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Introduction

This chapter presents an outline of the book, which provides technical information on the theories, as well as the practices, of rearing young stock on tropical dairy farms.

The main points in this chapter

- This book is the fourth book written on various aspects of tropical dairy farming.
- Young stock (milk-fed calves and growing heifers) are the most neglected class of stock on most dairy farms.
- Of the nine key activities on dairy farms, young stock management generally receives the least attention. This is primarily because it has the greatest time span between any financial investment and return.
- Even on the best dairy farms, heifers will not generate income for 2 yr after they enter the dairy herd as newborn calves.
- If farm incomes decrease and cost savings become necessary, replacement heifers are all too frequently the first ones to suffer from reduced farm inputs.
- On farms where growing heifers can be moved away from the rest of the dairy herd, many problems associated with 'out of sight, out of mind' can occur.
- Improved management strategies leading to lower calving intervals, higher calving rates, reduced stillborn and pre-weaned calf mortalities and fewer non-pregnant heifers can supply many more dairy herd replacements.
- Such strategies can increase the number of replacement heifer calves in the herd from 15 to 36%, thus allowing farmers to increase their herd sizes naturally.
- This book highlights many of these problems, as well as those arising from the fact that heifers, particularly milk-fed calves, are the most susceptible class of stock to poor farm management practices.

This book is a companion to three previous books I have written on small holder dairy (SHD) farming in the tropics. The first book, *Tropical Dairy Farming* (Moran 2005), details the production technology of SHD farming, with the emphasis on nutrition and feeding management. The second book, *Business Management for Tropical Dairy Farmers* (Moran 2009), discusses the farm business management (FBM) skills required to ensure

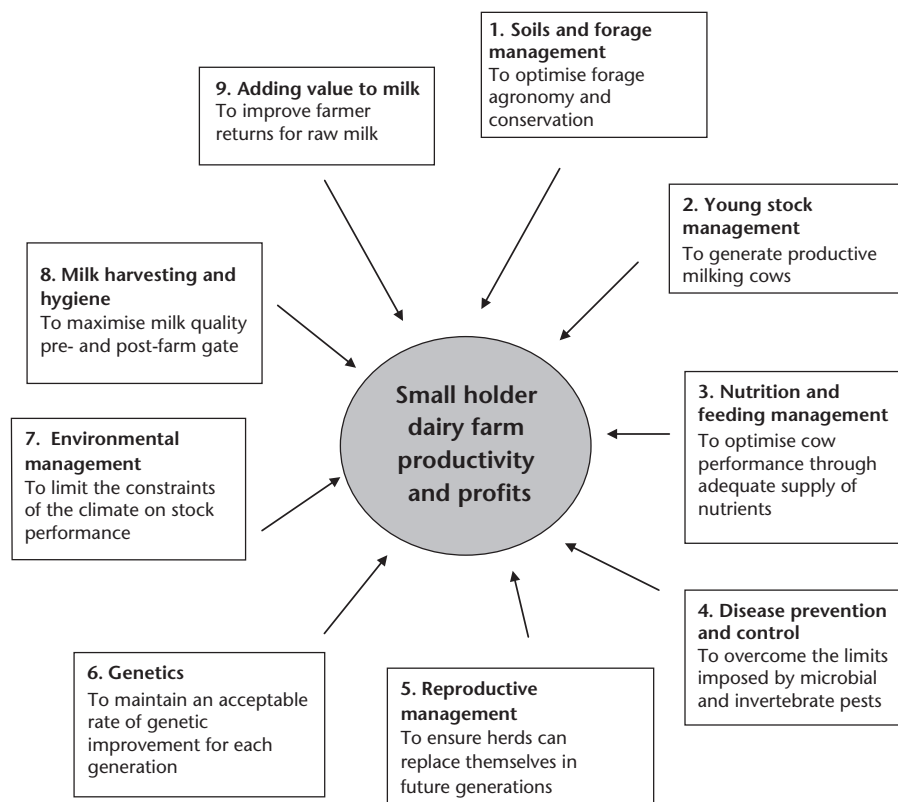


Figure 1.1. The nine links in the supply chain for a profitable dairy enterprise

such systems can remain financially sustainable. The third book, *Managing High Grade Dairy Cows in the Tropics* (Moran 2012), deals specifically with a major problem encountered by many tropical dairy farmers, namely the poor performance of exotic, high grade (that is high genetic merit) dairy cows when exported from their country of origin to a new, more stressful environment. This fourth book, *Rearing Young Stock on Tropical Dairy Farms in Asia*, deals with the most neglected of stock on most dairy farms, namely milk-fed and growing heifers.

