6

Calf and heifer mortalities in the tropics

This chapter documents the high calf and heifer mortalities reported in many tropical dairy farming surveys.

The main points in this chapter

- Tropical areas are not ideal locations for calf rearing because the high temperatures and humidities introduce many potential disease problems to young dairy stock.
- In addition, the type of dairy farming (generally poorly resourced small holder farming) and the general lack of awareness of the long-term implications of poorly reared stock do not encourage farmers to pay close attention to their calf- and heifer-rearing systems.
- Surveys of calf-rearing systems in tropical Asia, Africa and South America highlight the high calf and heifer mortalities.
- Pre-weaning calf mortality rates of 15–25% would be typical on many tropical dairy farms, but they can often be as high as 50%, indicating very poor calf management.
- This contrasts with 'gold standards' in the US of less than 8% mortality from birth to 6 months, while Australian farmers only suffer 3% losses.
- The involvement of farmers in simple extension programs in Sri Lanka and Kenya have drastically reduced calf mortalities and improved pre-weaning growth rates.
- Problems in calf rearing, as identified on Tanzanian small holder farms, have been ranked in decreasing order by farmers as labour, poor calf growth, diseases, little milk available and inadequate knowledge, which all led to high calf mortalities.
- Clearly, calf mortality in tropical SHD systems is a bigger problem than in temperate farms, for a variety of reasons.
- Unfortunately, such high rates are accepted as 'normal' on many farms, whereas they could be dramatically reduced by following a few relatively simple procedures.
- The research has yet to be undertaken (or at least reported) in the tropics where young stock are reared using the best management practices found on temperate farms, to ascertain more realistic targets for tropical dairy small holdings.

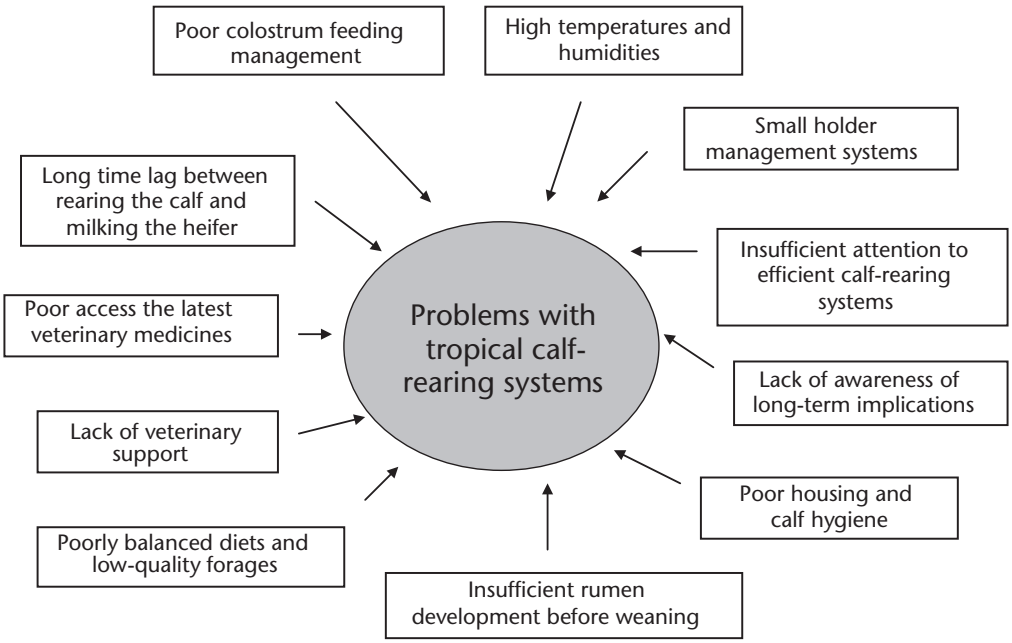

Figure 6.1. The major problems with many calf-rearing systems in the tropics

6.1 Difficulties with rearing replacement heifers in the tropics

Tropical areas are not ideal locations to rear young dairy stock for many reasons, such as those highlighted in Figure 6.1. The harsh tropical climate introduces many problems to milk-fed calves, while the type of dairy farming (generally poorly resourced small holder farming) and the lack of awareness of the long-term implications of poorly reared stock, do not encourage farmers to pay close attention to their calf-rearing systems.

