Chapter 5

Animal improvement, management and production

In the northern Australian beef and dairy industries, breeding for genetic improvement, and the adoption of better livestock management and husbandry practices, are vital for improving production efficiency and for meeting market specifications.

Animal improvement and management options in the wool industry are more limited because sheep are mainly run on extensively managed properties in arid environments.

The following principles and objectives are fundamental for all forms of forage-based livestock production.

**Principles**

- **Animal growth and reproductive efficiency** is about enhancing growth or production rate (meat, milk or fibre), reproductive efficiency, and feed conversion efficiency to increase, or more profitably achieve, products of the required quality per breeder mated and per unit of grazing land available.

- **Management efficiency** is about reducing time and costs, and improving timeliness in managing livestock.

- **Meeting market specifications** is about adopting the appropriate animal breed and production system to target the required market and to ensure the best product quality is maintained to the point of sale.

**Animal improvement and management objectives**

The aims are to:

- Increase the growth and reproduction potential of livestock, and the quality of their products, through genetic improvement.

- Adjust animal management practices to ensure that the genetic potential of the animals is effectively and profitably attained.

- Ensure the above are adopted in harmony with the sustainable use of forage resources.

**Generic management options**

Previous chapters have dealt with animal nutrition, feed utilisation efficiency, and the improvement and sustainable use of forage resources. Here the focus is on the following animal improvement and management options:

- breed choice
- breeding and selection programs
- herd or flock management
- market specifications
- production systems and meeting the market.

These are considered separately for beef, dairy and wool production, although some principles and practices are common to more than one industry (e.g., genetic improvement principles for beef and dairy cattle and automated mustering practices for beef cattle and sheep).
Beef production

Breed choice

More than 40 breeds of cattle are available for use in Australia.

No one breed is the best for all environments and all markets because of interactions that occur between the animal’s genetics (genotype) and the type of environment (climate and forage resource) within which it is grown (Figure 5.1).

Figure 5.1. Genotype x environment interactions for weight of calf weaned per cow joined when Hereford (H), Simmental x Hereford (SxH) and Brahman x Hereford (BXH) cows grazed high or low quality pasture in northern New South Wales (after Hearnshaw 1985).

Choice of beef breed depends on the production environment, the type of enterprise and the most desirable animal traits required for these. The required traits may be one or a combination of the following:

- environment and feed adaptation
- fertility and maternal ability
- growth rate
- maturity rate and carcase characteristics
- pest and disease tolerance.

Benefits claimed for particular breeds are not always supported by objective data and there is often as much genetic variation within a breed as there is between breeds.

Breed ranking for some production, reproductive and carcase traits is given in Appendix 3.

Beef breeds in northern Australia

Much of the northern Australian beef industry was first based on the Bos taurus breeds of Shorthorn, Hereford, Poll Hereford and Angus. The most northerly and coastal producers subsequently recognised the better adaptation to harsh, tropical environments of Bos indicus cattle (most commonly Brahman) and crossed these with the B. taurus breeds.

The resultant crossbred cattle have either been continually backcrossed to Brahman sires, to give a high grade Brahman, or selected within the crosses to develop new composite breeds like Santa Gertrudis, Braford and Brangus.

Many herds are now operating as straightbreds (self-replacing herds with often little variation in market type within the herd) with minimum heterosis or hybrid vigour compared to that present when the two parent breeds were first crossed. Heterosis is the difference in performance or vigour of crossbred progeny from the average of the parental breeds.
Estimates of production parameters achievable from further breeding and better herd management in the more northerly tropics indicate potential for significant production gains (Figure 5.3). Turnoff age in CQ is currently 36 months but 27 months should be achievable. Turnoff in NQ is 42 months and is unlikely to change.

Figure 5.3. Current and estimated achievable production traits for beef herds in central (CQ) and north (NQ) Queensland (Bertram et al., 1995a and R. Holroyd, pers. comm.)

![Graph showing current and achievable production traits for beef herds in CQ and NQ.](image)

**Breeding and selection programs**

**Principles**

Achievement of maximum productivity with breeding requires exploitation of maximum heterosis and the maximum number of desirable genes.

Selection of superior animals and their traits should occur in environments where the animals are to be reared and grown.

For greatest benefit in all crossbreeding programs it is imperative that only straightbred animals of high genetic merit for economically important traits are used.

**Heritability**, or the degree to which an animal will transmit to its offspring the performance it displays in any trait, controls the possible rate of gain through breeding and selection for that trait.

Estimated heritabilities of most growth traits in beef cattle are between 30 and 50 percent or, conversely, 50 to 70 percent of trait expression is due to environmental factors. Heritabilities of carcass characteristics are likely to be between 30 to 55 percent and female fertility traits between 15 to 20 percent (Appendix 4).

