and liveweight provide an objective

method by which to determine the adequacy of existing feeding levels. Feeding decisions based on fat scoring and liveweights will ensure more efficient use of feed.

Monitor a small portion of the mob on a regular basis. Fat scoring and weighing 50 sheep from a mob of 500 will be sufficient to find if there has been a change within the mob. It is important that these sheep be identified and the same sheep assessed on each occasion. Refer to Agnote DAI-258 *Fat scoring sheep and lambs*, for more information on the technique of fat scoring.

PREGNANT EWES

Special attention needs to be given to the nutrition of pregnant ewes if mortalities are to be prevented. To ensure adequate lamb birth weights and ewe mothering ability, pregnant ewes should be at least fat score 2 throughout pregnancy and preferably 3 score. Although placental development takes place in the first three months of pregnancy, ewes will be adequately maintained with a ration suitable for a dry sheep of the same weight.

Growth of the foetal lamb accelerates during the final 6 weeks of pregnancy and the feeding rate needs to be increased accordingly. The total increase in weight of the conceptus (including the foetus) during the last 6 weeks of pregnancy amounts to about 10 kg for ewes with a single lamb and more with twins. Ewes need to increase their gross liveweight by this amount during the period if they are to maintain their own body condition.

Lamb birth weights of over 3.5 kg are needed to ensure good survival rates. Overfeeding ewes in the last 4–6 weeks of pregnancy causes lambs to grow rapidly, which can lead to difficult births. However, this is unlikely to occur in drought. Under-nutrition during late pregnancy reduces mothering instincts of ewes. In these circumstances, it is common to see ewes abandoning their lambs shortly after birth.

Splitting mobs into early and late lambers or according to twins and singles will enable more precise feeding and will potentially save on the cost of feed.

LAMBING MANAGEMENT

Good management in later pregnancy is still no guarantee of having live lambs at weaning. It is imperative that the increased feed requirements after lambing are also provided to enable good lactation and lamb survival.

The main causes of lamb deaths during drought are usually a combination of two or more of the following:

- mismothering
- starvation
- exposure
- delayed or difficult birth.

It is generally recommended that dry sheep be concentrated into smaller paddocks or feedlots for drought feeding; however the opposite is true for lambing. High stock densities can lead to mismothering.

A maximum stocking density of 18 ewes per hectare is a reasonable guide for a mixed mob containing single- and twin-bearing ewes; and 10 ewes per hectare for twin bearers.

Select lambing paddocks well before lambing starts. Concentrating dry and pregnant stock onto smaller areas will allow lambing paddocks to be locked up early which may save some pasture for lambing. At best this may avoid hand feeding during lambing so reducing the risk of excessive levels of mismothering.

Generally it is the less vigorous lambs which tend to be mismothered. Adequate feeding during the pre-lambing period can reduce this. Use self-feeders to reduce mismothering. Daily feeding also helps to reduce the problem. Feeding in the early afternoon is the preferred time as it reduces the risk of mismothering.

Paddock selection and mob sizes are important factors influencing mismothering. Emphasis should be on small mobs in small paddocks, with paddocks free of dense or fallen timber and gullies.

EWES AND LAMBS

After lambing, the dietary requirements for energy and protein increase dramatically. While grain alone is satisfactory for dry and pregnant animals, roughage is needed to ensure better milk production from ewes. It is wise to save your best quality hay for lactation.

Lamb survival and growth are improved if there is at least 20% good-quality hay in a grain-based diet.

Silage can also be used as a roughage source. Silage is used successfully for all classes of sheep, and for a broad range of production levels. Unfortunately, silage is seldom economic to transport due to the high moisture content.

Chop length of silage is important as sheep intake of silage will be reduced significantly if chop length is too long. Use precision chop harvesting equipment when making silage for sheep.

If oat grain is the chosen feed, its high fibre content is likely to be sufficient without additional hay. However oats are often below 10% crude protein and it is important that diets for lactating ewes contain at least 12% crude protein.

Maintain lamb growth rates above 100 g a day for lambs from smaller framed ewes and 150 g a day for large-frame types to improve survival rates.

The nutritional requirements for lactating ewes are described in Table 12 of 'Full hand feeding of sheep – quantities'.

Mismothering of lambs during drought feeding is a serious problem. (See the section above, 'Lambing management'.)

WEANING

Lambs should be fed grain and hay supplements while they are still on their mothers. If lambs are not 'trained', it will take up to 3 weeks to bring weaners onto adequate quantities of hay or grain; during that time, substantial weight loss and deaths may occur.

Weaners require high quality rations but have relatively low intake. Weaning lambs early can achieve more efficient use of limited feed resources. Early weaning will also maintain higher ewe condition, increasing conception rates at the next joining. Lambs can be weaned successfully if they are a minimum of 8 kg and are at least 8 weeks of age.

