# 7

# Best management practices for smallholder dairy farmers

This chapter presents an overview of the essential on-farm practices necessary to effectively run a smallholder tropical dairy to sustainably produce a consistently saleable product.

Best Management Practice (BMP) and Quality Assurance (QA) are processes for describing and implementing the most suitable procedures for a particular set of tasks to achieve a desirable outcome. With something as complex as running a dairy farm, it is best to partition the major outcome, that is profitable milk production, into several sets of management decisions that producers must make such as those summarised in Figure 3.1 in Chapter 3. These include growing productive forages, efficient feeding management, hygienic milk harvesting, effective animal health and rearing replacement heifers. Essentially BMP means:

- saying what you should do
- doing what you say
- recording what you have done

and hence improving the activities of your dairy operation.

QA programs are in their infancy on Asian dairy farms. With increasing focus on meeting customer requirements, QA programs are likely to become an integral part of dairy enterprises in future years and should focus on people, environmental and animal welfare, as well as product quality and safety management.

## 7.1 The importance of record keeping on dairy farms

Farm records are an integral part of good dairy farming practice. They help farmers in many ways such as making:

- herd and farm management decisions
- financial accounting and decision-making
- identifying problems
- planning for the future
- determining whether farm production targets have been met.

The major criteria for good record keeping are:

- *They must be useful*. Unless data are used in some future time and turned into information in making management decisions, the information should not be recorded at all.
- *They must be kept in such a form that they can be easily converted into information*. Before keeping a record, the eventual end use must be decided upon so that the form in which the data are recorded will facilitate later analysis and interpretation. Too often the end use is not considered and then usefulness is questionable.
- *The system must be simple*. Farming is a busy enough profession without burdening farmers with a complex record keeping system.
- *Duplication must be avoided as much as possible*. Some data may have to be recorded more than once in different forms and this can be done at a later date.
- *They must lead to actions being taken in the near future*. Information must lead to quick actions.

In other words, they must be easy to:

- record
- regularly update
- understand
- access
- summarise into information.

This discussion will not include financial and staff working times, but be limited to farm production and animal health information.

The keeping of farm production records can be divided into the five main activities, namely:

- animal identification
- herd breeding records
- individual cow milk production records

- health records
- feeding records.

### 7.1.1 Animal identification

Information should be recorded when an event occurs. Putting this off leads to omissions and errors. A good herd recording system will include identification of each calf as soon as possible after birth. In addition to the identification name or number, the calf's birth date, its size, name and its sire and dam's names should be recorded on a simple identification record.

Such information is useful to dairy farmers when:

- a sire is to be selected and the farmer wishes to avoid in-breeding
- heifers are evaluated for breeding and superior bulls must be chosen
- evaluating overall herd reproduction and determining the age of heifers at first heat
- knowing the age at which a heifer should be targeted for breeding
- determining whether an animal is an appropriate size for its age
- comparing genetic lines across an area (with other dairy farmers) to determine which animals to cull
- determining which animal should be culled on the basis of age.

### 7.1.2 Herd breeding records

A farmer with records based on identified cows can improve his breeding management by being able to determine such matters as: the date at which to dry a cow off; knowing when a cow should deliver a calf; highlighting poor insemination or bull services; establishing breeding dates and feeding programs; identifying calf, sire and dams; and determining the date for pregnancy testing. Breeding records must be up-to-date and easily accessible. They should be kept on a computer or in a dry and clean place within the dairy shed in a position which the farmer passes each day and can easily stop to update records.

Herd breeding records should include:

- the identification of an animal including its birth date
- name of sire and dam
- heat dates and comments
- calving dates and comments
- earliest breeding date
- service information
- pregnancy examination
- expected calving date
- drying off date
- any additional remarks.

### 7.1.3 Milk production records

Milk production records help the farmer determine which animals are bringing down the average yield and therefore income from the herd. Good milk production records can assist to raise milk production from an individual cow and a herd through specific management for individual animals. The more frequently individual daily milk production (and milk composition) data are recorded, the better. Daily herd milk yields and milk composition/quality data should be easy to access and record. Seasonality of milk production needs to be quantified to develop the most appropriate feeding strategies to address troughs in monthly milk yields.

### 7.1.4 Health records

Calling in a veterinarian to examine animals once they show a health problem is a more common approach than organising regular veterinary visits. With the use of records, veterinarians can gain additional information about the probable causes of ill health or poor reproduction in an individual animal to compensate for lack of familiarity with an individual arrival. Information concerning milk yields, quality of milk, dates of last change of status in reproductive and lactation terms, and other general information are of value in addition to the farmer's observations. Health issues and treatment information can also be recorded for individual stock on-farm. As well as recording veterinarian visits (date, purpose, diagnosis and treatment), vaccination details (type and date) and calf and cow mortalities, records are useful information in disease management.

### 7.1.5 Feeding records

These can vary from simple records of when feed was purchased and for which category of stock, through to details of changes in feeding programs (such as feed types and daily quantities fed per cow). The more detailed the feeding records, the better the ability to assess feeding efficiency (milk produced per unit feed consumed) on the farm.

The best way of recording such information is using a daily diary kept in the office where changes in herd and feeding management can be routinely included. This diary could also be used to document appointments or other planned important farm activities.

An additional aid to farm record keeping is a small pocket-sized notebook carried by the farmer (and staff) in which they record any unusual observations, changes in routine management or other noteworthy farm events. Computers are becoming more common to aid record keeping, collation and interpretation although a simple notebook and hand calculator is better than relying on memory.

### 7.1.6 Action lists

This term refers to details of particular stock requiring particular attention.

- ***Daily action lists*** would include cows likely to show heat, cows due for drying off, through to cows and heifers due to calve.
- ***Weekly action lists*** could include drenching of young stock, changes in cow and heifer feeding groups, through to heifers now ready for insemination.
- ***Monthly action lists*** would include routine veterinary examination, such as cows and heifers for pregnancy testing. It would also include cows that have aborted within the last month, re-examination of cows previously treated by the veterinarian within the last month, cows not observed to be on heat after 42 days from calving and also cows still not pregnant after 110 days post-calving. Other stock that should be examined would be cows with irregular cycles, cows confirmed in calf but have cycled again and any other problems listed in the daily diary. This would also include vaccination and parasite control requirements.

  Examples of farm record pro formas are presented in Tables 7.1 to 7.5.

**Table 7.1.** Cow identification record within the herd.

| **Cow number** | | | | | | |
|---|---|---|---|---|---|---|
| Breed | | | | | | |
| Date of birth | | | | | | |
| Sire | | | | | | |
| Dam | | | | | | |
| **Calf 1** | | | | | | |
| Date of birth | | | | | | |
| Bull/heifer | | | | | | |
| Sire | | | | | | |
| **Calf 2** | | | | | | |
| Date of birth | | | | | | |
| Bull/heifer | | | | | | |
| Sire | | | | | | |
| **Calf 3** | | | | | | |
| Date of birth | | | | | | |
| Bull/heifer | | | | | | |
| Sire | | | | | | |
| **Calf 4** | | | | | | |
| Date of birth | | | | | | |
| Bull/heifer | | | | | | |
| Sire | | | | | | |

**Table 7.2.** Fortnightly milk production record card for each cow (L/cow/day).

| **Cow identification: ……** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Day** | **Mon** | **Tue** | **Wed** | **Thu** | **Fri** | **Sat** | **Sun** |
| Week: | | | | | | | |
| AM yield | | | | | | | |
| PM yield | | | | | | | |
| **Day** | | | | | | | |
| Week: | | | | | | | |
| AM yield | | | | | | | |
| PM yield | | | | | | | |
| **Day** | | | | | | | |

**Table 7.3.** Breeding record card for each cow at each mating.

| **Cow identification: …….**<br>**Lactation number: …….**<br>**Date of last calving: …….** | | | | |
|---|---|---|---|---|
| Date on heat | | | | |
| Service date | | | | |
| Bull/AI | | | | |
| Sire breed | | | | |
| Pregnancy check<br>Date and result | | | | |
| Date to dry off | | | | |
| Expected calving date | | | | |

**Table 7.4.** Vaccination record for the herd.

| **Date** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Routine vaccination record | | | | | | | |
| A* | | | | | | | |
| B | | | | | | | |
| C | | | | | | | |
| D | | | | | | | |

* A, B, C, D indicate type of vaccination.

**Table 7.5.** Veterinary treatment record for the herd.

| **Date** | **Animal number (s)** | **Clinical symptoms** | **Diagnosis** | **Treatment** | **Outcome** |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

The remainder of this chapter lists a range of BMPs for the day-to-day feeding and herd management of smallholder dairy (SHD) farmers in the tropics. It is split into two types of BMPs, first forage production and second, managing the dairy herd. The first is discussed under the banner 'Producing quality forages on smallholder dairy farms' while the second has been grouped under the banner 'Golden Rules for tropical smallholder dairy farming'.

This chapter simply lists the BMP, not detailing the scientific logic behind each one. There are so many BMPs (158 of them) with virtually every one of them discussed in detail in one or several of the senior author's previous five books on tropical dairy farming. Another section of this chapter discusses Key Performance Indicators (172 of them) and as with the BMPs, these are simply listed, rather than quantified (except for those listed in Table 7.6).