In benign environments, most economically important traits (except female fertility) are influenced more by selection within a breed than by crossbreeding, eg., dairy industry. In harsher environments, considerable gains in growth and fertility rates can be achieved through a combination of heterosis and selection (Figure 5.4).

Figure 5.4. Maximum genetic gain in beef cattle is achieved by combining selection and crossbreeding (after Bertram et al. 1995a).

![Graph showing trend with selection and crossbreeding.](image)

**Sire selection has a much greater impact than cow selection**, as demonstrated in data on yearling weights from long-term studies at the US Meat Animal Research Centre, Nebraska:

<table>
<thead>
<tr>
<th>Selection method</th>
<th>Improvement (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>heifer selection alone</td>
<td>5.5</td>
</tr>
<tr>
<td>bull selection alone</td>
<td>50</td>
</tr>
<tr>
<td>bull + heifer selection</td>
<td>51</td>
</tr>
</tbody>
</table>

The genetic contribution of the cow is largely predetermined by bulls previously used in the herd. Bulls also influence some 120 to 150 progeny in 4-5 years of working life compared to a cow’s influence on normally 6-8 progeny.

Artificial insemination (AI) allows a bull’s effect to be greatly magnified with the potential for thousands of progeny to be sired by one bull; cost and the mainly extensive nature of the production system presently limits its use within the beef industry.
Objective measures of genetic gain

‘Weight of calf weaned per cow exposed’, which is a major determinant of herd efficiency and profitability, is used to measure component heterosis benefits from crossbreeding (Figure 5.5); individual heterosis represents the component of heterosis due to the market animal being a crossbred and maternal heterosis that due to the dam being a crossbred.

Figure 5.5. Relative increase in calf weight weaned per cow exposed when mating either straightbred cows to bulls of a different breed (centre) or first-cross cows to bulls of a third breed (right) (American data presented by Bertram et al. 1995(a)).

Where: \[ M = \text{Maternal heterosis due to the dam being a crossbred.} \]
\[ I = \text{Individual heterosis due to the turnoff animal being a crossbred.} \]

Breeding systems

Breeding programs involve systems of breeding for planned genetic change, using either straightbreeding or pure breeding (defined earlier) or crossbreeding, but both must occur in conjunction with systems of herd management that enable the change to be achieved and maximised.

Purebred studs strongly focus breeding programs by mating closely related bloodlines (linebreeding or inbreeding) to supply straightbred females and high performance sires; these can be used with more predictable results for outbred or crossbred commercial animals.

Crossbreeding systems include 2 breed cross, backcross, 3 breed cross, rotational cross or sequence breeding and the development of composite or synthetic breeds (e.g. Droughtmaster, Braford, Charbray and Belmont Red). Details of these systems and their relative merit for beef improvement are provided by Bertram et al. 1995(a). Appendix 5 provides a pictorial representation of crossbreeding systems.
In general terms, the adoption of particular breeding systems depends on:
- their potential advantage within the other constraints of the production environment
- attitude toward the changes needed in the type and complexity of management
- the compromise accepted between management complexity and heterosis exploited
- product uniformity demanded by the particular market targeted.

**Straightbreeding** requires few changes in management, the genetic evaluation systems are easily used, breed characteristics for production and adaptation can be utilised and breed standards, such as colour and marking are retained.

**Crossbreeding**, although becoming more complex as the number of breeds used increases, makes better use of the good and complementary qualities of two or more breeds for production and market suitability. It additionally captures the benefits of hybrid vigour. In the early years of rotational crossbreeding the progeny are variable. This may create difficulty in meeting market specifications.

Different crossbreeding systems produce varying levels of heterosis and calf weight weaned per cow exposed (Figure 5.7).

Figure 5.7. Percentage increase in calf weight weaned per cow exposed in relation to the crossbreeding system and the number of breeds used (after Bertram et al. 1995a).

**Bull selection and management**

Replacement bulls in a progressive beef breeding enterprise can be a major cost. Under extensive production conditions they must have the capacity to walk long distances and serve large numbers of females.

Bulls must have superior genetic traits of economic importance (e.g. growth rate, fertility and carcass characteristics) **that are heritable and measurable**. They must also be reproductively sound (e.g. have adequate scrotal size and conformation, semen of high quality and the capacity and desire to serve), physically sound and healthy, and have a good temperament.

Temperament is economically important through its effects on labour requirements, incomplete musters, bruising and lowered meat quality.

**Selection of bulls for temperament is most important because the trait is highly heritable and quieter temperaments are correlated with faster growth rates.**

Important management issues are appropriate bull percentages for mating; bull dominance hierarchies in the herd that restrict genetic contribution; declining fertility, physical soundness and temperament with age; nutrition which avoids libido loss due to overfatness; and disease control, especially venereal diseases.

