13

The final words

This chapter highlights some of the developments and on-farm applications still required for tropical dairy farming to become and remain more efficient and profitable. It also provides details on an online course on recommended feeding management of tropical dairy cows and shows readers how to access it.

13.1 Constraints to dairy farm developments in Malaysia; a national case study

The following discussion refers specifically to Malaysia but it would apply equally to the dairy industries of many other Asian countries. Moran and Brouwer (2013a, 2013b) undertook a survey of 30 dairy farms in Peninsular Malaysia, the data of which has already been summarised in Chapter 11 in Section 11.3. Of equal interest, they also developed a list of dairy farm production constraints to Malaysia's milk industry, these being:

- **Shortages of land** for growing forages means that farmers must greatly depend on purchased supplies of forage over which they have less control of feed quality.
- **High feed costs.** Dairy cattle pellets and molasses, the most commonly used energy feeds, have the highest cost per unit energy of other alternatives.
- **Shortages of 'quality cows'.** All too often farmers blame the cows, rather than their lack of management skills, for poor stock and herd performance.
- **Poor infrastructure**, which includes power, water and local labour supplies.

- **Poor support from service providers**. This becomes increasingly apparent since many of the government services are free and this provides little incentive for the private sector to develop and compete for such services.
- **Poor reproductive performance**. Reduced milk yields through under-nutrition may be accepted as 'normal' by many farmers, but in many SE Asian countries farmers routinely complain about high ages at first calving, lengthy calving intervals and poor conception rates to AI.

In addition to those constraints highlighted in the farmer survey, they noted the need to improve:

- **Climate control**, through installing fans in every shed, sprinkler systems in most of them and higher roofs with open air spaces at the apex.
- **Cow comfort**, through thick rubber mats, free stalls, better shed hygiene and closer attention to treat and prevent lameness.
- **Adequate supplies of clean drinking water.**
- **Better agronomic management of existing forages**, such as routine use of inorganic fertilisers and shorter harvest intervals, to reduce forage fibre levels, stimulate more rapid feed digestion rates and so promote better appetites and cow performance.
- **Improved milking hygiene practices** such as more frequent replacement of rubber liners and greater attention to mastitis management.
- **Financial assistance** to source more feed to better feed existing animals before sourcing credit to buy more stock.
- **Capacity building** (both advisers and famers) with the two priorities being first, nutrition and feeding management and second, farm business management.

Despite the fact that Malaysia's farm gate milk prices are among the highest in SE Asia as is their milk to feed price ratio (Ahuja and Staal 2013), domestic milk production in Malaysia has stagnated over the last decade. There are many contributory factors for Malaysia to have 'flatlined' in domestic milk production. Among the possible reasons are:

- Dairy farming is expensive in the tropics because of lack of suitable stock, forages and quality ingredients for concentrate formulations. Farmers react by demanding higher milk prices but processors respond by purchasing more of their dairy ingredients from cheaper overseas sources.
- The poor understanding of most dairy farmers of how dairy cows need to 'function' to become profitable units of investment. They are just not simply 'cash cows'. They are living animals that require a degree of nurturing to remain healthy and productive. Basically dairy cows are temperate animals, so to fully utilise their propensity to produce milk they need to be provided with as comfortable an environment (in a very torrid hot and humid climate) as possible.

- Many farmers enter the industry with little, if any, practical experience in managing a dairy enterprise. Ideally, novice dairy farmers should have spent time either growing up on a farm or at least working on one, before they decide to invest their assets and livelihood in a dairy farm.
- Unfortunately, the banks and other credit agencies often lack the technical skills to assess the suitability of an applicant for a loan to invest (and further invest) in dairy farming. Consequently, unwise dairy loans can and have been made.
- On the whole, few farmers are business minded as they only consider profits through increasing unit milk returns rather than taking a more logical approach, namely reducing unit costs of milk production. This can be done either through reducing unit prices of farm inputs or diluting many of them through increased levels of per cow milk production.
- Over the last decade, there have been several attempts to establish large-scale intensive dairy enterprises in Malaysia. Unfortunately, most of these have failed to produce a long-term, sustainable and profitable dairy feedlot in the country. In other tropical Asian countries successful models are apparent, so one should expect at least one such enterprise to have evolved within Malaysia.
- There seems to be a lack of structured and ongoing encouragement within government advisers for farmers to share their problems and discuss possible solutions in dairy production technology. Other countries have dairy cooperatives in which communication lines are better developed between farmers. Farmers can learn a lot from each other rather than having to rely on government advisers, many of whom lack the practical experience in the day-to-day activities of a tropical dairy enterprise.
- There has been one very recent example of a group of dairy farmers forming an association to facilitate discussions of both dairy production technology and national government policies for future dairy development. This is the Association of Dairy Farmers Malaysia, which comprises mainly Indian dairy farmers and stakeholders.
- There are many free services provided by the government. In Malaysia the approach has always been that governments should look after infant industries such as dairy farming. However, a common result occurs – if farmers do not have to pay for such services themselves, they tend to undervalue them.
- Many of the farmers do not use government veterinary services (and only some use private veterinarians) or artificial insemination (they use their own bulls), because they find the services unreliable.
- There appears to be a gross shortage of experienced and competent private dairy farm consultants in Malaysia. The government is becoming a training ground for those who can eventually freelance their skills (advisers work in government first and then go out on their own). Universities should also provide such advisers both from within their teaching ranks and from

well-trained graduates in all aspects of dairy production technology. However, in dairy farming, this has hardly occurred in Malaysia.

