3

Addressing the key constraints to tropical dairy farming

This chapter presents an insight into the constraints that commonly limit tropical dairying productivity as well as the benefits and limitations of development and intensification of SHD tropical dairy farming.

3.1 Key activities on any dairy farm

On any dairy farm, no matter its size or location, the dairy production technology can be broken down into nine key activities, which can be considered as steps in the supply chain of profitable dairy farming (Moran 2009a). Just as any chain is only as strong as its weakest link, each step in this supply chain must be properly managed. Weakening any one link through poor decision-making can have severe ramifications on overall farm performance, and hence farm profits. In chronological order of their role in ensuring a profitable dairy enterprise, the 'links' are presented in Figure 3.1.

3.2 The benefits of intensification

There are many benefits in improved productivity and profitability of smallholder dairy (SHD) farmers. In addition to higher levels of milk production (hence gross returns) per cow and/or per farm, Falvey and Chantalakhana (1999) list the following:

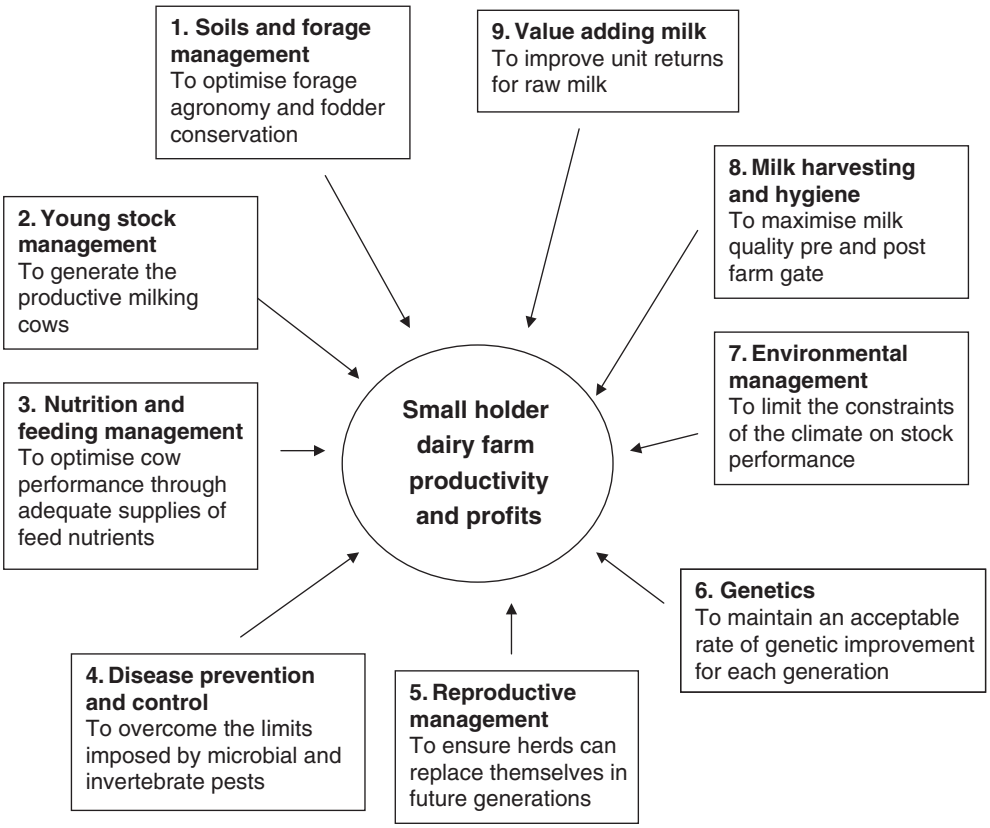

Figure 3.1: The nine steps in the supply chain of profitable dairy farming.

