

4

Young stock management

This chapter explains the nutritional needs of heifers in their two phases of development – milk-fed calf and weaned heifer.

The main points in this chapter

- A system of heifer rearing should produce healthy animals that are able to grow to target live weight with minimum input costs.
- It is essential that calves consume at least 4 L of high-quality colostrum in their first 6 hr of life. Calves must be hand-fed colostrum if they cannot suckle.
- Calves should be fed to promote rumen development using high-quality concentrates plus limited roughages.
- Calves can be weaned by 6 weeks of age if they are eating 0.75 kg concentrates/day.
- Calf scours is usually caused by poor feeding management and the first level of treatment should be feeding electrolyte solutions. Antibiotics should not be given until a specific bacterial agent has been identified as a major cause.
- Young calves cannot eat enough forage to sustain good growth rates. Forages alone are not suitable for milk-fed calves or for weaned calves until they reach 200 kg live weight.
- Good heifer growth rates are important for milk production and fertility and to minimise calving difficulties. Growth rate in Friesians after weaning should average 0.6–0.7 kg/day.
- Growth should be monitored regularly (preferably by weighing) to ensure that targets are being met.
- Forages should be high quality (11 MJ/kg DM of metabolisable energy) if it is used as the sole food for heifers less than 12 months of age.

When importing high genetic merit pregnant heifers into small holder systems, the dairy farmer is getting two animals – the pregnant heifer and the unborn calf – for the price of one. If the unborn calf is a heifer bred from a good quality dairy bull, the farmer will have two generations of potentially highly productive milk producers. If the unborn calf

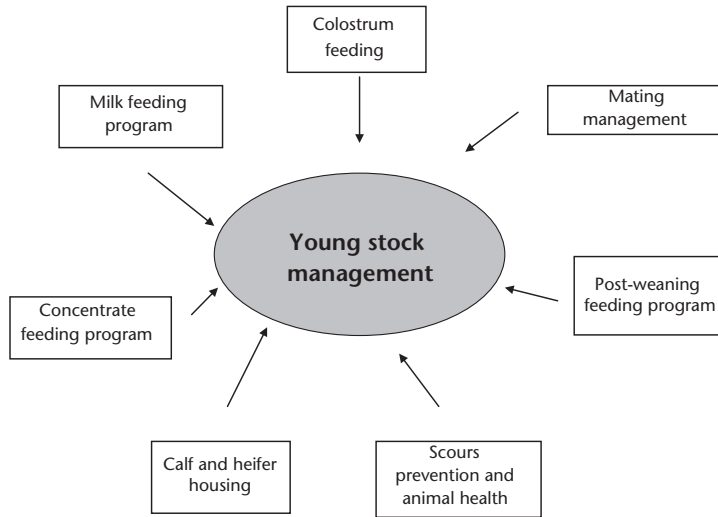


Figure 4.1. The key factors to consider when planning young stock programs

is a bull, it is likely that it will be able to grow at a faster rate than any of the farmer's bull calves born from local stock.

If the imported heifer is purchased as a non-pregnant heifer, then it is important that she be mated to a good-quality dairy bull, either through natural mating or artificial insemination (AI) to ensure her progeny can grow to become another potential high-producing cow in the herd. The emphasis is on the word 'potential' because high genetic merit calves require close attention during rearing to ensure they can achieve close to their genetic potential once they calve and join the milking herd.

Unfortunately, far too many dairy farmers in SHD herds restrict the potential of their newborn calves (Moran 2012). This results in the all too common observation that the second generation of imported stock are invariably less productive than their dams. Because this is entirely the result of poor calf rearing practices, this chapter is essential reading for all dairy farmers because it provides the groundwork to improve the ultimate performance of their heifer calves.

Well-grown dairy heifers are a good investment in the milking herd. To ensure they grow to become productive and efficient dairy cows, their management must be carefully planned and begins the day they are born.