1.1 The importance of young stock management on any dairy farm

Any financially viable dairy farmer, no matter where he or she is located, requires skills in a wide range of farm management practices, to be able to produce milk for considerably less money than consumers will have to pay for it once that milk enters into the supply chain of dairy processing, distribution and retail marketing.

Dairy farmers are fortunate in that, with raw milk in high demand, infrastructure is generally in place to sell their raw milk into the market place. Therefore their major efforts



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

should be placed not in seeking markets, but on reducing its cost of production to provide an acceptable profit margin. This is the key objective of profitable dairy farming, whether the farmer manages five or 10 cows on a small holder traditional farm in the tropics, a larger operation with say, 200 cows predominantly grazing temperate pastures in the more established dairy industries of Australia or Europe, or a large-scale dairy feedlot located to strategically source forage crops and agro-industrial by-products anywhere in the world.

Figure 1.1 highlights the nine key dairy farm management practices that can be listed as links in the supply chain of a profitable dairy enterprise. The supply chain is the conversion of farm resources into saleable raw milk. The term 'enterprise' is used because many farmers, particularly those on small holder tropical farms, incorporate milk production into their mixed farming business. This figure details only those key activities in dairy production technology. It does not consider other equally important farmer activities that could be listed under the category of farm business management and, for larger farms, people skills. As with any commercial operation, the chain is only as strong as its weakest link, so each step needs to be properly managed. Weakening any one link through poor decision making can have severe ramifications on overall farm performance, and hence profitability.

Of these nine key links in profitable dairy farming, young stock management is the one that all too often receives the least attention. This occurs primarily because this link is the one with the greatest time span between financial investment and return. In other

words, with the other eight links, the impact of decreasing farm inputs (which includes skills, time and money) will become more apparent as reduced farm returns. Conversely, increasing other farm inputs will return greater farm profits more quickly compared with improving young stock management.

One major concern of SHD farming throughout the tropics is the rearing of replacement heifers. The objective is to attain optimal growth so they can calve at an appropriate early age and at the lowest cost. They should promptly substitute for culled cows in the milking herd, so providing continuing returns on the investments of feed, labour and other farm resources. Success in raising replacement heifers is of major importance to the viability and profitability of any dairy enterprise. Rearing costs should then not be seen as herd costs, but as farm investments.

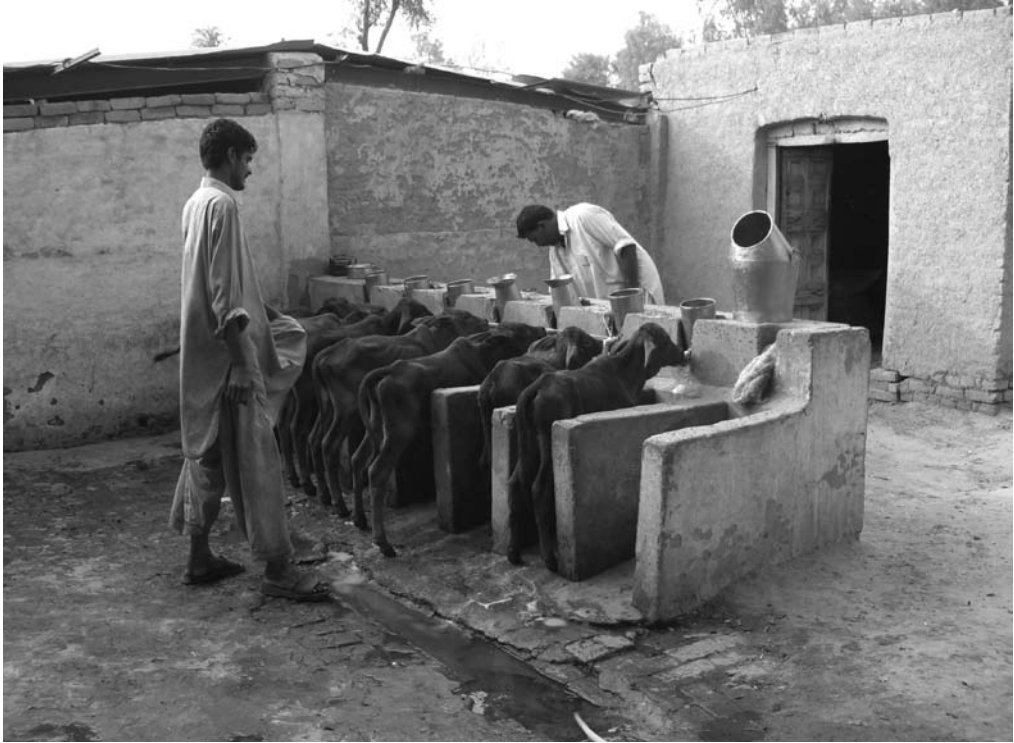
Even on the best dairy farms, heifers will not generate income for 2 yr after they enter the dairy herd as newborn calves. On many tropical farms, this can extend to 3 yr or even more. Consequently, any money spent on the young stock must be considered a relatively long-term investment. If farm incomes decrease and cost savings become necessary, replacement heifers are all too frequently the first ones to succumb to reduced farm inputs.