- year-round engagement of rural and peri-urban labour
- utilisation of agricultural and other by-products
- integration with cropping systems management
- conversion of by-products into organic manure for application to crops
- provision of nutritious and hygienic food for children
- production of meat from male calves and older cows
- reducing the cost of meat production for traditional markets as draught power declines as the primary bovine product
- a basis for rural and peri-rural industrial development through milk factories
- the development of new products for niche exports
- reducing rural to urban population drift
- draught and traction as a dairy industry by-product or adjunct
- landless people making a reasonable local living from dairying.

Prior to assessing the constraints to dairy production technology, it is worthwhile summarising a recent industry study of SHD farming in the tropics.

This study (Anon 2005) highlights the role of SHD farming, using a SWOT analysis to evaluate the industry's strengths and weaknesses. The analysis assesses the business or industry's strengths (S), weaknesses (W), opportunities (O) and threats (T). Although Table 3.1 refers specifically to Indonesia's SHD industry, it is applicable to any SHD industry in tropical Asia. Anon (2005) then concluded that SHD farming in Indonesia, as in other tropical Asian countries:

- improves the food security of milk-producing households
- creates employment opportunities throughout the entire dairy chain (for both producers and processors)
- is a powerful tool for reducing poverty and creating wealth in rural areas
- can incur relatively low production costs.

Table 3.1. Findings of a SWOT analysis of Indonesia's SHD industry (Anon 2005).

Components of SWOT	Findings
Strengths	Low production costs High farm income margins Low liabilities Relative resilience to rising feed prices SHD farmers are then cost competitive and resilient to market fluctuations They thus provide a competitive source of milk supply to imported dairy products
Weaknesses	Lack of knowledge and technical skills Poor access to support services Low capital reserves and limited access to credit Low labour productivity (small herd sizes and low output per cow) Poor milk quality and safety SHD farmers are often unable to take advantage of existing market opportunities
Opportunities	Growing demand for dairy products in developing countries Likelihood of increased milk returns Major potential to increase labour productivity Great potential to increase milk yields Employment generation Significant opportunities to improve the demand (quality and milk price) Significant opportunities to improve the supply (improving production technology) Empowerment of women Development of farmer and village cooperatives
Threats	Policy support in developed countries Exposure from competitive business forces Underinvestment in dairy chain infrastructure Unsuitable dairy development plans Environmental concerns such as a high carbon footprint Increasing consumer demand for food safety Succession of dairy farms Increasing local wage SHD rarely meets its full potential because of many threats, particularly the last four

However, in spite of several decades of dairy farming in developing countries, the productivity of SHD farms has remained relatively low due to a lack of appropriate dairy research and extension. Due to their socio-economic and agro-economic conditions being greatly different to those in developed countries, small farmers cannot readily adopt the science and technology available internationally. It is essential that any production technology being transferred is relevant to the needs of these smallholders as well as being feasible, given their local support networks of dairy cooperatives, advisers (government and agribusiness), creditors and milk-handling and processing infrastructures. Even the most appropriate technology is rarely transferred successfully to smallholders due to a lack of effective support services. There must be 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.

For intensification to be sustainable, there must then be:

- adequate infrastructure and marketing opportunities
- access to reliable markets for increased milk production
- promotion of dairy development through government policy
- availability of credit for purchasing of livestock and planting pastures
- available productive and adapted forage species
- a supply of affordable cattle of the appropriate type
- ready access to information
- a supply of reliable and affordable labour
- farm management systems that ensure adequate feed throughout the year
- management of animal wastes
- health management and disease control measures
- adequate hygiene and management for milk collection.

3.3 Key constraints facing smallholder dairy farmers in tropical Asia

As a result of applied dairy research, development and extension over the last 20 years, Western countries have devised sophisticated dairy production systems (such as those described by Little 2012). Herd sizes have grown, efficient feeding, housing and herd management systems have evolved and many farmers routinely monitor test results on their cows for milk production, composition, quality and for mastitis. They then use this information for making decisions on nutrition, management and culling of milking cows and for breeding genetically improved stock. High labour costs have led to much mechanisation, such as machine milking

and forage conservation, while grazing cows in SHDs can harvest their own forages far more efficiently than can farmers. Low population pressures, hence relatively cheap land, have allowed these farms to expand in both size and cow numbers.