A well-managed heifer rearing system aims for:

- good animal performance, with minimal disease and mortality
- optimum growth rates to achieve target live weights
- minimum costs of inputs, such as feed (milk, concentrates and forages), animal health needs (veterinary fees and drugs) and other operating costs (milk-feeding equipment) to achieve well-reared heifers
- minimum labour requirements
- maximum utilisation of existing facilities such as sheds for rearing and quality forages for feeding.



A well-managed calf-rearing shed (Sri Lanka).

There is no single best way to milk rear calves. All sorts of combinations of feeding, housing and husbandry can be successful in the right hands and on the right farm. Successful calf rearing is a specialist job requiring suitable facilities. It also requires a genuine concern for the welfare of young calves and quick responses to early symptoms of disease. If farmers are unable to commit the time and resources to rearing their own replacement heifers, they should seriously consider paying someone who is better placed to do a good job. The establishment of cow colonies in many Asian dairy industries, and the sharing of resources of farmers supplying a single dairy cooperative, provide the opportunity for a specialist calf and heifer rearer to milk rear and grow out the replacement stock for many farmers.

The first 3 months are the most expensive period in the life of any dairy cow. During that time, mortality rates are high, up to 20% in many cases. Calves need protection from the extremes of sun, wind and rain, no matter what the rearing system. Disease prevention and treatment can be costly during early life (Moran 2002).

Deaths of young stock should not exceed 4–6%, while the incidence of calf sickness should not exceed 10%.

4.1 Rearing the milk-fed calf

With their undeveloped digestive tract, calves require the highest quality and the most easily digestible source of nutrients: namely, whole milk or milk replacer. Unfortunately,

these are also the most expensive feeds. The most effective way of minimising the high feed costs of calf rearing is through early weaning and reduced milk feeding.

The essence of good calf rearing depends on two major nutritional factors. Firstly, an adequate intake of high-quality colostrum within the first day of life and, secondly, feeding management to encourage early rumen development.

4.1.1 Colostrum feeding

Newborn calves are very susceptible to disease. Before they develop their own immunity, they are entirely dependent on the antibodies contained in their mother's milk. It is therefore vital that they receive adequate quantities of antibody-rich colostrum from their mothers or from other freshly calved cows.

Calves should have access to 4 L of colostrum within the first 6 hr of life. They will not need any additional milk for the next 12–24 hr. Any calf that is suspected of not having suckled in the first 3–6 hr should be hand-fed the colostrum. With sick or weak calves, colostrum may have to be administered by stomach tube. It is not difficult to stomach-tube young calves.

Frozen colostrum (which can be stored for 18 months) can be thawed out and used, or colostrum from a mature cow within the herd can be fed. Fresh colostrum can be refrigerated for 7–10 days. Ideally, colostrum should be tested for antibody concentration to ensure it is of sufficient quality to store.

The level of immunity passed on by the cow increases with her age, because older animals have been exposed to a greater range of infectious organisms to which they have developed antibodies.

Replacement heifers born to first calving cows may require additional stored colostrum from older cows to ensure they develop good disease immunity. Vaccinating cows prior to calving for *E. coli*, *Clostridia* and *Salmonella* can enhance the immune properties of colostrum.

The longer calves spend with their dams, the greater their chances of contracting disease. Therefore newborn calves should be separated from their dams as quickly as is practically possible.

4.1.2 Early rumen development

The rumen is non-functional in newborn calves; hence, all digestion must take place in the abomasum (or true stomach) and the small intestine. The weaned calf needs a fully functional rumen in order to be well adapted to a forage-based diet. Before weaning, it is important to promote rumen development, so as to avoid growth checks when calves are weaned.

Rumen development occurs through the digestion or fermentation of feeds (roughages and concentrates) by the rumen microbes. Calves should be encouraged to eat solid feeds at an early age, mainly through limiting their access to milk to 4 kg/day. From the first week, roughage such as clean straw should be offered in combination with high-quality concentrates specially formulated for rearing calves.