- As in most developing dairy industries, much of the technical support originates from trained veterinarians. However, veterinarians are trained to attend only to sick animals and not healthy and potentially highly productive stock such as milking cows. Formal university training in dairy science requires a greater emphasis on the practical applications of the physiology and the economics of increasing per cow, per herd and per farm production. Unfortunately, this is a common problem in many SE Asian veterinary science university curricula.
- Many of the nutrition advisers in the dairy industry were originally trained in monogastric nutrition (poultry and pigs), whereas specialist dairy nutritionists require a theoretical and practical background in ruminant nutrition and physiology.
- In addition to providing advice on nutrition and feeding management, dairy farmers, both large and small, require consultants with practical knowledge in many aspects of dairy production technology. These include forage production, rearing young stock, optimising cow comfort (through appropriate housing and climate control), milk harvesting and, of even greater importance, farm business and entrepreneurial skills in managing a large investment such as a profitable and successful dairy enterprise.
- Government agencies could be more proactive in fostering relationships with the private sector through the formation of both formal and informal Public Private Partnerships. These should be seen as collaborative rather than competitive.

National policymakers in Malaysia's dairy support services, both government and agribusiness, would benefit from addressing much of the above in conjunction with greater collaboration with some of their SE Asian neighbours. The FAO in SE Asia is represented by APHCA (Animal Production and Health Commission for Asia and the Pacific), of which Malaysia is a member. It has recently established the Asia Dairy Network (APHCA 2013) to improve communication and knowledge-sharing among stakeholders in Asia and the Pacific region along the entire dairy value chain. Recent initiatives in this Network include an E-Conference on agro-industrial by-products for smallholder farmers (Moran 2014), a 'Question and Answers' open forum, an E-learning program in feeding management on tropical smallholder dairy (SHD) farms (see Section 13.5 of this chapter), in addition to regular sessions at future Asian international animal science congresses.

13.2 Risk in tropical dairy farming

Any business must live with risk and dairy farming is no exception. Farmers need to understand the types of risk and concentrate their efforts on dealing with those under their control. There are some specific strategies that dairy farmers can undertake and these are discussed in this lesson.

A dairy business is made up of a mix of people, livestock, natural resources, technology, economics and finance. Farmers buy their inputs to production and sell their milk in the markets. What they do is subject to laws and affected by things governments do. Running a farm business means dealing with lots of risks. There is risk about how much grass they can grow, how much milk their cows will produce and of what quality, hence unit price. There is risk about what their farm production will cost and how much it is worth. There is risk affecting how much spare cash they will have to pay interest to the people who have lent funds to their farm business. There is risk about what governments from all over the world might do that will affect how their farm business is able to operate.

In other words, farming is a risky business. Most farm decisions involve risk or uncertainty (Moran 2009a). Risk and uncertainty challenge the technical and managerial abilities of all farmers. They impact on every part of farming, its productivity, stability, resilience and equity. Uncertainty is defined as imperfect knowledge, or not knowing what is going to happen in the future. Decisions that do not have a single outcome are then uncertain decisions. Risk is only present when the uncertain outcomes of a decision are regarded as significant or worth worrying about. Rather than the risk, it is the consequences of the risk that matter because they have to be managed to achieve resilience in the farm business. Risk and uncertainties can create opportunities and rewards. If the risk is known, profits should have already been made.

13.2.1 Types of risk

There are a great many risks in farming, such as:

- business (farm performance) v financial (other people's money)
- external (outside farm) v internal (inside farm)
- short term (this year) v long term (future years)
- good v bad risks.

Tables 13.1 and 13.2 present risks encountered in different management activities on SHD farms.

Table 13.1. Risk management strategies available to smallholder dairy farmers.

