Drought management

Know when to act

Drought conditions begin as a delayed start to the wet season often accompanied by unseasonal hot weather in spring, making continued provision of quality green forage for dairy cows difficult. With high evaporation, temperate pastures require more frequent irrigation and rain-dependent summer pastures and crops make little growth. In extended dry periods moisture-stressed pastures tend to respond to any rainfall by becoming reproductive rather than with vegetative growth. In consequence, forage growth and quality are severely limited. Purchased feeds (concentrates, conserved fodder) necessary to maintain animal production are scarce and expensive. What strategies need to be considered to manage the cost impacts of drought? Decisions must be made about use of available water, forages to grow, feed purchases, number and class of animals to be fed or culled, level of feeding and herd replacement and reinstatement.

Appropriate strategies depend on a farm's resources and capacity to grow feed, economic assessment and contractual requirements. Planned responses consider possible duration of drought and its impact on forage seasonality and feed budgeting. Could late rains provide sufficient autumn feed or will additional purchases be necessary? Is conservation possible?

Herd management

Decide how many cows will be milked. Underfeeding, particularly fresh lactating cows, adversely impacts on their condition, production and fertility. Dry cows off early and cull more heavily to reduce feed demands, allowing better nutrition for the remaining, more responsive animals. Lactating, dry and growing stock can be fed closer to their respective needs; non-producing animals might be agisted or sold. Maintain sufficient replacements to assure income and quickly reinstate the herd after the drought breaks.

Cost effectiveness

For better production and use of scarce resources consider options to maximise homegrown forage, cow nutrient requirements, cost to supply as purchased feed and expected returns. Understanding of animal requirements, feed nutritive value and comparative costs will aid more cost effective ration formulation.

Feed utilisation, animal health

Care is necessary when grazing limited areas of green feed. Lablab and cowpeas, like lucerne and clovers can cause bloat. Forage sorghums may contain prussic acid (HCN); ryegrass may contain high levels of nitrate. Moisture-stress increases plant accumulation, while grazing pressure may increase animal intake, causing deaths. There may be other mineral imbalances e.g. high potassium or low magnesium (ryegrass, kikuyu), which can cause metabolic disease. Try to avoid grazing wilted or immature growth. Feed concentrate or conserved supplements before grazing suspect forages so cows are less hungry, and restrict area or access time to minimise risk. Use mineral supplements to meet animal requirements and support microbial fermentation.

Homegrown feed

Can the farm's pasture production be improved? Apply inputs to most appropriate forage for greatest yield response. With unseasonably high temperatures and evaporation in spring, shallow rooting ryegrass or clover pastures demand frequent irrigation (7-10 day interval) to survive. Tropical pasture or forages will use inputs more effectively. Are soil nutrients N, P, K, S adequate? Plant growth responds only to the level of the most limiting nutrient. Soil tests will help determine if there is a deficiency, and what level of additional fertiliser is required.

a) Irrigation: If available, a progressive switch to supplementary irrigation of forage crops or tropical pasture in spring-summer will grow more dry matter (DM) with less water than needed for annual or perennial temperate pastures.

b) Forage crops: Over-sow ryegrass with summer forages to increase homegrown feed supply. Previously irrigated temperate pastures may have moisture available at depth that could be accessed by summer forages with less water required. Irrigation will assist establishment. Grass-

type forages (sorghum, millet) produce more DM than legumes and allow repeat grazing. Legumes (lablab, soybean) provide moderate quality autumn feed. Surplus can be conserved.

c) Maize, grain sorghum: Crops of high nutritive value, purpose-grown for pit silage, can increase yield, quality and utilisation of forage grown for water supplied. Irrigation or rain is required at flowering for highest grain yield and silage quality.

d) Rain-grown pasture: Give tropical pastures the chance to respond if moisture is available. Despite drought, some summer storms can be expected. Nitrogen (N) fertiliser will increase grass response to light rain events for greater DM yields. Though dry weather increases volatilisation losses of N, fertiliser needs to be on when rain falls. Management and timing can enhance yields and minimise N loss. Be ready to fertilise if a rain event is likely. Ammonium sulphate or ammonium nitrate volatilise less than urea, but can affect soil pH in longer use. Reasonable grass cover will reduce nitrogen losses.