WEANERS

Weaners' weight gain should be enough to achieve 20–25 kg by 6 months of age depending on frame size. Once weaners reach this weight it is acceptable to reduce feeding rates to maintain this weight but a modest weight gain is preferable.

Incorporate roughage into weaner diets early in the post-weaning phase. Use a high-quality hay comprising at least 20% of the ration. Young sheep have a higher need for protein than older dry ewes and wethers.

Consider finishing prime lamb weaners through a feedlot. A realistic budget is the first step in this process as it may be more profitable to sell the lambs as stores and retain valuable feed supplies for other stock.

SHEARING

There is no need to change the time of shearing during a drought, although it may be advantageous to shear cull sheep before selling.

If forced to shear twice in one financial year due to drought, tax provisions do exist to allow this income to be carried forward into the next financial year. Contact the Tax Office or your accountant for details.

When shearing take into consideration how long the sheep will be without feed. Minimise stress associated with shearing especially for pregnant ewes. Sheep need more feed after shearing; and more frequent feeding may be required. If extra feed is needed, good quality hay is the best alternative as it avoids digestive upsets.

Make provision for shelter after shearing. Off-shears losses during drought can be severe. Provide shelter as all sheep are at risk from exposure.

Shelter sheds, sheep coats and sheltered paddocks are all options to reduce the risk. A well-sheltered paddock provides protection from the high risk winds. The ideal paddock has a north or north-easterly slope with no exposed hills, and timbered to reduce the wind speed. Sheep are less affected by chill with increased wool growth. The effect of chill is minimal once wool length is 3 cm.

SHY FEEDERS

A variable proportion of sheep and lambs will not adapt to drought feeding. The proportion depends on age, previous feeding history, ration, feeding frequency and mob size, but up to 10% is not uncommon.

Remove and feed shy feeders separately.

Treated in this way some of the shy feeders will eventually eat the ration. Those that don't can be fed with good-quality hay or pasture (if available) or sold.

When the drought breaks

Often the heaviest sheep losses are sustained during the period immediately following drought-breaking rain.

Prolonged wet conditions turn sheep off their feed and grain being fed on the ground may largely be wasted. Also as soon as the first green pick emerges, sheep will often chase this and go off their ration. It is essential that sheep be kept confined to the restricted feeding areas until adequate pasture is available. At that point, allow increasing grazing time each day until full grazing is provided after 6–7 days.

Allowing immediate full grazing can lead to digestive disorders.

Full hand feeding of sheep – quantities

The quantity of feed required for full hand feeding depends on the size and stage of production of the animal and also the quality of the intended feed stuff. It is impossible to offer glib rules of thumb as to the feeding rates for animals without some knowledge of the quality of the feed being used.

NUTRIENTS

Sheep, whether being fed for maintenance or production, need a balanced supply of nutrients. Nutrients divide broadly into:

- energy
- protein
- minerals
- vitamins.

Although water is not considered a nutrient, an adequate supply of drinkable water is also vital for livestock survival, particularly during drought.

ENERGY REQUIREMENTS FOR MAINTENANCE

Energy is needed by animals for all body functions. Energy is measured in megajoules (MJ). Animal requirements are assessed as megajoules of metabolisable energy (MJ.ME). Energy in feed is assessed as megajoules of metabolisable energy per kilogram of dry matter (MJ.ME/kg feed dry matter or simply M/D).

In drought, energy will always be the most limiting nutrient. Addressing this need is the first requirement in a drought feeding program.

Sheep requirements for energy depend on:

- liveweight
- energy concentration of the feed (M/D)
- pregnancy
- lactation
- growth
- weather conditions.

The first step in addressing the energy needs of adult sheep is to calculate the amount of feed needed to provide sufficient energy to maintain liveweight, assuming the sheep are neither pregnant nor lactating. Adjustments for pregnancy and lactation are discussed in the next section.

To calculate the maintenance feed requirement you must know the energy content of the ration to be used. Appendix 1 is a guide to the energy contained in various feeds. Feeds will vary dramatically in both energy and protein and the values contained in Appendix 1 are average values only. Whenever possible, a feed analysis is recommended so that rations can be calculated accurately. Your local livestock officer can provide information on testing laboratories.

Once the energy content of the feed is known, use Figure 2 to predict the amount of feed needed to meet maintenance requirements. If several feeds are being fed concurrently the following procedure is used to calculate the energy content of the mixed ration. Use the M/D of the mix to calculate rates from Figure 2.

For example a ration containing 80% wheat (13 M/D) and 20% clover hay (9 M/D). The calculation is as follows:

$$\frac{(80 \times 13) + (20 \times 9)}{100} = 12.2 \text{ M/D}$$

Find the appropriate value for 'Shorn empty liveweight (kg)' for your sheep and place a ruler intersecting this liveweight and 12.2 on the Feed M/D line. The point where the ruler cuts the right hand line indicates how much dry matter needs to be fed to maintain liveweight. For a 45 kg sheep and 12.2 M/D the feeding rate is 500g/hd/day of dry matter.