Fresh forages are not good sources of roughage for milk-fed calves. Such forages contain too little fibre, and their very high water content prevents high intakes of feed

energy in each mouthful. This limits the feed energy available for rapidly growing animals. Until their rumen capacity is larger, young calves just cannot eat enough fresh forage to sustain high growth rates.

4.2 A successful early weaning program

Dairy farmers generally want to feed their calves on the best quality feeds to give the calves a good start to life. On the whole though, most farmers feed too much milk for too long.

By continuing to feed milk longer than is necessary, farmers often feed 400–500 kg of milk (or its equivalent in milk replacer solution) to each calf. They need only feed 200 kg of milk or less. Furthermore, much of this milk can be colostrum from calving cows, making the milk feeding costs very low.

If calves are strong, healthy and kept warm and dry, they can be successfully reared on a once daily feeding with 4 L of whole milk, or its equivalent in milk replacer. All calves should be offered a specially formulated calf meal from 1 week of age. Milking cow concentrate formulations do not contain sufficient protein to meet the needs of young calves.

Calves should have limited access to fresh forages. The key to this rearing system is giving the calves continuous access to clean straw as a source of roughage. Note this is clean straw, not good quality pasture hay or lucerne hay.

All calves must be given the opportunity to nibble on the straw, even though they will eat very little of it. Straw will encourage rumen development rather than provide nutrients.

If better quality hay is fed in place of straw, calves will eat more roughage but at the expense of concentrate consumption. If good quality hay is fed, it should be limited to 100–200 g/calf/day. Clean drinking water must be available at all times.

Feeding milk only once each day helps the calves to develop an appetite for the concentrates. It is the concentrate, rather than the milk, that should provide the bulk of nutrients to keep the calf growing. Calves can be weaned off milk once they are consuming 0.75 kg/day of concentrates for 2–3 consecutive days. This usually occurs by about 6–8 weeks of age.

Provided calves are eating 0.75 kg/day of concentrates, milk feeding does not have to be reduced gradually. Calves should continue to be housed indoors during weaning.

This system rears the rumen rather than the calf. Systems that involve feeding more milk do not encourage early rumen development and hence calves must be older before they can continue to grow without milk.

It is important that each calf drinks its allocation of milk. Lower milk intakes will limit calf performance because of the inability of the young animal to compensate by eating more concentrates. As well as reducing growth rates, underfed calves may be more susceptible to diseases and other stresses during life. Higher milk intakes will discourage concentrate consumption.

Ideally, calves should be housed individually or in small groups. They should also be individually bucket-fed. There is no advantage in milk feeding using teats rather than buckets; it only creates extra work in keeping the buckets clean.

4.2.1 Weaning age

The age when milk is no longer fed should depend on the quality of feeds available. For example, Ibrahim (1988) suggested calves should be weaned at:

- 2 months, when quantity and quality of roughage and concentrates are good
- 4 months, when quantity and quality of roughage and concentrates are average
- 6 months, when quantity and quality of roughage and concentrates are poor
- 8 months, when suckling and cows are dried off.

Provided they are not adversely affected by disease or very poor feeding management, the growth rates of calves up to weaning is far less of an issue than their performance post-weaning. Prior to weaning, calves are fed milk, which contains all the essential nutrients for healthy growth, whereas after weaning the quality and amount of dry feeds have the biggest influence on calf performance. Invariably farmers save their best quality feeds for their milking cows, meaning that young stock suffer from poor feeding management. Weaning programs developed for young stock in temperate regions, where feed quality is usually better, therefore require close scrutiny to ensure they will still allow weaned stock to achieve their target growth rates (see Table 4.2).

4.2.2 Concentrate quality

Milk-fed and weaned calves require concentrates containing higher protein levels (18–20%) than do milking cows (16%). Low protein concentrates will not promote the same rate of rumen and body development in milk-fed calves. Consequently 2 months may be too young for weaning such calves.