Purchased feed

Ration formulation and purchased feeds are routinely used for economic milk production. In drought, feeding skills must be refined to contain costs. Farms may forward-contract to reduce operating costs and with on-farm storage capacity, they can better manage short-term drought. Purchase decisions for additional feed (concentrate or conserved forage) are necessarily based on cost and availability but for more cost-effective feeding, understanding of cost of nutrients supplied, the ability of the feeds to supply the animals' requirements and effects on intake must also be considered. Buy supplements at the best price relative to their nutrient content (Table 1), formulate rations to animal requirements and minimise feed wastage.

a) Concentrate feeds: Grain, molasses, by-products and protein concentrates are expensive per kg but are still generally cheaper to purchase, per unit of nutrients supplied, than conserved forage. Concentrates can comprise up to 40% of a cow's ration to increase diet quality and extend the availability of forage.

b) Conserved forage - hay or silage: Dairy cow diets need to provide 60% roughage to avoid metabolic problems and acidosis. Lactating cows require a minimum effective dietary fibre of 30% NDF, but low-cost roughage may be high-cost for nutrients. High-fibre feeds (grass hay, straw, sugar cane) have low nutrient content and digestibility - half the feed purchased may not be digested. Such feed can limit intake and production but can provide fibre and bulk to rations if quality feed is short.

c) Freight: Freight is a significant cost component of purchased feed, increasing the cost of nutrients for feeds with high moisture content or low digestibility.

d) Crop Residues: Ensure novel feeds or crop residues are free of pesticide residues or other harmful material. Obtain vendor declarations.

Nutritive value of feeds

There is a wide array of feedstuffs as well as opportunity by-products that can be used for dairy production. Roughage also may need to be obtained off farm.

Table 1 provides nutrient content information for a range of feeds. Feedstuffs are categorised on their primary nutrient contribution:

- concentrates rich in metabolisable energy (ME) (cereal grains, molasses, by-products)
- protein (CP) (extracted protein meals, oilseeds)
- roughages (conserved forages - silage, hay, straw).

Quoted nutritive values (Table 1), expressed on a DM-basis are indicative averages. Feed quality can vary with management during growth, harvest and storage. ME and CP are necessary macro-nutrients for production while fibre, measured as NDF and ADF, is essential to maintain a healthy rumen environment. NDF includes more digestible hemicellulose plus indigestible fibre, while ADF is the more complex, less digestible fibre (cellulose and lignin). The higher the fibre content (particularly ADF) in feed the lower is its digestibility and the longer it will stay in the rumen, reducing the amount the cow can eat and hence production. Adequate fibre is needed to prevent metabolic problems with high concentrate diets.

Table 1. Nutritive value of various concentrates and conserved forages (DM basis)

Concentrate/forage type	DM%	Protein CP %	Metabolisable energy MJ ME/kg	NDF %	ADF%
Energy concentrate					
Sorghum	89-90	9-12	13	18	9
Barley	89-90	9-12	13	21	9
Maize	89-90	10	13	9	3
Wheat	89-90	14	14.5	14	4
Molasses	75	6 (NPN)+	10.5	-	-
Protein concentrate					
Cottonseed meal	89-90	38-43	12.5	26	20
Sunflower meal	89-90	30-38	12	40	33
Protein and energy concentrate					
Whole cottonseed	89-90	20	12	37	26
Copra meal	89-90	20	12	28	19
Palm kernel extract	89-90	16-17	11.5	69	47
Conserved forage - higher quality					
Lucerne hay	86-88	20-22	10	40	28
Ryegrass ± clover round bale silage/hay	45-50	20-25	10-10.5	40	30
Maize silage (pit silage)	30-35	7-8	10-11	53	28
Oat hay vegetative	86-88	15-20	9.5-10	58	35
Conserved forage - medium quality					
Oats boot - dough stage	86-88	10-15	9.5	60	38
Forage sorghum hay/silage* -early vegetative (1 m)	86 (H)* 50 (S)*	16	9.5	58-60	36-40
Forage sorghum hay/silage - > 2 m to mid-bloom	86 (H) 50 (S)	10-14	7.5-8.5	68	42
Millet hay	86-88	10-16	7.5-8.5	60-65	36-40
Tropical grass high quality	86-88	16	8-9	60	35-40
Tropical grass medium quality	86-88	10 12	8	65	40
Conserved forage - lower quality					
Peanut hay	86-88	9.5	7.5	48	43
Tropical grass low quality	86-88	6-<10	6.5-7	70-76	42+
Barley straw	86-88	4.3	7.3	80	59
Sugarcane tops/trash - fresh	20-25	3	4-7	72	46
Sugarcane whole plant - mature	25	2	5.5	75	48
Sugarcane young whole plant =1 m	25	5-7	5-7	N/a	N/a
+NPN - Non protein nitrogen *(H) - Hay, 86-88% DM *(S) - Round bale silage ~50% DM					