All feeds contain some water. Hay and grain are typically 90% dry matter so to determine the quantity of the ration 'as fed', multiply the dry matter feeding rate by 100 and divide by the dry matter percentage.

For our example:

$$\frac{500 \times 100}{90} = 555 \text{ g/h/d of the mix}$$

Note that as the energy value of feeds declines below about 7.5 M/D, it is likely that a dry sheep will be unable to consume sufficient quantities to achieve maintenance. For pregnant and lactating ewes a feed below 9.5 and 11 M/D respectively is unlikely to be sufficient.

Figure 2. Daily feed (dry matter) required for maintenance of sheep

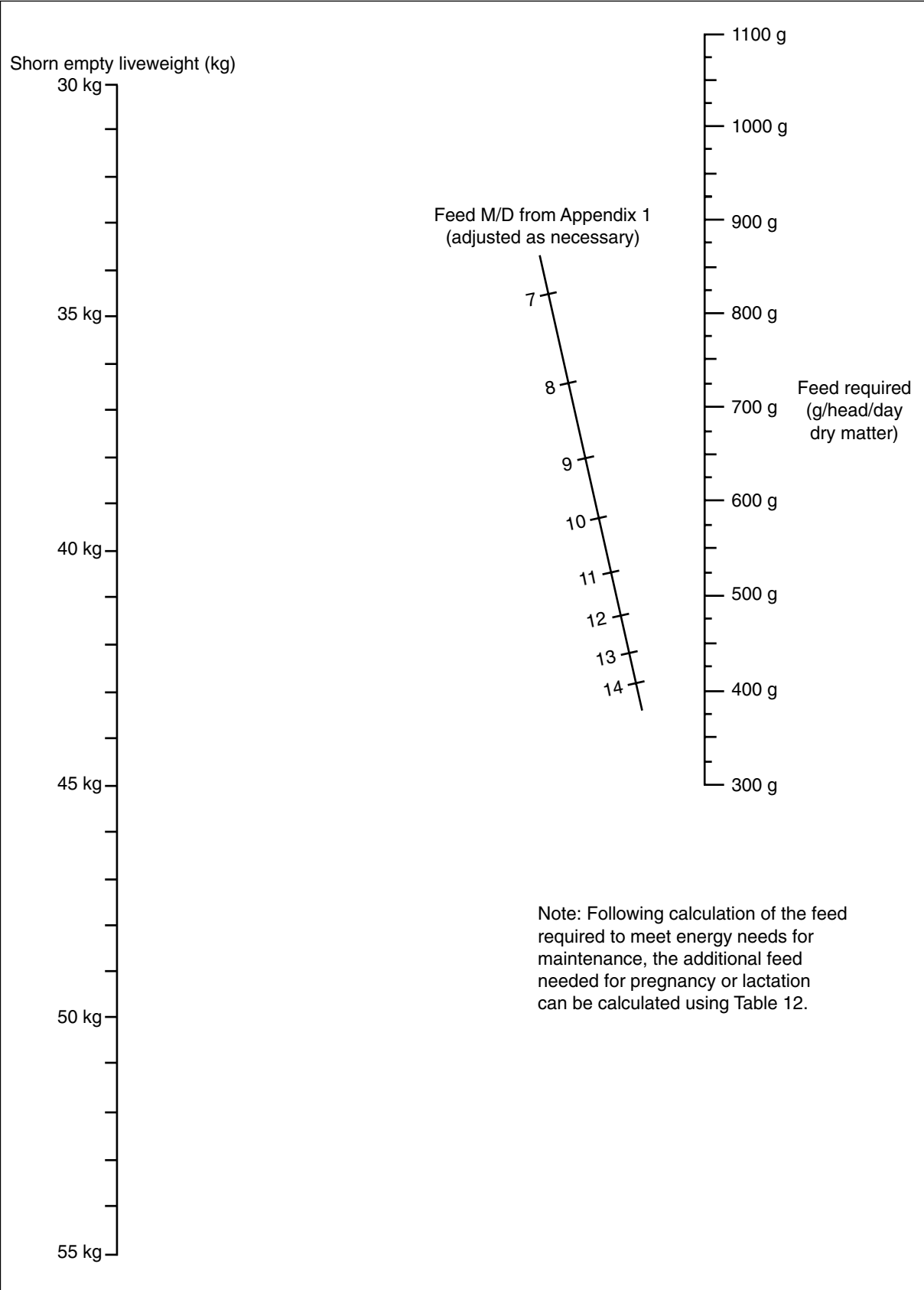


Table 12. Allowances for pregnancy and lactation.