## 7.2 Producing quality forages on smallholder dairy farms

There are four basic principles of producing quality forages. These are:

1. Select the most appropriate forage species for the region.
2. Prepare the forage production area for sowing.
3. Manage the crop, particularly with adequate fertiliser to optimise growth and quality.
4. Harvest the crop at the best stage of maturity for nutritive value.

### 7.2.1 Selection of forage species

Key questions to ask when selecting varieties of forages to grow:

- Are there advantages over local varieties?
- Are they adapted to the climate and soils?
- Do they suit the intended use?
- Do they fit into the particular farming system?

More specific questions to ask are:

- Have they been tried and found successful in the region?
- Do they suit local farming systems and ecological conditions?
- What extra inputs are required, such as seed costs, labour and fertilisers?
- Will their extra cost return a profit?
- What are the risks of crop failure?
- Do the seeds come from a reliable source of supply?

No forages grow well everywhere. Some grow well in acidic soils while others do not. Some grow well in cooler areas, while others do not. Forages can survive in areas where they are not adapted but they may not thrive. It is important to choose forages that are adapted to local soils and climate.

### 7.2.2 Important soil and climatic factors

Important climatic factors affecting forage adaptation are the length of the growing season, air temperatures, soil fertility, soil pH and drainage.

The key properties of a soil that influence forage selection and plant growth are:

- soil texture: light (sandy, sandy loam), medium (loam, clay loam), heavy (heavy clay)
- soil fertility: low, medium, high. Soil fertility is the ability of the soil to hold and release nutrients for plant growth, rather than the amount of nutrients in the soil at any one time
- soil pH: strongly acid (5.0), acidic (5.0 to 6.5), neutral (6.5 to 7.5), alkaline (> 7.5)
- drainage: well drained, moderately drained (occasionally waterlogged), poorly drained (frequently waterlogged)
- level of soil salinity: low, medium, high
- level of available Al (aluminium) and Mn (manganese): low, medium, high.

Other important key descriptors of forage plants are:

- latitude: tropics, subtropics
- altitude (m above sea level): 0–1000, 1000–2000, 2000–2500, > 2,500
- annual rainfall: from 200 to 6000 mm/yr
- family: grass, legume, other (e.g. trees)
- life cycle: annual, perennial
- longevity of forage crop: long-term (> 4 yr), short-term (< 4 yr)
- purpose: grazing, cut and carry, conservation, hedgerow or living fence
- defined dry season: < 6 months, > 6 months
- inundation: 1 wk, 1 month, > 1 month
- stem habit: erect, prostrate, climbing, stoloniferous (stems growing along the ground), rhizomatous (root nodules that convert atmospheric nitrogen into plant nitrogen)
- shade environment: moderate (30–50% shade), dense (> 50% shade)
- frost intensity: light, heavy.

### 7.2.3 Agronomy of forage crops

The key issues to ensure high yields of quality forage from any forage crop are:

- Preparation of the soil for sowing, to ensure a good establishment of the crop and minimum weed invasion.
- Fertilising the crop with sufficient soil nutrients, using inorganic fertilisers to supplement dairy shed effluent. Ensure fertilisers are routinely applied after every (or at least every second) forage harvest.
- Having a crop harvesting program to ensure quality forage as well as adequate forage yields.

- Appreciating the difficulty of recommending specific harvesting regimes for all crops in every situation, because the rate of forage growth depends on variety, rainfall and irrigation, soil fertility and harvest interval.
- Wilting the harvested forage is one way to improve forage intakes through reduced plant water loads.

### 7.2.4 Ensuring year round forage supplies

The seasonality of rainfall and soil temperature does not allow for regular growth of forage crops throughout the year. High growth rates during the wet season provide the opportunity to harvest excess forage for conserving and storage to be fed out during the dry season when forage sources are usually in short supply.

Excess forages can be conserved as hay or silage. However, good ensiling practices generally produce better quality roughages than do hay because less time is required to wilt the feed, during which time the forage loses nutrients, causing a reduction in feed quality. Hay making requires a longer period of rain-free days, which are often rare in the tropics during the wet season when feed excesses generally occur.

## 7.3 The Golden Rules for tropical smallholder dairy farming

The following Golden Rules arose out of an FAO program entitled 'Smallholder Dairy Development Program (SDDP)' that operated in Thailand, Bangladesh and Myanmar from 2011 to 2015 (Asia Dairy Network 2015). A recent innovation was to crystallise farm management practices into eight Golden Rules that covered the entire range of on-farm herd management practices, from rearing young stock and feeding milking cows through to reproductive, animal health, housing and heat stress management, culminating in milking hygiene. For each Golden Rule, the SDDP developed a glossy brochure highlighting the key seven to eight BMPs to provide a simple set of 'take home messages' that could easily be translated into the language of the target country. To date, they are freely available in English and the languages of the three SDDP participating countries. We have also translated them into the Indonesian and Malaysian languages.

Forage production was not included as one of the Golden Rules because of the diversity of soil and climatic variables in the tropics and the wide variation in BMPs that can produce quality forages.

The 158 BMPs for the Golden Rules have been grouped into two types. First, for each Golden Rule, there are the seven or eight BMPs that are included as part of the original Golden Rules brochure. These are the simple 'take home messages' associated with hand drawings in the brochure and these have been numbered and highlighted in italics in the lists below. Second, there are the remainder of the

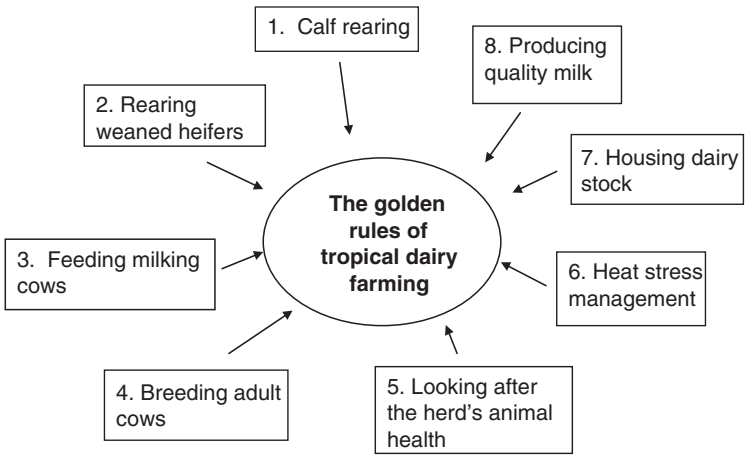


**Figure 7.1:** The eight Golden Rules of tropical smallholder dairy farming.

158 BMPs that are additional to the original 'take home messages' – these have not been numbered and they appear as non-italic bullet points in the following lists. The total number of BMPs for each Golden Rule are shown after each subheading.

### 7.3.1 Golden Rules of calf rearing (21)

1. *Calves must be born under hygienic conditions. Calving cows must be provided with a clean dry area in which to calve down.*
2. *The calves' umbilical cord should be sprayed with iodine solution (7%) immediately after birth.*
3. *Calves must be given a good drink of quality colostrum early in their lives. Each calf should receive 4 L of colostrum within 6 h of birth.*
4. *Calves must be always provided with adequate clean drinking water.*
5. *Calf pens should be provided with good natural ventilation against heat stress and also protection from any severe cold weather in winter.*
6. *Calves can be weaned off milk when each one consumes ~1 kg/day of calf concentrate. With the correct feeding management, this should occur by 3 months of age.*
7. *Permanent identification of each calf (with an eartag) and good record keeping will always benefit the farmer in the long run.*

- The colostrum must be of good quality with adequate amounts of antibodies; this can be tested by simple and cheap colostrometers or refractometers in a laboratory but thick creamier-looking colostrum is likely to have more antibodies than thin, diluted-looking colostrum.

- The colostrum can either be given by assisting calves to drink from their dam, or fed from a teat bottle or via stomach tube.
- Milk-fed calves must be fed a balanced diet of milk, concentrates and a small amount of roughage from the second week onwards. This varies with the age of the calf. The concentrate stimulates development of the rumen wall while the roughage stretches the rumen wall.
- Calf milk replacer is generally cheaper and can be as good quality as whole milk. Ask your local veterinarian or dairy cooperative for advice.
- There is no benefit whatsoever in allowing calves to suckle their dams. Milking cows do not require a suckling calf to stimulate milk letdown, and this can even lead to poor letdown behaviour over time.
- Calves can grow just as well if fed their milk once each day rather than twice each day as the clotted milk is slowly digested in the calf's stomach over the next 10 to 12 hr.
- Do not feed milking cow concentrate to young calves as it does not contain enough protein for a rapidly growing calf. Find a special calf-rearing concentrate.
- Calf-rearing concentrate should include minerals and vitamin supplements to provide all the essential nutrients for heifer growth.
- Calves should be reared in clean, manure-free and dry pens, ideally with no more than four calves in a pen.
- Minimise stresses by following a set feeding routine each day, especially with reference to time of day, milk volume and temperature.
- Scouring calves should be given electrolyte fluid replacer and antibiotics only under veterinary advice.
- Develop a disease action plan that includes good hygiene, isolation of sick calves, and TLC (tender loving care). Drugs should only be used as a last resort to complement a well-managed system.
- If more than 10% of your milk-fed calves die within the first three months of feeding (that is 1 out of every 10 calves), there are problems with their feeding and herd management. Ideally such death rates should be less than 5% (that is 1 in every 20 calves).
- A good calf rearer knows which calves are likely to be sick tomorrow.