Management activity	Strategy	Type of risk reduced
Production	Use of stable enterprise - dairy genotypes	Yield, technology, policy
	Use of proven forages - e.g. Napier grass	
	Diversifying enterprises - in livestock - in cash crops - within seasons - across farm area	
	Maintain flexibility - over time - in durable assets	
	Keep reserves - seed - fodder - concentrate ingredients	
	Use risk-reducing inputs	
	Share-leasing	
	Assess new technology	
	Seek information	
	Develop annual operational plan	
	Develop animal health and disease management plans	
Marketing	Spread sales over time	Price
	Arrange alternative outlet	
	Seek barter opportunities	
	Consider value-adding and niche marketing	
Financial	Maintain high equity ratio	Financial, yield, price
	Maintain credit worthiness	
	Maintain a cash reserve	
	Develop relationship with cooperatives	
	Maintain farm assets	
	Maintain social network	
	Off-farm employment	
	Develop farm business plan	

13.2.2 Managing risk

Risk minimisation is a major goal of farming.

- Managing risk involves planning for the unexpected
- Most on-farm risks over which farmers have greatest influence:
  - ➤ have moderate to high likelihood of occurring
  - ➤ have some nutritional basis.

Table 13.2. Types of risk based on farmer's ease of influencing.

Ease of influencing	Risk & Likelihood of occurrence (*)	Strategy to rectify risk
Difficult Outside farmer control	Adverse climate (H)	Cannot be overcome
	Poor industry infrastructure (M)	Government policy and investment
	Uncertain industry future in region (?)	Government policy
	Poor industry technical support (M)	Government training programs
Probable Farmer has some influence	Inappropriate breed (M)	Government support
	Low base milk price (M)	Government, agribusiness and cooperative negotiations
	Poor dairy genetic merit (M)	Government importation programs
	Low post-farm gate milk quality (M)	Cooperative infrastructure
Possible Farmer has great influence	Low farm income (M)	Feeding and herd management
	Inadequate water (M)	Farm development
	Poor forage quality (H)	Agronomic practices
	Low forage availability (H)	Farm development
	Poor concentrate quality (M)	Cooperative program
	Low concentrate feeding (M)	Feeding management
	Adverse diseases (M)	Herd management and cooperative programs
	Low farm milk price (M)	Feeding management
	Poor milk composition (M)	Improved feeding
	Poor on-farm milk quality (M)	Improved hygiene
	Inefficient effluent system (M)	Facilities and herd management
	Adverse heat stress (H)	Shed design and herd management
	Poor animal health (H)	Herd management
	Poor reproductive performance (M)	Herd management
	High cost of production (M)	Farmer management skills
	Poor young stock performance (M)	Feeding management
	Low farm profitability (M)	Farm and herd management
	Increased farm investments (M)	Cooperative advice

* M, moderate; H, high.

On-farm risk management

There are some specific ways that dairy farmers can manage on-farm risk. These include:

- minimising the number of non-pregnant milking cows, particularly those non-lactating
- ensuring sufficient herd replacements
- initiating simple recording systems
- developing annual feed budget
- prioritising farm investment, 'feed before breed'

- concentrating their efforts on low cost management strategies that return greatest income
- becoming active member of local milk cooperative
- becoming an information seeker
- seeking professional support before investing in farm infrastructure
- developing appropriate staff training and management system
- implementing herd health program (record and monitor activity systems for health and production).

Every day farmers must make decisions and strategies to handle risk. These should be prioritised into those within and outside the farmer's control.

13.3 The relevance of 'high technology' to tropical dairy farming

Dairy farming is one of the most sophisticated forms of livestock production and researchers are continually developing innovations in dairy production technology and farm management. However, with many of these innovations originating in countries with advanced dairy industries, we need to ask the question about their relevance to SHD farming in the tropics (Moran 2009a).

Over the last 20 years, most Western countries have produced sophisticated dairy production systems:

- herd sizes have grown
- more efficient feeding systems have evolved
- these days farmers routinely test their cows for production, milk quality and mastitis
- farmers use this information to cull cows and select breeding stock
- high labour costs have led to much mechanisation
- cheap land and grazing cows have led to large herds and farms.

But how relevant is this for smallholder Asian farmers? Furthermore, some of these systems have been unwisely transplanted into tropical smallholdings, such as the all too frequent poor feeding management of high genetic cows. All too often, such advanced genetics and technology is considered the panacea for many Asian dairy industries. However, basic dairy husbandry must be addressed before the potential of such 'high tech' innovations can be more fully realised.

13.3.1 High technology versus appropriate technology

The term 'high or new technology' can be defined as the latest production technology in current or potential use by developed Western dairy industries.

Much of this has been developed in advanced temperate countries with far more sophisticated and productive dairy industries and less challenging climatic environments than in Asia. This is likely to be the case for many years to come.

Advances in biotechnology offer potentially large benefits as long as they are combined with other appropriate farm practices. But today's investments are all too often driven by commercial interests, many of which may have limited impacts in Asia.

Rather than 'high tech', Asian dairy industry policymakers should be looking for appropriate technology that:

- is in accord with the farmers' objectives and constraints
- matches the consumers' demands in accessible market outlets
- leads to sustainable livestock operations.

The relevance of such technologies depends on the capacity and objectives of the farmer. But because SHD farmers have low labour costs and few economies of scale, how can they best make use of them particularly considering the fact that up to 30% of potential livestock production can be lost through animal health issues?

