15

The business of calf and heifer rearing

This chapter discusses the importance of documenting all the costs of calf and heifer rearing to be able to prioritise efforts to reduce those that are most expensive.

The main points in this chapter

- Calf rearing is not cheap and producers who try to cut costs will eventually pay for it in the long run.
- Feed costs are generally the most expensive component in calf rearing, but when considering them, it is essential that all existing and alternative feeds are compared on an equivalent basis, such as their supply of dry matter or feed energy.
- An example of costing feeds in the tropics is provided for feeds available in Malaysia.
- A second example is provided for various milk feeding systems in Vietnam.
- The full cost of calf disease is more than just the costs of drugs and veterinary care.
- The full costs of young stock management include variable costs in addition to feed and animal health, and fixed or overhead costs, such as labour, depreciation and sourcing farm finances.
- It is not good farming practice to underfeed replacement heifers. Delayed calving, reduced milk yields and fewer lactations in the milking herd can be the price to pay if calf and heifer growth rates suffer due to poor feeding management.
- Lifetime productivity is very responsive to well-programmed feeding management during heifer growth and milking cow lactation. However, such benefits can be quickly eroded if animal health problems lead to high mortality and stock turnover.
- Farmers feeding lower-quality diets have more to gain, in terms of higher and more secure income, from reducing mortality and involuntary culling than solely from investing in better feeding management.

Calf rearing is not a cheap enterprise, and producers who try and cut costs will eventually pay for it in the long run. Because of the uncertainties of weather in many tropical dairying regions, there can be unusually cold, wet or hot spells and calves are

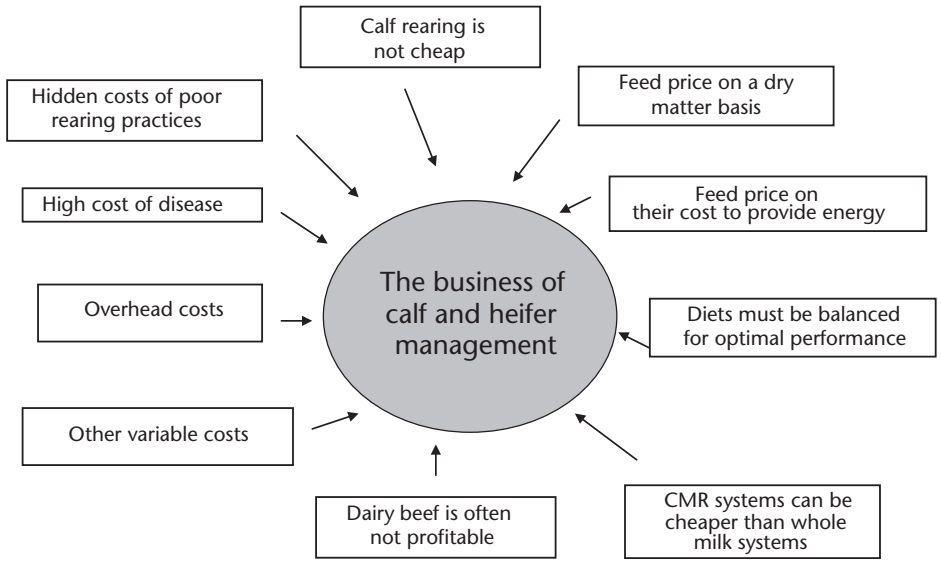

Figure 15.1. The key factors to consider when planning the business of calf and heifer rearing

very susceptible to these changes unless provided with some form of effective and relatively climate-proof housing. Inefficient milk feeding and cleaning systems require more labour and, despite what many producers believe, labour is not free and not even cheap. 'Cut price' milk replacers are generally cheap because they are lower in quality

Newborn calves are an investment to the dairy farm.

than normally priced powders, often because of poor processing techniques. Figure 15.1 highlights the complexity of planning the calf- and heifer-rearing business within the farm's dairy enterprise.

Calves can be reared on less whole milk or milk replacer than is often fed, provided their feeding and management allows for early rumen development. Once calves are weaned, poor feeding practices, such as grazing or being hand fed on low-quality roughages, together with inappropriate concentrate feeding regimes will lead to slow growth. If dairy heifer replacements do not achieve realistic target live weights, long-term milk yields, reproductive performance and longevity will suffer. Sub-optimal growth rates in animals grown for dairy beef increase slaughter ages and can even adversely affect carcass and meat quality. Money spent on good rearing and growing practices will be recouped in improved returns for milk or meat.