### 7.3.2 Golden Rules for rearing weaned heifers (13)

1. *Weaned heifers require a balanced diet of quality roughages and concentrates. This varies with the age of the calf.*
2. *Their rumen is still too small for them to only be fed roughages so also feed quality concentrates, containing at least 16 to 18% protein. This could simply be good quality milking cow concentrate.*

3. *All dairy animals require regular access to clean drinking water.*
4. *Well-reared heifers will show signs of heat within the first 10 to 12 months of their life.*
5. *Well-reared heifers have well-developed bones, hence a good frame size, as assessed by wither height.*
6. *Well-reared heifers will calve down at 24 to 27 months of age, not 30 or 36 months of age, as is generally the case in most Asian countries.*
7. *During their lifetime, well-reared heifers will produce sufficient extra milk and calves to not only pay for their higher feeding costs but also yield substantial profits.*

- Their concentrate should include minerals and vitamin supplements to provide all the essential nutrients for heifer growth.
- If allowed to lose weight or grow very slowly for lengthy periods, heifers will not achieve their potential bone frame size and that can lead to problems in later life.
- Low mating live weights can lead to calving difficulties 9 months later. This can reduce milk yield and increase the number of days to the second conception.
- Poorly reared heifers are stunted and often have a big 'pot belly'.
- If more than 30% of your young stock dies before they calve down (that is 3 out of every 10 calves and heifers), there are problems with their feeding and herd management. Ideally such death rates should be less than 10% (that is 1 in every 10 calves and heifers).
- Internal parasite control is necessary if heifers are being grazed or fed green feed from manure-fertilised forage or pasture.

### 7.3.3 Golden Rules for feeding milking cows (23)

1. *Milking cows have high requirements for water, which should be supplied separately as clean drinking water rather than as part of any concentrate slurry.*
2. *Feed sufficient quality forages (20 to 40 kg fresh forage/cow/day). The daily amount will depend on the cow's live weight and milk yield and the farmer's available forage resources.*
3. *Supplement feed with concentrates that are formulated to overcome specific nutrient deficiencies.*
4. *Consider wilting the forage, by leaving it out in the sun during the day before chopping it up, to reduce its moisture content and encourage the cows to eat more of it, hence produce more milk.*
5. *At any one time, 60% of milking cows at rest should be ruminating. This is a good reflection of the overall good herd management, which includes appropriate feeding management.*
6. *If concerned about unbalanced diets in the milking herd, closely monitor the manure characteristics, changes in feed intakes, changes in milk yield and*

*composition (fat and protein or solids-not-fat) and the proportion of cows that are ruminating.*

7. *Remember that potentially higher yielding cows are more susceptible to other farm constraints such as insufficient quality feed, heat stress, poor animal health and the limited management skills of the farmer.*
8. *Farmers need to develop the skills to identify when cows are on heat. This requires consistent observations, including night-time observations.*

- Milking cows may cost more to feed better but they will do more than simply return this investment and will also yield substantial profits in producing more milk and more calves over their lifetime.
- There is no benefit whatsoever in providing concentrates in the form of a slurry.
- When planning milking cow feeding programs, it is important to feed more concentrates to higher yielding cows.
- It is better to feed green forages rather than dried ones, such as rice straw, as long as cows are consuming enough dry matter.
- Selection of forages to grow for livestock fodder should be based on those most suited to the soils, climate and local farmer skills.
- Growing forages requires additional inorganic fertilisers as well as cow manure and shed effluent.
- You must feed the grass as well as feed the cows. Use inorganic fertilisers for forage production.
- The optimum time to harvest forages should be based on their nutritive value rather than their total forage yield. Over-mature forages have a low nutritive value.
- Concentrate supplements should be formulated to provide sufficient energy, protein, minerals and vitamins for good consistent milk yield and fertility.
- Calcium and phosphorus supplements are particularly important for milking cows.
- Sourcing ingredients for concentrate supplements should be based on their relative costs of feed energy and protein.
- Cows should be able to lie down and rest for as long as they need to (up to 11–12 hr/day), on comfortable and dry bedding as this increases salivation, rumination, blood flow to the udder and hence milk yield. It also reduces lameness.
- It is best to set realistic target milk yields based on the genetic quality of the cows and the feed (forages and concentrates) available.
- It is more efficient to feed fewer milking cows better but the ideal target milk yields should depend on the farmer's resources (for feed supplies), management skills and the motivation to have high yielding cows.
- Cows tend to moo when they are on heat or are hungry. Don't ignore their cry.

### 7.3.4 Golden Rules for breeding adult cows (17)

1. *Milking cows need to be well fed to rebreed. If cows are too thin or over fat, they will have poorer fertility.*
2. *The voluntary waiting period, or days between calving down and rebreeding, should be no more than 50 days.*
3. *Look for signs of heat 18 to 24 days after their last heat, if they are still non-pregnant.*
4. *The best conception rates occur on insemination (natural or artificial) 4 to 12 h after the first signs of heat.*
5. *It is important to keep good records of inseminations and natural matings to ensure good herd reproductive performance and to know when to seek veterinary advice.*
6. *It may be necessary to cull additional cows if more than 15% of the herd have more than 16 months between calvings.*
7. *Each month farmers should identify non-pregnant cows that have calved more than 80 days beforehand but have not been detected to be on heat. The veterinarian should be asked to examine their reproductive tracts for abnormalities.*

- Unhealthy cows, such as those with retained placentas, lameness, mastitis or infections in their reproductive tract, have poorer fertility.
- One of the biggest challenges when rebreeding cows is to feed them an adequate well balanced diet in early lactation (the first 100 days of their lactation). Without sufficient feed nutrients, the cows will use their body reserves to produce milk, quickly lose weight and not cycle (show signs of heat). Pay particular attention to first-calf heifers.
- Farmers need to develop the skills to identify when cows are on heat.
- Identifying which cows are on heat requires consistent observations, including night-time observations.
- High temperatures and humidities will markedly reduce the number of hours that cows can be successfully rebred, either by insemination or using a bull.
- With artificial insemination, it is important to use insemination technicians with reliable good inseminating skills and use semen that has been tested as good quality.
- Veterinary advice should be sought if too many cows show signs of ill health such as assisted calvings, retained foetal membranes, lameness, abortions or vaginal discharges more than 14 days after calving and other health problems.
- Cows with calving problems are more likely to have uterine infections that can last for weeks (even months) after calving down, even though the cow shows normal signs of heat and does not have any abnormal vaginal discharge.

- It is just not possible to get 100% conception rate (cows getting back in calf), no matter how many inseminations the cow has. Identify any suspected problem cows for veterinary inspection.
- But remember that poor feeding management during the dry period (in high yielding cows) and the first 100 days of lactation is the most common cause for repeat breedings. Heat stress will make it worse.

### 7.3.5 Golden Rules for looking after the herd's animal health (19)

1. *Develop a disease prevention plan that includes good hygiene, isolation of stock and a regular vaccination program.*
2. *Learn to quickly identify subclinically sick animals from their physical appearance and behaviour.*
3. *If an animal is obviously sick, then move it to an isolation pen in order not to infect other stock.*
4. *Lameness can be a major problem with cows living in sheds. As it can be due to trauma, unbalanced diets or overgrown hooves, its cause must be identified.*
5. *Providing cows with soft bedding, such as a dry soil or sand resting area or rubber mats improves cow comfort as well as reducing feet and leg problems.*
6. *A written herd health program should be developed that contains management actions for herd health to prevent and control diseases and disorders specific for the region.*
7. *Do not use old drugs that are past their use by date to treat sick animals.*

- Drugs should only be used as a last resort to complement a well-managed system.
- Keep the hospital pen clean and occasionally sterilised.
- Learn to monitor respiration rates to quickly identify cows that are sick and heat stressed, to take appropriate action and cool them down.
- Develop a regular vaccination program to guard against local disease problems.
- Develop a regular dosing program to guard against internal parasites, which can even be introduced with cut forages.
- Be aware of external parasites that can adversely affect cow performance, therefore, treatment must be anticipated for such infestations in the herd.
- If lameness is most likely due to trauma, ensure floors are not too abrasive and all stones and broken pieces of concrete or metal have been removed.
- Consider foot trimming if the claws appear overgrown, and provide footbaths which contain formalin (to harden up the hooves) or copper sulphate (to treat sore feet).
- Sore feet can be due to feeding problems (acidosis) and if identified, rumen buffers and additional forages should be fed.

- The herd health plan should contain actions for foot care, mastitis, parasite control, infectious diseases and calf care.
- Remember that care and support for a sick animal is just as important as the veterinarian developing a treatment protocol.
- If advised to do so, keep drugs in dark and cool place.