Furthermore, young stock can suffer through reduced non-cash farm inputs, particularly when they are weaned off milk and become the most neglected stock of the dairy herd enterprise. Milk-fed calves and milking cows require twice daily attention (feeding and milking respectively) while non-lactating stock (be they adult cows or growing heifers) can be, and often are, managed with less input. So long as they have access to drinking water, some forages and stay disease free, they will survive. On farms where replacement heifers can be moved away from the rest of the dairy herd, the situation can get even worse with the many problems associated with the 'out of sight, hence out of mind' scenario.

If SHD farmers cannot achieve realistic targets for heifer mortalities, live weight gain, mating age and age and live weight at first calving, they should look for a competent farmer who can, and then consider contracting that farmer to grow out their replacement stock. Another alternative would be to sell all their calves at birth or weaning and purchase older replacement heifers when required. However, purchasing all the replacements risks introducing disease onto the home farm and there is no guarantee that the genetic merit of the purchased stock is as good as the existing milking herd.

Low reproductive rates and high calf mortality are the major causes of reproductive wastage. This has a direct bearing on culling and replacement strategies and on genetic improvement. In many tropical countries, calf mortality can be as high as 50%. In some areas, this can be due to unacclimatised temperate or crossbred stock in addition to poor management. Climatic stress compounds the other hazards of calf life, but high calf mortality is usually due to diseases and poor feeding management.

This book highlights many of these issues, as well as those arising from the fact that heifers, particularly milk-fed calves, are the most susceptible of all dairy stock to poor farm management practices. This is due to their reduced resistance to the dairy farm environment (namely disease and climatic stress) and the fact that, until they become fully functioning ruminants, their monogastric digestive system requires a specific feed: namely milk.



Milk-rearing calves in Pakistan.

1.1.1 Benefits of bigger heifers

It is a well-researched fact (Moran and McLean 2001) that heavier heifers:

- get into calf easier the first time
- produce more milk in their first lactation
- get back in calf sooner during their first lactation
- stay in the herd longer
- need less help at calving
- cope better with herd competition
- put more money into the farmer's pocket.

Light heifers reduce herd fertility two ways: through delayed first calving and by having a longer period to get back in calf after first calving.

1.2 Outline of the manual

This book is written primarily for the stakeholders of SHD production in the tropics, although it is equally relevant to any tropical dairy farmer. Small holders are the major suppliers of milk in the tropics. However, numerous larger farms with many hundreds of milking cows, using intensive feedlot or less-intensive grazing systems, have been

established throughout Asia in recent years, in an attempt to satisfy the increasing demand for fresh milk. However, I believe that, SHD farming is, and always will be, the backbone of domestic milk production throughout the tropics (Moran 2005, 2009, 2012).