Throughout Asia, the majority of formulated supplements for milking cows are formulated to 16% protein, even though on closer investigation (Moran 2005), they are frequently below this content. For convenience, many SHD farmers also feed these concentrates to their young stock. Such formulations are far from ideal because of the higher protein requirements of young stock. Depending on the quality of the basal roughage fed post-weaning, 18% may even be insufficient.

Very rarely can SHD farmers purchase higher protein formulated concentrates and in many cases farmers are not even aware of the benefits for their young stock in supplementing available milking concentrates with additional protein supplements.

High protein concentrates may be available, but at great expense, because they have been formulated for pig and poultry, incorporating high-quality protein ingredients. It would be ideal if a few large-scale feed mills, either owned by dairy cooperatives or agribusiness, could formulate calf and heifer mixes with higher protein contents, using better quality energy sources and additional minerals and vitamins for optimal growth of young stock. Compared with the higher demand of concentrates specially formulated for milking cows, the formulation of smaller batches of calf/heifer mixes would not be cost effective for small dairy cooperatives.

4.2.3 The high cost of milk rearing

Most Asian small holder farmers feed milk (or milk replacer) to their calves for 8–12 weeks. This is the 'accepted method' because the high nutrient intakes should ensure a

Table 4.1. The cost of dietary energy when rearing dairy calves in Sri Lanka

	Cost (Rs/kg)	Cost for DM (Rs/kg)	Cost for energy (Rs/MJ)
Whole milk			
Expensive	35	292	13.3
Cheap	20	167	7.6
Calf concentrate			
Expensive	35	39	3.1
Cheap	25	28	2.2

good growth rate, provided the calves remain healthy, because specially formulated calf concentrates are not readily available.

Feeding high levels of milk can cause several problems. Firstly, it is invariably more expensive to provide the same intake of feed nutrients from milk or milk replacer than from formulated calf concentrates.

Table 4.1 is based on whole milk containing 12.0% DM and 22.0 MJ/kg DM of energy and calf concentrates containing 90% DM and 12.5 MJ/kg DM of energy. The calculations are for Sri Lanka small holder farmers (using Sri Lankan rupees or Rs as the currency), but they provide a guide to farmers in any country.

For farmers receiving 35 Rs/kg for their milk, they are spending four times more per unit of energy by continuing milk feeding beyond the 6–8 weeks required for normal rumen development in a well-reared calf.

The second problem with high milk feeding is the increased likelihood of disease problems. Once milk is removed from their diet through weaning, calves are more resistant to scours. Unless a strict cleaning and sterilising routine is enforced in the calf shed, flies and other disease carrying agents will thrive on residual milk left in buckets, on floors and in other equipment used with milk feeding.

4.3 Scours in milk-fed calves

Animal health will be discussed in a later chapter, but any discussion of calf rearing must include calf scours (or neonatal diarrhoea). This is a major problem throughout Asian small holdings because many veterinarians just do not understand its causes, hence its prevention and treatment (Moran 2012). Antibiotics should be given as the last resort of treating scours, rather than administered routinely to all scouring calves.

Scours is the single most important cause of death in milk-fed calves. Even when calves survive, the increased labour requirements for their care, together with veterinary and drug bills, make scours a costly problem with calf rearers. Furthermore, their potential productivity is likely to be decreased by setbacks in early life.

The causes of scours, particularly in calves under 3 weeks of age, are complex. There is not usually a single cause, with contributing factors being calf management, diet, the environment and the presence of pathogens. Prevention and early treatment with fluid replacement (electrolyte therapy) can avoid the unnecessary use of antibiotics.

4.3.1 What is scours?

Calf scours is easily recognised. It is an increase in the frequency and quantity of faeces, which has a higher than normal water content. In some cases, blood and mucus may also be present. Whatever the cause of scours, farmers will see some or all of the following:

- bright yellow or white faeces
- depressed calves that are reluctant to feed or suck
- calves with sunken eyes and/or a temperature
- skin remaining peaked or tented when lifted, indicating dehydration
- weight loss and weakness
- if severe cases, calves will collapse, become comatose and die.