The reasons for poorly reared calves are many and include:

- The tropical environment encourages the proliferation of many disease organisms that can reduce calf and heifer performance. These include some diseases that only occur in the tropics.
- Dairy cows are essentially temperate animals, which are most comfortable at 6–18°C. The high tropical temperatures and humidities introduce specific climatic stresses that adversely affect calf and heifer feed intakes, growth rates and fertility.
- As ambient temperatures approach body temperatures, stock rely more on cutaneous evaporation to remove residual body heat, and this is less efficient than other forms of heat loss, requiring increasing amounts of water and minerals.
- The stock on many small holdings are multi-purpose, being farmed for manure, meat and even draught, in addition to milk. Young stock management is often not a high priority on such farms.
- Many of the dairy farms are small holdings where farmers often lack the resources to develop the most effective rearing systems for young stock, because most of their attention is directed towards income generation; namely feeding and managing their milking cows.

- The best way to reduce calf mortality is to practice good husbandry. Some common ailments can be treated by the farmer, but, once a calf is seriously ill or large numbers are ill, expert veterinary advice should be sought, but is not always readily available.
- The levels of shed hygiene are often sub-optimal and this can have detrimental effects on monogastric animals, such as milk-fed calves.
- The nutritive value of tropical forages is generally poorer than that in temperate areas, so weaned heifers cannot grow as fast as they do in temperate regions without continual access to high-energy and protein supplements. Because these are generally more expensive than forages, farmers are less likely to provide sufficient amounts.
- Sub-optimal feeding regimes, leading to low growth rates, can greatly reduce feed efficiency in replacement heifers.
- In many cases, farmer extension programs place little emphasis on feeding and managing calves and heifers because of the extended time required for such investments to reap rewards.
- Service providers and agribusinesses are less able to source the most up-to-date equipment and farm inputs, such as the latest generations of veterinary drugs or calf milk replacers that are more readily available to farmers in the developed temperate dairy regions.
- Many veterinarians are not fully aware of the most recent treatment and prevention animal health protocols readily adopted by dairy farmers in more developed countries.
- Many farmers are not fully aware of the high costs associated with poor management of young stock, arising through, firstly, the high wastage rates of calves and heifers and, secondly, the detrimental effects on potential milk yields and fertility.
- Delayed calving can greatly increase the total costs of rearing replacement heifers.
- We know less about the constraints to the performance of young stock in the tropics because there has been less research undertaken. Accordingly, there is less relevant extension material available for dissemination to tropical dairy industries.

The 'bottom line' is that fewer resources are devoted to young stock management in the tropics.

With increasing numbers of temperate, poorly adapted dairy stock being imported into tropical Asia, there is an even greater need for well-planned and conducted farmer training programs in these regions.

Considering all the above, it is not surprising that the performance of young stock on most tropical, or even subtropical, dairy farms is below that observed on temperate farms. Not only is the management of young stock sub-optimal, such documentation is often difficult to find, particularly from Asia.

6.2 Surveys of calf and heifer mortalities in the tropics

The results of recent published surveys on mortalities during calf rearing undertaken in tropical dairying areas are presented in Table 6.1. Altogether there are 17 studies reported, mostly in Africa and South America, but others in India, Sri Lanka and Vietnam. The surveys covered a wide range of dairy production systems, from large-scale grazing and feedlots to small holder systems. The highest pre-weaning mortality

Table 6.1. Details of studies documenting calf mortalities in tropical dairy farming areas, listed in decreasing level of pre-weaning calf mortality