### 7.3.6 Golden Rules for heat stress management (17)

1. *Hot cows lose their appetites. Very thirsty cows lose their appetites.*
2. *Heat stress will reduce the time cows can cycle, that is show signs of oestrus.*
3. *Heat stress will reduce the cow's fertility and if severe, can actually kill the developing foetus inside the pregnant cow.*
4. *It is better to feed cows during the night, when it is likely to be cooler, as well as during the day.*
5. *Extra water is essential on hot days or during summer for the cows to lose any extra body heat.*
6. *Sheds with low roofs and walls (which obstruct the wind) will reduce natural ventilation.*
7. *Spraying water on hot cows, even with a hose for just a few minutes, followed by placing them next to a fan (or better natural ventilation), will cool the hot cow. The water should be sprayed over the cow's trunk, enough to run off the cow's hide.*

- Cows eating a lot of feed to produce more milk, have a large mass of feed in their rumen being broken down by rumen microbes and this generates a lot of internal body heat.
- Cows feel the heat a lot more than humans do, so don't simply use your own level of comfort as a guide to how the cows are feeling.
- Cows must have regular access to clean drinking water, at least three or four times (preferably more frequent) each day, when they should be allowed to drink as much and for as long as they want.
- It is not always expensive to improve on the natural ventilation of any cowshed.
- A cow's heat stress can easily be monitored through counting the number of breaths she takes, that is her respiration rate.
- If the number of breaths is more than 70 or 80 per minute, the cow is heat stressed and requires extra attention. If the cow is breathing at more than 100 per minute, she is very heat stressed and requires immediate attention.
- Increasing air movement, even just using simple household fans, will improve cow cooling rates.
- Ideally cows should be able to go outside at night-time where they can cool off more effectively.

- Having a yard to walk around in at night makes it easier for cows to identify other cows that are on heat.
- Heat-stressed cows that drool saliva while panting are losing a lot of minerals from the body, hence require additional minerals in the concentrate formulation.

### 7.3.7 Golden Rules for housing dairy stock (30)

1. *Cows need 10 to 12 hr of undisturbed rest each day, preferably in comfortable stalls.*
2. *With well-designed walkways and resting stalls, comfortable lying surfaces and non-slip walking surfaces, cows suffer less lameness, can behave more normally and suffer less stress, have higher daily milk yields and longer productive lives.*
3. *Cows tied up all day every day on concrete floors are not comfortable.*
4. *Cows with hindquarters covered in fresh and dry manure are not comfortable.*
5. *Cows forced to continually lie on dirty hard floors when resting are not comfortable.*
6. *Cows that have difficulty lying down and standing up because their tie rope is too short are not comfortable.*
7. *Providing a portion of the daily feed in an outside yard encourages the cows to move around in the open.*

- Cow comfort is a new term to describe how cows 'feel' and can respond to better feeding and farm management.
- If cows are not 'comfortable', they will have poor reproductive and general health issues, will not produce more milk and more calves no matter how well they are fed.
- Comfort describes the housing conditions, the cow's ability to occasionally 'stretch her legs', the degree of heat stress she suffers and the way the farmer treats and handles her.
- Cows need a soft bedding which is kept clean and non-slippery.
- The best stalls are those that cows voluntarily enter and leave (called free stalls).
- Hot cows lose their appetites. Very thirsty cows lose their appetites.
- Sheds with low roofs and walls (which obstruct the wind) will reduce natural ventilation.
- Milking cows are unlikely to feel the cold anywhere in South-East Asia.
- Calves will rarely feel the cold anywhere in South-East Asia as long as they are dry, out of the wind and have loose hay to nest in.
- A cow's heat stress can easily be monitored through counting the number of breaths she takes, that is her respiration rate.
- If the number of breaths is more than 70 or 80 per minute, the cow is heat stressed and requires extra attention. If the cow is breathing at more than 100 per minute, she is very heat stressed and requires immediate attention.
- The presence of cobwebs in the roof area is indicative of low air movement, hence poor ventilation.

- Cows must have regular access to clean drinking water, at least 3 or 4 times (preferably more frequent) each day, when they should be allowed to drink as much and for as long as they want.
- Cows that have respiration rates exceeding 80 breaths per minute for many hours each day are not comfortable.
- Cows need to be allowed to walk around and 'stretch their legs' every day or so. This regular exercise decreases leg-related problems, mastitis, bloat and calving difficulties.
- It is not necessarily expensive to make cows more comfortable, hence more productive.
- Cows should never be made to fear any of the farm workers through their rough handling.
- Happy cows make happy farmers.
- Look after your cows and they will look after you.
- Cows feel secure when they know they have plenty of feed, have an escape route and know the stockman. They feel insecure on slippery floors, when very lame and when in the presence of unpredictable personnel.
- The body language of the cow is the best management adviser. If you can read the cow, you know what to do.
- Cows will tell you what they want.
- A good dairy farmer is one who extends his farming skills to cover cow psychology, cow behaviour as well as cow production technology and farm business management. In essence, he should be able to put himself 'inside the cow's skin' to develop the ability to 'think like a cow'.

### 7.3.8 Golden Rules for producing quality milk (18)

1. *Poor milk quality reduces the shelf life of liquid milk (that is pasteurised or ultra high treated or UHT) and is becoming more important for smallholder dairy farmers.*
2. *The most important point to producing quality milk is hygiene, both while milking the cows and handling the milk from the cowshed to the milk collection centre.*
3. *Milking staff should have clean hands and clothes, have no obvious signs of sickness and preferably use gloves.*
4. *Milking utensils should be thoroughly cleaned with detergent, sanitised and hung upside down to drain and dry out before the next milking.*
5. *Each milking cow should be provided with a separate cloth to clean the udders and teats before milking. It should then be washed, sterilised and hung up to dry in the sun before using at the next milking.*
6. *Cows' teats should be sprayed or dipped in 7% iodine solution following milking. Your local veterinarian or dairy cooperative should be able to provide this.*

7. *The California Mastitis Test (commonly called CMT) should be undertaken on each milking cow once each month until the herd reaches a low level of mastitis. Then it can be undertaken every three months.*

- Milk quality refers to the bacterial contamination in the cow's udder or the milking equipment whereas milk composition refers to constituents such as fat, protein, calcium and solids-not-fat.
- Cows must be encouraged to stand up for at least 30 min after being milked to allow the teat canal to become sealed off. This is easily achieved by feeding each cow immediately following milking.
- Mastitis is one of the biggest problems for smallholder dairy farmers throughout South-East Asia.
- Mastitis can be clinical (visually obvious) or subclinical (only apparent following the CMT).
- For every clinical case, there are generally 20 to 30 subclinical cases of mastitis.
- Infected quarters can lose 25% of their milk yield and produce only poor quality milk.
- Cows with mastitis should be milked last in the herd.
- Identified cases of subclinical mastitis should be immediately treated with antibiotics; this is called lactation therapy in milking cows. The milk must be discarded during treatment and for the next week or so, which is during the withholding period after treatment.
- Every cow should be given a dose of slow release antibiotic in each quarter when she is dried off. This is called dry cow treatment.
- Some cows will become carriers of mastitis and never be cured, so once identified as repeat cases they should be culled from the milking herd.
- Clean straw and laneway conditions, as well as managing heat stress will assist greatly in preventing mastitis.

## 7.4 Key Performance Indicators

The concept of Key Performance Indicators (KPI) is not new. However, it is when applied to quantifying the performance of SHD farmers in the developing tropics. Expressed simply, KPIs are diagnostic tools allowing farmers to improve their farm productivity, resulting in better financial performance. Farmers can use them to identify weaknesses in, as well as set specific targets for their farms. They are more likely to try to improve their systems if they know by how much they are less productive compared to others.

Each KPI provides a valuable insight into the farm resources and management skills of individual smallholders. However, it is important to prioritise them based on:

- their relevance to the farmer's current stage of farm development
- the farmer's ability to interpret the data and use it in future decision-making
- the ease and accuracy of collecting the necessary raw data.

Many Asian dairy farmers intuitively think about farm costs and returns. However, greater use could be made of formats allowing them to be more aware of the relative importance of all their financial inputs in terms of cost of production (COP) per kg of milk produced on the farm.

Knowing their cost of production allows smallholder farmers to determine their profit margins and this is critical to operating a sustainable dairy enterprise. Farmers must do more and better planning if they are to achieve greater profits. Profits are not something they end up with at the end of the year. Rather, profits are something for which farmers must plan.

Table 7.6 presents a range of and quantifies a series of Key Performance Indicators (KPI) to help farmers diagnose the strengths and weaknesses in their dairy enterprise. Farmers should use these indicators initially to identify these weaknesses in, rather than set targets for, their farm. Farmers are more likely to try to improve their systems if they know they are less productive compared to others.

**Table 7.6.** Ten key measures of smallholder dairy farm performance.

| Measure | Questions to ask |
|---|---|
| **Feeding management** | |
| 1. Stocking capacity | Is the farm carrying too many cattle for the available forage supplies? |
| 2. On-farm forage production | How much of the farm's annual forage requirements must be purchased? |
| 3. Forage quality | Is the forage being harvested or purchased at its optimal quality for milking cows? |
| 4. Concentrate feeding program | What is the quality of the concentrates being fed and how much is allocated per milking cow? |
| 5. Total feed costs | Are the forages and concentrates costing too much per unit of feed energy or protein? |
| 6. Milk income less feed costs | How does this compare with those of other farmers with good feeding management? |
| **Herd management** | |
| 7. % productive cows | What is the % of adult cows actually milking? What is the proportion of milking cows in the entire dairy herd, expressed as a percentage? |
| 8. Pattern of milk production | What is the peak milk yield of the herd and what is its lactation persistency (rate of decline from peak milk yield)? |
| 9. Reproductive performance | How many days after calving do cows cycle? What is the submission rate and the conception rate to first insemination? What is the inter-calving interval? |
| 10. Heifer management | What is the pre-weaning calf mortality and the wastage rate of heifers from birth to second lactation? What is their age and live weight at first calving? |

Such an approach may encourage farmers to look more critically at their cost structures. Expressed simply, this is a diagnostic tool to help identify production weaknesses adversely affecting financial performance.