Scours can be classified into two types, nutritional and infectious. Nutritional scours is usually caused by stress to the calf due to a breakdown in management routines. Nutritional scours often progresses to an infectious scour, which is caused by a high population of pathogens.

4.3.2 Causes of nutritional scours

Scours can be traced back to two major causes: poor colostrum feeding management and stress.

One of the first effects of stress in calves is a reduction of acid secretion into the abomasum. This reduces both the ability of the clot to form, and digestion of milk protein.

Stress can result from a wide variety of causes. It could be due to inappropriate milk feeding programs (e.g. over-feeding or irregular feeding), sudden changes in the concentration of milk replacers, incorrect milk temperatures or poor-quality milk powder. Calves reared on milk replacers are more prone to scours than those reared on whole milk.

Environmental stress is also a common cause of scours, such as sudden changes in the weather (for calves run outdoors) or cold, damp, draughty or humid conditions inside calf sheds. Overcrowding in calf sheds can result in outbreaks of scours. Even changes in staff can lead to scours through different handling of calves or changes in the standards of hygiene. Combinations of any of the above stresses will greatly increase the likelihood of scours.

The duration of scours is largely under the control of the calf rearer. During their second week of life, calves are particularly susceptible. By careful observation, it is possible for experienced calf rearers to anticipate the onset of scours on the day before it occurs, after which milk feeding can be reduced, with the result that the calf recovers quickly.

The following signs of impending scours should be looked for:

- dry muzzle, thick mucus appearing from the nostrils
- very firm faeces
- refusal of milk
- a tendency to lie down
- a high body temperature (over 39.3°C).

Scouring calves can lose up to 5 L of fluid each day including minerals salts essential for normal body function. With most infectious scours, it is the dehydration and acidosis, not the infection, that kills the calf. In fact, most calves can naturally overcome infectious scours if their dehydration is quickly treated. For viral infections, this is the only treatment option.

The loss of electrolytes reduces the ability of body tissues to retain water, thus aggravating the dehydration. This highlights the importance of quick recognition and treatment of scouring calves with electrolyte therapy to replace their lost body fluids.

4.3.3 Treating scours

To treat scours properly, its cause must be determined and eliminated. For example, if it results from poor shed design, a calf rearer may not be able to immediately rectify that problem, although temporary measures such as reducing draughts or decreasing calf numbers should be possible.

The top priority for treating scouring calves is to provide them with sufficient liquid and electrolytes to replace those lost in the faeces. The next priority is to supply additional sources of readily digestible energy, such as glucose (dextrose), but not sucrose. Finally, and only after diagnosis, should drugs be considered for treating the actual pathogens causing infectious scours.

There are a variety of electrolyte fluid replacers on the market, some of which contain a supply of energy, while others may contain chemicals to reduce the rate of passage of feed through the gut or to reduce the rate of loss of body fluids from the tissues into the intestines. Formulations incorporating antibiotics are only effective against scours caused by bacteria and/or protozoa, whereas many of the infectious scours are caused by viruses. Traditional thinking on treating scours was that milk feeding should cease, or at least be reduced. However, milk contains the best source of energy for calves, while some electrolyte treatments contain insufficient energy to maintain a sick calf. It is dangerous to withdraw milk for more than 24–48 hr because the intestinal wall will degenerate and lose its capacity to secrete enzymes that digest lactose. Many authorities now recommend withholding milk for no more than 24 hr, or even not at all.

Scouring calves should be isolated in a clean, dry and warm pen. Frequent small feeds of electrolytes or milk are better than fewer larger ones. Ideally, the daily volume of fluids required should be determined, based on the size of the calf, the degree of dehydration that needs to be corrected and the rate of continuing fluid loss via the faeces.

A decision must then be made as to how to administer the electrolytes. If the calf is able to suck, it can be fed by bucket or teat. If it is unable to drink, it should be fed by stomach tube. If it has collapsed and is in shock, it will require subcutaneous or intravenous therapy.

