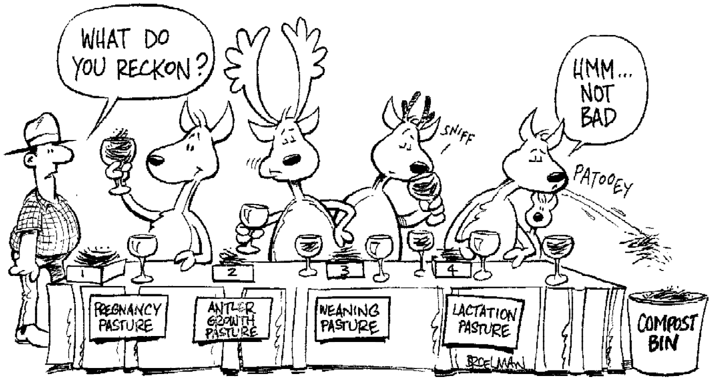
FEED AND WATER REQUIREMENTS



FEED AND WATER REQUIREMENTS

Simple estimation of feed requirements involves four basic steps:

- Determining energy or other nutrient requirements
- Estimating the availability of the nutrients from existing pastures
- Determining the shortfall if any
- Calculating the type and volume of supplementary feed to balance required nutrient intake

Determining Nutrient Requirements

The energy and protein requirements of deer through all stages of production are known through research undertaken across the world and are discussed earlier in this book.

Reasonable estimates of animal requirements can be made with knowledge of the animal's live weight, production status and effects of season on requirements (see chapter on nutrition).

In particular, knowledge of an animal's energy requirement and its maximum dry matter intake are always necessary and at times of late pregnancy, lactation and growth it is necessary to know about its protein needs.

For those looking for more precise estimates, computer programs like GrazFeed ® [72], developed by the CSIRO enables rapid analysis of factors including pasture, livestock, climate, supplements available and health status to predict livestock production from pasture.

However, being able to assess pasture in terms of quantity and quality is critical to making management decisions whether using self-estimates or using computer programs like GrazFeed ® to estimate animal requirements.

Example 1

From Graph 1 in the chapter on nutrition we can determine the requirements of mature Red hinds in early summer (lactation).

Live weight	Daily energy requirement MJ ME/day	Daily DM intake Kg DM/day
100	36.0	3.9

Table 12: Hind Requirements in Early Lactation

Nutrient Availability from Pastures

The available nutrient content of pasture can be reasonably estimated, especially by people who have been trained using the PROGRAZE technique, and the nutrient content of supplements can be tested by feed laboratories to provide accurate information about their nutrient content.

Feed Quality

The chapter on Pasture Assessment describes how pasture characteristics change throughout the year, in particular the quality of feed, the quantity of feed and the rate at which the pasture grows.

As animal requirements also change throughout the year, pastures must be continually monitored to ensure that nutrition needs (quality and quantity) of stock are met. Any shortfalls in requirements can and must be made up by supplementary feeding to ensure animal production and health is not compromised.

Pasture Height and Species

Red Deer

Rye grass/white clover

Research in New Zealand has shown that growth of weaner Red deer is very sensitive to pasture height [8]. The research showed that for maximum deer productivity, ryegrass/white clover pastures should be maintained in the vegetative state and grazed at a height of 8 to 10 cm as is common practice on most high performing dairy farms in New Zealand.

Red Clover/Chicory

However, Barry [8] also summarized deer grazing preference studies that showed that Red and Fallow deer select legumes (particularly red clover) and chicory in preference to perennial grasses.

Research showed that Red deer weaners given access to red clover or chicory pastures increase carcase weights by 11 to 17% above animals that do not have access.

Ideal management of red clover and chicory pastures must consider that during their winter dormancy their DM production is very poor so they should not be sown over more than 20% of the grazing area.

Red clover and chicory pastures should be rotationally grazed at 3 to 5 week intervals so that when animals enter the pasture it is at least 30 cm high and they leave it before its height drops below 10 cm.

The research showed that if white clover and ryegrass pastures are managed in this way an average of almost 75% of the weaners reach a 50 kg carcase weight by one year of age.

Other Legumes

Barry [8] suggests that other legumes that grow well in dry conditions such as lucerne should be considered as forages for farmed deer in temperate areas and tropical legumes considered for deer in tropical areas. However, there is little or no data on tropical pastures for deer and the physiology of tropical deer may be different [44].

Other Temperate Species

Although no research data is available, it seems reasonable to assume that other temperate species of deer (Fallow and Wapiti/Elk) will show similar growth advantages from management of pasture height and specialist pastures described for Red deer.

Tropical Species

Barry [8] suggests that the general principals of forage feeding defined for temperate deer may also apply to tropical species (Rusa and Chital) and that tropical legumes should be considered for deer in tropical areas. Anecdotal information from Queensland [27] suggests short pasture (e.g. green couch) gives good results for Rusa deer.

Estimating the Daily Available Energy from Pasture

Estimate the daily available energy (MJ ME) from a pasture by (see the chapter on Pasture Assessment):

- Measuring the kg of dry matter/hectare
- Using information about the digestibility of the pasture, estimate its energy content (MJ ME/kg DM)
- Estimate daily intake (kg DM) of the pasture by grazing stock
- Multiply the value of the energy content of the pasture (MJ ME per kg DM) by the dry matter content of the pasture (kg DM per hectare) to estimate the total daily energy intake available from the paddock

Supplementary Feeding

Supplementary feeding is principally used to correct seasonal deficiencies in available pasture and to increase the carrying capacity of a defined area of land.

The amount of supplement necessary to maintain required growth and production from animals managed is dependant on the volume and quality of pasture available to the animals.