Unfortunately the dairy industries of tropical Asia have failed to keep pace with the speed of such dairy development in Western countries (Devendra 2001). Cow numbers have increased in most Asian countries, largely through government support for social welfare and rural development programs. The increased demand for milk (accentuated through school milk programs) and the concept of national food security are the driving forces behind many dairy development initiatives. However, in terms of milk production per cow and feed inputs per kg of milk produced, improvements have been slow (Moran 2005, 2009a, 2012a).

Many of these developing dairy industries are located in tropical regions where high temperatures and humidity and, in some cases, seasonal growing conditions, adversely affect cow comfort and potential milk yields. Milking cows are not well suited to the tropics because their large requirements for feed nutrients, and their high internal heat production (compared to other species of livestock), cannot easily be incorporated into production systems that have to cope with poor forage quality, exposure to many disease agents and the climatic stresses that constrain cow comfort, immunity, appetite, reproductive efficiency, performance of young stock and animal health (Moran 2005).

In addition, many of the farmers, usually smallholders with fewer than 10 milking cows, have not been able to develop the skills of, or resources for, efficient milk production. As previously mentioned, this has primarily been due to poor extension services rather than lack of technical knowledge on tropical dairy farming. SHD farmers, with socio-economic and agro-economic conditions vastly different to those in Western dairy industries, cannot readily adopt the science and technology available in developed countries. It is essential that any production technology being transferred is relevant to the needs of smallholders as well as being feasible, given their local support networks of dairy cooperatives, advisers (government and agribusiness), creditors and milk handling and processing infrastructures (Devendra 2001).

Falvey and Chantalakhana (1999) categorised the factors limiting SHD production into:

- institutional factors, such as dairy cooperatives, suppliers of credit, training, extension services
- government policies, such as development programs, milk promotion, dairy boards
- socio-economic factors, such as farmer education, off-farm jobs, traditional beliefs
- technical factors, which can be further categorised into feeding, breeding, health
- post-farm gate factors, such as milk processing, marketing and consumption.

This analysis can be compared with a more recent study (Burrell and Moran 2004). In the early 2000s a series of strategic planning workshops was conducted in Indonesia to identify and prioritise the key constraints for milk production and to develop action plans.

Burrell and Moran (2004) summarised the priority industry issues in East Java and some of the action plans for industry development as follows:

1. *Low cow productivity*: improve management of feeding, reproductive management, cow comfort and milk harvesting.
2. *Low milk price*: reduce costs of production, improve milk quality, mediate on milk pricing, find alternative markets.
3. *Poor milk quality*: improve milking hygiene at both farm and post-farm gate, improve milk composition through better feeding management.
4. *Poor feed quality and availability*: identify better forage species (e.g. legumes), appoint quality control teams for concentrate supplies, utilise marginal land for forages.
5. *Cooperative management*: reduce management structure and merge small cooperatives, improve post-harvest technology, improve calf and heifer-rearing practices.

There were other industry issues raised but not discussed in detail. These included the need to promote fresh and manufactured dairy products, improve technology transfer, identify the positives to stimulate farmer motivation, work towards autonomy of cooperatives and improve collaboration between government agencies and training organisations.

A similar list of priority industry issues was developed independently for West Java, with some of the action plans for industry development summarised as follows:

1. *Human resources:* improve knowledge, skills and attitudes of farmers and support staff.
2. *Poor feed quality and availability:* increase area of land for growing forages, overcome seasonality of forage supplies, reduce variability of concentrate quality.
3. *Low capital investments in industry:* invest in infrastructure for post-farm gate industry support.
4. *Small scale of farming:* increase herd sizes, overcome shortage of breeding stock.
5. *Insufficient technology:* increase supply of breeding bulls, improve feed supplies, diversify farming systems, value-add milk in farming areas to help overcome farmers' low cash flows.
6. *Institutions:* improve coordination among service providers, introduce better control over milk quality, improve efficiency of administration in institutions.