The following series of 10 questions should be asked on any farm, big or small. Because more than half of farm costs are feed related, the first six questions are directly related to feeding management. Even though the remaining four are more related to overall herd management, they are still very much feed-dependent. For some of the questions, specific indicators relevant to particular farming systems can be developed. However, for others, there is no single indicator that farmers can work towards because the most correct answer is the higher the better for some (such as on farm forage production or forage quality) or the lower the better for others (such as total feed costs or calf mortality and heifer wastage rates). These indicators should be presented as ranges rather than a single value emphasising the fact that they are only guidelines. These 10 key measures or symptoms of poor farm performance for which diagnoses should be considered are presented in Table 7.6.

Actual values for these KPIs have been discussed in detail by Moran (2009b). They could be summarised as shown in Table 7.7.

**Table 7.7.** Actual values for KPIs following Moran (2009b).

| | |
|---|---|
| 1. Stocking capacity | 8 to 12 adult cows per ha forage production |
| 2. On-farm forage production | The more the better |
| 3. Forage quality | 9.5 to 10.0 MJ/kg DM ME, 12 to 14% protein |
| 4. Concentrate quality | 11 to 12 MJ/kg DM of ME, 16 to 18% protein |
| 5. Total feed costs | Not too high, below 60% total cost of milk production |
| 6. Milk income less feed costs | The higher the better |
| 7. % productive cows | 60 to 74% of cows in milking herd of those that have calved |
| | 40 to 48% of milking cows in the total dairy herd |
| 8. Pattern of milk production | High peak milk yield, 25 to 30 kg/cow/day |
| | Low rate of decline from peak, >8% per month from peak |
| 9. Reproductive performance | 55 to 60% pregnant within 100 days of calving down |
| | 13 to 15% still non-pregnant within 200 days of calving down |
| | 65 to 70% '80 day submission rate' (that is cows which were inseminated within 80 days of calving down) |
| | 50 to 60 day voluntary waiting period before insemination |
| | 45 to 50% conception to first insemination |
| | 1.8 to 2.0 inseminations per conception |
| | 12 to 14 months inter-calving interval |
| 10. Heifer management | 4 to 6% calf mortality to weaning |
| | 20 to 25% 'wastage rate' (stock deaths between when they were born and their second calving) |
| | 250 to 300 kg live weight at mating |
| | 400 to 450 kg live weight at first calving |
| | 26 to 28 months age at first calving |

### 7.4.1 Ease of collecting raw data

Each and every one of the KPIs presented in Table 7.6 provides a valuable insight into the farm resources and management skills of individual smallholders.

The ability of smallholder dairy farmers to collect the raw data would vary greatly with their management skills, level of education, support from service providers and, of most importance, their motivation to want to use the particular KPI in their farm decision-making.

Some of the easiest to collect are the raw data to calculate the proportion of productive cows (KPI 7) as most smallholder farmers know the number of milking cows, dry cows, heifers and calves in their herd. In a matter of minutes, the senior author collected such data from a dozen smallholders at a dairy farmer conference in Vietnam a few years back, which indicated that most of these particular farmers had acceptable values for percentage of milking cows in the milking herd (KPI 7a) and percentage of milking cows in the entire herd (KPI 7b). That is why they were invited to attend the conference. Another 'easy to collect' dataset is the stocking capacity (KPI 1), as most farmers know their forage production area. These same farmers had eight to nine total stock/ha and five to six adult cows/ha, indicating that they did not overstock their farms. As they were selected to attend the conference, one could assume that they were considered to be 'good' farmers.

It is not difficult to collect raw data on pattern on milk production (KPI 8) as many farmers record daily milk yields from individual cows. The level of concentrate feeding (KPI 4) is another dataset readily available while many farmers could estimate their daily forage-feeding program (as a guide to KPI 2). Likewise, some of the reproductive (KPI 9) and heifer data (KPI 10) can be easily calculated from raw data on dates of inseminations, calvings and ages at first calving, while a chest girth tape can easily provide estimates of live weights of different classes of stock. Inter-calving interval is also relatively easily calculated and is a good general measure of herd health, nutrition and reproductive performance.

The above diagnoses require the calculation of many KPIs to allow a value judgement to be made on business performance. Many of these indicators are simply common ratios or proportions, assessing some level of output in relation to some level of input. Others measure success simply with numbers or amounts, such as target forage quality or heifer live weight. Although they are valuable guides, there is no all-encompassing or perfect indicator of business success. All indicators must be viewed within the whole business, with each one contributing only a part.

It is possible to achieve high performance in a KPI that does not translate into business financial success. If a farmer whose farm has very poor quality soils and may not be able to grow as good a quality forage as he can purchase, at a good price, close by, it would be more profitable to let someone else grow the bulk of his forages.

Low performance measures in some key factors, well below these KPIs, often lead to high performance measures in other key factors that can produce a false sense of security about the ability to achieve some of the production targets. One example is low peak milk yield and short inter-calving intervals in cows of low genetic merit. Because such cows are not 'genetically programmed' to use their body reserves to supplement the limited intakes of feed nutrients during early lactation, their live weight will hardly change and they may cycle soon after calving. If the farmer plans to improve the genetic merit of the cows by using imported cows or high-grade semen without improving the feeding management during early lactation, peak milk yields may not greatly improve while herd fertility is likely to drastically fall.

The list on Table 7.6 is an initial attempt to prioritise these indicators to develop a structured approach to addressing poor farm profitability. It must be stressed that no single KPI should be used in isolation to assess farm performance and hence profitability, as each one is the end result of interactions between many farm inputs. It is important to ensure there is a balance between their utilisation so that one production target is not achieved at the expense of others within the farming system.

The above are just a few of the KPIs available to assess a farm's performance. A more thorough collection of 172 KPIs related to the eight Golden Rule is presented below.

## 7.5 Selected KPIs quantifying each Golden Rule

### 1. Calf rearing

1. Average birthweight of female calf (kg).
2. Average weaning weight of female calf (kg).
3. Average weaning age of female calf (days).
4. Average daily growth of female calf (1–6 month) (kg/d).
5. % calves with diarrhoea.
6. % calves requiring veterinary attention.
7. % pre-weaning calf mortality.
8. % pre-weaning calf morbidity.
9. Clean dry area for cows to calve down (yes/no).
10. Iodine spray for umbilical cord (yes/no).
11. Are all newborn calves fed colostrum? (yes/no).
12. Calves milk fed from teat or bucket not from suckling (yes/no).
13. Permanently eartagged and recorded at birth (yes/no).
14. Have male calves been castrated before three months of age? (yes/no).

## 2. Rearing weaned heifers

1. Average age of heifer at first insemination (months).
2. Average weight of heifer at first insemination (kg).
3. Average weight of heifer at first calving (kg).
4. Average age at first calving (months).
5. % wastage rate (loss from the herd) from birth to second lactation.
6. Regular access to clean drinking water (yes/no).
7. Provided with quality ration of concentrates and limited forage (yes/no).
8. Crude protein content of heifer ration (%).
9. Wither height at say 12 and 24 months of age (cm).

## 3. Feeding milking cows

1. Good quality pasture fed per milking cow (kg/d).
2. Availability of good quality forage for cows feeding (months/yr).
3. Additional preserved forage fed per milking cow (kg/d).
4. Total concentrates fed per milking cow (kg/d).
5. Crude protein percentage of milking cow ration.
6. Frequency of offering drinking water to milking cows (times/d).
7. Source of drinking water and its quality.
8. Mean body condition score (/5 points); % of very lean cows and % very fat cows at 3 months of lactation.
9. Rumen score (/5 points); % cows with deeply hollow rumens.
10. Manure score (/5 points); % cows with any coarse particles in their dung and consistency of stiff balls (horse manure).
11. Number of stock per drinker or per cm of drinking trough, water flow (L/minute) and cleanliness of drinkers.
12. Stocking capacity (number of adult cows per ha forage production area).
13. On-farm forage production. How much of the farm's annual forage requirements must be purchased?
14. Forage quality. Is the forage being harvested or purchased at its optimal quality for milking cows?
15. Concentrate feeding program. What is the quality of the concentrates being fed?
16. Total feed costs.
17. Milk income less feed costs. Are the forages and concentrates costing too much per MJ of energy or kg of protein?
18. Proportion of adult cows actually milking (%).
19. Proportion of milking (and dry) cows in entire dairy herd (%).
20. Herd structure: replacement heifers (%), cows older than 4, 6 or 8 years (%).