Diarrhoea powders containing kaolin, pectin or chalk can reduce the severity of scouring. Other home-made treatments, used in the past to slow down the passage of feed through the gut (such as charcoal tablets, cornflour or even sawdust), can make the condition worse and should be avoided. Antibacterial compounds and antibiotics (e.g. calf scour tablets, drenches or injections) should be used only on recommendation of veterinarians and restricted to cases where *E. coli*, *Salmonella* or other bacteria have been

diagnosed or are suspected. Prolonged use of antibiotics can lead to nutritional scours by killing off *Lactobacilli* (the milk-digesting bacteria) in the abomasum and preventing development of rumen microflora.

Up to 90% of treated calves should be back to normal after 2 days of fluid therapy, while the remainder may require veterinary examination. This often includes faecal sampling to identify any infectious agent causing the scours. Recording the ages of scouring calves will assist veterinarians in diagnosing the causative pathogen.

When reintroducing milk after fluid therapy, it should be offered full strength. Milk should never be diluted with electrolyte solutions, because this can lead to poor milk clotting. If giving both electrolytes and milk, electrolytes should be given at least 30 min before a milk feed.

4.3.4 Preventing scours

To ensure healthy and disease-resistant calves, the importance of good colostrum feeding management cannot be overemphasised. Up to 40% of calves do not absorb sufficient antibodies within the first 12–24 hr of life because of inadequate attention to their colostrum feeding. Such calves are more likely to succumb to infectious scours.

Feeding high-quality colostrum for the first few days of life is beneficial. Even if some of these antibodies are not absorbed into the blood, they can still provide local protection in the intestines against infectious scours.

Prevention of scours centres around good hygiene and minimising stress. Measures that can be taken include:

- ensuring calves are protected from extremes of climate
- carefully planning shed designs to avoid overcrowding
- minimising stresses associated with routine management practices, such as disbudding and castration
- maintaining strict hygiene by cleaning and sterilising feeding utensils and facilities during milk rearing
- developing a routine milk feeding program, with as few people involved as possible
- weaning early to minimise the period of milk feeding
- quickly responding to early symptoms of scours, isolate sick calves and address the cause
- minimising the use of antibiotics and then only under veterinary supervision
- keeping records of treatment of sick calves to assist in veterinary diagnoses and for withholding periods if the calf is subsequently culled.

4.4 Management of weaned replacement heifers

All too often, farmers rear their heifer calves carefully until weaning but neglect them thereafter. Calves that are poorly managed after weaning are disadvantaged for their entire life. Even if they are well fed after mating, their ultimate mature size is restricted and if they do put on extra weight, it tends to be fat. Most of the growth in skeletal size occurs before, not after, puberty.

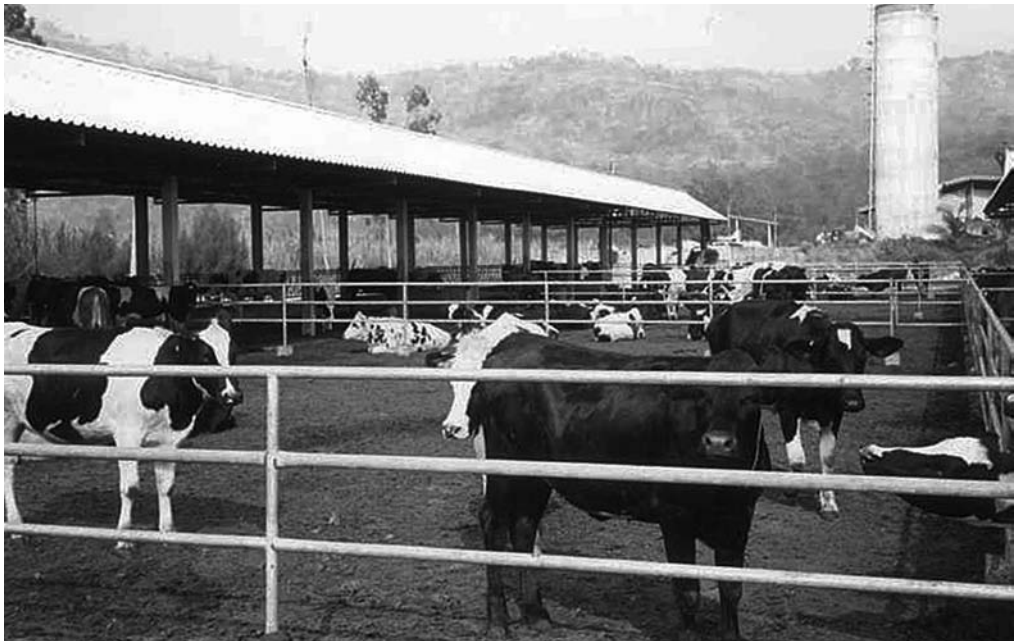
Weaned heifers do, however, require less attention than milk-fed calves and milking cows. Dairy heifers need to be well fed between weaning and first calving. If growth rates are not maintained, heifers will not reach their target live weights for mating and first calving.