Again other industry issues were raised but not discussed in detail. These included the need to promote fresh drinking milk, facilitate and support milk marketing and develop post-farm gate technology in milk processing.

The on-farm constraints to SHD production technology in tropical Asia are many and varied. Thirty-five key constraints were summarised by Moran (2013) and are listed in Table 3.2. They are categorised using the nine key activities from Figure 3.1 (see above) and complemented with a range of possible solutions to overcome each one. An extra category 'Other on-farm constraints' is included in this table to take into account those covering farm business skills.

Figures 3.2 to 3.4 highlight the contrasts in young stock management found in the tropics.

After several decades of dairy development in many Asian countries, typical milk yields per cow per day still range between 8 to 10 kg as compared to average yields of 20 to 30 kg in developed countries. In addition, the average calving interval of dairy cows on SHD farms is commonly as long as 16 to 20 months, when it could be reduced to 14 to 15 months. This clearly shows their low levels of farm productivity. Many technical solutions are available (as in Table 3.2) but they must be carefully selected so they will be suitable for small farmers and their socio-economic conditions. This means that scientists and extension workers must be able to understand all the factors influencing the acceptance when transferring such technology to farmers. Scientific knowledge alone cannot solve small-scale farm problems.

Socio-economic factors, including family and village structure, gender roles, family and individual goals, decision-making processes, financial drivers and drivers of change all must be understood and utilised in any new extension or farmer training process.

Policymakers should resist the all-too-common assumption that development efforts should move from smallholders towards supporting larger-scale, 'more efficient' milk producers to meet growing consumer demand. Instead, growing demand should be used as a stimulus to help continue and sustain SHD enterprises, particularly when they face increasing barriers to participate in value chain markets.

If well managed, SHD farms can compete with large-scale, capital intensive 'high tech' dairy farming systems as practised in both developed and developing countries. However, SHD development plans must include acceptable strategies to increase competitiveness in all segments of the dairy industry chain, namely input supply, milk production, processing, distribution and retailing. The future for SHD farming in tropical Asia is optimistic so long as the industry can rectify many of the constraints to improving domestic production of raw milk, particularly those at the farm level.

Table 3.2. Key constraints to improved milk production on tropical Asian smallholder dairy farms and possible approaches to solutions.

Key activity	Key constraints	Approaches to solutions
1. Soils and forage management	a. Low yields of forage	Use inorganic fertilisers as well as manure Reduce nitrogen volatilisation of shed effluent by directing it into water storage Optimise forage agronomy (soil preparation, weed control)
	b. Poor forage quality	Use inorganic fertilisers as well as manure Use most appropriate forage species for region Consider other forages such as tree legumes Reduce harvest intervals
	c. Shortage of dry season forages	Consider silage making of wet season forages Plan year-round forage supplies Utilise effective silage making and storage techniques
2. Young stock management	a. High calf mortality	Better parturition management to minimise likelihood of infecting newborn calf Ensure use of semen or bulls with low calf birthweights Improve colostrum feeding program (Quantity, Quality, Quickly) Pay greater attention to navel dipping with iodine Better shed hygiene Develop skills in identifying potentially sick calves Better health management Identify causes of death or sickness and change management accordingly Improve calf housing Minimise stress in calf shed Consider feeding less milk to encourage concentrate intakes Be more aware of fluid replacers v antibiotics for treating calf scours
	b. Poor post-weaning growth rates	Feed adequate amounts of concentrates Ensure calf concentrates have 18% protein Feed less forages to stimulate concentrate intakes Better health management Ensure routine Clostridial vaccination program Monitor post weaning growth rates Ensure free access to cool and clean water
	c. High wastage rates (from birth to conceiving in 2nd lactation)	Dairy cooperatives could consider heifer farms