Bull percentages vary according to bull ability and paddock characteristics, such as size and the distribution of watering points. Percentages are commonly 5%, but lower percentages down to 3% are effective when management includes a full bull soundness examination prior to mating.

Regular culling of bulls to accelerate genetic progress and to avoid performance problems is vital.

Bertram et al. 1995b provide a fuller account of bull selection.

**Herd management**

**Cattle control**

Effective cattle control underpins other management and husbandry practices by segregating and keeping cattle on forages and supplements they have been allocated, by providing the opportunity to give special attention to vulnerable classes of animals (e.g. small weaners and first-calf cows), and by facilitating mustering at low cost without fuss and detriment to product quality.
Self-mustering systems and other ‘automated’ husbandry technology for cattle (and sheep) reduce labour costs and stress on animals and their handlers and also:

- help facilitate a range of improved cattle control applications eg. dry season weaning and segregation for preferential treatment
- have potential to help sustain grazing land condition and stream water quality by providing scope to regularly move the location where stock congregate.

Breeder herd management

Management options can be classified into three categories according to their potential impact on production and relative priority for implementation (Figure 5.8).

Figure 5.8. Priority levels for breeder herd management in northern Australia (after Fordyce 1992).

First-level options

Early weaning down to 3 months of age at about 100 kg liveweight minimises cow nutritional stress and improves cow dry season survival, growth, and fertility (Bos indicus cross cows most sensitive).

Early weaning occurs when calves have high nutritional needs and therefore more attention to supplementation, supporting infrastructure and management is required to ensure weaner survival and subsequent performance.

Weaner supplementation depends on pasture quality and the animal growth objectives, with weaner weight, not age, the important determinant of supplement type and amount required (see Appendix 6):

- < 100 kg - complete ration and molasses avoided as a primary energy source
- 100-150 kg - true protein supplement
- > 150 kg - inorganic protein supplement

Strategic supplementation overcomes seasonal undernutrition which causes low growth, low fertility and high death rates. Briefly:

- conservative stocking of native pastures, use of improved pastures and P supplements or fertilisers can help offset these nutritional deficiencies (see Chapter 4)
- when pasture is limiting, significant energy is required in supplements (eg. fortified molasses/urea, protein meals and cotton seed meal)
- with increased levels of energy, N and S are often needed to arrest weight loss in the latter part of the dry season.
- rumen antibiotics or modifiers (e.g. monensin, lasalocid and avoparcin) can increase the value of supplements during the dry season, by either increasing responses or giving similar responses with less base supplement.
- wet season sodium and S deficiencies and responses to supplements have occurred on basaltic soils.

Botulism is the most economically important infectious disease in northern Australia and is related to P deficiency and drought; P supplementation and vaccination provide effective control.

Second-level options

Important diseases, other than botulism, are the infectious diseases tetanus, blackleg, babesiosis, campylobacteriosis or vibriosis, leptospirosis and ephemeral fever, and the parasitic pests coccidiosis, buffalo fly and ticks. A range of vaccines are available for the control of most of these diseases (Fordyce 1992).
Breeder culling aims to remove cows with low fertility, as fertility is both repeatable and heritable, and to remove aged cows which have higher survival risk under poor nutrition and drought conditions:

- a minimum requirement is a record of reproductive history, established by tagging individuals and recording lactation status at each muster
- pregnancy testing is more accurate and can identify low-fertility cows up to a year earlier
- conformational traits, other than obvious anatomical deficiencies, are doubtful criteria, and body size can be misleading.

Breeder selection for growth should occur in maiden heifers prior to first mating:

- traits related to environmental adaptation are important, but many are expressed through production traits
- tick burdens are a direct measure of tick resistance
- fertility selection can be based on ability to rear a calf to weaning by age 3.5 years.

Heifer management mainly concerns weight at age 2 years:

- only a small percentage of 200 kg heifers conceive but 80% of those weighing more than 275 kg will conceive
- pre-pubertal heifers losing weight in the dry season post-weaning can have reduced fertility when mated as 2 year-olds
- segregation of heifers gives optimum mating control and allows preferential treatment as required.

Third-level options

Spike feeding mid- to late-pregnant cows in the late dry season with a high-energy supplement for at least 50 days (Figure 5.9) reduces the calving to first oestrus interval and consistently increases pregnancy rates by about 15% in first-calf cows.

Figure 5.9. Spike feeding emulates an early start to the wet season (Fordyce 1992).

Controlled mating requires high levels of management and animal segregation but helps:

- avoid out-of-season calving and unwanted early conceptions in maiden heifers
- simplify many management practices
- improve bull control and limit spread of venereal diseases
- achieve more uniform progeny and market specification.