Location and year	Farms surveyed	Mortality	Further details	Reference
1. India 2005?	90 farms; 30 with 1–10 cows, 30 with 11–20 cows and 30 with >20 cows Restricted suckling Data to weaning?	68% in small herds 82% in medium herds 84% in large herds **81% pre-weaning**	Only 22% of farms reared dairy cattle calves Only 33% of farms reared buffalo calves Important causes are scours, endo- and ectoparasites, navel ill and pneumonia Only 17% of farms dewormed calves Only 17% of farmers call veterinarian if calf falls sick Farmers consider calf rearing uneconomic so only purchased mature stock	Tiwari *et al.* (2007)
2. Zimbabwe 1996	50 small holder farms 261 dairy stock, various sire breeds	4.7% stillbirths **35.0% mortality to 12 months**	Female mortalities: 25.3% to 12 months, 6.1% from 1 to 2 yr, 11.4% from 2 to 5 yr Jerseys had higher and Red Danes had lower calf mortalities	French *et al.* (2001)
3. Ethiopia 1997–1999	Five large farms with Friesian and Jersey cows 701 calves	19.7% in first year 4.8% from 12 to 18 months 5.2% from 18 to 24 months **29.7% from 0 to 24 months**	Higher in Friesians than Jerseys High loss 0–90 days and 5–6 months (post-weaning) First service at 28 months (22 months Jersey, 30 months Friesian) CCI: 6.4 months Friesian, 4.8 months Jersey	Asseged and Birhanu (2004)
4. Sri Lanka 1999	Only documenting 'control' or non-assisted farms 25 coconut grazing (CG) and 23 peri-urban (PU) farms 340 dairy XB cows	50–60% of the mortalities before 3 months **23.4% (CG farms) pre-weaning** **28.7% (PU farms) pre-weaning**	First lactation peak milk yield; 4.0 (CG) versus 5.9 (PU) kg/day Calves weaned at 5.9 (CG) versus 3.3 (PU) months 24 month weight: 233 kg (CG) versus 221 (PU) kg AFC: 36 (CG) versus 38 (PU) months	Nettisinghe *et al.* (2004)

Location and year	Farms surveyed	Mortality	Further details	Reference
5. Venezuela 1977–1979	One commercial farm with Friesian and Brown Swiss cows 1656 observations	2.5% stillbirths 15.6% deaths and culls to 9 months 28% in first week, 64% in first month, 18% in second month and 17% from 3 to 9 months and 9.9% from 9 months to first calving 94% of losses due to deaths **25.5% lost up to first calving**	Major causes are scours, pneumonia and joint-ill Losses up to first calving: 32% in Brown Swiss and 25% in Friesians	Vaccaro and Vaccaro (1981)
6. Tanzania 2002	125 small holder farms, stall feeding 977 dairy cattle	10% pre-weaning mortality **25% annual calf mortality**	Average milk yield, 8 L/day AFC: 33 months CI: 20 months	Kivaria *et al.* (2006)
7. Kenya 1991–1992	78 farms with 201 calves European × local dairy stock Weaned at 12 weeks of age	26.6% morbidity up to 12 months **21.6% mortality up to 12 months**	Scours was major cause of death Older calves had higher morbidity Poor shed hygiene related to higher mortality Clinical illness, low red blood cell count and concentrate feeding associated with higher mortality Mineral feeding associated with lower mortality	Gitau *et al.* (1994)
8. Tanzania 1999–2003	Two villages with 269 calves 25% Friesian × 75% Boran	**20.8% calf mortality**	12 months live weight only 88 kg 233 kg at 21 months (first conception) 4 kg/day milk yield during first lactation	Msanga and Bee (2006)
9. Ivory Coast 1997–1999	Three herds of 165 N'Dama cattle with day-time grazing and night-time yarding Limited milking for home consumption	**19% mortality within 7 months**	200–250 kg mature weight 250–600 kg milk/lactation 52% annual calving rate	Knopf *et al.* (2004)

Location and year	Farms surveyed	Mortality	Further details	Reference
10. Kenya 1990–2003	Four large-scale farms with Friesian XB cows 3508 calves	**19% mortality before first calving** Another 6% culled before first calving 22% mortality before 48 months Another 12% culled before 48 months	Most deaths within first 12 months AFC 35 months with range 30–45 months Total deaths and culls prior to AFC increased from 5% to 45% over 13 yr of study	Menjo *et al.* (2009)
11. Ethiopia 2003–2004	Three large and 112 small holder farms 236 Friesian cross calves up to 6 months old	61.5% morbidity **18.0% mortality**	Scours was major cause of mortalities Mortality related to calf age, age at first colostrum and shed cleanliness	Jemberu (2004)
12. Ethiopia 2003?	300 small holder farms Zebu × dairy breeds Calves suckled or bucket fed	1.4% abortions **17.4% pre-weaning**	CCI: 7.8 months	Lobago *et al.* (2006)
13. Mali 2002–2004	38 peri-urban dairy herds Zebus and XB dairy breeds 762 calves	3.9% in first 10 days 5.4% from 10 days to 3 months 4.2% from 3 to 6 months 3.4% from 6 to 15 months **16.9% from 0 to 15 months**	Higher in modern and large farms compared with traditional farms Higher in rainy season Important causes were peri-natal, accidents, digestive disorders (including parasites) and starvation	Wymann (2005)
14. Kenya 1996–1998	Five large-scale farms 673 Friesian calves Data to weaning unknown	**15.6% mortality**	Higher in heifers than bull calves Higher in calves born Jul–Sep Highest in 2–4.5-yr-old dams Pneumonia most important cause Higher in moveable compared with permanent pens	Bebe *et al.* (2001)
15. Brazil 1977–1981	One farm 614 Friesian × Guzera heifer calves Six breed groups Bucket reared to 4 months	Mortality to 12 months 10.1–20.4% range for six breed groups **15.5% average mortality**	Scours, respiratory and tick-borne diseases were major causes of mortality Intermediate crosses had lower mortalities	Madalena *et al.* (1996)