21. Milking cow herd structure: Pregnant/wet (P/W), P/D, NP/W, NP/D (%); wet means lactating.
22. Peak milk yield of the herd (kg/d).
23. Pattern of milk production (e.g. rapid decline from peak).
24. Lactation persistency (rate of decline from peak milk yield) (%/month).
25. Average milk yield (kg/d).
26. Average days in milk (d).
27. Average lactation length (d).
28. Average production/lactation and production/cow/year.
29. Milk composition (%fat, %SNF, %TS).
30. On-farm forage production: Proportion of the farm's annual forage requirements that are purchased (%) or harvested off-farm (%).
31. Forage quality: Is the forage harvested or purchased at its optimal quality for milking cows? (yes/no).
32. Frequency of concentrate feeding of milking cows each day (times per day).

## 4. Breeding adult cows

1. Time from calving to first heat (days).
2. Voluntary waiting period (days).
3. Time from calving to first service (days).
4. Time from first service to conception (days).
5. Time from calving to conception (days).
6. Average services per conception.
7. Cows conceiving to first service (%).
8. Cows conceiving to artificial insemination (%).
9. Average inter-calving interval (months).
10. Average gestation length (days).
11. Cows aborted (%).
12. Cows requiring assisted calving (%).
13. Milking cows with breeding performance records (%).
14. Cows applied upgrading breeding program (%).
15. Native cows in the milking herd (%).
16. Purebred/high grade cows in the milking herd (%).
17. Assisted calvings; % cows calving/year.
18. Herd's submission rate.
19. Herd's conception rate.
20. Herd's 100 day-in-calf rate.
21. Herd's 200 day-not-in-calf rate.

## 5. Looking after the herd's animal health

1. Cows/heifers with health recording (%).
2. Cows/heifers received FMD vaccination (%).
3. Cows/heifers received internal and external parasite prevention (%).
4. Cows/heifers free of brucellosis (%).
5. Cows/heifers free of TB (%).
6. Cows/heifers free of Para-TB (%).
7. Cows free of mastitis (%).
8. Cows/heifers with health problems (%).
9. Culled cows/heifers with health problems (%).
10. Locomotion score (/5 points), % cows moderately to severely lame.
11. Clinical lameness cases per month.
12. Hoof score (/3 points), % cows with severe hoof inflammation.
13. Teat score (/4 points), % cows with rough callous ring around the teat ends.
14. Mastitis, clinical cases; %/month.
15. Mastitis, subclinical cases; %/month.
16. Mean number of coughs per cow per day.
17. % on-farm mortality.
18. % downer cows.
19. Sudden deaths/casualties; %/year.
20. Dull/obviously sick cows; % cows/month.
21. % cows with nasal discharge.
22. % cows with discharge from their eyes.
23. % cows with hampered respiration.
24. % cows with diarrhoea.
25. % cows with discharge from the vulva.
26. % dystocia in 12 months.
27. % downer cows in 12 months.
28. % mortality in 12 months.
29. Milk fever; % incidence/year.
30. Metabolic diseases; % incidence/year (such as ketosis or hypomagnesaemia, but not milk fever, mastitis or lameness).
31. Are sick animals kept isolated from healthy stock? (yes/no).
32. High incidence of coughing (yes/no).
33. Indicators of pain; methods and use of anaesthetics and analgesics for disbudding, dehorning and tail docking (description).
34. Subjective visual assessment of animals: use comparative drawings of healthy and content v sick and distressed cow.
35. Subjective auditory assessment of animals: grinding of teeth, bellowing, laboured breathing, coughing.

36. Subjective olfactory assessment of animals: odours of calves' breath, faeces, bedding, mouldy feeds.

## 6. Heat stress management

1. Average respiration rates (number/minute).
2. Frequency of cows with respiration rates exceeding 70 (%) and exceeding 100 breaths per minute (%).
3. Cow comfort index; proportion of resting cows standing or lying in free stalls (%).
4. Panting score (/5 points).
5. Cow comfort index; % cows standing or lying in free stalls.
6. Temperature Humidity Index (units).
7. Score on shed ventilation (/5 points).
8. Climate control equipment: fans, sprinklers, regular usage of hoses to cool cows.
9. Are stock fed during the cooler evening following very hot days? (yes/no).

## 7. Housing dairy stock

1. Leg score; (/3 points), % cows with severe rotation of their feet.
2. Cows with swollen hocks; % cows/year.
3. Cows with ulcerated hocks; % cows/year.
4. Cows with non-hock traumatic injuries; % cows.
5. Ease of movement in laneways; % cows slipping and falling.
6. Resting behaviour; % cows lying partly or completely outside resting area.
7. Social behaviour; number of head butts and displacements/cow/hour.
8. Flight distance, measured by approaching cows at the feed trough from a distance of 2.5 m and measuring the distance between the hand and muzzle at the moment the animal withdraws.
9. % of cows 0 to 10 cm, 10 to 50 cm, 50 to 100 cm and > 100 cm.
10. Cow hygiene scores for back of udder, side of udder, thighs and hips and legs and hooves (/4 points): cows with excessively dirty lower hind legs, hindquarters or udders (%).
11. Idle cows; % cows standing but performing no activity, such as rumination
12. Rumination; % cows standing or lying that are ruminating.
13. Rising restriction; % cows showing severe difficulty in rising, or hitting fittings as they rise or seen to be 'dog sitting'.
14. Cows with hair loss in lower limbs; % cows/year.
15. Score on manure and waste management (/5 points).

16. Subjective assessment of cleanliness of cow shed and on manure and waste management, such as daily removal of slurry and hosing down concrete floors.
17. Shed layout: cement v dirt floors, good v poor drainage, tie stalls v free stalls v open lot.
18. Adequacy of effluent disposal and storage system.
19. Natural ventilation: open shed sides, incidence of cobwebs in roof.
20. Is there sufficient shelter from extreme weather? (yes/no).
21. Resting area: open lot (resting area per cow), free stalls (type of bedding), tie stalls (length of tie, floor type), outside area for night resting.
22. Is there a minimum of dry lying area of 3.5 $m^2$ for adult cattle/bulls and 2.5 $m^2$ for growing heifers? (yes/no).
23. If permanently tethered, are cows and calves given access to move freely each day? (yes/no).
24. Adequacy and cleanliness of feed troughs and water containers/troughs
25. Adequacy of drinking water supplies; stock per drinker (number) or per cm of drinking trough (number/cm), water flow (L/minute), clean water not concentrate slurry.
26. Climate control equipment: fans, sprinklers, regular usage of hoses to cool cows.
27. Young stock housing: tie stalls, separate pens, cleanliness of floors.
28. Subjective olfactory assessment of shed: odours of air (hence ventilation), bedding and from poor drainage.
29. Resting behaviour: cows lying partly or completely outside resting area (%).
30. Social behaviour; number of head butts and displacements/cow/hour.
31. Do cows and calves approach stock people? (yes/no).
32. Free stall use: proportion of resting cows using free stalls (%).
33. Proportion of idle cows: cows standing but performing no activity, such as rumination (%).
34. Cows with stereotypic behaviour: such as pacing or swaying in tethered cattle, extreme grooming with the tongue, bar biting, tongue rolling, urine drinking or 'dog sitting' (%).

## 8. Producing quality milk

1. Are there routine checks made on subclinical mastitis, using the California Mastitis Test kit? (yes/no).
2. Average fat content (%).
3. Average SNF content (%).
4. Average total solids content (%).

5. Average total plate count or TPC (/ml); proportion with TPC exceeding 200 000, 500 000 and 1 million (%).
6. Methylene blue reductase test or MBRT (hours) or some other measure of bacterial contamination of raw milk.
7. Average somatic cell count or SCC (/ml): proportion with SCC exceeding 200 000, 500 000 and 1 million (%).
8. Score on milking sanitation (machine, facility, sanitation) (5 points).
9. Teat score (points out of 4): proportion of cows with very rough calloused teat ends (%).
10. Proportion of farm milk delivered to market (%).
11. Proportion of milk penalised for poor quality and/or composition (%).
12. Access to hot water pre and post milking.
13. Is detergent used during milking equipment sanitation?
14. Cleanliness of milk containers.
15. Are milk containers hung upside down to dry? (yes/no).
16. Cleanliness of teats and udders pre-milking: is each cow's udder washed with a fresh clean cloth? (yes/no).

## 7.6 Quantifying improved herd management

### 7.6.1 Assessing adequacy of the current herd management using cow milk yields

All the above KPIs can be quantified to provide guidelines as to which ones require priority in any dairy farm improvement program. Although some are relatively easy to quantify, others are quite difficult. Probably the most simple, and most used, single measure of SHD farm performance is the average daily milk yield of the milking cows. The correct term for this figure is 'rolling herd average' as it is the average milk yield of all the lactating cows, which will be at various stages in their lactation cycle.

This single value provides a summation of all the important aspects of SHD farm management, so any interpretation must take into account a diversity of feeding, herd and farm factors. Accordingly, many dairy specialists may query its usefulness as a single measure of dairy farm performance. However, it is routinely used by farmers to describe their farm's performance in relation to their neighbour's farm and also in relation to production targets provided by many government advisers. In addition, government officials often quote this measure when summarising the stage of development of their national dairy industries. Table 7.8 attempts to describe the adequacy of the farm's dairy farm management practices using the rolling herd average; other factors to consider are also listed.