Its value is equivocal in some environments where traditional continuous mating helps:

- synchronise peaks of conception with highly variable seasonal conditions
- minimise incursion of unwanted neighbouring bulls
- maximise the number of calves born.

If controlled mating is used, the period of mating should be governed by the optimum time for calving with the start of the mating season being more critical than its length.

Breeder segregation is best done in the early dry season when few calves need to be mothered-up, and when prediction of subsequent survival and fertility is most accurate. Cows may be divided into high and low requirement groups for extra nutrition based on a compromise between survival risk and likely subsequent fertility. Stage of pregnancy and lactation appear more important than body condition in estimating survival risk.
**Market specifications**

The four primary markets for Australian beef cattle are domestic store steers, domestic meat, live export, and export meat, with the live export markets growing in importance, especially in northern Australia (Figure 5.10).

![Diagram showing the main markets for beef cattle](image)

**Figure 5.10. Main markets for beef cattle.**

Conditioned store steers suitable for ‘finishing’ to market condition are eagerly sought by lot-feeders and by producers who have the better classes of grazing and cropping lands.

Cattle sourced for domestic and export meat markets cover a wide range of specifications with those reaching specifications attracting premium prices.

Specifications for meat markets are based on:
- whether cattle are grass or grain fed
- live specifications of animal liveweight, age, dentition and sex
- carcase specifications of hot standard carcase weight, fat depth and colour, meat colour, butt shape, eye muscle area and marbling score.

Carcass weight and fat depth requirements for the main markets for grassfed and grainfed beef are summarised in Figure 5.11. More detail is given in Appendix 7.

**Production systems and meeting the market**

**Production systems**

Annual cattle growth patterns achievable from each of the different types of grazing lands (like the example given for black spear grass pastures in Figure 3.25, Chapter 3) provide a benchmark for feasible production systems, and for any feeding and cattle management strategies that may be needed to target particular markets.

Likely growth patterns may be constructed from the seasonal daily liveweight change expected from different pastures and forages (Figure 5.12), provided possible compensatory gain and stocking rate effects (Chapter 4) are accounted for when estimating the likely annual gain.
Figure 5.11. Meat market specifications of carcase weight and fat depth for grassfed and grainfed beef.

Figure 5.12. Range in daily liveweight change of beef cattle commonly achieved on different forages in northern Australia (data from Winter et al. 1991)
Using the above criteria, grazing lands in northern Australia may be broadly divided into four categories based on potential liveweight gain (LWG): breeding only and low, medium and high productivity.

**Breeding only (< 95 kg annual LWG)**

Example grazing lands include spinifex and the poorest spear grass and wire grass/blue grass pastures (refer Chapter 2).

Breeding of store cattle is the main activity with old breeding stock sold through manufacturing meat markets.

**Low productivity areas (95 to 120 kg annual LWG)**

Example grazing lands are the unimproved northern and coastal spear grass.

Liveweight gains on these pastures allow the average steer to weigh between 500-550 kg at 3.5 years which means:

- a further year is generally needed for most cattle to reach the 600+ kg liveweight target required for the Japanese grass fed market;
- at 4.5 years cattle will have 8 permanent teeth which disqualifies them from the age premium this market offers
- a small proportion of early born calves may reach 600 kg by 3.5 years.

**Medium productivity areas (120 to 160 kg annual LWG)**

Example grazing lands are the better quality or improved, coastal and inland spear grass and blue grass pastures.

Most producers breed and finish their own cattle on native pastures. They target the Japanese grass fed market with 3.5 year-olds having carcase weights in excess of 290 kg. Features of the production system are:

- normal management is for steers to graze less fertile country for 2 years post-weaning (100-150 kg and 110-190 kg annual gain in first and second years, respectively) followed by 1.5 years finishing on the more fertile areas of the property (150-220 kg annual gain)
- weight gains are very dependent on seasonal conditions, although where cattle have made poor early gains it is common for greater gains to occur later so that the 3.5 year target is met
- areas favoured with high fertility forest country give opportunities for accelerating weight gains after weaning (500 kg liveweight by 2.5 years), and for implementing extra feeding to achieve target sale weights earlier
- native pastures in these areas can be improved by sowing introduced perennial legumes that give steer annual liveweight benefits of up to 40 kg.

**High productivity areas (> 160 kg annual LWG)**

Example grazing lands are sown grass pastures associated with cropping within the bragalow lands of central and southern Queensland.

Following development, and an associated boost in available soil nitrogen from clearing and disturbance, these pastures initially supported 180-200 kg annual LWG per animal for from 8 to 20 years. Without further inputs, however, the sustainable levels of production are more like 160-180 kg. Production features are:

- only a small percentage of cattle attain Japanese Ox weight of 600+ kg by 2.5 years and the remainder require a further 6 - 12 months to reach this target weight (many therefore miss the 4 tooth price premium)
- many opportunities exist to improve nutrition for more flexible marketing through legume oversowing of pastures, summer and winter forage crops and on-farm feedlotting.