	Factor	Minimum* crude protein %
Dry ewe or wether	1.0	6
Ewe flock to last month of pregnancy	1.0	6
Ewe flock during the last month of pregnancy	1.7**	8
Ewe flock – first month of lactation	2.5	12
Ewe flock – second and third months of lactation	1.8	12

* These minimum values are shown as a guide for maintenance feeding in circumstances where feeding costs need to be minimised. For any diet, but especially one based on grain, crude protein must be adequate (see Table 14).

** Feeding levels should be gradually increased to this allowance from 6 weeks before lambing.

ENERGY REQUIREMENT FOR PREGNANCY AND LACTATION

Once the feed requirements for a dry sheep have been calculated, allowances can be made for the increased requirements for pregnancy and lactation. This is achieved by multiplying the maintenance requirement by the appropriate factor in Table 12.

The requirements indicated in Table 12 for late pregnancy and lactation are average requirements and assumes a flock consisting of both single-bearing (70–80%) and twin-bearing (20–30%) ewes. Individual ewe requirements vary around this average. For example, ewes at the peak of lactation rearing twins need about 3.3 times maintenance but within a flock, ewes vary in their stage of pregnancy and lactation and the factors in Table 12 are the best indication of flock needs.

ENERGY REQUIREMENTS FOR WEANERS

Both energy and protein will be important to achieve adequate performance from weaned lambs

Table 13 predicts the daily amount of feed of a specific M/D required to achieve a given growth rate in merino weaners. The minimum crude protein requirement for each situation is also shown.

Table 13. Predicted feed and minimum protein requirements for merino weaners

		Weaner Liveweight									
		10 kg		15 kg		20 kg		25 kg		30 kg+	
Growth target	M/D	Feed g/d	Protein %	Feed g/d	Protein %	Feed g/d	Protein %	Feed g/d	Protein %	Feed g/d	Protein g/d
Maintain weight	8	Feeding to maintain weaners below 20 kg is not recommended				510	8.7	590	8.7	680	8.7
	9					440	9.5	510	9.5	590	9.5
	10					380	10.0	450	10.0	510	10.0
	11					340	10.8	400	10.8	450	10.8
	12					300	11.5	350	11.5	400	11.5
	13					270	12.5	320	12.5	360	12.5
50 g/d	10	350	14.5	450	13.0	560	11.8	610	11.1	770	10.4
	11	300	16.3	400	14.0	490	12.9	580	12.0	660	11.6
	12	260	18.7	350	15.4	430	14.0	510	13.0	580	12.5
	13	240	19.5	310	16.7	380	15.2	450	14.1	510	13.6
100 g/d	11	420	17.9	540	15.1	660	13.5	780	12.3	880	11.7
	12	360	20.2	460	17.0	570	14.9	670	13.6	760	12.8
	13	330	22.4	410	18.4	500	16.3	590	14.7	670	13.8
150 g/d	12	470	20.5	590	17.5	710	15.5	840	13.8	950	11.8
	13	420	23.4	510	19.5	620	16.9	730	15.1	830	13.9

The rate required varies according to the M/D of the feed, the current weight of the lamb and the required weight gain.

Example: for a 15 kg weaner to achieve 100 g/hd/day weight gain on a ration with 12 M/D the required feeding rate will be 460 g/hd/day at a minimum crude protein requirement of 17%

If a feed M/D is not shown in the table it means that feed of that energy concentration would be unsuitable for the intended liveweight and weight gain. This is because weaners of that weight would reach their intake limit before sufficient ME is consumed to achieve that growth rate target.

Young weaners also need roughage as part of their diet to encourage continued rumen development. This should comprise at least 20% of the total ration, and preferably be a high-quality legume hay.

ENERGY ALLOWANCE FOR CHILL

Chill (the combination of wind, low temperatures or rain, or both) can significantly increase the energy requirements of sheep. For example, freshly shorn sheep will need at least double the calculated feed requirements if wind conditions approach 15 km/h and daily minimum and maximum temperatures are in the range of 0–10°C.

The same sheep, in calm conditions experiencing similar temperatures, requires only 60% more than the calculated feed requirement.

For sheep off-shears, 20% additional feed will be a minimum requirement even in relatively mild conditions. Chill can significantly influence energy requirements until fleece length exceeds 3 cm.

Good-quality hay is the best source of extra feed during cold stress periods as there is no risk of grain poisoning from increased feeding rates and digestion occurs over a longer time frame so raising body temperature for longer. Ad lib feeding is necessary to achieve maximum intake.

Lupins are the only grain which can be fed at rapidly increased quantities without risk of acidosis (grain poisoning).

PROTEIN

Rapidly growing sheep or lambs, and ewes in late pregnancy and through lactation, have greater needs for protein than do animals just maintaining weight. The amount of protein

required must also balance the energy content of the diet if rumen fermentation is to have the greatest efficiency.