Location and year	Farms surveyed	Mortality	Further details	Reference
16. Ethiopia 1983–2003	One farm 1829 Fogera (Zebu) × Friesian calves Suckled dams until 6–8 months of age	Mortality rates: 3.6% to 30 days, 5.8% to 180 days, 6.5% to 240 days **9.7% mortality to 12 months**	–	Amuamuta *et al.* (2006)
17. Vietnam 2002–2003	99 small holder dairy farms (two to three Zebu XB cows/ farm) Data to weaning unknown	3.1% per annum abortions 2.3% per annum peri-natal mortality (first 24 hr) 4.7% per annum calf mortality **7% per annum total calf mortality**	3500 L milk/lactation, 2.5 month dry period, 13.0 months ICI Cows calved twice and 60 m old on average	Suzuki (2005)
18. US 2009	'Gold standards' for calf rearing in temperate regions	Mortality: <5% from 1 to 60 days <2% from 2 to 4 months <1% from 4 to 6 months **<8% from 0 to 6 months**	Morbidity for scours (S) and pneumonia (P): 1–60 days; <25% (S), <10% (P) 2–4 months; <2% (S), <15% (P) 4–6 months; <1% (S), <2% (P) **0–6 months; <28% (S), 27% (P)**	DCHA (2009)

Abbreviations: XB = crossbred; CCI = calving to conception interval; AFC = age at first-calving; ICI = inter-calving interval

Heifer mortalities are very high in overcrowded, poorly cleaned pens.

reported was 81%, from a survey of various Indian dairy systems (Tiwari *et al.* 2007) in which it was found that over half the 90 farmers ceased to rear any calves because they considered it uneconomic and it was cheaper for them to purchase all their herd replacements. This was an extreme finding because the calf mortalities in the other reported studies varied mainly from 10% to 35%, although one Vietnamese study recording only 7% calf mortality.

Unfortunately, the studies documented a wide variety of ages over which calf mortalities were reported, making it difficult to fully interpret the data. However, a range of 15–25% pre-weaning and early post-weaning mortality rates would be typical on many tropical dairy farms. De Jong (1996) highlighted these problems when he concluded that typical calf mortalities in the tropics of 20–45% are much higher than the 7–16% found in temperate regions, because of higher disease incidence and low feeding levels. This was further compounded by the low value of calves reared for meat or replacement heifers. With regard to its potential economic impact, Amuamutu *et al.* (2006) calculated that a calf mortality of 20% can reduce dairy farm net profits by 38%, compared with a target mortality level of 5%.

For comparison, DCHA (2009) present 'gold standards' for dairy farms in the US: namely less than 8% mortality from birth to 6 months (with less than 28% of the calves

Weaned heifers require better management than this.

suffering from scours or pneumonia). 'Gold standards' for post-weaning mortalities are less than 1% from 6 to 12 months and less than 0.5% from 12 months to first calving. Accepted norms are even lower in Australia, where a recent survey of 300 dairy farmers reported mortalities due to illness in calves reared to weaning to be only 3.3% (McNeil 2009).

In his survey of 112 SHD farms in Ethiopia, Jemberu (2004) reported that many of the farmers considered high calf mortality to be their number one herd health problem, compared with mastitis and infertility. On three larger farms he surveyed, calf health problems were generally rated second behind mastitis. The incidence of calf health morbidity (or disease incidence) was higher on the large farms, probably due to the greater number of calves being reared, hence the potential for transfer of pathogens. However, despite the lower morbidity on small holder farms, mortality rates were higher: an observation that the author interpreted as poorer management of sick calves and lack of easy access to health professionals for calf treatment.