Dairy production technology can be broken down to nine key task areas in the supply chain for any dairy farm, no matter its size or location, as summarised in Figure 3.1 in Chapter 3.

Table 13.3 categorise these technologies into:

1. Those currently very relevant to all sized dairy farms in tropical Asia.
2. Those that may be currently relevant to large-scale dairy operations in tropical Asia.
3. Those not likely to be relevant to smallholders within the next 5 to 10 years.

The term 'latest generation' refers to the most recent stage of commercial evolution in particular farm aids.

Table 13.3 is quite subjective and may be incomplete. However, its contents could become the basis of lengthy discussions between dairy production specialists into the future. Whatever their outcome, it is important to differentiate between high technology and appropriate technology.

Therefore, not all new technologies are currently relevant to the needs of tropical SHD farmers. In fact some may be detrimental to farm profits as the cows are not sufficiently well managed to benefit from their inclusion in the farming system (see Figure 13.1). The term 'appropriate technology' is more relevant when assessing new aids to dairy production technology (see Figure 13.2).

Table 13.3. The relevance of 'high technology' to developing tropical dairy industries.

Links in the production supply chain	Very relevant in all sized dairies	Maybe relevant in large dairy farm	Less relevant on SHD farms for next 5 years or so
1. Soils and fodder production	Effluent distribution systems Macro nutrient fertilisers Micro nutrient fertilisers Latest generation pesticides Latest generation herbicides Most farm mechanisation Latest generation plant genetics	Some farm mechanisation Commercial silage additives	Genetically modified plants Organic production technology Biodynamic production technology 'Alternative' fertilisers
2. Young stock	Electrolyte fluid replacers Thermometers to monitor sick calves	Routine antibiotic therapy Immunoglobulin monitoring equipment	Computerised (automatic) calf feeders Unnecessary overuse of antibiotic therapy
3. Nutrition and feeding	Macro mineral supplements Access to computer software to formulate rations Individual animal identification	Computer software to monitor farm costs Computerised animal identification systems Total mixed rations	Probiotics Micro mineral supplements Vitamin/micro mineral injections Computerised feed dispensers
4. Animal health	Latest generation drugs Latest generation vaccines Access to most modern veterinary practices	Computer software to document animal health procedures Access to some very sophisticated veterinary practices Walk-over weighing scales to routinely record changes in live weight	Routine blood profiles Excessive use of antibiotics
5. Reproduction	Artificial insemination technology Aids for heat detection Single sexed semen	Oestrus synchronisation Tail paint, cameras and activity metres to assist with oestrous detection	Electronic oestrous detection

(Continued)

Table 13.3. (Continued)

Links in the production supply chain	Very relevant in all sized dairies	Maybe relevant in large dairy farm	Less relevant on SHD farms for next 5 years or so
6. Breeding	High genetic merit semen	Exotic high genetic merit heifers	Embryo transfers
7. Environment	Effluent management systems Farm biogas systems Advances in building designs Latest generation heat stress alleviation systems	Village biogas systems Climate controlled sheds Solar panels	–
8. Milk harvesting	Bucket milking machines Herringbone dairies	Automatic teat cup removers Automatic cow exit Computerised (information) technology	Bovine somatotrophin (BST) Robotic milkers Rotary dairies Automatic laboratory milk assay equipment Rapid exit dairy systems Computers in the milking parlour for individual cow monitoring
9. Value-adding	Farmer access to equipment to value-add raw milk Processing, packaging and marketing at the dairy coop level	Village access to equipment to value-add raw milk	The latest advanced equipment to value-add raw milk

13.4 'Words of Wisdom' from Asia Dairy Network's E-Conference on by-product feeding

During Nov/Dec 2013, the Asia Dairy Network of the Animal Production and Health Commission for Asia and the Pacific (APHCA), in collaboration with the FAO Animal Production and Health Division, conducted an E-Conference entitled 'The role of agro-industrial and forestry by-products in the feeding of dairy animals in Asia and other tropical regions'. Over 530 people participated in this E-Conference, submitting 288 contributions over the 4-week period (Moran 2014).