Much of the protein in feed is reduced to ammonia in the rumen. Ammonia is then used as a nitrogen source by rumen microbes to construct new protein. It is the flow of microbial protein to the true stomach and intestine that provides the majority of digestible protein to ruminant animals.

The minimum crude protein requirements for various classes of mature sheep are listed in Table 12; the requirements for weaners are listed in Table 13. Appendix 1 shows average protein levels for various types of feeds.

If more than one feed is being fed the following procedure is used to calculate the protein content of the mixed ration.

For example a ration containing 80% wheat (14% protein) and 20% lucerne hay (16% protein). The calculation is as follows:

$$\frac{(80 \times 14) + (20 \times 16)}{100} = 14.4\% \text{ protein}$$

Although Table 12 indicates relatively low minimum protein requirements for various types of sheep, it may be financially viable to use feeds with a better balance between energy and protein. To do this, you may need to increase the protein proportion of some diets according to the suggested protein contents in Table 14. Oat grain is a common feed which is often unbalanced for protein. Oat grain can often be at least 11 M/D but only 8% crude protein (CP). Referring to Table 14 it is clear that this oats would need to be 14% CP in order to be balanced. Some other source of protein or nitrogen could be mixed with the oats to raise the CP of the diet. Lupins are often fed with oats for this purpose.

The benefits of balancing the protein in the ration would come from either increased productivity from the same amount fed, or feeding less for the same level of productivity. For maintenance feeding, the required rate may only be reduced by 10% so the financial viability of adding another source of protein to the grain will depend on the relative cost of feeds (particularly protein-rich feeds). If high levels of production are expected (e.g. finishing lambs), the viability of adding extra protein is likely to be better due to the higher value the product. Each circumstance needs to be evaluated on its individual merit. (Your local NSW Department of Primary Industries Sheep and Wool Adviser can provide assistance in this task.)

Table 14. Crude protein required to maintain a balance between energy and protein

Energy content of diet (M/D)	Crude protein requirement* (%)
13	16
12	15
11	14
10	13
9	11.5
8	10
7	9

* Assumes 70 percent rumen degradability.

UREA AS A PROTEIN SUPPLEMENT

Urea, while not a protein, will form ammonia for use by rumen micro-organisms.

Adding 1% of urea by ration weight to the diet will increase the overall crude protein by 2.6%.

Warning: urea is toxic if fed at too high a rate. Sheep should receive a maximum of 3 g of urea per 10 kg of liveweight so the percentage added to the ration will be determined by the intended feeding rate. A dry sheep of 50 kg may only need 500 g of feed per day and can safely consume up to 15g of urea. This equates to 15g in 500g or 3%. A 25 kg weaner can only consume 7.5 g of urea per day and if eating 800g of feed per day the appropriate maximum urea concentration would be only 1%. If allowed ad lib access that same weaner may eat up to 1200 g per day and the safe urea rate would be limited to around 0.6%.

Urea concentrations above 2% are likely to depress diet intake. Urea supplementation will only be effective if:

- there is a good supply of energy and protein is limiting;
- sheep are fed daily or through self-feeders.

Urea is toxic, so it is important that it be properly mixed into the feed, as concentrated pockets of urea will kill stock. The preferred method of mixing urea with feed is to dissolve it in hot water and spray the solution onto grain when augering or filling the feed bin. The rate will depend on the concentration of the solution and the speed and size of the auger.

MINERALS

Six major minerals and seven minor minerals are recognised as being important to sheep production. However, only two – calcium and sodium – are needed as additional supplements during drought feeding.

Calcium is deficient when diets consist mainly of cereal grain. To prevent calcium deficiency, add 1.5% by weight of ration of finely ground agricultural limestone (calcium carbonate) to cereal grain. That is, for every 100 kg of grain, add 1.5 kg of limestone. Do not use builders lime, burnt lime or slaked lime.

Spread lime onto grain when filling the feed-out bin. Lime is not lost when feeding-out as the fine particles stick to the grain.

Sodium is also deficient in most grains. Add 0.5% of fine salt to grain diets to prevent a deficiency.

Water can often be a source of sodium.

Additional amounts of salt are not needed if the water has high salt levels. The likelihood of any other mineral being deficient is low.

VITAMINS

Two vitamins, A and E, are the only vitamins likely to be deficient as a direct result of drought feeding. Vitamin A is obtained from green pasture, hay with good green colour and yellow maize. Even a short green pick will supply adequate quantities of the vitamin. Vitamin A is stored in the liver. Young sheep usually experience deficiencies when they have been without green pasture, green hay or yellow maize for 6 months, and adults will be deficient after 12 months. Symptoms are night blindness, eye discharges and ill-thrift.

An inter-relationship exists between vitamin E and selenium. Grains and hays are fair to good sources of vitamin E, although there is considerable variation.