Calf mortality in the tropics is undoubtedly very high, often as high as 50% but that almost invariably denotes poor calf management. The best way to reduce calf mortality is to practice good husbandry, the topic of this manual. Some common ailments can be treated by the farmer, but if large numbers of calves show disease symptoms or if stock become seriously ill, expert veterinary advice should be sought.

Table 6.2. Wastage rates for imported and local/mixed stock

Wastage from	Imported stock	Local/mixed stock
Abortions (%)	12.1	6.7
Stillbirths (%)	9.2	6.0
Pre-weaning deaths (%)	37.6	19.9
Pre-weaning culls (%)	1.4	1.9

Source: Vaccaro (1990)

6.2.1 Poor adaptation of imported stock

High calf mortality can also be the result of poor adaptation of exotic stock, such as when unacclimatised temperate or crossbred dairy stock are imported to the tropics, thus adding severe climatic stress to the other hazards of calf life. Vaccaro (1990) reviewed published data on the losses of European dairy breeds in the tropics, compared with European × Zebu crossbreds. Approximately 15% of the imported calves failed to reach first calving or survive their first year of life. He separated data for European breeds as to whether the dams of the calves stock were imported or they originated from local or mixed origin, reporting the wastage rates shown in Table 6.2.

Following weaning, the average wastage rates up to first calving for both groups amounted to 3.9% heifer deaths and 6.6% heifer culls. Over their herd life, imported stock only produced 2.6 calves compared with 3.1 for the local cows. For every 100 females conceived, an average of 56 would have died or been culled before first calving in the case of imported dams, compared with 39 for local dams.

Clearly, young stock management of exotic dairy stock or their progeny require closer attention than was the case prior to 1990, and possibly even after. Anecdotal stories during the 2000s of high mortalities among imported European dairy heifers, milking cows and their progeny in various Asian countries clearly indicate that their survival, as well as their post-calving performance, could still be vastly improved.

6.2.2 The effect of grazing system on calf and heifer mortalities

Table 6.3 presents the results of a detailed survey, undertaken between 1996 and 1998, in which Bebe (2008) and Bebe *et al.* (2003) documented the dairy herd dynamics of 1755 small holder farms in the highlands of Kenya. Of these farms, 987 had dairying enterprises as part of their mixed farming systems, and these had evolved to diversify the risks from dependence on a single crop or livestock enterprise. There was a large movement of weaned heifers from their home farms to other dairy farms as purchased heifer replacements. This strategy was used by farmers to reduce spending scarce feed resources on raising, as yet, unproductive stock.

In the densely populated highlands of Kenya, farmers have had to intensify their dairy systems by changing from free grazing to zero grazing, due to decreasing farm sizes. This led to changes in herd structure, with more emphasis on milk production and increased stocking rates. High stocking rates can be maintained through cut and carry feeding of Napier grass and crop residues, as well as sourcing additional fodder from neighbours and communal areas, together with purchasing more concentrates.

Table 6.3. The effect of grazing system on heifer rearing and herd dynamics on 987 farms in the Kenyan highlands (Bebe 2008)

Grazing system[a]	Free grazing	Semi zero grazing	Zero grazing	Average	Sig[b]
Number of farms	227	326	434	–	–
Farm size (ha)	2.4	1.8	0.9	**1.7**	*
Herd size (number)	4.3	3.1	2.1	**3.2**	*
Cows (number)	2.2	1.7	1.2	**1.7**	*
Calves fed milk using buckets (%)	38	61	68	**60**	*
Milk fed to calves to 3 months of age (L/calf)	321	230	193	–	*
Average weaning age (months)	5.5	4.6	3.8	–	*
Proportion of heifers to cows (%)	40	36	29	–	*
Cow milk yield (L/day)	3.8	4.8	5.6	–	*
Stocking rates (TLU/ha)	1.1	1.0	1.4	**1.2**	*
Proportion of cows in the herd (%)	51	55	62	**53**	*
Annual calving rate (%)	69	51	52	**58**	*
Age at first calving (yr)	2.8	2.7	2.5	**2.7**	*
Heifer calf mortality (%)	15	13	15	**14**	–
Heifer mortality (%)	8	12	7	**9**	–
Cow mortality (%)	13	14	12	**13**	–
Bull calf mortality (%)	21	19	14	**18**	–
Immature bull mortality (%)	16	16	11	**14**	–
Mature bull mortality (%)	13	10	13	**12**	–
Heifers dead before reaching breeding age (%)	27	31	25	**28**	–
Heifers sold before reaching breeding age (%)	11	15	22	**15**	*
Heifers reaching breeding age (%)	62	54	53	**57**	*

[a]Classification of stock. Heifer calf, pre-weaned female; Heifer, post-weaned until first calving; Cow, after first calving; Bull calf, pre-weaned male; Immature bull, post-weaned to 3 yr old; Bull, older than 3 yr.