**Feeding to enhance base nutrition**

Options are many and may include use of improved pastures, leucaena and dry land forage crops; feeding of grain, fortified molasses and protein meal in the paddock; commercial feedlotting; and rumen modifiers and hormonal growth promotants, provided these do not violate market specifications.

Relationships between base pasture and additional feeding responses required to reach a range of market specifications are summarised in Figure 5.13.
Post-farm and pre-slaughter management

Important issues are liveweight loss, mainly governed by the elapsed time between mustering and slaughter, and lowered meat quality due to pre-slaughter mishandling stress and to bruising.

Liveweight losses up to 12% and carcase weight losses up to 5% can occur in cattle deprived of feed and water (Figure 5.14).

Stress and bruising are minimised by efficient and quiet handling, use of efficient loading ramp and stock crate designs, and 'volume' loading procedures that prevent overcrowding.

Pre-slaughter stress depletes glycogen concentration and increases pH of muscle tissue. This reduces meat tenderness and causes dark meat. Stress incurred immediately before slaughter is most damaging as glycogen restoration requires a resting period.

Figure 5.13. Growth patterns of beef cattle on different pastures and the finishing options for various markets (Gramshaw and Lloyd 1993).

Figure 5.14. Typical losses in (a) liveweight and (b) carcase weight of cattle deprived feed and water for varying periods of time (Wythes 1984).
Dairy production

The dairy industry in northern Australia is confined to the sub-tropical, 800-1200 mm annual rainfall zone of eastern Australia extending from mid-coast New South Wales to the Atherton Tablelands in North Queensland. Only one commercial dairy operates elsewhere in northern Australia, at Katherine in the Northern Territory.

Each farm in the northern dairy zone has an average of 100 dairy cows comprised of milkers and dry stock. Average annual milk production per cow is around 4000 litres over all herds and about 5000 litres for recorded herds. There is potential to achieve above 6000 litres per cow.

The dairy industry is more highly developed for feeding systems, genetic improvement and herd management in comparison with most of the northern beef industry.

Breed choice

Holstein-Friesian (Holsteins) comprise more than 80 percent of the milk in northern dairy herds. The remaining 20% comprise Illawarras plus a minor contribution from the Jersey, Guernsey and Ayrshire breeds.

Holsteins produce about 15% more milk, butterfat and protein per lactation than Illawarras.

DPI has used the Sahiwal (Bos indicus) and Holstein-Friesian breeds to develop a tropically adapted dairy breed, the Australian Friesian Sahiwal (AFS). The AFS has high fertility and outstanding maternal performance. It out-performs Holsteins in strongly tropical environments, such as in the Northern Territory and overseas.

Holsteins produce 25-30% more milk than AFS in Queensland’s subtropical dairy environment.

Breeding and selection

Principles

Many of the principles for breeding and selection of beef cattle apply to dairy cattle.

In contrast to beef cattle, dairy herd improvement relies mainly on straightbreeding and selection to exploit the genetic variation within an existing superior breed.

Also by contrast, the intensive and localised nature of the dairy industry allows it to efficiently and economically use artificial breeding techniques. For example, the easy use of artificial insemination (AI) gives access to genetically superior semen nationally and internationally.

The Australian Dairy Herd Improvement Scheme (ADHIS) underpins dairy genetic improvement through its voluntary scheme established in 1982 for assessing the genetic potential of bulls and cows through a rating system.

Australian Breeding Values (ABVs) analogous to the EBVs for beef cattle are used as estimates of genetic merit (Figure 5.15). ADHIS also provides ‘conversions’ (estimates), or ABV(C)Is, for Holstein and Jersey sires available in the USA, Canada and New Zealand; these help to align the different methods used overseas to the Australian method.

Figure 5. 15. ABV traits (from Lake 1995).

ADHIS also provides a National AB Sire Identification Scheme (NASIS) listing details and traits of around 5000 pedigree bulls providing semen for AI in Australia.

Estimates, based on gains in both milk protein and milk fat yields, indicate a 30% production advantage attributable to genetic improvement within recorded herds in Queensland over the last decade.