The digestibility of feed ingredients for deer is commonly considered to be similar to those for sheep. However, Ru et al [76] found that digestibility data for sheep cannot be applied to deer for all ingredients. For example sheep and Fallow deer show a higher digestibility for sorghum than Red deer and sheep are able to digest protein in medic hay more readily than deer.

However until more exact information is available, digestibility data used for sheep can be considered a reasonable guide.

Differences in digestibility can be influenced by factors including rate of passage of food through the digestive tract, structure of the digestive tract and chemical composition of feed.

A Guide to Average Nutritional Value of Common Supplementary Feeds

Principal sources of information used for information provided in Table 13 'A Guide to Average Nutritional Value of Common Supplementary Feeds' were [57] and [73].

Note:

- Values shown are intended as a guide only and have been compiled from a range of sources and personal experiences
- Although values can be considered a reasonable guide , actual energy and protein values for any feed can change markedly between seasons and 'average' values for some locations may vary from those shown
- Protein values are determined by laboratory analysis
- Analytical feed laboratories can test representative samples of feed and provide information on nutrient content
- DM = Dry Matter, ME = Metabolisable Energy, MJ = Mega Joules, DP = Digestible Protein

Feed	DM (%)	Energy (MJME/kg DM)	Crude Protein (%)	Fibre (% DM)
Grains				
Barley	90	13.7	12.1	5.3
Lupins	90	13.2	32.0	14.0
Maize	90	14.2	8.0	2.4
Oats	90	11.5	11.0	14.0
Peas	90	13.4	24.9	8.0
Sorghum	90	12.4	13.1	2.8
Triticale	90	14.0	10.8	3.5
Vetches	90	13.6	26.5	6.9
Wheat	90	12.9	13.8	2.6
Clover Dominant Pasture				
Immature	20	11.0	17.0	19.0
Flowering	23	10.0	15.0	30.0
Dry	70	4.0	5.7	32.0
Grass Dominant Pasture				
Immature	20	11.0	22.9	13.0
Flowering	23	10.0	15.9	15.0
Dry	72	5.0	3.5	30.0
Lucerne Pasture				
Immature	15	10.2	20.2	22.0
Pre Flowering	22	9.4	15.3	28.0
Full Flowering	24	8.2	12.0	30.0
Growing Cereals				
Barley - tillering	21	9.5	11.7	23.0
Barley - flowering	25	8.4	6.8	28.0
Maize	19	8.8	8.9	28.9
Oats - tillering	23	10.0	13.9	32.0
Oats - flowering	25	9.8	8.3	36.0
Wheat - tillering	26	9.0	16.3	23.0
Wheat - flowering	28	8.5	5.2	27.0
Hays				
Oaten	90	7.7	6.0	32.0
Pasture (mainly grass)	90	8.0	7.0	33.0
Grass dominant clover	90	10.0	9.0	27.0
Red clover	90	8.9	16.1	29.0
Lucerne	90	8.2	16.7	32.0
Medic	90	11.0	11.5	32.0
Pea	90	9.0	10.2	34.0
Vetch	90	8.1	12.8	30.6
Silage				
Grass	20	9.5	19.6	30.0
Maize	20	10.8	4.8	23.0

Table 13: A Guide to Average Nutritional Value of Common Supplementary Feeds

Determining the 'Cheapest' Supplement

The most cost effective supplementary feed is not necessarily the cheapest (cost per tonne) feed available.

The most cost effective supplementary feed is usually the feed that provides the cheapest form of energy or depending on need, perhaps protein. Table 14 shows how to calculate the cost per MJ of energy for any feed. It assumes that the asking price (column A), the DM percentage (column B) and the energy content per kg DM (column E) are known.

The formulae used to calculate values in columns C, D and F are shown below Table 14. In the example provided in Table 14, based on the asking price and energy content for each of the feeds shown, the cheapest form of energy is provided by Clover Hay. By calculation, if the cost of the Clover Hay increases to more than $120 per tonne and other costs do not change, a different source of energy should be considered.

Foodstuff	Cost ($/Tonne)	DM (%)	Cost ($/Tonne DM)	Cost ($/Kg DM)	ME (MJ/Kg DM)	Cost ($/MJ)	Cheapness rank
	A	**B**	**C**	**D**	**E**	**F**	**G**
Barley	**$185**	90	$206	$0.206	**13.7**	$0.0150	2
Oats	**$165**	90	$183	$0.183	**11.5**	$0.0159	3
Triticale	**$200**	90	$222	$0.222	**14.0**	$0.0159	3
Lupins	**$260**	90	$289	$0.289	**13.2**	$0.0219	6
Peas	**$240**	90	$267	$0.267	**13.4**	$0.0199	5
Vetches	**$230**	90	$256	$0.256	**13.6**	$0.0188	4
Clover Hay	**$120**	90	$133	$0.133	**10.0**	$0.0133	1
Lucerne Hay	**$190**	90	$211	$0.211	**8.2**	$0.0257	6
Formula			**(A x 100)÷B**	**C÷1000**		**D÷E**	

Table 14: Determining the Cheapest Feed on an ME Content Basis

Calculating Feed Requirements

To calculate supplementary feed requirements for a mob of deer:

1. Identify the class (breed, sex, average live weight, production status - maintenance, growth, stage of gestation, stage of lactation) of animals that require supplementation

2. Determine average daily requirement of Mega Joules of Metabolisable Energy (MJ ME) for the mob (average individual MJ ME requirement multiplied by the number in the mob) (see the chapter on Nutrition)
3. Estimate the daily available energy (MJ ME) from the existing pasture by (see above)
4. Determine the daily energy imbalance, if any, by subtracting the total available from the total requirement
5. Estimate the maximum volume of supplement dry matter that can be consumed by the animal (maximum DM intake less estimated DM intake from pasture)
6. Select the most suitable (cost effective) supplement(s) and calculate the daily amount dry matter of the supplement that is required to provide the energy required - see 4 above (divide the amount required by the ME value for the feed)
7. If the animal(s) cannot consume the volume of DM required to supply their energy imbalance, a supplement that provides more energy/kg DM is required, other wise go to step 8
8. Calculate the amount of supplement to feed (correct for dry matter content by dividing the dry matter volume by the dry matter percentage)

Dry Matter Intake

Dry matter intake estimates for Red and Fallow deer are provided in the chapter on nutrition - Table 6.