[b]Sig: An asterisk (*) indicates a statistically significant difference between grazing systems.

TLU = Total Livestock Unit; Stocking rate weighted for bulls (1.0), cows (0.7), heifers/young bulls (0.5) and calves (0.2).

Farm sizes and total herd numbers decreased as farms became more intensive. In addition, calves were more likely to be bucket fed, they were fed less milk to 3 months of age, and were weaned earlier. The cows produced more milk. However, the proportion of heifers to cows was reduced because they were younger when sold to other farmers as heifer replacements. To provide sufficient heifers for a more intensive dairy industry, Bebe (2008) recommended an increasing need for heifer breeding and growing farms.

Mortality rates of all classes of stock were very high, varying from 7 to 19%, but were not statistically significant across grazing systems for any of the animal classes. Losses due to animal diseases and their interaction with nutritional level were a major constraint to small holder dairying, irrespective of the grazing system. With 25% of the heifers dying

and 22% being sold before breeding, only 53% of the heifers on the zero grazed farms could have become pregnant, produced milk and hence generate farm income.

The high mortality and low calving rates then led to very high reproductive wastages, irrespective of the level of farm intensification. Together with the numbers of heifers sold, many of these farms were not able to maintain sufficient heifers for their own herd replacements. Herd sizes could not then increase without an external supply of replacement animals. Constraints to rearing replacement heifers on these farms ranged from high losses due to disease and malnutrition through to inadequate breeding services and credit.

6.3 Impact of extension programs on calf and heifer performance in the tropics

Clearly there is much to improve on most tropical dairy farms (whether large scale or small holder) with regards to calf rearing. Two studies have quantified the impact of simple extension programs on the improved performance of milk-fed calves and weaned heifers in the tropics.

6.3.1 Sri Lankan study

To reduce calf mortality and age at first calving of heifers in an artificial insemination heifer calf-rearing scheme during the 1990s, the Sri Lankan Ministry of Livestock Development instigated a heifer-rearing program that supported small holders with subsidised calf meal together with free mineral mixtures, drugs and acaricides for 30 months. Nettisinghe *et al.* (2004) reported the outcome among 100 small holder farmers in the Coconut Triangle grazing and the peri-urban dairy production systems in the wet lowlands of Western Province. About 50 scheme and 50 non-scheme farmers were surveyed in the two production systems 3 yr after the scheme finished and the data are summarised in Table 6.4. Virtually all the coconut grazers were part-time dairy farmers and supplied the formal milk market (receiving 10–11 Rs/L in 1999), whereas the peri-urban farmers supplied the informal milk market (receiving 19–20 Rs/L), while about one-third of them were full-time dairy farmers. About half the coconut grazing farmers stall fed their stock whereas most of the peri-urban farmers employed grazing only.

Live weight at 24 months varied between breeds with Friesians being the heaviest (244–251 kg), followed by Australian Milking Zebus (AMZ, 219–241 kg), then Jerseys (220–248 kg), with the lightest being Sahiwals (191–204 kg). Scheme heifers calved five months earlier than non-scheme heifers (32 versus 37 months) while coconut grazing herds calved 3 months earlier than peri-urban herds (33 versus 36 months). Across breeds, scheme Jersey and AMZ heifers were the youngest to calve (28 months) with non-scheme Sahiwal being the oldest (42 months).

Calf mortalities were lower in the coconut grazing compared with the peri-urban herds (18 versus 21%) and on former scheme compared with the non-scheme farms (13 versus 26%), with 50–60% of these mortalities occurring in the first 3 months of age. In coconut grazing herds, scheme farmers had more young female stock present per cow, whereas there was no difference with the peri-urban farmers.