Undersized heifers have more calving difficulties, produce less milk and have greater difficulty getting back into calf during their first lactation. When lactating, they compete poorly with older, bigger cows for feed. Because they are still growing, they use feed for growth rather than for producing milk. Many studies have demonstrated the benefits of well-grown heifers in terms of fertility, milk production and longevity.

4.4.1 Fertility

The onset of puberty, and commencement of cycling, is related to live weight more than to age. A delay in puberty means later conception. All heifers should achieve their target weight before joining, because lighter heifers have lower conception rates. Calving problems depend more on heifer live weights at mating, than on live weights or body condition at calving. Frame size is determined early, so there is doubtful merit in the practice of feeding older heifers to make up for poor growth earlier in life.

Studies showed that Friesian heifers mated below 260 kg had 34% conception to first insemination compared with 58% for heifers mated weighing 300 kg or more. Of the smaller heifers, 24% had difficult calvings. This declined to 8% in heifers mated at 260–280 kg and was lowest in 340–360 kg heifers. Heifers underweight at mating required considerable assistance if in difficulty during calving.



Contract heifer rearing in Thailand.

4.4.2 Milk production

Increasing calving live weights for Friesians from 360 kg to 460 kg increased milk production during the first lactation by 400 kg (Freeman 1993). This production benefit extended into both the second lactation, with an extra 830 kg/extra 100 kg live weight, and the third lactation, with an extra 840 kg/extra 100 kg live weight. Heifers calving 100 kg heavier can increase their peak production by 5 kg/day during the first lactation.

However, there is little point in rearing well-grown heifers then underfeeding them during their first lactation. Bigger heifers have higher maintenance requirements, which must be met before additional nutrients produce milk. Therefore good heifer-rearing systems should be considered only after feeding systems for milking cows have been developed. Many Asian small holder farmers do not feed their cows well enough to justify producing bigger heifers.

4.4.3 Heifer wastage

Poorly grown heifers do not last long in the milking herd. They are more likely to be culled for poor milk yield or poor fertility during their first lactation.

Total herd costs can be greatly increased by this high rate of wastage. Producers should aim to lose (through deaths or culling) no more than 20% of their replacement heifers between weaning and their second lactation.

4.5 Targets for replacement heifers

4.5.1 Live weight

Traditional target weights are too low to ensure first lactation heifers achieve their productivity potential, particularly on farms where milking cows are well fed. Table 4.2 summarises recommended live weights for Friesian and Jersey heifers at various ages. Targets for Zebu or local breed heifers would be similar to those for Jerseys.

Puberty occurs in dairy heifers at 35–45% of mature weight, while conception can occur at 45–50% of mature weight. A dairy cow will attain her mature live weight in about the fourth lactation and the objective of rearing heifers is to produce an animal 80–85% of mature live weight by first calving. Wither height sticks or chest girth tapes are an alternative to scales, but they are not as accurate and tend to overestimate live weights.