**Table 7.8.** Interpreting the adequacy of dairy farm management from cow milk yields.

Range in average herd milk yields on tropical South-East Asian dairy farms

| Herd milk yield (kg/cow/day) | Adequacy of dairy farm management practices |
|---|---|
| 5 | Very poor feeding and herd management and low genetic merit cows (or milking buffalo) |
| 7 | |
| 9 | Typical of many SE Asian smallholder farms, even with high grade Friesians |
| 11 | Gradual response with grade and crossbred Friesian cows to improved feeding, herd, young stock and shed management. *Milk yields of 15 kg/day are considered acceptable by many government dairy advisers* |
| 13 | |
| 15 | |
| 17 | |
| 19 | |
| 20 | Potential level in **lowland humid tropics** following improved management of body condition throughout lactation |
| 25 | High genetic merit cows in **tropical highlands** or **lowland dry tropics** with good farm management |
| 30 | Typical peak milk yields in herds with 25 kg/cow/day rolling herd averages |
| 35 | Unrealistic in SE Asia except where all major constraints to milk production have been overcome |

### Other factors to consider

- It is important to differentiate between rolling herd averages and peak milk yields.
- Milk composition is also a good indicator of feeding management.
- Excessive body condition is indicative of nutrient status and low production.
- Herd dynamics (number of dry cows and percentage of lactating adult cows in the herd) can also indicate adequacy of herd management.

## 7.6.2 An example of improved herd management in Indonesia

When comparing the herd response to improved management, controlled studies on research stations provide a better scientific environment to vary certain aspects of feeding and herd management while keeping others constant. However, farm-generated data is generally considered more realistic. To provide such a valuable dataset, a series of statistical analyses were undertaken on data generated over 10 years (1992 to 2002) to quantify such KPIs in both commercial farms and a government breeding station in Central Java.

Herd performance data from the breeding station (BS) were compared with data from nearby smallholder dairy farms (SHD) for Friesian cows of similar genetic merit with many variables, such as age of calving, parity and season of calving accounted for before comparing the location, or origin of the data (BS v SHD); 200 to 600 datasets per location were included in these analyses.

The authors (Anggraeni and Rowlinson 2005a,b) considered the BS herd to be intensively managed in contrast to the SHD's semi-intensive management. The increases in milk yield formed typically curvilinear patterns with the highest values recorded during the 3rd lactation. Parity and year of calving affected most of the lactation indices in Table 7.9 but not season of calving, indicating a sufficiency of forages to fulfil the needs of cows milking all year.

**Table 7.9.** Performance of cows managed in the breeding station (BS) or on smallholder dairy farms (SHD) in Central Java.

| | BS | SHD |
|---|---|---|
| *Lactation indicators* | | |
| Complete milk yields (kg) | 4406 | 3287 |
| Daily milk yields (kg/d) | 14.5 | 9.8 |
| Annual milk yields (kg) | 3919 | 2731 |
| 305 day milk yields (kg) | 4674 | 3096 |
| *Reproductive indicators* | | |
| Age at first calving (m) | 29 | 31 |
| Days dry (d) | 104 | 96 |
| Calving to 1st mating (d) | 92 | 109 |
| 1st to 2nd mating (d) | 52 | 45 |
| Days open (d) | 149 | 177 |
| Calving interval (d) | 418 | 433 |

Compared to the SHD cows, the BS cows produced more milk (averaging 4.7 kg/cow/day extra), were mated more quickly after calving (17 days), had fewer days open (28 days) and shorter calving intervals (15 days). They also first calved down 2 months before the SHD cows. However, they had slightly longer dry periods (8 days). Therefore, in herds of similar genetic merit, better herd and feeding management can increase milk yields by up to 5 kg/cow/day and reduce calving intervals from 14.4 to 13.9 months.

## 7.7 A checklist to assess current herd and farm management

The following series of observations can easily be made when visiting any dairy farm to assess the current management, performance and welfare of the stock and the likely profitability of the farm. Answers to the following questions could also be sought to help understand the current farm management.

### 7.7.1 Shed and facilities

- Roof height, eave height and natural ventilation.
- Temperature, humidity and air flow inside shed.

- Shed floor and cow lying area (cement, mats).
- Mats, enough for all cows, thin v thick.
- Stalls; tie stalls v free stalls v open lot.
- General stocking density and space for cows to rest.
- Adequacy and cleanliness of pens for young stock (heifers, milk-fed calves).
- Area for outside resting at night.
- Adequacy and cleanliness of feed troughs and water containers.
- Access to clean drinking water, not only as slurry feeding.
- Source and adequacy of water for drinking and cleaning.
- If sufficient cows, use of mechanical forage chopper.
- Room for feed processing and preparation.
- Adequacy and hygiene of milking area, including teat dipping and access to hot water.
- If machine milking, state of rubber linings.
- Cleanliness of milking buckets and milk cans.
- General hygiene and condition of cow teats and coats.
- Adequacy of effluent disposal and storage system.
- Adequacy of office and farm staff area.

### 7.7.2 Stock

- General condition (thin v good v fat).
- Obvious health issues, such as lameness.
- Is mastitis an issue? If so, what are the management procedures?
- Signs of heat stress (< 70 respirations/minute).
- % cows ruminating at rest.
- % of cows lying down and ruminating.
- Cow 'comfort' and contentment (obviously hungry and unsettled).
- Herd numbers and structure.
    - ➤ Milking cows.
    - ➤ Dry cows.
    - ➤ Heifers (weaning to calving).
    - ➤ Milk fed calves.
    - ➤ Other dairy stock (bulls steers).

### 7.7.3 Feed supplies

- Enough fresh forage fed each day? Typical amount fed per milking cow in wet/dry season.
- State of forage (improved v native v forage by-products, immature v mature).
- Sourcing fresh forage, grown v off farm.
- Enough concentrates fed each day? Typical amount fed per cow.

- Concentrates (formulated v mixed).
- What by-products are fed?
- If on farm mixing, specific feed additives (macro minerals, vitamins/minerals, rumen buffers).
- Use of shed effluent for forage production.

### 7.7.4 Answers to simple questions

- How many cows did you milk yesterday?
- How much milk did you sell yesterday?
- How much milk did you use to feed your milk-fed calves yesterday?

These answers should allow you to calculate the average milk yield per milking cow.

- How much per litre of milk were you paid yesterday?
- If there is a milk grading scheme, what grade was your milk yesterday?
- What was the typical composition of your milk (fat, solids not fat, protein).
- What was the typical quality of your milk (somatic cell count, TPC or MBRT).

### 7.7.5 Answers to more complex questions

- How aware are you of the importance of colostrum feeding to your newborn calves?
- Do you keep any farm records? If so, which ones?
- Is mastitis a problem?
- Is cow lameness a problem?
- What is the typical peak yield of your cows in early lactation?
- What are your typical number of days between calving to conception?
- What is your typical number of days between cows drying off and then calving.
- What is your typical age (number of months) of heifers when they first calve down?
- Are there animal health management and biosecurity plans in place? If so, describe them (protocols for biosecurity, mastitis, lameness, reproductive disease management, vaccinations, parasite control etc.).
- What is your typical proportion of calves that die during milk rearing?
- How many years have you been milking cows?
- Will you still be milking cows in 1 year's time or 5 years' time?
- Do your children want to follow you on the farm?
- Name three of your biggest problems on your farm. This can be any constraint at all, such as labour supplies, government/coop or milk processor support and services, dry season forage supplies. Poor milk returns and high cost of production are universal problems for all SHD farmers, so don't include them unless they are a real problem on your farm.

## 7.8 A checklist for assessing current calf and heifer rearing systems

More specific to young stock management, the following checklist can be used.

### 7.8.1 Peri-natal (Pre-calving and first 24 h)

- Pre-calving facilities and hygiene.
- Note the following observations soon after birth:
  - ➤ Calf is sitting in a sternal position within 5 min.
  - ➤ Calf makes standing attempts within 15 min.
  - ➤ Shivering often begins within 30 min.
  - ➤ Calf is standing by 1 hr.
  - ➤ Calf is suckling within 2 hr.
- Separation of calf from dam.
- Hours from birth when drinking first colostrum.
- Colostrum feeding (awareness of how best to obtain benefits from colostrum, putting theory into practice).
- Calf identification and recording.
- Housing of pre-weaned calves (stalls, bedding, separation from adult stock, cleanliness).

### 7.8.2 Pre-weaning feeding management

- Develop feeding programs to promote rumen development.
- Continual access to clean water.
- Type and method of liquid feed (type, feeding frequency, method of feeding, daily feeding rate).
- Type of concentrate (age when commence feeding, quantity fed, formulation).
- Type of forage (age when commence feeding, fresh v hay, forage quality).

### 7.8.3 Pre-weaning herd and health management

- Development of animal health program.
- Pre-weaning calf mortality.
- Condition of the milk-fed calves (body condition, signs of ill thrift).
- Prevention and treatment of scours (electrolytes, identification of causative agent, effective use of antibiotics).
- Prevention and treatment of pneumonia.
- Prevention and treatment of other animal health issues (such as lameness or climatic stress).
- Skills with identifying and nursing sick calves.