Trait heritability and selection strategy

In general terms, fertility and fitness traits have low heritability (0-20%), total milk and fat yield have moderate heritability (20-40%), and milk components and measures of skeletal size and shape have high heritability (>40%).
Specific heritabilities for milk production traits are:

<table>
<thead>
<tr>
<th>Trait</th>
<th>% Heritability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein yield</td>
<td>13</td>
</tr>
<tr>
<td>Fat yield</td>
<td>15</td>
</tr>
<tr>
<td>Milk yield</td>
<td>17</td>
</tr>
<tr>
<td>Protein %</td>
<td>25</td>
</tr>
<tr>
<td>Solids not fat (SNF) yield</td>
<td>25</td>
</tr>
<tr>
<td>Fat %</td>
<td>38</td>
</tr>
<tr>
<td>SNF %</td>
<td>45</td>
</tr>
</tbody>
</table>

Traits are to varying degrees correlated so that selection for a particular trait may lead to positive or negative responses in the other traits. In selecting for milk yield, for example, a positive response should occur in fat and protein yields but fat and protein percentages may be depressed.

The best strategy to achieve progress in all production traits is to select on fat plus protein yield.

**Herd management**

Not surprisingly, priority management issues for dairying essentially parallel those for beef production with the nutrition of herd replacements and their mothers being pre-eminent.

Similar practices are early weaning, feed supplementation for herd replacements and for producing animals (lactating cows), culling of low producing and defective animals, and disease management and control.

Contrasts relate to the intensiveness of the dairy industry and the different primary product marketed. They include higher levels and continuity of supplementation, easier control and segregation of animal classes, a wider range of pasture and other forage options, availability of irrigation, heat stress (Bos taurus breed), milk quality control, and disposal of effluent (also critical for beef feedlots). Some of these management differences are expanded on below.

**Reproductive efficiency**

Milk production is fundamentally driven by reproductive efficiency through current cow performance and the potential performance of the replacement cows reared, with both influences strongly modified by nutrition.

The period from pre-calving to next conception is the critical period of management for maximising cow and herd reproduction efficiency; there are both current and subsequent flow-on effects for milk production. Guidelines for high herd reproductive efficiency are:

**Interval criteria**

- Calving to first heat: 40 days or less
- Calving to first service: 60 days
- Calving to conception: 83 days
- Lactation: 300 days
- Dry period: 60 days
- Calving interval: 365 days

**Rate criteria**

- Abortion rate: < 5%
- Culling for infertility: < 5%
- On heat by 60 days: 85+%
- 42 versus 21 day cycles: 16% or less
- Pregnancy rate: 85+
- Calves per service: >50%
- Dry cows in herd: 17% or less

Key management factors are nutrition in the period about 60 days either side of calving (see Figures 3.35 and 3.36, Chapter 3), heat detection, appropriate bull management or AI techniques, and control of venereal and other diseases. Individual cow performance recording is most helpful for meeting the efficiency criteria.

Pressure for seasonal calving is much less than in the markedly seasonal forage environments experienced in Victoria, Tasmania and New Zealand. The northern Australian dairy industry is geared for milk production year-round for local consumption. This demands a continuous supply of quality forage.

**Cow replacement**

Early weaning improves the subsequent milking performance of the mother but, in contrast with beef cattle, weaning occurs mostly 1 day after birth to maximise saleable milk yield.

Dairy heifer or cow liveweight at first calving is strongly related to subsequent lactation performance (Figure 5.16) with effects also persisting to the third lactation.
Figure 5.16. Suggested relationship between milk production (litres per lactation) and liveweight of heifers and cows at calving (Moss 1993).

![Graph showing the relationship between milk yield and liveweight for heifers and cows.]

Depending on breed size, dairy replacements preferably should reach a minimum range in livewights between 240-320 kg by mating at 15 months and between 450-550, or more, by calving at 24 months.

Herds targeting milk production of more than 4000 litres per cow per year require liveweight at calving to be at least 550 kg (Figure 5.16). This requires an average growth rate from birth to first calving near 0.6 kg per day.

Calves pre-weaning (birth to age 2 months) need to be suckled or artificially reared (bucket-fed milk replacer) to achieve acceptable growth rates of 0.35-0.45 and 0.15-0.30 kg per day, respectively, and to ensure adequate rumen development. Calves artificially reared must receive some colostrum in the first 24 hours after birth. Feeding concentrates after 4 weeks of age significantly lifts growth rate.

Early weaning can occur earlier than for beef cattle at between age 2-6 weeks, or at liveweights between 50-150 kg, provided the earlier weaned calves are fed suitable supplements.

Weaned heifer growth rates rarely exceed 0.5 kg per day without feed supplementation and requirements are:

- **< 6 months old** - grain (maize, sorghum, oats or wheat) combined with high protein concentrate (meat, soybean or cotton seed meal) fed in the ratio of about 4:1 of grain:protein meal plus calcium and P; and
- **> 6 months old** - an energy supplement only, unless pastures are of poor quality.

In both cases concentrate intake should not exceed 1.5% of liveweight.

Figure 5.17 shows the predicted dietary energy and crude protein requirements of heifers for different rates of liveweight gain and the ability of tropical pastures to meet these. Supplements that give high growth rates are detailed in Appendix 8.