Chapter 2 provides a concise summary of all the key elements of young stock management outlined in this book. Chapters 3, 4 and 5 review the key principles of nutrition of young stock: namely digestion of feeds in the milk-fed calf (Chapter 3), the nutrient requirements of calves (Chapter 4) and the importance of colostrum to newborn calves (Chapter 5). Chapter 6 reviews the recent published literature surveying calf and heifer mortalities in the tropics, while Chapter 7 discusses the facilities farmers require for rearing their young stock; it also discusses the important issue of ensuring good calf welfare.

Chapters 8–12 discuss the important components of the milk-rearing phase: namely feeding whole milk (Chapter 8), feeding calf milk replacer (Chapter 9), solid feeds (Chapter 10), disease management (Chapter 11) and communicating with the calves (Chapter 12). The next two chapters deal with feeding weaned replacement heifers (Chapter 13) and their management during mating and pre-calving (Chapter 14).

The remaining chapters of the book discuss improvements to the system of rearing replacement dairy heifers. These are the business aspects, or the costs and potential returns, from heifer rearing (Chapter 15), and assessing current rearing systems (Chapter 16), while Chapter 17 details some of the training programs that I have conducted around Asia in recent years. Finally, the best management practices for rearing young dairy stock are presented in Chapter 18.

Full publication details of all sources of information are presented in References. Every profession has its jargon, or words developed specifically for that profession, and agriculture is no exception. There are some very specific terms and acronyms that are routinely used by dairy researchers and advisers. These are explained in the Glossary and when they are first used in this book.

Appendix 1 lists what I have called ‘John Moran’s golden rules for calf and heifer management’. These were originally developed for Australian dairy farmers, but are equally relevant to dairy farmers throughout the world. Appendix 2 provides conversion factors to the standard metric system from a wide variety of systems used for describing weights and measures. Appendix 3 presents a conversion chart for the various Asian currencies used when discussing farm costs and returns associated with calf and heifer rearing. Appendix 4 presents typical expectation and evaluation forms developed for farmer workshops on improved young stock management.

Finally for ease of finding specific information, the Index lists all the key topics covered in the book and their relevant page numbers.

1.3 Role of the manual in farmer and adviser training programs

This manual is multipurpose in that it forms the basis of structured training programs in small holder dairying for a range of stakeholders in tropical dairy farming.

It is quite likely that many small holder (and even large-scale) farmers would find this book too technical and difficult to comprehend. In the first place, if English is not

their mother tongue, unless they were well educated and/or travelled, very few would fully understand the level of English used. Secondly, the book is not simply a practical guide of how to undertake good young stock management. Rather, it is a technical manual about:

- why dairy calves and heifers suffer from poor stock management
- the symptoms of their suffering
- why their management needs to be modified
- how these practices can be improved for the betterment of the stock.

In other words, the book provides the theory behind the observations arising from poor management practices so farmers and advisers can understand the reasons why these practices need to be improved; that is, ‘why unacceptable things happen’ and ‘how they should be changed’ to ensure they do not happen again.

Most tropical countries have proactive programs to increase local supplies of milk, which require increasing numbers of well-trained workers to service the dairy industry. Consequently, educators from agricultural schools, universities and technical colleges need to be kept abreast of the latest technical developments and applications in dairy farming.

The key target audiences for this book are then:

- farmers who can understand this logical approach to improved young stock management
- farm advisers who assist farmers to improve their management practices
- educators, usually at technical level, who develop training programs for farmers
- educators, usually university level, who train dairy advisers in the basics of dairy production technology
- other stakeholders in tropical dairy production, such as agribusiness, policymakers and research scientists.

The text is written to be understood by advisers and tertiary students. As the trainers must ensure that other target audiences can comprehend their course material, they should select the most relevant sections to incorporate into basic programs for farmers. Each chapter has been written as a ‘stand alone’ document that can be individually downloaded from the internet, but there is some repetition, which has been kept to a minimum. For example there are several ‘lists’ of key farm practices for rearing milk-fed calves and weaned heifers, but each list has a specific purpose. Chapter 2 introduces all the key principles and processes for improved young stock management, while a checklist is provided in Chapter 16 for a structured assessment of current rearing practices on any farm. Chapter 17 briefly lists all the key elements of a training workshop for dairy farmers and advisers, while users of this manual are given the opportunity to answer ‘yes’ or ‘no’ to the 79 questions that make up the best management practices for calf and heifer rearing in Chapter 18.