3. Nutrition and feeding management	a. Low quality of by-products and formulated concentrates	Routine laboratory testing of ingredients and formulation Quality control during formulation Use coop system to bulk purchase quality by-products
	b. Poor performance of cows during early lactation (poor peak and daily milk yields, delayed cycling)	Ensure best forages for cows in early lactation, never rice straw Ensure enough forages are fed (30 to 50 kg fresh grass per cow per day) Monitor total dry matter intakes and increase if insufficient Consider wilting fresh forages to stimulate intake Ensure at least 16% protein in total ration Ensure all feeds are palatable Ensure free access to drinking water Provide Ca & P supplements in formulation Check if sufficient rumen buffers in concentrates Do not make concentrates into a slurry with water Chop forages to reduce selection and wastage Address any cow comfort and heat stress issues
	c. Cows (particularly high genetic merit cows) do not cycle for many weeks after calving	Ensure sufficient forages and concentrates are fed Check to see if rapid loss in weight or body condition Ensure at least 16% protein in total ration Consider vet checking for ovarian or uterine health Address any cow comfort and heat issues
	d. Seasonality of milk production	Plan year-round sourcing (growing or purchasing) of quality forages Ensure year-round supplies of by-products and formulated concentrates Ensure adequate supplies of drinking (and washing) water throughout the dry season Ensure adequate cow comfort throughout the year
	e. Little profits in milking cows	Check Milk Income less Feed Costs (MIFC) Be aware of marginal milk responses if feeding too much Set realistic target milk yields and feed to achieve them Ensure ration is balanced for nutrient contents Maybe feeding too many cows for available feed supplies Feed fewer cows better

(Continued)

Table 3.2. (Continued)

Key activity	Key constraints	Approaches to solutions
4. Disease prevention and management	a. Problems with lameness	Check floors for ease of walking on them Ensure appropriate animal husbandry and handling Consider footbath for all stock when required Check ration if too much concentrates causing laminitis Undertake locomotion test Identify and treat affected cows quickly
	b. Problems with mastitis	Ensure appropriate milking management Ensure milking machines (if used) are working effectively Identify subclinical cases with California Mastitis Test Ensure one towel one cow policy and towels are properly cleaned and dried Treat every infected cow with antibiotics ensuring withdrawal period is followed Milk infected cows last Initiate routine dry cow antibiotic therapy Consider culling chronically infected cows Ensure purchased cows are free of mastitis
	c. High calf and heifer morbidity and mortality	Follow procedures as in activity 2. Young stock management
	d. General animal health problems	Ensure appropriate animal health biosecurity plans are in place Develop skills in identifying potentially sick stock Routinely inspect stock for disease and external parasites Isolate sick stock Improve routine use of vaccinations Routinely use quality and viable pharmaceuticals Reduce the degree of exposure to infection by improving shed hygiene Consider testing for internal parasite egg counts Reduce any overuse of antibiotics Find well-trained and more practical veterinarians

5. Reproductive management	a. High age at first calving	Follow recommended procedures for improved post-weaning growth rates
	b. Low 100 day in-calf rate (pregnant within 100 days from calving) or high 200 not in-calf rate (not pregnant within 200 days of calving)	Better feeding management during early lactation Appropriate body condition score for stage of lactation Improve heat stress management and cow comfort Check AI techniques Can veterinarian confidently undertake pregnancy diagnosis? Pay closer attention to heat detection
	c. High number of services per conception	Improve AI techniques or check that technician is sufficiently skilled Pay closer attention to heat detection Consider vet checking for ovarian or uterine health
	d. Low % mature cows are milking	This is a simpler measure of poor reproductive performance so follow procedures above
	e. Increasing the proportion of heifer calves	There may well be a role for sexed semen in well-managed dairy farms
6. Genetics	a. Poor milking cow quality	This generally is not an issue because the genetic merit of imported dairy heifers is likely to be better than any cow on the farm, although more focus needs to be on tropical adaptability It is quite likely that the performance of most milking cows will be limited by environment (feeding, disease, heat stress etc.) rather than genetic merit Be aware of the genotype by environment interaction which means that high genetic merit stock require better levels of feeding and farm management to express their higher potential performance
	b. Most suitable genotype for the system	Some countries will not allow Jersey crossbreds or Brown Swiss to be imported, hence the imported Friesians limit the dairy production to the highlands If Jersey crossbreds and Brown Swiss are allowed to be imported, they may well prove the more profitable breed in lowland regions
	c. Difficulty of collecting robust data for genetic improvement programs	More emphasis on permanent identification of heifers Pay greater attention to maintaining cows in milking herds for relatively lengthy periods