Often the cheapest cost of feed energy may be provided by a supplement that has an MD (energy density - see above) so low, it is impossible for stock to consume enough of the feed to meet their energy need.

Example 1

For example if a mature Red hind in mid December has an energy requirement of 36.0 MJ ME/day (Graph 1) it would need to eat 3.6 kg of the clover hay DM listed in Table 13 above [3.6 ÷10.0] to meet its energy requirement.

From Table 6 (chapter on nutrition) the maximum dry matter intake for this hind in spring is 3.9 kg per day so she is able to consume the volume of hay required to supply her energy requirement.

However, Table 13 shows that clover hay is 90% DM (the other 10% is water) so the animal will need to eat 4.0 kg (3.6 ÷ 0.90) of the clover hay on an 'as fed' basis to meet it energy requirement.

Daily energy requirement (MJ ME/day)	Maximum DM intake (kg DM/day)	Feed Quality		DM intake required to meet ME requirement	Comment
		Digestibility	MJ ME /kg DM		
36	3.9	40%	4.8	7.5	*Cannot consume enough feed to meet ME need*
36	3.9	50%	5.7	6.3	*Cannot consume enough feed to meet ME need*
36	3.9	60%	8.2	4.4	*Cannot consume enough feed to meet ME need*
36	3.9	70%	9.9	3.6	*OK*
36	3.9	80%	11.6	3.1	*OK*

Table 15: Effect of Feed Quality on DM Intake

Combining Alternate Feeds to Provide a Balanced Ration

Often farmers will want to supplement an existing pasture with a supplement (grain or hay) or combine two alternate supplements to provide all of the nutritional (energy) needs of selected stock.

Minimum Energy Density of the Ration

The first task when assessing how much of any two feeds to mix together to provide specific animal requirements is to determine the minimum energy density (MD) for the ration.

Continuing the example in 'Dry Matter' above, and from Table 6, the maximum DM intake in spring for the hind described above is 3.9 kg per day.

The hind requires 36 MJ/day so the minimum energy density (MD) for a ration for this hind is 9.2 MJ/kg DM (36 ÷ 3.9). If the energy density of the ration is less than 9.2 MJ/kg DM, the hind will not be able to consume enough to meet her energy requirement.

If the ration MD is greater than 9.2 MJ/kg DM, the hind will be able to meet her energy requirement by eating a smaller volume of the ration.

Pearson's Square

The second task is to determine the required mix of two feeds. One commonly used method is the Pearson's Square method.

The format of a Pearson's square is shown below. In the example:

- '1' and '2' are the names of the feeds
- A is the energy density (MJ/kg DM) of feed '1'
- B is the energy density (MJ/kg DM) of feed '2'
- C is the required energy density of the final ration
- If A is greater than C, E is calculated as A minus C, if A is less than C, E is calculated as C minus A
- If B is greater than C, D is calculated as B minus C, if C is less than B, D is calculated as B minus C

Standard Format

Feed	ME (MJ/Kg DM)	MD Required	Ratio	% of the DM in the ration
1	**A**		**D** [B - C] or [C - B]	D ÷ F
		C		
2	**B**		**E** [A - C] or [C - A]	E ÷ F
			F [D + E]	

Supplementing Existing Pasture

One method to determine volume required of a single supplement is described in 'Calculating Feed Requirements' above.

Alternatively estimate the energy content of the pasture (MJ ME/kg DM) and with information on available supplements calculate the supplement requirement using the Pearson's Square.

Examples described below determine requirements for a mature Red hind in spring that has an energy requirement of 36 MJ ME/day. From above if the energy density (MD) of the pasture is greater than or equal to 9.2 MJ/kg DM, the hind will be able to meet her energy requirements.

Example 1 - Supplementation Not Required

If the animals have access to good quality pasture (70% digestible - 9.9 MJ ME/kg DM) the hind will not need any supplementation. If she eats 3.6 [36 ÷ 9.9] kgs of DM (she can consume 3.9) of pasture DM she will meet her energy requirements.

Example 2- Supplementation Required

If the animals have access to a full flowering lucerne pasture that provides 8.2 MJ ME/kg DM, the hind will not be able to consume enough of the pasture to meet her energy requirements. She would need to eat 4.4 [36 ÷ 8.2] kgs of DM to meet her energy requirements and she can consume a maximum of 3.9kg DM/day.

If barley grain is available as a supplement, a Pearson's Square calculation can determine how much barley is required each day to provide the hind with her energy requirements and ensure that pasture use is maximised.

Feed	MJ/Kg DM	MD Required	Ratio	% of the DM in the ration
Barley	13.7		1.0	18.2%
		9.2		
Lucerne Pasture	8.2		4.5	81.8%
			5.5	

The example shows that a daily ration of 3.91 kg DM/day that comprises a mixture of 18.2% barley (0.71 kgs) and 81.8% (3.2 kgs) lucerne pasture on a dry matter basis will provide the hind with ration containing 9.2 MJ ME/kg DM.