- Routine husbandry practices (disbudding, vaccinations, drenching, ectoparasite treatment, castration).
- Drug storage.
- Hospital pens.
- Veterinarian support (when sought, quality of support).
- Document pre-weaning morbidities (sickness) and mortalities (deaths).
- Fate of bull calves.
- Sources of labour (owner, family, employed and their efficient usage).
- Shed environment (effluent management, ventilation, coping with heat stress).
- General stock welfare and handling facilities/skills.
- Record keeping (system, feed inputs, animal health, labour).
- Calculating total pre-weaning costs.
- General hygiene (cleaning of feeding equipment, calf pen and shed hygiene).

### 7.8.4 Weaning process

- Basis of weaning (age, weight, concentrate intake).
- Movement to weaner pens.
- Reduce milk offered slowly or instantaneously.

### 7.8.5 Weaning to first calving

- Continual access to drinking water.
- Shed environment (effluent management, ventilation, coping with heat and cold stress).
- Feeding management (forages and concentrates).
- Chopping forages.
- Feed storage facilities.
- Monitoring feed intakes, weight, body condition, heat stress (stock and shed).
- Post-weaning heifer mortality.
- Condition of stock (body condition, signs of ill thrift).
- Age of first oestrus.
- Criteria for mating (age, weight).
- Mating program (bull v AI).
- Routine pregnancy testing.
- Preparation for calving (pre-calving facilities and hygiene).
- Calculating total rearing costs.
- Fate of weaned bulls.
- Age at first calving.
- Wastage rate from birth to 2nd calving.
- Subjective assessment of overall farm management skills.

## 7.9 Examples of improved management practices

The following lists some of the improved management practices that should be key objectives of farm development programs and should be demonstrated on model farms.

### 7.9.1 Sheds and facilities

- Loose housing rather than tie stalls.
- Free stalls rather than open lounging.
- Rubber mats in the free stalls.
- Outside sand yard for resting at night.
- Good slope on floor to aid cleaning.
- Flood wash system to clean floor.
- Adequate roof height.
- Cattle crush and yards for ease of handling stock.
- Mating yard if using bulls not AI.
- Young stock rearing area not directly adjacent to adult cow area.
- Individual pens or cages for milk rearing calves.
- Effluent dam to minimise nitrogen losses through volatilisation.
- Pump and pipes to distribute effluent onto forage production area.
- Mechanical milking, not hand milking, probably with bucket milkers.
- Hot water to clean milk handling and milk feeding equipment.
- Separate area in which cows can give birth.
- Hospital or isolation pen for sick stock.
- Vermin-free and insect-proof storage area for feeds.
- Refrigerator and lockable cabinet for drug storage.
- Fans and maybe even sprinklers for heat stress management.
- Plant trees and grass around sheds.
- Area for staff to relax when not working.
- Office area for keeping and storing farm records.

### 7.9.2 Feed and forage management

- Routine use of inorganic fertilisers on grass production area.
- Short harvest interval for Napier grass (30 days not 60 days).
- Consider routine wilting of freshly harvested forage to improve appetite, hence productivity.
- Consider making silage out of excess wet season forage to feed back to stock in dry season.
- If using raw ingredients for concentrate formulations, a separate area for mixing them on the floor.
- Ensure can source adequate supplies of quality forages to make up for any shortfalls in home-grown forages.

- Ensure can source adequate supplies of quality ingredients for supplementing forages.
- Provision of adequate fresh clean drinking water.
- Harvest and feed adequate quantities of quality green forages (say 40 kg/cow/d) to milking herd.
- Use mechanical chopper for processing forages.
- Consider ribbon mixer or small TMR wagon to mix all the feed ingredients.
- Consider routine analyses of nutritive value of all feed inputs.
- Formulate rations based on minimum costs of feed energy and protein within each feed type.
- Feed scales for weighing feeds.
- Chest girth tape for assessing stock live weights.
- Picture guides to routinely monitor body condition.

### 7.9.3 Herd management practices

- Feed colostrum immediately following birth.
- Consider calf milk replacer as cheaper alternative to whole milk.
- Ensure calves are fed high protein concentrate formulations, not the same as for milking cows.
- Develop regular vaccination for young stock (Clostridium) as well as adult stock.
- Monitor respiration rates to decide on heat stress alleviation procedures.
- Learn to identify early symptoms of ill health in calves, heifers and adult cows.
- Develop animal health protocols for milk-fed calves with local veterinarian.
- Develop animal health protocols for weaned heifers and adult cows with local veterinarian.
- Follow recommended Best Management Practices (BMP) for all aspects of herd management such as feeding, breeding, rearing young stock, milk harvesting, animal health and stock welfare.
- Do not use calves for milk letdown before milking.
- Only wash teats when preparing cows for milking.
- Ensure cows stand for 30 min following milking.
- Change milk liners after every 2500 milkings.
- Encourage staff to be involved in monitoring stock health and performance during their daily work routines, and writing observations down on a white board.
- Collect sufficient production and financial data to routinely monitor the relevant Key Performance Indicators.

Good cow performance depends largely on adequate intakes of high quality feeds as depicted in Figure 7.2 (molasses) and Figure 7.3 (leucaena) supplements.


**Figure 7.2:** In sugarcane-producing areas, molasses is a cheap, high energy feed for milking cows.

**Figure 7.3:** Leucaena leaves are a high quality protein, roughage source.

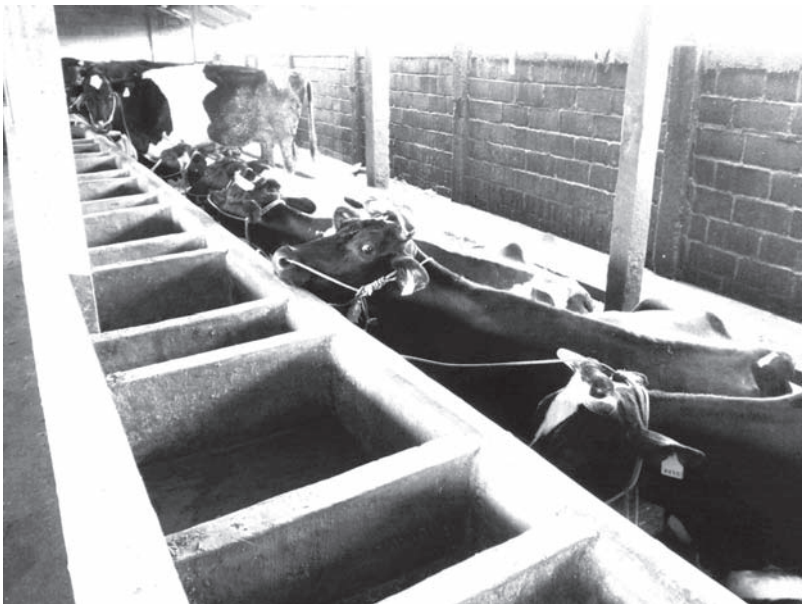

**Figure 7.4:** Permanent tethering of milking cows contravenes all our concepts of good cow welfare. Logic tells us that even a 1 or 2-hr break every day, when they are allowed out into a small yard next to the shed to 'stretch their legs' will stimulate their appetite, produce more milk (provided they are offered more feed) and make the farmer more money.

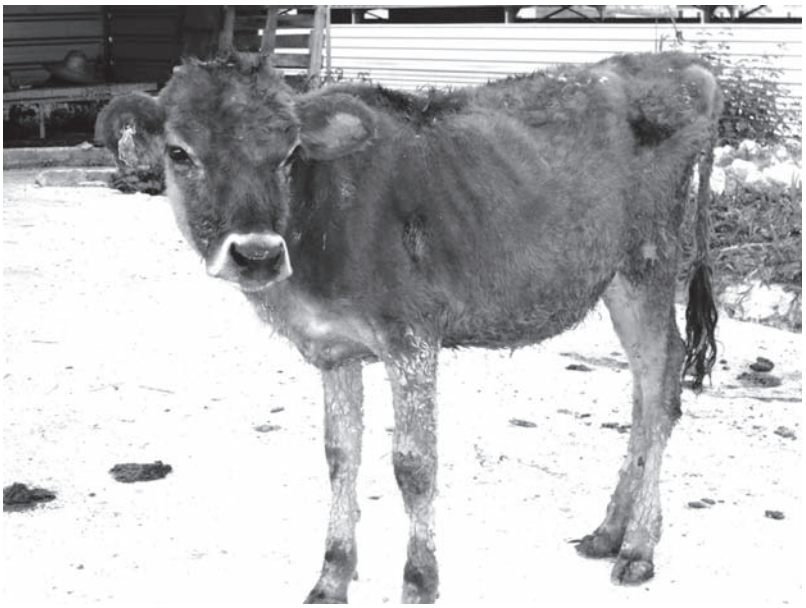

**Figure 7.5:** This 'half starved' Malaysian Jersey heifer is an extreme result of poor feeding management but it is all too common on many smallholder farms throughout the tropics. It will never be a productive member of the farm's milking team. Farmers must not look at heifer rearing as a farm cost; it is an investment in the farm's future.

However, if herd management is suboptimal, such as permanent tie stalls (Figure 7.4) and poor young stock rearing (Figure 7.5), cow appetites are depressed leading to reduced milk yields and fertility.