To more fully understand the key factors influencing these basic steps of dairy production technology, they have been highlighted in diagrams at the beginning of each relevant chapter. This will provide extension workers and other dairy specialists with an ‘easy-to-follow’ checklist when using this manual to develop farmer training workshops.

For a book covering such a diversity of tropical dairy industries, every attempt has been made to present information from many countries. Much of the manual is based on my previous Australian calf and heifer books (Moran and McLean 2001, Moran 2002), but these key principles are relevant to any country with a dairy industry. Chapter 6 reviews published data of calf and heifer mortalities in the tropics, citing information from over 25 studies throughout the tropical world. Chapter 8 discusses restricted suckling and hand or machine milking, citing information from many Central and South American countries. Chapter 15 uses data from studies in Malaysia, Vietnam and Kenya to review the business of calf and heifer rearing. Chapter 17 is based on my experiences in developing farmer and adviser training programs throughout South and East Asia. Although the most common measures of currency seems to be the US dollar, Appendix 3 allows this to be converted into 12 other currencies to allow readers from many countries to more fully comprehend the costs and returns of their dairy farming. Throughout this book, milk intakes will be expressed either in volume (L) or weight (kg): because the density of whole milk is close to 1.0, the value is the same using both terms.

As previously mentioned, this is the fourth manual specifically written on tropical SHD farming. There is some inevitable overlap in topics covered within these books, so some repetition is inevitable because not all readers of this fourth manual will be familiar with all the technical aspects covered in the first three tropical dairy farming manuals.

1.4 The size of the heifer herd

It has been argued that, because every dairy farmer is different, there are just about as many systems of milk production as there are dairy farmers. For this reason, it is just not possible to categorise dairy farming into several discrete systems, with each system having a typical calf and heifer herd for which there would be an ideal set of herd management practices.

However, there can be some agreement on what constitutes small holder as against a large-scale dairy farming. In two of my previous books (Moran 2009, 2012), I used the following generally accepted descriptors to categorise dairy farms:

1. Small holder: up to 20 milking cows plus replacement heifers.
2. Semi-commercial: 20–50 milking cows plus replacement heifers.
3. Commercial: more than 50 milking cows plus replacement heifers.

Each of these farm types is usually located in a separate area with some degree of independence of supplies of forages and farm management. However, in certain countries, small holder farmers can be clustered together as ‘colony farms’, such as in centralised governed societies like China and even in dairy cooperatives in other countries such as Indonesia. With colony farming, small holders house their stock together in large dairy sheds, but are still responsible for feeding and maintaining their animals. These innovations require a large investment in buildings but they do allow small holders to own and manage their stock in a well-constructed durable shed with the benefits of magnitude of scale. This provides for communal activities such as forage production, machine milking and, of relevance to this book, heifer rearing. Either a single farmer takes charge

of the rearing the replacement heifers for some or all of the small holder farmers in the 'colony', or the dairy cooperative may employ a specialist to rear them.

Assuming dairy farmers do not keep their male calves for breeding or dairy beef, they should aim to rear 25% annual replacements for their milking herd. Therefore each year, each small holder farmer with 20 milking cows should be rearing up to five heifers less than 12 months old (which are commonly called calves) together with another five weaned heifers over 12 months old (which are commonly called yearlings or heifers). Because the average herd size in many Asian countries is only two or three milking cows, the young stock herd may number only one or two.

Hence the calf and heifer herd size can be:

- one to two on many very small farms
- 10 on a 20 cow small holder farm
- 25 on a 50 cow semi-commercial farm
- 50 on a 100 cow commercial farm
- 100 or more on a colony farm.

In addition to young stock, non-lactating milking cows are also non-productive; that is, until they calve down again and recommence their lactation cycle. With non-productive dairy stock totalling 50% of the milking herd, young stock management cannot just be bulked together with general dairy farm management, but fully justifies a specific set of goals, procedures and a separate business plan.