However if the barley is 90% DM and the lucerne pasture is 24% DM (the remainder of each is water), so she will need to combine 0.79 kg (0.71 ÷ 0.90) of the barley and 13.3 kg (3.2 ÷ 0.24) of lucerne pasture on an 'as fed' basis to meet her daily energy requirement.

Can the Pasture Supply Required Dry Matter

- Estimate the sustainable pasture availability (kg DM/hectare) - see chapter on pastures
- Multiply the estimated volume available by the paddock area (Kg DM/hectare x number of hectares)
- Compare supply with requirement (available less requirement)
- In our example a herd of 25 hinds of similar age size and production status will require a total of 332.5 kg (80 kg DM) of lucerne pasture per day combined with 19.8 kg (17.8 kg DM) of barley per day
- If the pasture production cannot be supplied from the paddock an increased level of supplementation will be required

As the digestibility and the rate of growth of the pasture declines the requirement for concentrate supplementation increases.

Combining Two Feed Supplements

Often farmers will want to provide stock with a combination of two alternate feed supplements, for example a grain and a hay supplement, so that energy needs are met, the ration is as cheap as possible and can be comfortably consumed.

Example 1

Feed	ME	MD Required	Ratio	% of the DM in the ration
Barley	13.7		0.3	6.2%
		9.2		
Clover Hay	8.9		4.5	93.8%
			4.8	

The example shows that a daily ration of 3.91 kg DM/day that comprises a mixture of 6.2% barley (0.24 kgs) and 93.8% clover hay (3.65 kgs) on a dry matter basis will provide the hind with a ration containing 9.2 MJ ME/kg DM.

However as the ration is 90% DM (the remaining 10% is water), she will need to eat 4.33 kg (3.9 ÷ 0.90) of the ration (0.27 kg barley and 4.06 kg clover hay) on an 'as fed' basis to meet her energy requirement.

A herd of 25 hinds of similar age size and production status will require a total of 6.8 kg (6.0 kg DM) of barley combined with 101.5 kg (91.3 kg DM) of clover hay per day.

Example 2

Feed	ME	MD Required	Ratio	% of the DM in the ration
Oats	11.5		1.0	30.3%
		9.2		
Clover Hay	8.9		2.3	69.7%
			3.3	

This example shows that a daily ration of 3.91 kg DM/day that comprises a mixture of 30.3% oats (1.18 kgs) and 69.7% clover hay (2.72 kgs) on a dry matter basis will provide the hind with ration containing 9.2 MJ ME/kg DM.

However as the ration is 90% DM (the remaining 10% is water), she will need to eat 1.31 kg (1.18 ÷ 0.90) of the oats and 3.02 kg (2.72 ÷ 0.90) of the clover hay on an 'as fed' basis to meet her energy requirement.

A herd of 25 hinds of similar age size and production status will require a total of 32.8 kg (29.5 kg DM) of oats combined with 75.5 kg (68.0 kg DM) of clover hay per day.

Energy and Protein Rule of Thumb

The Pearson's Square can also be used to balance protein and fibre requirements although not at the same time.

A reasonable rule of thumb is that when supplementing animals that have a high protein requirement (growth, late pregnancy, high lactation), a combination of about 75% of the cheapest (cost per unit of MJ) cereal grain and 25% of the cheapest (cost per unit of MJ) legume grain will approximately meet energy and protein requirements of the stock.

Buying Feed

The most cost effective supplementary feed is usually the feed that provides the cheapest form of energy (see 'Determining the 'Cheapest' Supplement above).

After determining the most cost effective feed, all purchases should be on a weight basis including hay as variation in bale weights can mean purchasing hay on a per bale basis can result in significant variation in the per tonne price.

Always consider risk of chemical residues or seeds of unwanted weed species in purchased feed and remember that the energy content of feeds can vary depending on the source (farm) of the feed and can also vary between seasons on the same farm. It is wise to have feed tested before purchase if possible.

Introducing Deer to Grain

There is the risk of grain poisoning from grain (i.e. barley and wheat) and pelleted rations that provide a high proportion of their energy as starch if stock is introduced to them too quickly. Stock can be safely introduced more quickly to supplements that have a relatively low starch content (i.e. lupins).

The pattern of introduction to high starch content supplements should be similar to that for other ruminant species. Stock should be introduced to the supplement over a period of at least 14 days starting at 50 grams per head per day and increasing by 50 grams every second day. The use of sodium bentonite added at the rate of 2 kg per 100 kg of grain during the introductory period can reduce the risk of grain poisoning.

Grain Poisoning

More fibrous grains, such as oats and lupins are safer to feed than are less fibrous grains like wheat and barley. However, any factor that causes variation in the intake of grain, or variation in the availability of carbohydrate, may lead to grain poisoning problems. For example, bad weather may put animals off their feed on one day, and the next day they gorge their feed.

As effects of grain poisoning may be worse if animals are suffering from cold stress, a wise precaution is to increase the proportion of roughage fed during particularly cold weather.

Grain poisoning effects can range from mild to acute. Symptoms reported in other grazing livestock that may also be seen deer are listed below. In mild cases symptoms in may include:

- Depression
- Non eating
- Abdominal pain indicated by the animal grinding its teeth or kicking at its belly
- Rumen contractions slow

In intermediate cases symptoms may include:

- Profuse, pale, bad smelling scour
- Abdominal pain and appearance of bloat
- Rumen contractions may stop
- Body temperature may be normal or a little below normal
- Respiration rate increases
- Lameness with heat and pain around the feet

In severe cases symptoms may include:

- Apparent blindness, staggers as if drunk
- Inability to stand
- Severe depression
- Low body temperature
- Recumbency
- Death can occur

Treatment

Grain should be immediately removed from the ration of mildly affected animals. If they continue to eat hay, they will usually recover without requiring other treatment. After they recover grain can be gradually reintroduced to the ration.