Whole milk should not be put into the bulk milk vat for periods of up to 4 or 6 days after calving; recommendations on this vary in different regions. During this period, cows produce colostrum and transition milk, which should all be fed to calves. If only rearing heifer replacements for the dairy herd, the colostrum produced by cows calving down bull and cull heifer calves should provide ample liquid feed for milk-fed calves. Assuming a 25% replacement rate in the dairy herd, together with 45 L of available colostrum and transition milk over several days from each cow, to rear the herd's replacement heifers, this provides 180 L of transition milk for each heifer calf in addition to feeding milk to the remaining calves until their sale at one week of age. This quantity is sufficient to rear a calf from birth to weaning. There should be little need for dairy farmers to buy milk replacers or use marketable whole milk to rear their calves.

This chapter discusses the business of young stock management using recent information from three different tropical countries. Firstly, the feed costs for calf rearing in Malaysia are documented; secondly, the total feed costs for rearing heifer and bull calves in Vietnam are presented; and thirdly, using computer simulation, a detailed evaluation of lifetime productivity of stock on SHD farms in Kenya is discussed in relation to stock mortality and culling procedures.

15.1 Costing different feeds for calf rearing

Various methods for costing whole milk and milk replacers have been described in Chapter 9. Costs can be expressed in terms of local financial units either per kg of dry matter (DM) or per MJ of metabolisable energy (ME) in the product. The latter is calculated from fat and protein levels in the whole milk or milk replacer. Local currency units for various Asian countries are presented in Appendix 3.

Costs for solid feeds, such as concentrates or roughages, can be calculated in a similar manner to liquid feeds once their cost per tonne and their DM and/or ME contents are known. Costs for purchased feeds are easy to calculate, but costs for home-grown feeds are more difficult to determine. Many economists use the opportunity cost of the feed as the basis of its pricing. This is the value of that particular feed if it was sold on the open market. For example, in Australia, wheat can be grown on-farm for say, A$180 per tonne yet could be sold for A$200 per tonne. It should then be priced at A$200 per tonne because that is its actual value to the grower.

The nutritive value of selected feeds has been presented in Chapter 10 in terms of DM, ME and protein, but these can vary considerably for any one feed type. It is strongly recommended when formulating rations for weaned calves, or any livestock for that matter, that actual measures of dry matter, energy and protein be obtained from commercial feed testing laboratories.

Energy- and protein-rich feeds can be purchased already formulated and sometimes pelleted as commercial pellets or they can be blended on farm from the raw ingredients to form a balanced concentrate mix. Calf-rearing pellets often contain vitamin and mineral additives. Commercial pellets, despite being more expensive than on-farm mixtures, are usually the preferred solid feed for calf rearers. Cow pellets are not suitable for rearing calves.

Conserved pasture hay or silage can be priced on its opportunity costs in the open market. However, grazed pasture cannot be priced this way because it has less value as standing feed than when grazed and used by calves. Many farmers undervalue the cost of grazed pasture on their farms. After including the actual cash costs (such as fertiliser, weed control and irrigation), the indirect costs (such as fencing, repairs and maintenance on farm machinery), as well as the costs for labour and depreciation of farm machinery, grazed pasture is not cheap. Some economists even consider council or shire rates and the return on total capital invested in land and equipment when calculating the real cost of grazed pasture. Finally, these are all costs for producing the pasture in the paddock, but it must be remembered that only about half of the pasture grown is actually consumed by grazing stock. At least with cut and carry pastures in the tropics, a greater proportion of that grown (say 70–80%) is converted into a saleable product by the animal.

15.1.1 Feed costs associated with calf rearing in Malaysia

The relative costs of the smorgasbord of feeds available for milk-rearing calves is likely to vary from country to country. Table 15.1 presents a case study for Malaysia in Malaysian ringgits (MR), for various feeds available, using costs in March 2010, and assumed DM, energy and protein values for 'typical' feeds of each type (Brouwer, *pers. comm*). The table includes data on:

- whole milk of two milk fat and protein contents, called good (4.4% fat and 3.6% protein) and average (3.2% fat and 2.7% protein)
- calf milk replacer or CMR (containing 15% fat and 20% protein)
- calf muesli, specially formulated for milk-fed calves
- cow milking concentrate: the usual source of concentrates for milk-fed calves
- palm kernel cake or PKC, the most readily available protein concentrate
- three sources of forage, namely Napier grass, whole crop maize and leucaena leaves.