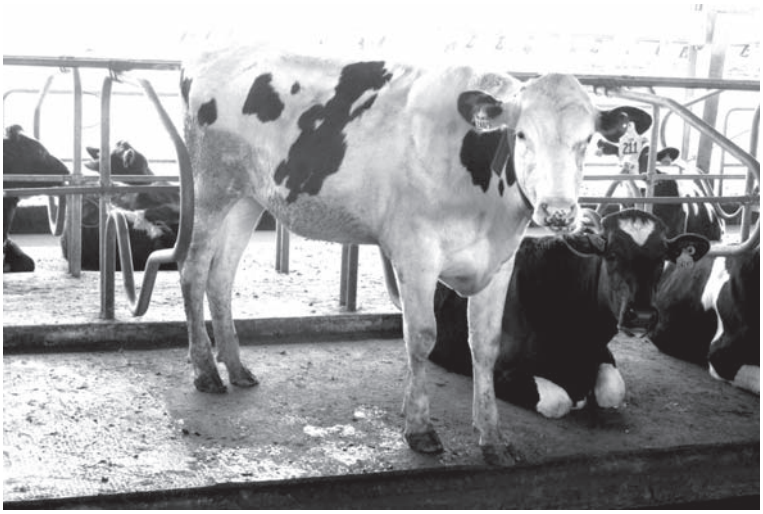

Figure 13.1: This animal is a US dairy heifer, imported into a north Vietnamese dairy feedlot, where the climate stress is extreme but onto a farm with no tunnel ventilation barns. How it will perform as a milking cow is unknown. Will it reach the desired 40+ L/day peak milk yield? If so, will it be able to easily conceive soon after calving? Its purchase was a risky decision.

Figure 13.2: Everywhere throughout the tropical world, forage maize is grown to supplement forage supplies on dairy farms, large or small. These bags of maize silage (on a Kenyan smallholder farm) are very simple to make as they are easy to compact and seal. Even though the initial adoption of the technology may be slow, once farmers see the benefits firsthand, it will become routine in their feeding management.

Many of these contributions provided valuable insights into the feeding and management of dairy stock in the tropics and some of these have been selected and collated below as 'Words of Wisdom' from the E-Conference. Together with the authors, these are categorised into three headings below, namely:

- by-product feeding
- feeding and herd management
- technology transfer.

13.4.1 By-product feeding

Treating straw just to improve its digestibility seems to be mostly a waste of time, when we can easily feed urea and sugar to the animal and thereby improve the digestion of straw within the digestive tract. Dr Steve ***Sutherland*** *of Australia*

Plant breeders have paid little attention to the quality of the by-products and not explored whether the quality could be improved without diminishing the quality and quantity of the main product. Dr Bob ***Ørskov*** *of UK*

The failure of technologies like urea-ammonia treatment of straws is not because of any gap in the technology. It is mainly because farmers, first, do not have time to treat their poor quality crop residues as they want ready-made feedstuffs at their doorsteps and second, because of a general lack of awareness of the methodology and potential benefits. Dr M ***Bakshi*** *of India*

Sometimes it helps to forget about classifying and grouping items as by-products, commodities, forages, energy supplements, protein supplements, food wastes etc., but rather just look at them all objectively as ingredients available at the farm gate for a certain price. Local or imported, it doesn't matter, as long as it is available, and the price is known. Then look at the analysis and formulate a ration to the desired specifications. Dr Steve ***Sutherland*** *of Australia*

Instead of costly chemical and physical treatments to render dietary protein undegradable, it would be more appropriate for low to medium milk producing cows to balance the rumen through less expensive locally available feeds for maximum microbial growth. Dr Ghulam ***Habib*** *of Pakistan*

13.4.2 Feeding and herd management

With the majority of the local dairy breeds in south Asia low producers, the question arises 'Do we need bypass protein supplementation for these cows?' Dr Ghulam ***Habib*** *of Pakistan*

For high producing cows (> 15 L/cow/day), intestinal supplies of amino acids from microbial protein alone may not be adequate and will then require

*undegradable protein supplement to complement their intestinal protein supplies. Dr Ghulam **Habib** of Pakistan*

*Straw feeding is suggested for low yielding cows and as a maintenance ration with some supplementation of critical nutrients. For moderate to high yielders, feeding of green fodder/tree leaves (if green grass is not available) is a must. Dr Ali **Akbar** of Bangladesh, Dr Sahoo **Biswanth** of India*

*Despite the numerous extension programs promoting silage as a potential quality forage, SHD farmers do not want to readily adopt it because it requires 'double handling' of forage, just like wilting fresh forage to reduce excess feed water. Once they have manually harvested the forage, most SHD farmers simply want to feed it to their stock. Dr John **Moran**, Australia*

*Farmers find it easier, time and labour saving and had the idea that green fodders are more nutritious than silage. Therefore, farmers are generally more interested in feeding green fodder rather than making silage and only when they will produce it in large quantities and much more than the requirement, they will be interested. Dr M. **Akbar** of Bangladesh*

*Water is almost always a neglected item in many smallholder dairy farms where all too often, milking cows are tied up all day with little or only occasional access to drinking water. Dr Sharif **Chowdhury** of Bangladesh*

*Excessive consumption of soluble proteins fail[s] to increase milk production, adversely affects reproductive performance and cause[s] excessive excretion of N that adds to environmental pollution. There are also energy losses associated with high N excretion because urea synthesis from ammonia is an energy costing process. This energy cost may attribute to reducing milk yield, lowering reproductive performance and losses in body condition. Dr Ghulam **Habib** of Pakistan*