WARNING: It is illegal to feed animal-derived protein meals, including fish meal, or feeds contaminated by animal protein to ruminants (cattle, sheep, deer). This ban was initiated to reduce risks of diseases such as foot and mouth disease and BSE (mad cow). Financial penalties can be incurred.

Ration formulation

Nutrients (ME and N) need to be fed in correct proportion for optimum rumen degradation and microbial protein synthesis. The cow uses protein at the small intestine for milk synthesis. Most is microbial protein with some undegraded feed protein. Most of the feed energy and at least 70 % of the cow's dietary protein are utilised by rumen fermentation and resynthesis to microbial protein. Balanced rations more efficiently and cost-effectively maintain productivity; reduce the risk of metabolic disturbance, lost production and possible mortalities. By-products of food manufacture can be opportunity feeds and management can minimise metabolic health risks of unusual diets. Nutrient analysis will allow better diet formulation. Care is needed if there are risks of toxins or anti-nutritional factors in feeds. Do not use mouldy feed.

a) Least cost rations: Economics may favour feeding more concentrate. Ensure energy, protein and fibre are fed in correct proportions. With care, concentrates can be fed up to 40% of the diet, provided effective fibre (NDF) content is maintained at or above 30% and rations are buffered.

   - Diets with high-energy, low-fibre, increase the risk of digestive disturbances. Milk fat is reduced. Falling milk fat content is an indicator of subclinical acidosis. Watch cows for signs of tender-footed walking, arched backs or lameness. Use buffers (sodium bicarbonate) with high concentrate rations.
   - Protein to energy balance in the diet affects how nutrients are partitioned. Diets balanced for ME and protein increase milk yield and protein content.
   - Protein requirement increases with milk yield so a diet offering 15% CP is adequate for cows producing 18 L milk/day (5500 L), but cows producing 30 L/day (8000 L) require 17.5% CP.
   - Diets with a high energy/protein ratio (insufficient protein) partition to body condition (fat) rather than milk production.
   - Surplus dietary protein can be used as an energy source but there is an energy cost to excrete the excess nitrogen.
   - Cows can utilise dietary protein to mobilise fat reserves for milk production but severe energy deficiency will adversely affect reproduction and recovery and can result in ketosis if the cow starts to break down her own body tissues.

b) NPN: Nitrogen fertilisers - urea (46% N) and ammonium sulphate (Gran-Am) (20% N) are useful non-protein nitrogen sources. Fed with high ME supplements (molasses, grain, maize silage), NPN is converted by rumen bacteria to microbial protein. Urea can be offered in rations at 1-3% of the concentrate to a maximum of 100 gm/cow a day. Toxicity is a risk and urea must be carefully mixed and higher levels introduced gradually. Do not feed high levels of urea in rations already high in rapidly fermentable protein. Do not add urea to molasses until all previous ration is finished and in wet weather pour off water after rain as the urea dissolved and concentrated in the water can kill animals. Ammonium sulphate is less palatable and probably best restricted to 1% of concentrate (30 g a cow per day), or used at higher concentration to limit grain intake by group fed heifers. High urea/molasses concentrate 'M8U' as used in the beef industry to self-limit animal intakes could be considered for heifers and dry stock.