Table 6.4. The benefits in belonging to an AI heifer-rearing scheme in the Western Province of Sri Lanka (Nettisinghe *et al.* 2004)

	Coconut grazing		Peri-urban	
Production system	**Scheme**	**Non-scheme**	**Scheme**	**Non-scheme**
Number of cattle/cows per farm	5.3/2.5	5.7/2.8	8.3/4.4	8.5/4.4
Peak milk yield in first lactation (kg/day)	4.2	4.0	5.8	5.9
Concentrate fed at peak yield (kg/day)	0.8	0.6	2.0	2.1
Calf weaning age (months)	5.7	5.9	3.3	3.2
Weight at 24 months (kg)	273	233	238	221
Age at first calving (m)	31.1	36.0	33.5	37.9
Calf mortality (%)	12.5	23.4	14.2	28.7
Young female stock present per cow	0.9	0.6	0.6	0.5
Deworming frequency	2.6	1.5	1.4	1.4
De-ticking frequency	5.1	3.7	4.8	4.1
Minerals fed (kg)	2.0	1.2	1.0	1.5
Milk fed (L/calf)	660	572	328	298
Concentrates fed (kg/calf)	646	112	569	66
Concentrate costs (Rs/calf)[a]	847	492	577	518
Total rearing costs (Rs/calf)	14737	6432	14419	6531
Total returns (Rs/calf)	22598	12666	27482	12434
Total profit (Rs/calf)	7861	6234	13063	5903

[a]Rs = Sri Lankan rupee.

Most non-scheme and former scheme farmers applied deworming drugs and fed concentrates, whereas less than half applied de-ticking treatments, while very few fed minerals. On the coconut grazing farms, former scheme farmers dewormed their calves more frequently and spent more money on concentrate feeding than did non-scheme farmers. There was no difference in these calf management practices in former scheme or non-scheme peri-urban farmers. The former scheme peri-urban farmers had higher costs and, because of their higher unit milk returns, they still achieved higher profits than did the coconut grazing farmers.

Poorer calf housing and low level of health management led to peri-urban farmers' herds experiencing higher calf mortalities (see Table 6.4 for details). The coconut grazing farmers' herds produced more female stock per cow because of reduced calf mortality and younger ages at first calving. Because the peri-urban farmers were less motivated to continue the improved calf-rearing practices after the scheme was stopped, differences between former scheme and non-scheme farmers were much smaller.

The total production cost per in-calf heifer was considerably cheaper than the production of such animals, either by multiplication on state farms or imports. The authors calculated the cost of importing one exotic heifer to be the same as producing 16 well-adapted heifers from this study. As in other countries, importation of exotic stock or multiplication of breeding stock on state farms has a poor record for expanding dairy populations. This study showed that only in certain production systems – in this case

grazing under coconuts – were farmers likely to continue their improved heifer management practices after such government-supported schemes had finished.

An additional observation from this study was the very high levels of milk fed to rear heifers for the coconut grazing system compared with the peri-urban farmers (600 versus 300 L/calf). For a cow producing, say, 2500 L in a lactation, that represents 12% of her milk fed to rear a calf.

6.3.2 Kenyan study

Lanyasunya *et al.* (2006) reported on a study of 120 small holder farmers in Kenya. It involved 60 test farmers, each provided with a chest girth tape (to estimate live weight), a spring balance and 10 L bucket (to weigh feed), a graduated jug (to measure milk) and a note book. An additional 60 control farmers continued with their traditional calf-rearing practices. Each of the test farmers was also provided with moveable calf pens, compartmentalised with feed and water troughs, a daily heifer feeding schedule and forage planting material (which included improved tropical grasses and legumes). Test farmers regularly dewormed their calves and were visited every fortnight by extension staff. The dairy production systems were categorised as zero grazing, semi zero grazing or free grazing.

Pre-weaning growth rates were higher on the test farms (0.37 versus 0.31 kg/calf/day) while calves offered legume forages (lucerne, *Desmodium and Leucaena)* grew faster than those only offered sweet potato vines (0.40 versus 0.34 kg/calf/day). Mortality of heifer calves on zero grazed farms was lower than on semi zero and free grazed farms (6 versus 15 versus 20%). Mortality of bull calves was higher than for heifer calves, at 13 versus 6% on test zero grazed farms and 11 versus 9% on control zero grazed farms. Heifer live weight at 24 months was 295 kg for zero grazed and 296 kg for semi zero grazed compared with only 240 kg for free grazed stock.

The key messages from this study included:

- The beneficial impact of legumes enabled calves to use low-quality forages more efficiently.
- Calf survival was improved because individual calf pens reduced disease transfer.
- Better performance of zero grazed stock was due to greater attention and improved management.