4.5.2 Wither height

Wither height (or height at the shoulder) is a good measure of bone growth and frame size in heifers. Frame size can influence ease of calving and appetite of milking cows.

Table 4.2. Target weights for Friesian and Jersey heifers at different ages (Moran 2002)

Age (months)	Friesian live weight (kg)	Jersey live weight (kg)
2–3 (weaning)	90–110	65–85
12	250–270	200–230
15 (mating)	300–350	250–275
24 (pre-calving)	500–520	380–410

Farmers should aim for wither heights in Friesians of 123–125 cm at 15 months of age and 133–135 cm at 24 months. Corresponding wither heights in Jerseys (and Zebus) are 110–112 cm at 15 months and 120–122 cm at 24 months.

4.5.3 Age of teeth eruption

It is easy to estimate the approximate age of a heifer by inspecting the state of her teeth. A calf may be born without teeth, with the temporary cheek teeth erupting within a few days and the temporary incisor teeth within 2 weeks.

The age at which the pairs of permanent incisor teeth erupt is as follows:

- First incisor teeth: 18–24 months
- Second incisor teeth: 24–30 months
- Third incisor teeth: 36 months
- Fourth incisor teeth: 40–48 months

The permanent cheek teeth erupt between 6 and 36 months, but are harder to identify than the incisor teeth. The age of eruption of permanent incisor teeth can vary with feeding regime.

This is a very useful guide when objectively assessing the feeding management of young stock because poorly fed heifers may look healthy and relatively well grown, but if their first (or even second) incisor teeth have erupted they are likely to be much older than at first glance.

4.5.4 Energy and protein requirements for heifers

Table 4.3 shows the energy requirements (for maintenance and growth) of heifers growing at different rates at various live weights. The growth rates for 500 kg heifers assume a contribution of 0.4 kg/day from the growing foetus.

See Chapter 5 for a description of ME (metabolisable energy). Growing heifers require a constant source of protein for optimum bone and muscle growth. Table 4.3 also lists crude protein requirements at different live weights.

4.5.5 Feeding heifers to achieve target live weights

Recommendations for grazing and feeding systems will differ between regions. Rather than depend on recipes, producers should regularly weigh their young stock, then vary feeding strategies according to their growth rates. Growth should average 0.6–0.7 kg/day,

Table 4.3. Energy and protein requirements for growing heifers (NRC 1989)

Live weight (kg)	Energy requirement MJ/day of ME				Crude protein (%)
	Growth rate (kg/day)				
	0.4	0.5	0.6	0.7	
100	28	30	33	36	17
200	42	45	48	51	16
300	50	60	64	68	15
400	75	79	84	89	13
500	91	95	99	103	13

although that can vary between 0.5 and 1.0 kg/day, depending on available pasture and the supply and cost of suitable supplements.

As fresh forage is the cheapest feed, it should constitute the bulk of the diet, with hay, silage or concentrates used to overcome forage shortages. Fresh forages or conserved hay or silage must be of sufficient quality (at least 10 MJ of ME) to satisfy the requirements for growth and maintenance.

Until calves reach 200 kg in weight, they are not able to maintain the growth rates needed to reach target weights on diets of either average quality forages or even top quality silage. Their capacity is limited and they simply cannot eat enough DM from the forages to meet their nutrient requirements for rapid growth. Forages must be good quality (at least 11 MJ of ME) if used as the sole feed for heifers less than 12 months of age.

Forage quality and allocation should allow for continuous growth throughout the first 2 yr. Uniform growth is not necessary and may be impracticable with seasonality of quality forage supplies. Yearling heifers have some ability for compensatory gain following periods of mild undernutrition, as long as they have not been grossly underfed. However, heifers should not be allowed to lose weight or to grow very slowly for long periods of time (i.e. no more than 1 month).

Ideally, growing heifers should be continuously fed concentrates to supplement the fresh forage, the quantity offered depending on target growth rates and the nutrients provided from the forage.