c) Salt: Salt is a required nutrient, but many soils and drinking water are saline and provide adequate amounts. Red basalt soils are low in salt and pastures and water can be deficient. It may be beneficial with mixed-ration (feed pad) diets, if drinking water is low in dissolved salts. Salt has been used to limit concentrate intakes by group-fed animals but excess is excreted and has adverse environmental impacts. Other intake limiters are more environmentally friendly.

d) Buffers: A buffer such as sodium bicarbonate should be used with grain when feeding 6 kg or more of grain-based concentrate per cow per day, or at lower grain levels with wheat (> 3 kg/day). Use at a rate of 20-25 grams sodium bicarbonate per kg grain or concentrate (150 to 200 g per cow a day).

e) Lipids: Digested post-rumen, lipids (fats, oils) at low levels enhance energy content of the ration without adding to the acidosis risk from too rapid degradation of highly fermentable carbohydrate diets. Fat however should not exceed 5 % of the diet as it can coat feed, reducing fibre and ration digestibility. Oilseeds such as whole cottonseed, soybean, peanuts, canola, sunflower can be fed

to 2-3 kg per cow, or small amounts of vegetable oil (< 1% of grain mix) added in high concentrate rations. Oil in grain mixes can cause bridging problems for auguring. Do not feed previously heated oils (such as deep frying waste).

f) Toxins, anti-nutritional factors: Wet, mouldy or poorly conserved feeds may contain fungal toxins, which affect animal health and production. Stock losses have occurred when hungry animals consume green forage very quickly or immature plants are grazed. Lablab, cowpeas, lucerne and clovers can all cause bloat. Some plants accumulate inorganic nitrogen compounds, which at high intakes cause illness and deaths. Forage sorghums contain prussic acid (HCN) or nitrate; ryegrass, other plants and weeds may also accumulate nitrate and conserved forages may contain high levels. To reduce prussic acid content allow forage sorghum and regrowth to reach 60 cm before grazing or conservation. Ensiling (fermentation) can reduce prussic acid content but drying as hay does not. Conservation as hay or silage does not reduce nitrate. Do not feed large amounts of potentially dangerous forages to hungry stock. Use high ME-lower protein concentrates with high N forages, and use sulphur supplements with sorghum forages to assist microbial fermentation to utilise the inorganic nitrogen. Losses to clostridial diseases e.g. enterotoxaemia are more common in hand-fed animals and all cattle should be routinely vaccinated (five-in-one). Vaccination for botulism is advisable due to risk of decaying carcases of small animals caught in crops at harvest.

g) Rumen modifiers can help prevent digestive upsets (acidosis) on high grain diets. They act by reducing rumen populations of acid forming bacteria but need to be correctly used. By changing rumen fermentation, rumen modifiers might reduce ability of bacteria to degrade nitrate or prussic acid, increasing risk if the diet is high in soluble nitrogen. As low dosage antibiotics they potentially may contribute to bacterial antibiotic resistance in long-term use.

Intake and production

Feed consumed provides the energy, protein and other nutrients the dairy cow requires for maintenance and production (lactation, live weight gain, calf development). A cow can consume about 3% of her live weight each day as DM of good quality forage and concentrate but will consume less if digestibility of the feed is low, it is unpalatable or difficult to eat or she is heat stressed. When cows graze a pasture, they select more nutritious green leaf but when conserved, both leaf and stem are harvested and feed quality consumed is lower. With conserved fodder in short supply and expensive, low-quality and unusual roughage sources are utilised in drought. Rations with a high proportion of poorly digested roughage increase dietary fibre, restrict dry matter and nutrient intakes and production.