A vitamin E deficiency induces symptoms similar to selenium deficiency (that is, still-born lambs, and older lambs that suffer from a stiff, stilted gait, lameness and arch back). If you suspect a deficiency, seek veterinary advice for confirmation and dose rates.

The most efficient solution to both problems is to administer a Vitamin A,D,E injection which will alleviate the problems for some months.

FURTHER INFORMATION

The NSW Department of Primary Industries website has a wealth of information available at

www.dpi.nsw.gov.au/drought

Full hand feeding of sheep – feeding management

GRAIN INTRODUCTION

When introducing sheep to grain and pelleted diets, there is a significant risk of grain poisoning or acidosis. It is the high starch content of most grains that causes the problem. Lupins, being low in starch, are the exception and are useful when animals need immediate introduction to a high energy diet.

Slowly introduce sheep to high-grain diets according to the schedule shown in Table 15. It is useful to use hay in addition to the recommended rate of grain in order to get animals eating. The amount of hay can be reduced to nil over the introduction period.

Note: If sheep show symptoms of grain poisoning, return to the next lowest level of feeding for 2–3 days and treat individual animals for grain poisoning. Adding 2% sodium bentonite or 1% salt to grain rations helps to reduce the risk of poisoning during grain introduction.

Table 15. Grain introductory program

Days	Amount of grain grams per head	Frequency of feeding
1 and 2	50	Daily
3 and 4	100	Daily
5 and 6	200	Daily
7 and 8	300	Daily
9, 10 and 11	370	Daily
12, 13 and 14	430	Daily
15 and 17	860	Every 2nd day
19, 22 and thereafter	1290	Every 3rd day

CHANGING GRAINS, NUTS OR PELLETS

Sheep which have been accustomed to one type of grain can not immediately adjust to another. Consequently, deaths and a high incidence of tender wool can result from a sudden switch of feed. Even the same grain type obtained from a different source has caused losses. Manufactured feeds can cause grain poisoning as the manufacturer may change the major grain ingredients, or change the processing procedure from one batch to the next.

If it is necessary to use a different grain, arrange the supplies early and mix the old grain with the new, gradually increasing the concentration of the new grain over at least four feeds.

Incorporate sodium bentonite or salt (as outlined above) to reduce the risk of grain poisoning during the change.

FREQUENCY OF FEEDING

Frequency of feeding is determined by the physiological state of the sheep, type of feed, availability, the capacity of troughs and self-feeders, and also the risk of feed losses through rain, birds and other animals.

Feed dry sheep, and ewes up to the last 4 weeks of pregnancy, twice weekly as it gives better results than more regular feeding. However, ewes in late pregnancy or during lactation and young weaners require daily feeding or a constant supply of feed such as from self-feeders. These sheep are commonly fed both hay and grain. Feeding each on alternate days is a satisfactory practice.

FEEDING METHODS

Grains are normally fed by trailing on the ground, particularly the larger grains (for example, corn) which are easily picked up by sheep. Trailing is not advisable when the ground is either cracked or excessively dusty. Troughing is then necessary. Low-cost troughs can be made from surplus farm materials. Examples of such materials are corrugated iron between steel posts, timber or rubber belting. If using materials salvaged from industrial use take care that there is no risk from chemical residues.

It is advisable to feed meals and fine materials in troughs. Trail length and trough space depend on the size and number of sheep, and

the amount of ration being fed out. If you are using small daily feeds, allow up to 15 cm of double-sided trough for large-framed sheep; with less frequent feeding, trough lengths can be reduced to 7 cm.

Feed lambs and weaners from troughs with hay placed in hay racks. When feeding hay on the ground, break bales open and scatter them widely to allow ready access. Rolling out round bales will improve accessibility.

RATION PROCESSING

Hammermilling, cracking or soaking grain is not necessary for sheep. All sheep, including young weaners, can digest whole grain without wastage. Hammermilling increases the risk of grain poisoning.

There is no advantage in processing hay.

FEEDING PADDOCKS AND LOTS

In drought, sheep should be restricted to very small areas or even feed lots. This limits pasture damage and erosion, restricts possible weed contamination derived from purchased fodders, leads to more efficient fodder usage, and reduces costs associated with feeding.

In addition, when the drought breaks, restricting sheep prevents animals chasing the first green pick.

When choosing the areas to feed stock, consider such aspects as proximity of the feed supply, shelter, access to good quality water, soil type, pasture quality and proximity to residential areas. Wet weather access is also important.

FURTHER INFORMATION

The NSW Department of Primary Industries website has a wealth of information available at

www.dpi.nsw.gov.au/drought

Water requirements for sheep and cattle

Warning

Chemical residues and pollutants

Contamination of water supplies by chemicals and other pollutants is a risk, particularly in mixed farming areas, where the use of pesticides and herbicides is common. Producers should be aware of the risks involved in the use or misuse of these compounds. Contamination of ground water or catchment areas could lead to intake of chemicals by stock and wildlife. While there may not be any direct toxic effect on the stock, some chemicals can stay in the animal as residues which may render the produce of that animal unfit for consumption and expose the owner to the cost and inconvenience of quarantine or prosecution or both.