*We produce enough roughage to feed our cattle, but it is not readily available to all animals. The major challenges are then how to make them available in different seasons and regions. Dr Khan **Huque** of Bangladesh*

Considering the cost of feed and the return from dairying, indigenous cattle and low yielding improved cows producing less than 7 L/day do not return sufficient to be suitable for commercial dairy farming, even with 4 or 5 cows per household. From a practical point of view, the type of dairy animal (and its potential milk yield) must be considered, such as the cost of rearing and

the return to the pockets of farmers and in Bangladesh, cows need to be able to produce 10 L/day of milk to be profitable. Dr Quazi ***Huque*** *of Bangladesh*

13.4.3 Technology transfer

Training programs often cover the communication aspect but rarely bring behavioural changes in farmers for adoption. This requires continuous and strong technical backup visits to farmers after training, which unfortunately is frequently missing in many of our extension systems. Once trained, farmers are generally left on their own and seldom visited again. Dr ***Habib*** *of Pakistan*

Farmers are the best economists for their livelihood development. Dr Khan ***Huque*** *of Bangladesh*

Research or technology development should not only be technically sound but also economically beneficial (to producer) and adoptable (by animal owners most being smallholders or resource poor). Dr D. ***Rangnekar*** *of India*

There is a need to develop a system of regular and planned interactions between research and development organisations (both government and non-government), farmer organisations etc. for scientist groups to understand production systems, problems/constraints faced by livestock. Dr D. ***Rangnekar*** *of India*

While economics is an important factor, farmer perception of economics is different from conventional economics, and there are two other equally important factors – convenience and risk perception. So, recommendations may be initially accepted if they are apparently beneficial but if [it] becomes too inconvenient or time consuming, it may not be adopted. Dr D. ***Rangnekar*** *of India*

Women have many other jobs to perform and responsibilities to handle – in a mixed farming, smallholder situation. And in case they smell some risk (such as spoilage during ensiling or treatment), the adoption is difficult since they cannot afford to take further risks. Dr D. ***Rangnekar*** *of India*

Regarding acceptance of improved livestock technology by the village farmers, they will not accept the good words from the scientists, rather they will accept the words from their neighbour fellow farmers who are benefiting by using this technology. So, for proper effective adoption of technology, field and

farmer days at the farmer's house are obviously required. Dr S. ***Khan*** *of Bangladesh*

The only way to change behaviour of farmers is through seeing and believing and understanding the direct economic benefits. Dr Quazi ***Huque*** *of Bangladesh*

The model farm concept is beneficial [if] it is established in villages using one of the farmers that are set up for improving their management, making use of the means and ways within their limited resources. There is no point taking resource poor farmers to facilities (such as those established in public or commercial private sectors with expensive state of art technology) that cannot be copied and adopted by them. When farmers see the possibility and benefits of improving farm management under conditions close to their own, they are motivated to adopt. Dr Ghalam ***Habib*** *in Pakistan*

After functioning as a development worker, I have learnt that it is 'a blessing in disguise' for small farmers in that they often resist change thus creating challenges for technical persons. I say this with full knowledge of the way that livestock extension works. Dr D ***Rangnekar*** *of India*

It's possible there is much re-inventing of the wheel going on, even in the vast Bathan dairying lands that feed milk into Milk Vita's Bagharbarighat powder plant; and into other more recently established plants based on the Milk Vita model. Plainly these earlier interventions have not taken root, nor been able to get the right message out to typical milk producers. Perhaps someone might consider collecting the many manuals, guidelines, resource books and the like that dairy interventions (project and research) have churned out over the past half century since independence and distil them into user-friendly, area-specific, best feeding practice for Bangladeshi milk producers – small, medium and large. Dr Brian ***Dugdill*** *of England*

13.5 FAO course on 'Feeding management of dairy cattle in tropical countries'

A new program written by the senior author is being offered by the Animal Production and Health Division of the Food and Agriculture Organization (FAO), in Rome, Italy, as part of their capacity building activities for advisers to tropical SHD farmers. This is a training program in the area of feeding management of dairy stock, both milking cows and young stock. The course has proven very popular as it has been downloaded 457 times and accessed online 226 times over

the 12-month period up to December 2015; it has even been translated into French. The course comprises 16 self-learning modules accessible on the internet. Each module has a series of Knowledge Assessment Tasks to assess the learning process.

The objective of the course is for dairy stakeholders to gain a more objective, comprehensive and technical understanding of the complex nature of the feeding management decisions carried out by successful and profitable smallholder and large-scale dairy farmers.

The target audience is:

- extension workers working directly with dairy farmers
- government and agribusiness dairy advisers
- progressive smallholder and/or large-scale dairy farmers/managers
- dairy cooperatives and their support infrastructure educators (both degree and certificate level)
- senior government management and policymakers
- staff of Non-Government Organisations
- teachers and university lecturers.