Figure 5.17. Predicted dietary energy and crude protein requirements of dairy heifers at various rates of gain (Moss and Goodchild 1992).

![Graph showing the predicted dietary energy and crude protein requirements of dairy heifers.]

**Feed supplements for milk production**

Supplement feeding for milk production in the subtropics is essential to overcome seasonal variability in pasture production and quality, and to maintain adequate production and product quality for market requirements. Mostly energy is deficient but protein is also needed for high levels of production.

Most northern dairy farmers feed supplements of some kind in the form of molasses, grain, prepared meal, hay and silage. Concentrate supplements are fed mainly during milking. The necessary level of feeding is approximately 1500 kg per cow per lactation.
The rationale for supplement feeding is the increased feed conversion and cost efficiency for production obtained at higher milk yields per cow, at least up to yields of 20 litres per day or 6000 litre per lactation.

Greatest benefits from supplementary feeding are derived when microbial protein production in the rumen and protein availability in the small intestine are maximised; that is, responses to extra energy may be constrained by the amount of protein absorbed in the small intestine (see Chapter 3).

In practical terms, when dietary crude protein is below about 16-17%, increased production requires increased protein and increased energy. When dietary protein content is around 20% or more, increased production generally only requires high energy concentrates or highly digestible forages.

Other factors influencing response to supplements are forage yield (intake effects), carry over responses from previous supplementation (not likely if levels of nutrition have subsequently become limiting), and stage and pattern of feeding during the lactation (synchrony with peak nutritional demand).

Cost per litre of milk from supplement is more expensive than that from paddock feed, so it is sound economics to maximise production from paddock feed, and then lift per cow production a further 30 to 40% using concentrates.

It follows that efficient use of supplements without wastage or excessive forage substitution is important in maximising profits.

**Diseases**

Diseases and parasites that may afflict dairy cattle differ little from those of beef cattle.

One exception is mastitis, which is of particular importance for dairying through its direct and significant impact on milk yield and quality.

The sub-clinical form of mastitis is estimated to cause 70-80% of total milk losses due to this disease. It is insidious by showing no visible signs in the milk though remaining as a source of more severe infection within the herd. The clinical form of mastitis is treated with udder infusion of antibiotics. Cows with more than three cases of clinical mastitis during a lactation are considered to have chronic mastitis and are culled.

Mastitis is monitored using milk somatic cell counts taken from farm bulk milk vats once a month; counts less than 200 000 are considered very good with a herd mastitis problem evident when counts exceed 400 000.

**Metabolic and other disorders**

Two metabolic disorders of significance are hypocalcaemia (milk fever) in cows at calving and hypomagnesaemia (grass tetany) associated with rapidly growing forage and high fertiliser use in inland dairying areas.

Poisoning and other ailments associated with high production pastures and legumes are an issue and some examples are: nitrate poisoning in late winter or early spring on forage oats and irrigated ryegrass, especially when fertilised with high rates of N; prussic acid poisoning from forage sorghum, especially young regrowth; and bloat on irrigated clover-based pastures or on lucerne.

Most of the basalt derived soils in coastal Queensland are selenium deficient and may also be marginal for copper.

**Herd improvement recording**

A range of herd improvement schemes and services foster a high and efficient production ethic needed for economic viability and sustainability in the dairy industry.

Services available include herd recording for culling purposes, butterfat and protein testing, milk somatic cell counts, herd management scheme for improvement of herd reproductive performance, lactation and pedigree certificates, and a bull proving scheme.

**Effluent Management**

The fate of concentrated nutrients in effluent from milking sheds and intensive stock-use areas is increasingly under scrutiny.

Almost all dairy shed effluent, representing about 10 percent of the herd’s daily excrement, is presently disposed as fresh effluent onto pastures. Disposal of fresh or ponded effluent directly or indirectly into watercourses breaches environmental legislation.
Production systems

Dairy farming systems used in northern Australia may be defined in four categories:

- pasture-based with unrestricted irrigation
- pasture-based with restricted irrigation
- crop-based
- feedlotting.

The pasture-based systems predominate and rely on an array of seasonal pasture and forage crop options that may be variously combined to provide continuity of forage supplies year-round. Options include:

Summer

- native pastures, with or without N fertiliser
- sown grass pastures, with or without N fertiliser
- tropical grass/legume pastures
- forage sorghums and millets
- legume forage crops (lablab, cowpeas, soybeans).

Winter

- high density ryegrass, with or without N fertiliser
- high density clover
- ryegrass/clover pastures (mainly white clover)
- cereal forage crops (oats, barley, triticale)
- legume forage crops (snail medic, wooly pod vetch).

Year-round

- lucerne (mainly irrigated).