If animals show signs of more intermediate symptoms, drenching with sodium bicarbonate ($NaHCO_3$) or magnesium oxide (MgO) to neutralise the excess lactic acid in the rumen can be effective. Contact your local veterinarian or animal health adviser for dose rate information.

Urgent veterinary attention and perhaps euthanasia should be considered for severely affected animals.

Changing Supplements

When changing from one type of high energy supplement (grain) to another it is necessary to make the change over 10 to 14 days by mixing the new grain with the old, gradually increasing the concentration of the new grain.

It is important to remember that the energy content of grain can vary markedly between seasons and even between properties and districts in the same season. If the energy content of a supplement of the same grain type but from a new source is unknown, a wise precaution is to make the change over 10 to 14 days as described above.

A simple precaution is to have the feed tested by a feed testing laboratory to both reduce grain poisoning risks from changing feeds and to provide information that allows better matching of animal requirements with available supplements.

Manufactured Feed

Manufactured feeds such as pellets can represent a high risk feed for grain poisoning because of the finely ground nature of the material so stock must be introduced to manufactured feed carefully (see above).

Regularly check with manufacturers about the ingredients of each batch of feed as they may change the major grain ingredients or the processing procedure between batches. Although the final nutrient level in each batch is similar the form of the energy in the batch may be different so a change to a new batch of feed may need to occur gradually.

Processing Feed

Most information suggests that hammer milling, cracking, rolling or soaking grain is not necessary for deer (will not improve digestion efficiency). All deer including young weaners can digest whole grain without significant wastage.

Processing can increase the risk of grain poisoning as animals can consume more of the processed grain. There may be some advantage in processing hay to minimise wastage but care must be taken not to powder the feed.

Frequency of Feeding

Daily feeding is the safest way to introduce deer to a grain or concentrate ration. When animals are accustomed to the feed, they can be satisfactorily fed on alternate days. The risk of grain poisoning increases as the frequency of feeding decreases.

Mineral Supplements

Cereal grain based diets are likely to be deficient in calcium.

Adding 1.5 per cent by weight of finely ground agricultural limestone (not builders, burnt or slaked lime) to cereal based rations can prevent calcium deficiencies in stock consuming the ration. The lime should be spread onto the grain in the trough or when filling the feed out bin.

Urea

Urea can be used to increase the protein content of the ration and can replace up to 30% of protein nitrogen in the ration. However urea can easily be toxic so it should only be provided to stock with care.

The maximum rate of inclusion in any ration is 1% by weight of the total supplement (1 kg per 100 kg of feed).

Although urea can be added to feed as a dry powder, if the powder is not properly mixed or accumulates at the bottom of feed troughs, animals can inadvertently consume a toxic volume of urea powder. The preferred method of mixing urea with feed is to dissolve it in hot water (not boiling) and spray it onto the feed when auguring or filling the feed bins.

To ensure urea can provide an effective form of protein supplementation, before adding urea to any ration stock managers must ensure that the ration:

- Will provide an adequate supply of energy
- Cannot supply protein requirements of animals requiring the supplement
- Is fed daily

Lick Blocks

Commercial urea, protein and salt blocks are convenient and can be used with moderate success as supplements to dry feed, but they usually cost significantly more than high quality protein feeds.

Although they provided some ease-of-feeding convenience, if eaten by stock, not all stock consume the same quantity of the block (some may eat more than required and some less or none at all).

Usually better, more cost effective, results can be achieved by providing required nutrients direct through balanced rations of grain, hay and pasture supplements.

Water Requirements

Although accepted management practice recognises that all deer require access to good quality, clean, cool water at all times, there is little information published on the water requirements of farmed deer.

Limited research has determined [10] and [8] that like other commercial ruminant species water intake of Red deer varies with diet and water restrictions reduce DM and cellulose digestibility in deer [58].

Research [58] has shown that the voluntary water intake of Red deer (litres/kg DM) is at least 50% greater than is normal for sheep although Fallow deer appear to require less water per kg DM intake than Red deer. Rusa deer eating dry pasture are thought to have greater water requirements than Red deer [95].

Red deer are not as well adapted to water deprivation as sheep [16] and [59] also showed that low water intake decreases the rate of DM intake of Red deer. Anecdotal evidence [67] also indicates that that DM intake of Fallow deer deprived of water is significantly depressed when water intake is restricted.

Deer, males in particular, can prevent access of subordinate animals to restricted water supplies. Anecdotes relate the death, by dehydration, in summer of subordinate male deer that were prevented by a dominant male from access to water. Paddocks must be regularly checked to ensure all deer have unrestricted access to water. More than one source of water may be required.

Species	**Water: DM ratio (L/kg DM)**			
	Autumn	**Winter**	**Spring**	**Summer**
Red deer	3.3	3.3	2.6	2.6
Rusa deer [96]	3.1	3.1	3.7	3.7

Table 16: Guide Water Requirements of Deer

Without specific information for other seasons and for other species of deer, those requirements can only be broadly estimated from the guide requirements provided in Table 16.