Because the CMR is less than half the cost of marketable whole milk, it would seem logical to feed whole milk only when it has no market value, such as immediately after calving, and then change to CMR. The calf muesli has been specifically formulated with some long fibre to promote rumen development in the early milk-rearing period. In addition, its high protein content provides for the high protein demands of the young calf. Both the cow milking concentrate and PKC – the usual concentrates fed during milk rearing – contain insufficient protein, hence would delay weaning age.

Table 15.1. Costs for dry matter and energy in various calf feeds in Malaysia (in Malaysian ringgits)

Feed	Dry matter (%)	Energy (MJ/kg DM)	Protein (% DM)	Cost per unit (MR)	Cost for DM (MR/kg)	Cost for energy (MR/MJ)
Whole milk						
Good quality	13.3	23.7	27.1	2.00/L	15.0	0.63
Average quality	11.7	21.8	23.1	2.00/L	17.1	0.78
Calf milk replacer						
Powder	96	18.7	15	6.80/kg	7.1	0.38
Solution	9.1	18.7	15	0.62/L	7.1	0.38
Concentrates						
Calf muesli	89	12	22	3.40/kg	3.8	0.32
Cow milking	85	10	16	1.20/kg	1.4	0.14
Palm kernel cake	85	11	15	0.35/kg	0.4	0.04
Forages						
Napier grass	15	8	11	0.10/kg	0.7	0.08
Whole crop maize	20	8	8	0.10/kg	0.5	0.06
Leucaena leaves	30	8	22	0.30/kg	1.0	0.13

Clearly the lower cost per MJ of energy in calf muesli, compared with whole milk and CMR, would reduce total feed costs through earlier weaning. Even though PKC is the cheapest form of energy of all calf feeds, its lower energy and protein contents and reduced palatability, will limit its potential as a concentrate for young stock. Furthermore, its lack of long fibre will limit its potential to encourage rumen development in milk-fed calves. The calf muesli, even though only recently available, is quickly becoming integrated into successful dairy calf-rearing operations. As demands increase, the cost is likely to decrease, thus improving it economic feasibility for SHD farmers in Malaysia.

Once weaned, the cheaper forages could then become major components of the diet. However, to ensure adequate post-weaning growth rates, the high protein demands of weaned heifers would necessitate incorporating legumes into the forage base and/or feeding high-protein concentrates.

15.1.2 A case study of different milk-rearing systems in Vietnam

Traditionally, in Vietnam, farmers feed fresh milk until weaning at 12 weeks: up to 440 L/calf. In recent times, they have found that recently available CMR is cheaper than whole milk and that calves can be weaned considerably earlier than 12 weeks of age. Rearing male calves for beef is generally not considered economic in Vietnam.

Tiberghien (2009) compared four different calf-rearing systems, each with six male and six female calves. Calves were individually reared in elevated cages until 20 days then in individual pens until weaning at 3 months. They were fed colostrum and transition milk (at 10% of birth weight) for their first 7 days then placed on one of the four feeding systems. They were teat fed the milk or CMR and offered concentrates, hay and water in buckets. The systems were:

Table 15.2. Live weight and growth rates in heifer calves reared on four milk-feeding systems

	Milk 440 L	Milk 10% BWT	CMR standard	CMR EW
Live weight (kg)				
Birth weight	35	31	31	32
3 months	99	92	80	80
6 months	146	143	134	130
9 months	189	186	174	173
12 months	236	230	220	220
15 months	278	282	275	273
Average daily gain (kg/day)				
0–3 months	0.76	0.72	0.58	0.57
3–6 months	0.56	0.60	0.65	0.60
6–9 months	0.50	0.51	0.48	0.50
9–12 months	0.50	0.52	0.55	0.57
12–15 months	0.50	0.61	0.65	0.63
0–15 months	0.49	0.52	0.53	0.52

1. Fresh milk with the amount varying with age totalling 440 L/calf (Milk 400 L).
2. Fresh milk, fixed at 10% birth weight (Milk 10% BWT) then weaned when calves consumed 1 kg/day of starter concentrate.
3. Milk replacer (CMR), standard protocol (CMR standard).
4. CMR and early weaning (CMR EW) then weaned when calves consumed 1 kg/day of starter concentrate.