Animal requirements

A 550 kg Holstein-Friesian cow can consume 18-20 kg DM per day of a balanced high digestible diet offering 10 MJ ME (metabolisable energy) per kg DM. Such a diet may comprise about 35% concentrate (6-7 kg/day) with 16% crude protein (CP). Her intake for this ration will be 180 - 200 MJ ME per day. She will use 60 MJ ME for maintenance with approximately 120 MJ ME available for production. As she requires 5.2 MJ ME to produce a litre of milk, this ration will support a milk yield of 25 litres a day. Higher quality diets support higher production, less digestible feeds reduce intake and milk yield.

Forage quality

Forage quality affects production in two ways: nutrient intake is lower with less digestible feed and total DM intake is reduced as the feed will remain longer in the rumen. More of the feed is required for maintenance with less for production. High-quality forages - lucerne hay, maize silage or ryegrass contain 9.5-10.5 MJ ME/kg DM (Table 1). Leafy tropical pasture or forage (sorghum, millet hay) provides 8-9 MJ ME per kg DM, but more mature forages offer < 8 MJ ME/kg DM. The cow requires 8 kg DM of lower quality forage for maintenance (60 MJ ME) compared to 6 kg of a higher quality feed.

If offered tropical pasture (8.5 MJ ME) as the sole diet, she can consume only about 15 kg DM, a nutrient intake of approximately 130 MJ ME/day, sufficient for maintenance plus 11 litres of milk. The higher is the fibre content of a feed (mature grass hay, cereal stubble, sugar cane chop), the slower and less it is digested and the less the cow is able to eat. If the forage offers only 5-6 MJ ME /kg DM she may only consume 10-12 kg DM per day, at or below maintenance even for dry cows. Substantial supplementation will be needed to produce milk. Diets high in indigestible fibre (ADF) also pose a risk of rumen impaction.

Economics

The economics of differing feeding options needs to be assessed. Precise ration formulation is necessary to satisfy dietary needs and contain costs. Unbalanced diets increase cost inefficiencies. Although high-quality forages are preferred for production, a lower quality fodder can help satisfy appetite and extend scarce home grown or purchased forage. Least cost ration formulation is based on comparative nutrient cost, effects on intake, expected production and other nutrients required. A diet of 150 MJ ME/day supporting 17 L of milk is supplied with 10 kg of medium quality hay/silage (8.5 MJ ME/kg DM, 14% CP) plus 5 kg concentrate (12% CP). It could also be met with 7 kg of lower quality roughage (7 MJ ME/kg DM) plus 8 kg of a higher protein concentrate (13 MJ ME/kg DM, 16% CP). Costs will then determine which option should be chosen.

Feed budgeting and herd management

Forward plan

Consider feed reserves and potential requirements if the dry period is extended. Do you have sufficient capacity to feed the herd if rainfall remains well below average for the whole wet season? Can forage be conserved to maintain quality for subsequent use? What forage can be grown, will irrigation be available for winter pasture or are rain-grown crops necessary? Paddock preparation, with a weed-free fallow to conserve summer-autumn moisture, should be implemented for winter cereal cropping. Will conserved fodder also be required in autumn or next spring?

Dry-off stale cows

Drying cows off early to conserve reserves will allow more feed for higher producing, more responsive cows in early to mid-lactation. The selected fresher cows may produce nearly as much milk as underfeeding the whole herd, and will be more able to respond when finally the season breaks. Dried-off cows will have a longer period to regain condition for next calving. Some animals may be agisted or sold.

Increase culling

Increasing culling of high cell count, lower production, aged or problem animals to extend feed supplies and reduce need for purchased feed.

Heifers and dry stock

Lower quality roughages can contribute to maintenance requirements for dry stock. Low-quality forage for young heifers will limit their growth and increase time to first calving. Heifers potentially are the best animals in the herd but are unproven. Feeding all animals to their preferred optimum is expensive and compromise will be necessary. Decisions on calf and heifer numbers reared, agisted or sold, and their feeding levels should be considered together with culling of older animals to ensure sufficient pregnant animals are maintained to quickly reinstate the herd when the drought breaks.

Source: Queensland Department of Agriculture, Fisheries and Forestry; 2009