(Continued)

Table 3.2. (Continued)

Key activity	Key constraints	Approaches to solutions
7. Environmental management	a. High incidence of heat stress during the 24 h period	Ensure shed construction is appropriate, such as roof height and access to breeze Count respiration rates to quantify degree of heat stress Pay closer attention to heat dissipation - Check shed design for ventilation - Consider artificial cooling (sprinklers and fans) Feed cows during the evening, when cooler Consider outside area for night-time cooling and heat (cycling) observations Feed better quality forages to reduce internal heat production
	b. High incidence of animal health problems due to poor bedding and shed hygiene	Improve shed hygiene Ensure bed is comfortable and not just cement Remove manure frequently Isolate sick stock
	c. Reduced forage quality due to high temperatures and rainfall	Unfortunately it is not easy since tropical forages are more fibrous than temperate forages. Soil testing can assist with overcoming monitoring leaching due to high rainfall. Harvest grass earlier
8. Milk harvesting management	a. Poor milk composition (fat and protein contents)	Address any limiting feed nutrient deficiencies and imbalances Ensure sufficient forage intake to maintain milk fat content Maximise cow comfort so cows will maintain their appetite and lie down for appropriate periods of time
	b. Poor milk quality (bacterial contamination)	Improve milking hygiene (hot water, detergent, sanitiser) Ensure machine milkers are operating effectively (short milking times, correct pulsation rate) Ensure rubber liners are correctly replaced Address any mastitis problems Ensure rapid milk cooling Could be a post farm gate issue hence outside farmer's control

9. Value-adding milk	a. Poor milk returns	Consider processing/value-adding to improve unit milk returns
10. Other on-farm constraints	a. The small farm size restricts development potential	Dairy cooperatives could develop cow colonies
	b. Poor profitability of dairy farming	Quantify profitability over 6 to 12 month period Quantify milk returns and overall farm income (actual and potential) Quantify Cost of Production (COP) Be aware that increased profitability can result from decreased COP as well as increased farm income Dilute fixed costs with higher farm cash throughput
	c. Low capital resources for investing in farm infrastructure	Seek alternative low interest loans
	d. Poor dairy farming skills	Institutional support to improve farmer training
	e. Underdeveloped entrepreneurial skills in dairy farmers	Work closely with potentially successful farmers to help develop these skills Provide training in farm business management and developing farmer business skills
	f. Poor farmer-management dairy coop relationships	Become more vocal to improve them

Figure 3.2: The constraint here is both genetic and feeding management. This dairy cow is still suckling her calf which is probably older than 9 months. Her Zebu ancestry will limit her milk producing potential while her calf would be drinking most of her saleable milk. The Kenyan farmer runs 13 beef stock plus two milking cows and only sells 3 L milk/day.

Figure 3.3: In comparison with Figure 3.2, the other extreme is this calf-rearing unit in a large-scale dairy feedlot in northern Vietnam. The Friesian calves are reared on calf milk replacer, as it is cheaper than whole milk, until 10 weeks of age with a target weaned live weight of 70 kg. Note the infrared heat lamps above the pens and the closed side walls, because winter temperatures and humidities can lead to cold stress in young stock. Clearly the environmental constraints have been minimised during winter.

Figure 3.4: Once weaned and fed a concentrate based ration until 11 months of age in small groups, the heifers are then run together as a large herd in the free stall shed and fed a high quality total mixed ration based on maize grain and imported lucerne hay. Any constraints in feeding management have been minimised.