The research team recorded intakes of milk, CMR and total feed, calf health and live weights up to 12 months (males) or 15 months (females). They also recorded slaughter data for males at 6, 9 and 12 months of age. The growth rate data are presented in Table 15.2. There were no statistical significant differences between feeding systems in live weights at any age and all groups reached the target 270 kg by 15 months of age.

Total feed costs presented in Tables 15.3 and 15.4 were based on the following:

- Whole milk at 7200 VND/L.
- CMR solution at 4500 VND/L.
- Concentrate at 7600 VND/kg.
- Hay at 5700 VND/L.

Table 15.3. Feed intakes and feed costs to 3 months of age for heifers calves reared on four milk-feeding systems

	Milk 440 L	Milk 10% BWT	CMR standard	CMR EW
Milk intake (L/calf)	440	261	54	58
CMR solution intake (L/calf)	–	–	275	347
Concentrate (kg/calf)	58	68	48	51
Hay (kg/calf)	62	70	51	46
Feed costs (000 VND/calf)	**3962**	**2795**	**2281**	**2628**

Table 15.4. Live weight, growth rates and total feed costs in bull calves reared on four milk-feeding systems

	Milk 440 L	Milk 10% BWT	CMR standard	CMR EW
Birth weight (kg)	34	35	35	32
3 months (kg)	92	83	89	79
6 months (kg)	148	135	149	132
9 months (kg)	196	181	197	162
12 months (kg)	**242**	**226**	**247**	**202**
Average daily gain (0–12 months) (kg/day)	**0.57**	**0.53**	**0.58**	**0.47**
Feed costs to 12 months (000 VND/calf)	**8366**	**7407**	**6751**	**7249**

Up to three months of age, the CMR standard system cost only 58% of the Milk 440 L system, but the heifers were 19 kg lighter (80 versus 99 kg). However, by 15 months of age, this weight advantage had disappeared.

The CMR standard system resulted in the fastest growth rates in bulls to 12 months of age followed by the Milk 440 L system. The CMR standard system had the lowest total feed costs to 12 months of age, which were 81% of those in the Milk 440 L system. It is of interest that when expressed as a percentage of total feed costs for bull calves to 12 months of age, the feed costs of heifer calves to 3 months of age ranged from a high of 47% for the Milk 440 L diet to a low of 33% in the CMR standard diet.

One measure of profitability of the bull calves in the various systems, namely the carcass return less total feed costs, are presented for all systems in Table 15.5 and for the CMR standard system in Table 15.6. The carcass return is based on 90 000 VND/kg meat. The only profitable rearing system for slaughter calves was CMR standard. Profit decreased with advancing slaughter age mainly because the increase in feed costs was greater than the increase in carcass value.

The CMR standard rearing system has also been assessed on a Vietnamese commercial dairy farm where the calves grew at 0.48 kg/day over their first 3 months with total feed costs of 2.134 million VND, compared with 0.55 kg/day and 2.329 M VND respectively on the above trial.

Tiberghien (2009) concluded that, although the calves grew more slowly on the CMR standard system, total feed costs were lower than when fed whole milk, and by 15 months of age, any weight advantage disappeared. In addition, with the low meat returns in December 2009 for slaughtered calves in Vietnam, the CMR standard system was the only one profitable for rearing dairy beef.

Table 15.5. Profitability of rearing bull calves for slaughter at three ages on four milk-feeding systems (000 VND/calf)

Slaughter age (months)	Milk 440 L	Milk 10% BWT	CMR standard	CMR EW
6	–1356	–678	1165	–688
9	–1285	–1226	835	–995
12	–981	–539	768	–1117

Table 15.6. Profitability of rearing bull calves for slaughter at three ages on the CMR standard system

	Slaughter age (months)		
	6	9	12
Slaughter live weight (kg)	149.1	197.2	247.3
Meat (%)	37.5	34.1	33.8
Carcass value (000 VND/calf)	5031	6039	7524
Total feed costs (000 VND/calf)	3866	5204	6756
Profit (000 VND/calf)	1165	835	768

15.2 Other costs for calf and heifer rearing

Surveys conducted in the US and the UK found that feed accounted for only 50–60% of the total costs for raising heifer replacements to first calving. Additional costs that should be considered include:

- other variable costs such as veterinary and drugs, replacing feeding equipment, replacing bedding, mating (using bulls or semen), fuel and electricity, and death losses
- fixed or overhead costs such as labour, depreciation of facilities and interest on finances specifically borrowed for the calf- and heifer-rearing enterprise.