6.4 Results from other calf and heifer studies in the tropics

6.4.1 Tanzanian study

Lyimo *et al.* (2004) surveyed calf-rearing practices on 60 small holder mixed farmers in Tanzania, with average herd sizes of only three cows. The area had fertile soils and a favourable climate, therefore cropping was given greater emphasis than milk production. Most farmers practiced restricted suckling. Calf survival and growth rates were low, but

no mortality data were provided. Calves weighed only 96 kg at 6 months of age. Calves stayed with their dams until 4–7 days, were only provided with concentrates after 4 weeks and were weaned at 4–6 months of age. Calves were then stall fed with limited forages and poorly formulated concentrates. The major constraints to forage supplies were season of year, labour, ease of harvesting and distance to forage supplies. Farmers ranked the problems in calf rearing (mean score out of 8) as follows:

- labour (7.5)
- poor calf growth (7.0)
- diseases (6.5)
- little milk available (6.5)
- inadequate knowledge (4.8)
- mortality (3.4).

They ranked the options for improvement (mean score out of 8) as follows:

- strategic feeding (7.7)
- provide more supervision and adequate management (6.3)
- use cheaper concentrates (5.5)
- farmer's training (5.5)
- adopt more appropriate housing (5.3)
- allocate more funds to calf rearing (5.0)
- accept technical advice (3.8).

It was not easy to say what 'disease' meant to these Tanzanian farmers. In a general sense, it meant anything that was not 'normal'. Disease was then a condition which was detrimental to the health and wellbeing of that animal. It included injuries, infections by micro-organisms, infestations of parasites, nutritional deficiencies, poisoning and hereditary abnormalities. The presence of disease, acute or chronic, reduced cow performance, which invariably reduced farm production and profitability.

Many of their problems were nutritional, with strategic feeding of milk, concentrates and forages seen as most important. These can be solved by improved farmer training and supervision to practice more appropriate husbandry.

6.4.2 Philippines study

A study was undertaken in the Philippines in which heifers were reared in different systems from 3 to 12 months of age and their performance monitored (Payne *et al.* 1967). They were raised indoors or at pasture, or a combination of the two, with or without strategic drenching for internal parasites (Table 6.5).

The indoor/outdoor system was used as it provided protection from heat stress during the day while at night the larvae of most internal parasites would move down the stems of the pasture so calves could safely select the better quality components of the forages. Calf growth rates were highest (0.40 kg/day) in the two drenched groups with access to grazed pasture (outdoor and indoor/outdoor), while mortalities were lowest in

Table 6.5. Performance of Friesian cross calves from 3 to 12 months of age under various rearing systems (Payne *et al.* 1967)

Management system	Drenched	Growth rate (kg/day)	Mortality (%)
Indoor (day and night)	+	0.38	6.7
	–	0.30	0
	Mean	**0.34**	**3.3**
Indoor (day) – outdoor (night)	+	0.40	10.0
	–	0.38	7.7
	Mean	**0.39**	**8.8**
Outdoor (day and night)	+	0.40	16.7
	–	0.37	40.0
	Mean	**0.38**	**28.3**

the indoor groups. Even allowing for their higher mortality, the overall production was superior in the indoor/outdoor and drenched group. The most dramatic finding was the very high mortality in the outdoor and undrenched group.

6.4.3 Conclusions

Clearly, calf mortality in tropical SHD systems is a bigger problem than in temperate farms, for a variety of reasons. Unfortunately, such high rates are accepted as 'normal' on many farms, whereas they could be dramatically reduced by following a few relatively simple procedures. It is quite likely that the DCHA (2009) 'gold standards' in the US may not be achievable in tropical small holder environments. The research has yet to be undertaken (or at least reported) in the tropics where calf and heifer rearing follows the best management practices found on temperate farms, to ascertain more realistic targets for tropical dairy small holdings. The key procedures that clearly require closer attention include:

- ensuring newborn calves ingest sufficient good-quality colostrum and absorb sufficient immunoglobulins to provide adequate passive immunity against calfhood diseases
- providing calves with a hygienic environment, both in the rearing pen and with clean and frequently sterilised feeding utensils
- following a pre-planned feeding program to encourage both early rumen development and adequate growth rates
- following an animal health protocol to minimise the adverse effects of exposure to local disease pathogens.