1.5 Key performance indicators for rearing replacement heifers

1.5.1 Key performance indicators for components of heifer management

Poor heifer management is a major problem on many (if not most) Asian SHD farms (Moran 2005). Young stock receive insufficient attention because they do not generate income for many months. In addition, the first 3 months are the most expensive period in the life of any dairy cow and many farmers are just not prepared to invest in the calves' future. A low calf mortality rate indicates that early milk-rearing practices are adequate and allow for greater opportunity for economic and genetic improvement in the herd. When a heifer dies, there are fewer opportunities for culling unprofitable cows.

There are many hidden costs arising from poor management of the replacement dairy herd. The milking potential of small stunted animals that do not calve until 3 yr of age has been markedly reduced, while very high mortality and morbidity rates in calves during their milk feeding period represent an enormous waste of genetic potential in the dairy herd, as well as cash outlay (Moran 2002).

There are easily quantifiable benefits in having more newly calved heifers available to replace older unprofitable cows as both heifer and reproductive management improve. These benefits are:

- 1–2% more first-calf heifers for every month reduction in age at first calving
- 3–5% more first-calf heifers for every 10% reduction in calf mortality
- 2–3% more first-calf heifers for every month reduction in inter-calving interval.

Farmers should aim to rear 20–25% of their milking herd each year as replacements, to calve down for the first time by about 2 yr of age and produce at least five calves during their productive life. Realistic targets for tropical dairy systems (Moran and Tranter 2004) are:

- calf mortality to weaning: 4–6%
- heifer wastage rate from birth to second calving: 20–25%
- live weight at mating: 250–300 kg
- live weight at first calving: 400–500 kg (depending on breed type)
- age at first calving: 28–30 months.

Another good indication of heifer management is first lactation milk yield. This is expressed as a percentage of mature cow production, with a target of 80–85%. If first lactation yields are less than 75% of the mature equivalent, then the heifer-rearing program should be reviewed (Moran and McLean 2001).

On most dairy farms, heifers don't cover their rearing costs until they reach their second lactation. If they are culled or die earlier, they will leave the farm with an unpaid debt. A feed plan for heifers is as important as having a feed plan for milking cows. It is easy to let heifers drop down the priority list. Growing heavier, well-framed heifers is an investment in the future of the farm.

1.5.2 Key performance indicators for entire heifer herds

Replacement heifers are bred to allow for the culling of cows no longer suitable for the milking herd. Good heifer management is essential to provide sufficient animals for this to occur on a regular basis. The proportion of heifer calves that survive and grow well enough to become replacements depends on the many factors. These can be quantified as the proportion of:

- milking cows that actually conceive (the conception rate)
- those that produce a live calf (namely, do not abort during pregnancy or suffer neonatal death)
- those that are heifers (usually 50% of the viable calf drop, except when using sexed semen)
- those that survive until calving (namely, do not die during milk rearing and post-weaning)

Table 1.1. Measures of reproduction and calf rearing to produce replacements for a stable dairy herd (STOAS 1999)

Rearing system	A	B
Inter-calving interval (months)	12	18
Calving rate (%)	85	65
Stillborn calves (%)	2	5
Calf mortality from 0 to 24 months (%)	8	20
Non-pregnant heifers (%)	5	10
Heifer calves born (%)	36	15

- those that conceive as maiden heifers
- those that are suitable as milking cows in the herd (for example, are not culled because of poor temperament, poor udder conformation or because of lengthy illness).

STOAS (1999) compared reproduction and calf survival in two rearing systems (A and B) to calculate their relative replacement rates for a dairy herd with stable stock numbers (Table 1.1).

Assuming cows remain in the milking herd for up to four to five lactations, 20–25% should be replaced each year. From Table 1.1, the supply of 36% heifers from System A allows for the sale of young breeding stock or a higher culling rate to better address genetic improvements in the herd. Only one in every six or seven cows could be replaced annually in System B, which would hardly be enough to maintain herd numbers, let alone allow for much genetic selection. System A could then be considered as a set of key performance indicators.

With high ages at first calving (>30 months) and long inter-calving intervals (>15 months), it is very difficult to increase herd size through natural increases. That is why it is so important to seek the underlying causes of herds with high percentages of dry cows or a high proportion of heifers to cows. The most likely cause is poor feeding management, but there could be others, such as disease, heat stress or simply poor reproductive practices.

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