Calculating Requirements

Water requirements constantly change according to changes in:

- Digestibility of the feed and subsequent DM intake by the animal
- Live weight of the animal
- DM content of the feed

To estimate the volume of water that must be available each day for Red deer:

- Determine daily dry matter intake - daily energy requirement (MJ ME from chapter on nutrition) - energy density of feed (MD from chapter on feeding)
- Estimate the volume of water required (see Table 26 above)
- Estimate the volume provided by the available feed
- Determine the shortfall that must be provided as free water

Example 1 - Red Deer Hinds in Summer

Assume:

- Season is summer
- 100 kg Red deer hinds are grazing pasture that is 70% digestible (MD = 9.9 MJ ME/kg DM)
- Daily energy requirement is 31.3 MJ ME/day (Table 9 - chapter on nutrition)
- 50 hinds in the mob
- Dry matter intake required is 3.15 kg/day (31.1 ÷ 9.9 = 3.15)
- The pasture is 85% dry matter

Calculations:

- The pasture is 85% dry matter, it must contain 15% water
- The total amount of this feed consumed each day is 3.71 kg (3.15 ÷ 0.85) which is comprised of 3.15 kg DM and 0.56 kgs of water
- Estimated daily water requirement per animal is 3.15 (DM intake) x 2.6 (water:DM ratio) from Table 16 above, = 8.19 litres/day
- Daily per animal shortfall equals total required less that provided in feed, 8.19 - 0.56 = 7.64 litres per day
- Total daily free water requirement for this mob in summer is the shortfall from feed multiplied by the number in the mob - 7.64 x 50 = 382 litres/day

Note this example calculation makes no allowance for evaporation or other losses that must be considered when developing water budgets. Calculations do not consider extra requirements that may relate to very hot weather.

Summary requirements for a Red deer hind that is 100 kg at mating and grazing pasture that is 70% digestible (MD = 9.9 MJ ME/kg DM) and 85% DM is shown in Table 17.

Season	Feed requirement			Water requirement			
	ME/day MJ	DM/day Kg	As fed Kg	Rate/kg DM Litres	Total/day Litres	From Feed Litres	Free Water Litres
Autumn	16.6	1.68	1.97	3.3	5.533	0.296	5.237
Winter	15.6	1.58	1.85	3.3	5.200	0.278	4.922
Spring	17.9	1.81	2.13	2.6	4.701	0.319	4.382
Summer	31.2	3.15	3.71	2.6	8.194	0.556	7.638

Note: requirements will change with changes in digestibility of the feed and subsequent DM intake by the animal, live weight of the animal and DM content of the feed

Table 17: Guide Water Requirements for Red Hinds that are 100 kg at Mating

Example 2 - Rusa Deer Hinds in Winter

Assume:

- Season is winter
- 90 kg Rusa hinds are grazing pasture that is 60% digestible (MD = 8.2 MJ ME/kg DM)
- Daily energy requirement is 15.5 MJ ME/day (Table 12 - chapter on nutrition)
- 50 hinds in the mob
- Dry matter intake required is 1.89 kg/day (15.5 ÷ 8.2 = 1.89)
- The pasture is 90% dry matter

Calculations:

- If the pasture is 90% dry matter it must contain 10% water
- The total daily amount consumed is 1.89 kg (1.89 ÷ 0.90 = 2.10) which is comprised of 1.89 kg DM 0.210 kgs of water
- Estimated daily water requirement per animal is 1.89 (DM intake) x 3.1 (water:DM ratio) from Table 16 above, = 5.86 litres/day
- Daily per animal shortfall equals total required less that provided in feed, 5.86 - 0.210 = 5.65 litres per day
- Total daily free water requirement for this mob is shortfall from feed multiplied by the number in the mob - 5.65 x 50 = 283 litres/day

Note this example calculation makes no allowance for evaporation or other losses that must be considered when developing water budgets. Calculations do not consider extra requirements that may relate to very hot weather.

Summary requirement for a Rusa deer hind that is 90 kg at mating and grazing pasture that is 60% digestible (MD = 8.2 MJ ME/kg DM) and 90% DM is shown in Table 18.

Season	Feed requirement			Water requirement			
	ME/day MJ	DM/day Kg	As fed Kg	Rate/kg DM Litres	Total/day Litres	From Feed Litres	Free Water Litres
Autumn	22.4	2.73	3.04	3.1	8.468	0.304	8.165
Winter	15.5	1.89	2.10	3.1	5.860	0.210	5.650
Spring	15.7	1.91	2.13	3.7	7.084	0.213	6.871
Summer	20.9	2.55	2.83	3.7	9.430	0.283	9.147

Note: requirements will change with changes in digestibility of the feed and subsequent DM intake by the animal, live weight of the animal and DM content of the feed

Table 18: Guide Water Requirements for Rusa Hinds that are 90 kg at Mating

Salinity

Research on Fallow deer [75] suggests that Fallow weaner deer can tolerate salt content up to 1.2% (equivalent to 5400 ppm Na) in the water. The research also reports that Red and Fallow deer can tolerate up to 6% salt in their diet if fresh water is available. There is almost no data on the ability of Red deer and Wapiti/Elk to tolerate salts in water.

Limited research on Rusa deer [96] shows that Rusa deer show similar responses to dissolved salts reported for other ruminants. They suggest that the upper limit of tolerance to dissolved salts for Rusa deer is 8,500 mg/L.

Until more information is available, tolerance levels for cattle could be used as a broad guide to tolerance of saline water by Red deer, Fallow deer and Wapiti/Elk although anecdotal evidence suggests that deer are less tolerant of saline water than other ruminants (sheep in particular).

Drought Feeding

Difficult decisions must be made early in a drought because farmers are responsible for the welfare of the animals on their property. It is important to recognise the onset of drought and act early even though delaying action may seem logical (in the hope the drought may be short). However delays usually reduce the number of options, both practical and economic, available for stock management.

It is important during drought that deer farmers continually assess and modify their objectives to meet their current situation and ensure that any production decisions made take account of both long-term and short-term objectives for their deer enterprise.