13.5.1 What does the course contain?

There are 16 modules (lessons). The content covers:

- Principles of dairy nutrition and feeding management as cows move through their annual lactation cycle.
- Quantification of the likely milk responses to changes in intakes of feed nutrients so that a ration can be formulated to achieve a targeted milk yield.
- A practical session on troubleshooting feeding problems.
- Specific aspects of dairy production technology, such as rearing young stock and feeding for improved fertility.

Each module is composed of a set of structured slides. Slides contain learning material, tests and supplementary files for further reading. During the learning process users will be led from one slide to another sequentially, but they can also jump from one to another slide. The contents of each module are generally organised in the following sequence:

1. Welcome.
2. Learning objectives.
3. Introduction.
4. Learning contents.
5. Summary.
6. Self-assessment.
7. Further readings.

Title of each lesson:

1. A brief introduction to tropical smallholder dairy farming.
2. Principles of feeding management.
3. Key nutrients in feeds.
4. Key nutrients in milk.
5. The lactation cycle.
6. Quantifying the nutrient requirements of milking cows.
7. Supplying these key nutrients from forages.
8. Balancing rations with supplements.
9. Formulating a ration.
10. Milk responses to supplements.
11. Troubleshooting feeding problems.
12. Feeding for improved fertility.
13. Feeding pre-weaned calves.
14. Feeding weaned heifers.
15. Measuring body condition score.
16. How feeding management impacts on other aspects of herd management.

13.5.2 How to access the course

The course is available on the FAO website from which it can be easily downloaded onto a computer or it can be accessed online.

The instructions to access it are as follows:

- A video has been developed to present the program. It can be accessed via Google on https://www.youtube.com/watch?v = CcbxNdcgW8c
- Type in http://www.fao.org/elearning/#/elc/en/courses/APH
- Select the course, which is called 'Feeding management of dairy cattle in tropical countries'.
- First-time users must register with a User name, Password and some personal details such as your organisation, email address, gender, country of origin and identifying the hidden letters.
- Once you have successfully registered and re-entered your User name and Password, you have the option of either running the course online or downloading it onto a folder in your computer.
- To download it, you need to select a specific folder, then once the 21.7 MB has been downloaded, you choose 'Extract All' from the options and select a destination folder from which to actually run the course.
- You then find and activate the file 'start-course.exe' which takes you to the opening page on which you click on 'Click here to start now', then follow the simple instructions to open up any of the 16 modules.

13.6 Future directions for SHD production in the humid tropics

The following are some of the key issues in feeding management on SHD farms that require further attention at both the research and extension levels. The senior author wrote out these issues over 10 years ago, as a 'wish list' for his first book (Moran 2005). Since they are still highly relevant to Asia's developing dairy industries, we believe that it is worth listing them again.

13.6.1 Feed nutrients

- As forage supplies are of paramount importance, inexpensive, year-round and sustainable supplies of quality roughages must be developed for every system of SHD farming.
- Because dry season forages are poorer in nutritive value, conserved excess wet season forages often form the basis of most profitable dairy systems.
- Tropical forages are high in fibre, so farmers will always require concentrate supplements.
- Energy will continue to be the major limiting feed nutrient in smallholder dairying. Improving the energy status of milking cows will be of benefit to both the production of milk and milk solids.
- Home-grown forages will almost always be cheaper sources of feed nutrients than purchased forages, particularly when managed to provide optimum yields and quality.

13.6.2 Feeding management

- The high nutrient demands of milking cows negate many of the recommended feeding systems based on chemically treated low quality roughages.
- Agro-industrial by-products will always form the basis of concentrate supplements, because of increasing demand for land to grow crops for human consumption.
- With continuing emphasis on increasing the domestic milk production in all SE Asian countries, it is important not to 'overstock' any developing dairy region. Feed audits, particularly of 'home-grown' forage supplies, should be undertaken and adhered to when projecting optimum numbers of dairy stock for any particular region.
- In addition to encouraging farmers to improve agronomic practices on their own smallholder farms, 'home-grown' forages can be produced on communal areas, utilising the expertise of cooperative staff to oversee management to optimise fertilising, harvesting and if necessary, conservation of quality forages for use by nearby farmers. If there are economic justifications for cooperatives to bulk purchase ingredients and formulate concentrates, similar benefits could arise with managing forage production areas.

- High yielding cows are very susceptible to heat stress. Every effort should be made to alleviate the adverse effects of heat stress on appetite and fertility, hence milk production and profitability.
- An underutilised measure of feeding management is the persistency of the lactation curve. It is one thing to feed for high peak yields, but it is just as important for good milk yields to be maintained throughout the lactation. Farmers should feed cows to allow milk yields to fall by no more than 10% decline from peak yield per month.
- The simplest 'take home message' from all the technical books, seminars, demonstration farms and farmer discussion groups relevant to tropical dairy farming is **feed fewer cows better**.