15.2.1 The high cost of diseases in calves

The losses through disease during calf rearing can be classified as follows:

- deaths, hence loss of calf value with little (or usually no) salvage value for the carcass
- costs of veterinary services plus drugs
- costs of extra feed required when calves lose or do not gain weight when sick, hence require more feed to reach target live weights
- costs of transport and resale of any calves culled
- costs of reduced throughput in rearing unit, additional labour for treatment and greater interest on loans, etc.

Veterinarians in the US have calculated that each sick calf requires on average, 53 min of extra care before recovery occurs. In terms of labour, veterinary services and drugs, the cost for each sick calf was at least US$18. Good calf rearing and husbandry and sound economics must then go hand in hand.

15.3 The hidden costs of poor heifer rearing

It is not good farming practice to underfeed replacement heifers. Growth rates should be maintained between weaning and first calving, otherwise 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 cows for feed and because they are still growing, will use feed for growth rather than for producing milk. They are more likely to be culled for poor milk yield and/or infertility.

Well-grown heifers require a lot of feed. For example a 12-month-old heifer can consume 55–60% of the feed consumed by a milking cow producing 20 kg/day of milk. Adopting low-input feeding programs could decrease heifer rearing costs. These include reducing the amount of concentrates and hay fed or only feeding heifers on poor-quality forages. Furthermore, 60% of the cost of heifer rearing occurs during the first year when management demands are higher.

As previously discussed, low live weights at mating can lead to poorer conception rates, increased calving difficulties and reduced fertility in later years. Life-time performance of poorly managed heifers can be adversely affected in at least three ways:

1. The potential milk production of dairy heifers is reduced by any increase in age at first calving. For example, if calving age was increased from 24 to 30 months and heifers produced 4000 L in their first lactation, each heifer would forgo 2000 L of milk.
2. Assuming a herd replacement rate of 25% for a 50-cow herd, delaying calving by 6 months would result in an extra seven non-productive heifers competing with the milking herd for resources. If these resources were used to feed more cows, an extra three cows could be milked. Assuming cows produced 4000 L per lactation, this amounts to a loss of 6000 L (4000 L × 0.5 lactation × 3 cows) or 857 L per heifer.
3. Failure to reach target live weights at first calving can reduce lifetime milk production by up to 20 L/kg below target live weight at first calving. This amounts to a potential loss of, say, 1050 L per heifer with 50 kg reduced live weights.

Therefore, if rearing costs were reduced to such an extent that heifers calved at 30 months weighing 500 kg, rather than 24 months weighing 550 kg, this can decrease their potential milk yield by 3950 L per heifer.

There are other less obvious costs in later calving, such as slower rates of genetic progress, older herd age structure, hence potential to increase the incidence of age-related problems (such as mastitis and infertility), and increasing involuntary culling, hence reduced opportunities for selection on milk production.

Therefore, when rearing replacement heifers, farmers must plan heifer feeding carefully because, in the long run, underfeeding them can cost a lot of money.

15.4 Measures of lifetime productivity on small holder dairy farms

Undertaking long-term studies of the key on-farm factors influencing lifetime productivity of dairy cows on small holder farms would require numbers of researchers and resources rarely available, if at all, in the tropics. Through the use of computer simulation, Rufino *et al.* (2009) have developed a dynamic model to undertake such a detailed evaluation of the impact of various feeding and herd strategies on the performance of crossbred dairy cows under traditional and improved production systems on small holder farms in Kenya. They simulated four different feeding systems, as follows:

- System 1: *Ad lib* Napier grass with no supplements
- System 2: *Ad lib* Napier grass with strategic supplements of maize silage for 6 months of the year

- System 3: *Ad lib* Napier grass plus strategic maize silage supplements together with 2 kg/day of formulated concentrates throughout the entire lactation
- System 4: *Ad lib* Napier grass plus strategic maize silage supplements together with optimal concentrates, namely 0.5 kg/day of formulated concentrates during calf and heifer rearing and during the dry period, 5 kg/day during the first 150 days of lactation and 1 kg during the rest of the lactation.