There are two equally important primary objectives of any drought strategy for a deer enterprise. They are to:

- Ensure that the welfare of the deer is maintained
- All decisions made must be humane and reasonable
- Act early while stock are still fit and strong
- Ensure the breeding stock (the genetic base) of the enterprise is maintained

After objectives have been agreed then a range of strategies must be considered to help meet the objectives.

Water Requirements

Even though feed energy intake may be reduced to survival levels during droughts, animals are often forced to consume more dry matter to achieve the energy intake they require. The extra dry matter intake means that the total volume of water consumed per day is likely to increase (see chapter on water requirements).

Often salt is added to drought rations to increase feed intake, however if sufficient good quality, low salinity, water is not available added salt may depress appetite rather than stimulate it.

Common Strategies

Sell Stock

This offers the opportunity to generate some income immediately and to reduce grazing pressure and livestock water demand on the property.

Stock selling is a common option that is initiated early in a drought but may continue through a long-term drought.

Stock should be sold by class, starting with finished young stock, then castrate stock, replacement stock, aged stock and older breeders until all that remains is a nucleus of young, sound breeding females [54].

Production Feeding

During a drought there can be an opportunity to maximise returns by only selling when premium prices are paid for quality stock. An opportunity also exists to maintain feed normal intake (nutrition) of animals in the breeding herd in anticipation of improved conditions allowing future progeny to be finished normally.

Lot Feeding

Farm lot feeding generally involves restricting animals to a small area and providing them with a ration that allows them to meet required target weights. The cost/benefit of this option needs to be considered carefully as the cost of feed inputs may be greater than the return achieved for prime finished animals. Specific advice must be sought in relation to feeding technologies, likely animal performance and environmental impacts.

Breeding Herd Maintenance

This option assumes that the breeding herd will be mated as normal in anticipation of a normal offspring drop. It requires good understanding of the nutritional requirements of breeding deer (see chapter on nutrition) and the availability of appropriately priced feed supplements (grain, hay, etc).

Costs of this option can be very high as inevitable shortages of supplements during a drought lead to high prices. If successful, an advantage of this option is that the breeding program of the enterprise is not interrupted and sale animals are likely to be available at usual times after the drought so cash income is less affected.

However, if the drought extends well after the birth of offspring, costs of feed to keep newborn animals and their mothers alive and growing can be very high.

Maintenance Feeding

Maintenance energy requirements for grazing livestock combine physiological (basal) maintenance requirements and an activity requirement. Physiological maintenance activities are those that are required for life, i.e. heartbeat and breathing. The activity requirement includes energy needed to search for food (walking), select food, stand, control body temperature, eat and ruminate.

Maintenance feeding can only be considered for animals that are not pregnant, not lactating or not required to grow rapidly and is solely aimed at maintaining an animal's live weight. Tables 19 to 26 show daily maintenance energy requirements and example feed requirements for deer to maintain body weight. The tables show:

1. A range of live weights for both sexes of each species
2. Daily maintenance energy requirements (MJ ME/day) for specific live weights
3. A guide to supplying the daily maintenance energy requirement, on an 'As Fed Basis' (see the chapter on nutrition) from:

   a. Grain (MD = 12 MJ ME/kg DM) or
   b. Hay (MD = 8.5 MJ ME/kg DM) or
   c. A 20:80 mix, by weight, of the grain and hay (20% grain:80% hay)
4. Calculations assume that the grain and hay is 90% dry matter

Caution:

- If the animal is incapable of consuming the dry matter (DM) in the ration, it will not be able to meet its energy requirement (see chapter on nutrition)
- If the energy density of the feed is different to those suggested in the example new requirements must be determined
- Requirements may increase in periods of cold wet weather

Live Weight	Required	Kgs feed per day 'as fed'		
Kgs	MJ ME per day	Grain 12 MJ	Hay 8.5 MJ	20:80 Mix Grain:Hay 9.2 MJ
50	8.9	0.8	1.2	1.1
60	10.2	0.9	1.3	1.2
80	12.6	1.2	1.6	1.5
100	14.9	1.4	1.9	1.8
120	17.1	1.6	2.2	2.1

Table 19: Feed Options to Maintain Red Hinds

Live Weight	Required	Kgs feed per day 'as fed'		
Kgs	MJ ME per day	Grain 12 MJ	Hay 8.5 MJ	20:80 Mix Grain:Hay 9.2 MJ
60	12.4	1.1	1.6	1.5
100	18.2	1.7	2.4	2.2
140	23.4	2.2	3.1	2.8
180	28.2	2.6	3.7	3.4
220	32.8	3.0	4.3	4.0

Table 20: Feed Options to Maintain Red Stags

Live Weight Kgs	Required MJ ME per day	Kgs feed per day 'as fed' Grain 12 MJ	Hay 8.5 MJ	20:80 Mix Grain:Hay 9.2 MJ
15	3.2	0.3	0.4	0.4
25	4.6	0.4	0.6	0.6
35	6.0	0.6	0.8	0.7
45	7.2	0.7	0.9	0.9
55	8.4	0.8	1.1	1.0

Table 21: Feed Options to Maintain Fallow Does

Live Weight Kgs	Required MJ ME per day	Kgs feed per day 'as fed' Grain 12 MJ	Hay 8.5 MJ	20:80 Mix Grain:Hay 9.2 MJ
35	4.7	0.4	0.6	0.6
40	8.0	0.7	1.0	1.0
60	10.8	1.0	1.4	1.3
80	13.4	1.2	1.7	1.6
100	15.8	1.5	2.1	1.9