13.6.3 Other issues

- There is little sense in importing 'improved genetics' or growing out bigger heifers if they cannot be fed well when milking.
- Dairying is a business, so feeding decisions should be based on logical and appropriate economic information with 'Milk income above feed costs' being the single most useful measure of success. Although this measure does not take into account non-feed costs, a farm with high costs of production usually has high non-feed as well as high feed costs.
- Improving the knowledge of basic ruminant nutrition will greatly assist many dairy advisers to formulate more profitable milking rations, because generic recipes are notoriously unreliable.
- Farm development is often limited by inefficient (and even inappropriate) technology transfer in that extension procedures do not always acknowledge farmer skills and adult learning principles.

Concern is often expressed that most SE Asian countries are not in a position to develop large-scale intensive livestock industries without the importation of feedstuffs. This certainly applies to pig and poultry but for dairying, another relatively intensive industry, the future may not be for large farms requiring high tonnages of fresh forages and imported concentrates. Unlike Europe, North America and Australasia, where dairying evolved from smallholders to larger and often corporate farms, we believe the future for dairying in SE Asia is still with the smallholder sector. For these systems, fresh quality forages can often be sourced close by while local by-products can form the bulk of the concentrate formulations.

Even in one of the most densely populated islands in the world, Java, there are large tracts of underutilised land such as forest plantations and aging coffee and rubber plantations, where SHD farmers currently can freely harvest limited amounts of forage for their stock. In recognising their potential, Indonesian

policymakers place high priority in developing such resources through providing greater access to farmers and plantings of improved forage species (Burrell and Moran 2004). With better feeding management skills, smallholder farmers can profitably increase raw milk supplies, to the nutritional benefits of their fellow consumers and the improved food security of their nations.

13.7 In summary

In spite of several decades of dairy farming in the tropical developing countries of SE Asia, the productivity of SHD farming has remained relatively low due in part to the lack of appropriate dairy research and application. Small farmers, due to their socio-economic and agro-economic conditions being greatly different to those in developed countries, cannot readily adopt the science and technology available in developed countries. Even the most appropriate technology is rarely transferred to smallholders *en masse* due to a general lack of effective extension support services. There needs to be large-scale institutional support to facilitate dairy industry growth through mechanisms such as providers of farmer credit, farmer training centres, well-equipped milk collection centres, processing and marketing facilities, farmer cooperatives or groups and appropriate research and extension infrastructures and methodologies. School milk programs have been successful in encouraging the development of SHD farming by promoting milk drinking to improve health among children, particularly in rural areas. It is then essential for any production technology being transferred to these farmers to be relevant to their needs as well as being economically and practically feasible, given their local support networks of dairy cooperatives, advisers (government and agribusiness), creditors and milk handling and processing infrastructures. Production technology skills should automatically lead onto animal welfare skills.

Despite the complexities of establishing and successfully operating large-scale, intensive dairy feedlots, this has been and is being undertaken in developing countries such as China and Vietnam. Granted the advice and assistance from intensive dairy specialists from more developed Western dairy industries have been sought and utilised, however, these successful models demonstrate that even in the humid tropics, such production systems have a viable, hence long-term future. Many other SE Asian countries are also following down this line with fewer, though equally successful, dairy feedlots, such as Thailand, Indonesia, India, Pakistan and Malaysia. The more consistent production of high quality raw milk arising from these more controlled dairy production systems provides the basis of satisfying consumer demands for both liquid milk and the more expensive, value-added dairy products. Such large-scale dairy systems will increase in both numbers and product supply, being driven by national policies for dairy self-sufficiency and increasing affluence of local populations.

Good dairy cattle husbandry includes the provision of appropriate resources of feed and shelter, effective management and sympathetic stockmanship. These include:

- Physical resources necessary to ensure proper feeding, housing and hygiene
  - ➤ well-constructed, properly replenished feed stores
  - ➤ accommodation that is hygienic, physically and thermally comfortable and unlikely to cause injury
  - ➤ facilities for routine preventative medicine and the care of individual sick animals
- Strategic management designed to address the physiological, health and behavioural needs of the animals
  - ➤ feeding, production, health and welfare plans devised and implemented with professional advice as appropriate to the needs of the system and the individual animals
  - ➤ comprehensive records relating to feeding, production, health and welfare
- Competent stockmanship, sympathetic to the day-to-day needs of the stock
  - ➤ a skilled empathetic approach to animal handling
  - ➤ early recognition and attention to any signs of disease or injury
  - ➤ work practices that encourage competent and caring stock keepers and which give them the time to develop empathy with the animals in their care.

A competent, welfare-minded dairy farmer is then one who extends his farming skills to cover cow psychology 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'. Optimum cow comfort is just as important as the provision of the most appropriate resources on-farm, because if the cow is stressed, their appetite for feed nutrients can be as much a limiting factor as their nutrient supplies.