Being a series of computer simulations, the authors had to make various assumptions about farm management and cow performance, all of which were based on locally derived research findings. These included:

- Cows lived until 13 yr of age with mature live weights of 500 kg.
- Calves were weaned at 4 months of age.
- Cows had maximum milk yields of 14.6 kg/day and 4450 kg/lactation.
- Cows had 10 month lactations and were dry for 2 months.
- Calving rates varied from 25% to 90% depending on cow live weight loss and body condition.
- Mortality rates for calves up to 3 months of age were 15%.
- Mortality rates for cows were 7% (between 2 and 6 yr) and 12% (between 7 and 13 yr).

Rufino *et al.* (2009) repeated the computer analyses using two different scenarios, firstly without, and secondly with, the various assumptions for mortality rates (which

Table 15.7. Influence of feeding management on indicators of lifetime productivity in two different scenarios, namely with (+) or without (–) assumed mortality and culling rates, on small holder dairy farms in Kenya (see text for details of each feeding system)

Indicators	Mortality and culling rates	System 1	System 2	System 3	System 4
Lifetime (yr)	– +	13.0 7.8	13.0 7.3	13.0 8.1	13.0 7.9
Productive life span (yr)	– +	9.4 4.4	8.9 4.0	9.0 4.0	9.9 5.0
Calves (no./lifetime)	- +	5.8 3.0	5.2 2.8	5.6 2.9	7.3 3.9
Cumulative milk yield (t/ lifetime)	– +	14.6 7.5	10.7 3.7	17.0 8.2	25.4 14.4
Days in milk (% per lifetime)	– +	35 28	33 25	35 26	45 37
Daily milk yield (kg/day)	– +	8.5 8.3	7.2 5.3	10.6 9.9	12.0 11.9
Cumulative net income* (% relative to System 1)	– +	100 54	80 27	122 59	180 102
Milk yield (kg/lactation)	–	2500	1900	3000	3500
Days open (days/parity)	–	382	363	358	254
Age at first calving (months)	–	43	48	48	37
Calving interval (months)	–	20	20	19	14

* cumulative net income takes into account milk returns, concentrate purchases and sale values of bull and heifer calves.

also included involuntary cullings) for stock of different ages. The indicators of lifetime productivity, using these two scenarios are presented in Table 15.7.

15.4.1 Scenario 1. Assuming zero mortality and culling

Providing maize silage with targeted concentrate feeding had a dramatic impact on both milk yields (per lactation and over the entire productive life) and cumulative net incomes. Feeding concentrates during calf and heifer rearing markedly reduced age at first calving and days open, which can be quantified as days in milk over the entire lifetime, which was up to 26% higher in System 4. Even though the total productive life span was only up to a year longer, the cows in System 4 calved up to 7 months earlier and had calving intervals up to 6 months shorter. Net farm returns were up to 80% higher in System 4, clearly indicating that improved feeding management is highly profitable.

15.4.2 Scenario 2. After taking into account the impacts of mortality and culling

Only 28–31% of stock survived for 13 yr. Productive life spans, calves produced and cumulative milk yields are all dramatically reduced once stock wastage (mortalities and involuntary cullings) were taken into account. These productivity indicators were reduced by between 43 and 65%, depending on the feeding system. The impact of animal health was such that the cumulative net income of the most profitable System (4) was reduced to that of System 1 with no stock losses. In other words, the effect of improving feeding management was completely negated by the 49% reduction in length of productive life span. Associated studies in Tanzania (Ngategize 1989) concluded that the benefits of increasing survival by 5% (namely higher milk production, higher off take and higher capital value) exceeded the costs in implementing a disease-control program.

15.4.3 Conclusions

The fact is that farmers feeding lower-quality diets have more to gain, in terms of higher and more secure income, from reducing mortality and involuntary culling rates than solely from investing in improved feeding management. This emphasises the importance of tackling probably the major constraint of animal health: namely during the calf- and heifer-rearing phase.

Calving at an early age and short calving intervals should be major goals in small holder dairy farming, otherwise farmers cannot achieve the returns of their large investments in animal and farm capital. If optimised diets are used without reducing current mortality rates, farmers are prevented from earning higher and more stable incomes. Therefore, improving lifetime productivity requires investments in both improved feeding management and reduced disease-related mortality rates.

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