Table 22: Feed Options to Maintain Fallow Bucks

Live Weight Kgs	Required MJ ME per day	Kgs feed per day 'as fed' Grain 12 MJ	Hay 8.5 MJ	20:80 Mix Grain:Hay 9.2 MJ
80	12.6	1.2	1.6	1.5
120	17.1	1.6	2.2	2.1
160	21.2	2.0	2.8	2.6
200	25.1	2.3	3.3	3.0
240	28.7	2.7-	3.8	3.5

Table 23: Feed Options to Maintain Wapiti/Elk Hinds

Live Weight Kgs	Required MJ ME per day	Kgs feed per day 'as fed' Grain 12 MJ	Hay 8.5 MJ	20:80 Mix Grain:Hay 9.2 MJ
50	8.9	0.8	1.2	1.1
60	10.2	0.9	1.3	1.2
80	12.6	1.2	1.6	1.5
100	14.9	1.4	1.9	1.8
120	17.1	1.6	2.2	2.1

Table 24: Feed Options to Maintain Wapiti/Elk Stags

Live Weight Kgs	Required MJ ME per day	Kgs feed per day 'as fed' Grain 12 MJ	Hay 8.5 MJ	20:80 Mix Grain:Hay 9.2 MJ
50	8.9	0.8	1.2	1.1
60	10.2	0.9	1.3	1.2
70	11.4	1.1	1.5	1.4
80	12.6	1.2	1.6	1.5
90	13.8	1.3	1.8	1.7

Table 25: Feed Options to Maintain Rusa Hinds

Live Weight Kgs	Required MJ ME per day	Kgs feed per day 'as fed' Grain 12 MJ	Hay 8.5 MJ	20:80 Mix Grain:Hay 9.2 MJ
60	11.3	1.0	1.5	1.4
80	14.0	1.3	1.8	1.7
100	16.6	1.5	2.2	2.0
120	19.0	1.8	2.5	2.3
140	21.3	2.0	2.8	2.6

Table 26: Feed Options to Maintain Rusa Stags

Growing Stock

It is usually better to either sell young stock that are actively growing or feed them for production in a restricted area. Costs related to recovery of stock that are deprived of ideal nutrition during their normal adolescent period of fast growth are often difficult to recoup at sale.

Survival Feeding

Survival feeding means low volume feeding that allows animals to use some of their body reserves and slowly fall to store condition (body condition score 2). They are then fed a diet that will maintain them in store condition.

This is a low cost (in the short term), non-productive strategy. However this strategy is likely to be expensive if the drought persists because:

- Resources (feed) may become limiting
- Animals will need time after the drought to recover their body condition
- In an extended drought future income from sale animals may not cover feed costs

Feed requirements can be minimised when full hand feeding by confining the deer to a small area. This can also aid in reducing pasture degradation and allow for faster recovery of unstocked paddocks once the drought breaks.

Estimating Survival Requirements

As described above, maintenance energy requirements combine minimum physiological requirements with activity requirements for searching for food (walking), selecting food, standing, eating and ruminating. Normal activity may increase maintenance feed energy requirements by about 30% above physiological maintenance requirements [46], see the chapter on nutrition.

Energy requirements for searching for and selecting forage are about .005 MJ/kg0.75/hour [46] or by calculation about 10% of daily maintenance requirements[3].

By inference it is reasonable to suggest that the energy content of survival rations could be about 10 % less than requirements for maintenance. However, survival feeding requirements assume that:

- Animals are not pregnant or lactating
- Animals are fed in restricted areas to reduce energy requirements of foraging
- Animals will be maintained in BCS 2 (see chapter on Body Condition Scoring)

Agistment

Although agistment is widely used as a management strategy for sheep and cattle it is a less likely option for adult deer because of their fencing requirements. However an experienced manager can manage young (immature) Red deer on good pasture behind good quality cattle fences.

Careful consideration of agistment costs, risk of disease, risks of loss due to predation, risks of weed seed contamination and other chemical contaminations must be made.

Humane Destruction

This option must be considered when stock are unfit for transport or when feed is unavailable or too expensive and sale prices are likely to result in increased financial loss to the owner.

It is illegal under the Prevention of Cruelty to Animals Act in each State to allow animals to starve to death and State governments can fine people who fail to provide animals with appropriate and sufficient food and drink (see Code of Practice for the Welfare of Deer for the appropriate manner to humanely slaughter deer).

[3]Assumes grazing and foraging for about 9.6 hours per day

Alternate Supplements

Table 27 provides information on the nutritive value of feeds that may be available to supplement stock during times of drought. As explained for Table 13, although values provided can be considered a reasonable guide, actual energy and protein values for any feed can change markedly between seasons and 'average' values for some locations may vary from those shown.

Feed	DM (%)	Energy (MJME/kg DM)	Crude Protein (%)	Fibre (% DM)
Vegetables				
Apples	17	10.0	3.0	N/A
Cabbage leaves	15	10.0	14.0	16.0
Carrots	13	12.8	6.2	10.8
Citrus pulp	18	12.0	7.0	N/A
Potatoes	21	12.7	1.2	3.8
Pumpkins	9	13.0	16.0	N/A
Turnips	9	13.0	14.0	11.1
Straws				
Oat straw	92	7.0	4.0	39.4
Pea straw	86	6.5	10.5	41.0
Rice straw	91	6.0	4.0	42.1
Wheat straw	89	7.0	4.0	41.7
Other				
Bread - dry	92	13.0	13.0	N/A
Cotton hull waste	93	5.6	1.0	91.1
Cottonseed meal	90	10.3	36.0	27.9
Grape Marc	91	5.0	13.0	N/A
Molasses	75	12.6	2.4	0.0

Table 27: A Guide to Average Nutritional Value of Supplementary Feeds for Drought

Further Reading

A suggested reference for further reading is the NSW Agriculture publication 'Managing Drought' compiled by Bruce Mackay [54].