Water is an essential nutrient for all animals. It is important for both animal welfare and business profitability that sheep and cattle have an adequate supply of good quality water. Amount and quality of water required vary between species of livestock, between classes of stock within the species, and in response to the environment in which the stock are running (see Table 16a).

The suitability of water for stock use is determined by the following factors:

- water quality, which includes salinity, acidity, toxic elements and compounds, and algal growth;
- environmental factors such as air temperature and feed quality;
- animal factors, which include breed differences and age and condition of stock.

WATER QUALITY

Quality of water is broadly defined as its fitness for consumption by livestock to maintain satisfactory production. The principal factors affecting water quality are as follows.

Salinity

The main factor which determines the suitability of water for stock is the proportion of dissolved salts in the water. Dissolved salts in water are

expressed in milligrams per litre (equivalent to parts per million – ppm) or in terms of the electrical conductivity of the water, measured in decisiemens per metre (dS/m) or microsiemens per centimetre (µS/cm). Maximum advisable levels are shown in Table 16. (1 dS/m = 1000 µS/cm = approx. 640 mg/L or 640 ppm.)

Generally, surface waters are low in salts compared with artesian or underground water. Many factors influence the concentration of salts that animals can tolerate in their drinking water. Salinity increases the intake of water by animals, partly through the taste and partly to allow greater water turnover so that the body can regulate the salt balance.

Acidity or alkalinity (pH)

Water with a pH value below 6.5 (acid) or above 8.5 (alkaline) can cause digestive upsets in stock, resulting in rejection of the water, depressed appetite and consequent loss of production. If this problem is present, animals may perish, even when they apparently have adequate water.

Adding alum can correct high pH, but this should be undertaken with care as alum is highly acidic. Likewise, water with a pH below 6.5 can be treated by adding lime.

Toxic elements and compounds

Water is a potential source of important minerals and other compounds. However, the concentration of these substances can reach toxic levels, particularly in underground water.

There are a number of elements which, if present in high enough concentrations, can lower livestock productivity. These include iron,

magnesium, arsenic, lead, mercury, selenium and the fluorides. Where productivity losses are suspected, the problem can be investigated by a veterinarian or livestock adviser. Such an investigation would include a detailed water analysis, combined with an examination of affected stock.

Algae growth or bloom

Algae occur naturally in both fresh and brackish waters. They respond to sunlight and fertilisers, and when environmental conditions are right, algal growth may occur that can make water unpalatable to stock.

Algal blooms are excessive growth of particular algal species. Blooms are most likely to occur when the water is still, warm and contains high nutrient levels.

All algal blooms can cause water use problems. However of most concern are those caused by blue-green algae, as a number of these are toxic.

Currently in NSW, only Coptrol Aquatic Algicide®, Cupricide Algicide® and Cupricide 110 Algicide® are approved for the control of blue-green algae and some other algae types. They must be used in strict accordance with their label conditions and directions. These products are registered for use in farm dams, rice paddies and irrigation conveyance systems. They must not be used in rivers, streams, creeks, wetlands, lakes or billabongs, and water treated with these products must not be allowed to spill into these water bodies.

Table 16. Tolerances of livestock to total dissolved solids (salinity) in drinking water (mg/L)

Stock	Desirable maximum concentration for healthy growth	Maximum concentration at which good condition might be expected*	Maximum concentration that may be safe for limited periods*
Sheep	5,000	5,000–10,000	10,000–13,000
Beef cattle	4,000	4,000–5,000	5,000–10,000
Dairy cattle	2,500	2,500–4,000	4,000–7,000
Horses	4,000	4,000–6,000	6,000–7,000
Pigs	4,000	4,000–6,000	6,000–8,000
Poultry	2,000	2,000–3,000	3,000–4,000

* The level depends on the type of feed.

Adapted from *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000*.

Table 16a: Average water requirements of stock

Stock type	Consumption Per head per day (L)
Sheep Weaners	2–4
Adult dry sheep – grassland – saltbush	2–6 4–12
Ewes with lambs	4–10
Cattle Lactating cows – grassland – saltbush	40–100 70–140
Young stock	25–50
Dry stock (400 kg)	35–80
Horses	40–50

Notes

- Figures quoted for consumption have a wide range; this variation is explained in the text.
- When planning water supply requirements, allow for evaporation losses and consumption by native and feral animals.

ENVIRONMENTAL FACTORS

Temperature

In hot weather, animals use more water for evaporative cooling. For example, shearing increases the heat load on sheep in summer because the insulation formerly provided by the fleece is lost. The sheep adjust to this heat load by increasing evaporative cooling through panting. Water consumption can increase by 78 per cent under extreme conditions. The provision of shade will largely relieve this situation. In normal conditions with good quality water, consumption in summer will be about 40 per cent higher than in winter. However, with salty water the summer intake may be 50 to 80 per cent higher than consumption in the cooler months.