On the restricted irrigation and crop-based farms there is a greater need for high levels of concentrate feeding.

Feedlotting is limited by the capacity to ensure a regular supply of feed, difficulties in balancing rations, land suitability constraints, and environmental concerns. Growth in feedlot dairying is likely to be restricted to situations where large herds can be by-product fed, or to a few operations in favourable grain cropping areas.

The many available combinations of paddock and supplementary feed for dairying make it difficult to overview all production systems and their production potential. Selected examples typical of pasture-based systems are presented in Figure 5.18.

Quality pasture and forage for grazing, with a heavy emphasis on forage legumes, is likely to remain the main feed base for dairying well into the future. The poor quality of summer pastures is presently a primary deficiency, although forage peanut is showing increasing promise as a productive and persistent summer legume.

Figure 5.18. Milk and milk component yields expected in the subtropics from Holstein-Friesian cows feeding on various forage and supplement combinations (after Lake 1995).
Wool production

Wool is the primary product from the 13M sheep grazed in northern Australia. Most of the wool producing flocks are run on native pastures in the semi-arid and arid rangelands of Western Queensland inside the dingo barrier fence. A reliable source of stock water is provided by the underground waters of the Great Artesian Basin.

Sheep are managed extensively on properties ranging mainly from 5,000 to 30,000 ha with flock size between 2,000 to 10,000 (Figure 5.19).

Figure 5.19. Frequency distribution of sheep flock sizes in Queensland.

Breeding

Merinos, grown for their fine and medium wools, comprise more than 98% of the sheep. Improvement is almost solely achieved by the use of genetically superior rams supplied by stud breeders. Some 70% of the stud rams used are sourced from Queensland studs.

WOOLPLAN, an Australian genetic improvement scheme, provides a basis for better selection of Merino rams for mainly fleece yield and quality.

Managing reproduction

Sheep in Queensland rarely achieve their reproduction potential. Average lamb marking percentages vary between 50 to 65% but with a possible range from 10 to 80%; percentages tend to be lower and more variable in the north and western, compared with south and south western areas.

High pregnancy rates between 85 and 100% are commonly achieved and most ewes carry their lambs to term.

Major lamb deaths (averaging 25-40%) occur between lambing and lamb marking with further losses of about 10% between lamb marking and first shearing.

Reeasons are:
- heat stress of ewes during pregnancy which results in low lamb birth weights
- poor ewe nutrition in late pregnancy and after lambing which decreases mothering ability of the ewe
- effects of lamb marking including wound infections such as tetanus, suppurative arthritis, shock and mismothering
- accessibility of water for lambs
- predation by feral pigs, foxes and eagles
- worms, blowflies, parasites and diseases.

Management to reduce the impact of these includes:
- Saving the best forage supplies on the property for the breeding flock, and the provision of adequate watering points and shade
- Feeding of true protein supplements in the form of cottonseed meal and meat meal, although the economics of this is marginal
- Control of predators, especially pigs either by shooting or pig baiting enclosures.

Managing health

Blowflies, lice and worms are the main health problems. Blowflies are the most economically damaging by causing sheep deaths, spoiled wool, reduced fertility, and expenditure on chemicals and labour.

Management practices for maintaining health and the efficiency of wool production include:
- jetting, crutching, wigging, mulesing and shearing to control the sheep blowfly
- drenching to control worms
- dipping and jetting for lice
- vaccination for clostridial diseases such as pulpy kidney, tetanus and blackleg.

Efficient schedules for worm and lice control are provided by LICEBUSTER and WORMBUSTER programs.
**Production systems**

Enterprises either run a combination of breeding ewe and wether flocks or are solely based on wool production from wethers. Wether only enterprises are usually on the poorer country which is unsuitable for breeding.

Wethers also cut more wool than non-breeding ewes and have fewer problems with blowflies.

In south-western Queensland, mulga provides a feed source that is used mainly as a drought reserve. Mulga is supplemented with dry licks containing phosphorus, sulphur, nitrogen and sodium to provide a maintenance diet, mainly for dry sheep.

The majority of wool produced in Queensland is good topmaking Merino fleece with light vegetable fault (1.1 to 3%). The main fibre diameter classes produced are: Type 78B: 20.6 to 21.5 microns; Type 79B: 21.6 to 22.5 microns; and Type 80B: 22.6 to 23.5 microns.

**A key constraint**

Three relationships in Figure 5.20, based on long-term flock records from a sheep station in western Queensland, emphasise the key role played by rainfall in determining green forage supply and the productivity of the tropical wool industry in Australia.

Figure 5.20. Relationship between immediate past rainfall and (a) sheep losses; (b) the average fleece weight of grown sheep; and (c) lamb marking percentage (Oxley 1987).
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