The amount of water that stock drink also depends on the temperature of the water. Generally, animals prefer water at or below body temperature and avoid warmer water. Cool water is preferred in hot conditions.

Marginal quality water may become unsatisfactory during summer because animals drink more because of high temperatures and

drier pasture. The salinity of some water may also increase because of evaporation from troughs, bore drains and shallow tanks.

Drought

During drought, stock require more water as they are forced to select more fibrous and less digestible feed. This extra water is used to maintain the movement of the coarse feed in the gut. As drought worsens and stock become weaker, marginal waters may become unsuitable as the animals' tolerance of the salt decreases.

Feeding salt or salt-based licks or blocks during dry periods increases water intake. If water quality is marginal, this added salt intake may depress appetite and cause digestive upsets – the opposite of the supplement's purpose.

Pasture composition

The diet of stock has a large influence on their water requirement. Good green pasture can supply all an animal's water needs. Sheep under these conditions may not need to drink for many weeks.

Good pasture allows stock to use water which would normally be unsuitable at higher levels of consumption. Stock on dry pasture need increased water consumption to utilise the less digestible fodder.

In pastoral areas, stock grazing saltbush or other chenopod plants require large quantities of relatively low-salinity water. This is because of the high level of salt in the diet and the need for a high water turnover to maintain the salt balance in the body.

ANIMAL FACTORS

Age and condition of stock

Young animals, heavily pregnant or lactating females, and aged or weakened stock are less tolerant of saline water. In weaner sheep, high salinity depresses growth rate and wool production, and causes scouring.

Breed differences

British breed sheep need about 20 per cent more water than do Merino sheep in hot weather.

Cattle of the *Bos indicus* or *Bos indicus*-infused breeds drink less water under hot conditions than do *Bos taurus* breeds (British or European breeds).

WATERING POINTS

The consumption of water can be affected by the cleanliness of the watering point.

Where the water level in an earth tank is low, animals may be forced to wade through mud to get to the water. Due to the boggy surroundings, the water becomes heavily contaminated with suspended soil and faeces, which can make stock reject the water. Also, animals in weak condition may become bogged and die.

Feral pigs can create the same effect by wallowing along the water's edge.

Such dams should be fenced off and the water pumped or gravitated to temporary troughing. This will ensure maximum use of the available water by avoiding fouling, and will remove the risk of stock losses from bogging.

Troughs used in watering systems should be drained and cleaned regularly. Algae grow in troughs, producing unpleasant odours in the water which can repel stock. Salinity also builds up due to evaporation if troughs are not drained.

The frequency of cleaning depends mainly on the temperature, which affects intake and the rates of evaporation and algae growth. The type of stock will also have some influence

on the frequency of cleaning, as tolerance of contamination varies according to the requirements of the particular class of stock.

Contamination of trough water need only be very slight to cause problems with some stock. Instances have been recorded of weaner sheep refusing water because of a thin layer of dust on the surface of an otherwise clean trough.

Care should be taken when introducing stock to extensive paddocks or unfamiliar watering systems. When introducing stock to a new paddock, make sure they are familiar with the location of the watering point and are drinking the water, particularly in pastoral areas. If water quality is marginal or unknown, check newly introduced stock during the first week to ensure that there is no problem.

WATERING RADIUS

In pastoral areas, sheep normally graze within a radius of about 2.5 km of a watering point, and cattle within a radius of about 5 km.

If stock require more water due to lactation, salinity or dry feed, they may need to drink more than once a day. This will reduce their foraging radius and the area of the paddock being used.

Feed Quality Service

NSW DPI operates a Feed Quality Service based at Wagga Wagga which provides a quality assured analytical service with a fast turnaround time. The service is based on the latest technology and is fully accredited by NATA.

The Service also participates in all proficiency tests conducted by the Australian Fodder Industry Association (AFIA).

Packages and sampling kits

The service offers **standard packages** for rapid turnaround. The sampling kits are available through any NSW DPI office or by contacting the Wagga Wagga Customer Service Unit.

- Standard Forage package – \$53.30
- Premium Silage package – \$90.00
- By-Products package – \$85.00
- Grain and Mixed Feed package – \$53.30

We can also offer a **tailored package** for special requirements, from the following tests:

- Dry matter % (DM)
- Dry matter digestibility % (DMD)
- Crude protein (CP)
- Fibre
- Metabolisable energy (ME)
- Fat
- Ash content
- Organic matter
- Silage pH
- Silage ammonia-nitrogen

Further information

For information on custom pricing, turnaround times, collecting samples, submission and reporting procedures, etc., please contact the Customer Service Unit on (02) 6938 1957.