**Improving smallholder dairy farming in tropical Asia**

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**Abstract**

This chapter reviews the importance of smallholder dairy farmers in Asia. It assesses their needs and the obstacles they face in improving dairy production. The chapter discusses ways of benchmarking performance and examples of initiatives to support smallholders. It identifies both constraints faced by smallholder dairy farmers in Asia and ways of addressing them to ensure sustainable increases in production and yield.

Key words

Smallholders, dairy farming, tropics, Asia, milk production

Contents

1 Introduction

2 Dairy farming in Asia

3 Supporting smallholder dairy farmers

4 Key constraints facing smallholder dairy farmers in tropical Asia

5 Benchmarking performance

6 Case study: cow colonies

7 Summary and future trends

8 Where to look for further information

9 References and further reading

**1 Introduction**

Globally, agriculture provides a livelihood for more people than any other industry (primary or secondary) while dairy farming is one of the major agricultural activities. The FAO has estimated world milk production in 2012 at 754 billion litres. Hemme and Otto (2010) estimated that 12 to 14% of the world’s population (or a total of 750 to 900 million people) live on dairy farms or are within dairy farming households. Livestock provide over half the value of global agricultural output and one third in developing countries. Milk is nature’s most complete food and dairy farming represents one of the fastest returns for livestock keepers in the developing world.

The Asia-Pacific region has seen the world’s highest growth in demand for milk and dairy products over the last 30 years. Even though Asia has increased its milk outputs (as a percentage of global production) from 15% in 1981 to 37% in 2011, it still accounts for over 40% of the world’s total dairy imports. The consumption of milk and dairy products in Asia has doubled over the last 30 years, now contributing to more than 60% of the total increases in global consumption.

Many of these countries now have school milk programs to encourage young children to drink more milk hence improve their health through increased consumption of the energy, protein and minerals (particularly calcium and phosphorus). In future years, as these children grow and have their own families, milk consumption will increase at an even faster rate. In the future per capita milk consumption in SE Asia is expected to nearly double from the current 10 to 12 kg/hd/yr to 19 to 20 kg/hd/yr by the year 2020 (Delgardo *et al* 2003). This 3% per annum growth will lead to a total milk consumption of 12 million tonnes/yr by 2020, which Delgardo *et al* (2003) predict will require 9 million tonnes of milk/yr net imports just to satisfy this demand. This is up from the 4.7 million tonnes of milk/yr imported in 2000. In summary by 2020, SE Asia will then only be producing 25% of its total milk requirements.

Such growing demands have arisen by a combination of:

* increasing per capita incomes
* the emergence of affluent middle class people in many low to middle income countries
* westernisation trends which increase the demand for protein foods and value added dairy products
* increasing urbanization
* expansion of modern retail outlets (with refrigeration cabinets) throughout Asia

In other words, higher incomes and increasing urbanisation have combined with economic reforms and market liberalisation policies to heighten the import dependency of many countries in this region. Asia has then become increasingly dependent on the highly competitive, but ever increasingly volatile, global dairy commodity markets. Consequently, many Asian countries are striving towards self-sufficiency in dairy production, at least in drinking milk

Most Asian countries still and will rely heavily on imported dairy products even though many have active government policies to increase domestic milk production. There are a group of Asian countries with low per capita milk consumption and low self-sufficiencies and these are likely to be the ones with most pro-active dairy development programs. These include Philippines, Indonesia, Thailand, Malaysia, Vietnam, Cambodia and Laos.

**2 Dairy farming in Asia**

Dairy farming in Asia can be broadly classified into three major types of production systems:

1. *Mixed farming*, in which milk production only contributes a relatively small proportion of total farm income. Many of these farms have evolved from essentially cropping enterprises to those where livestock production becomes more important. Milking herd sizes are generally quite small on these farms, ranging from less than 5 to more than say, 20 cows.
2. *Essentially smallholder dairy farms,* where milk production has increased over recent years to become a major contributor to farm income. In many cases, construction of the dairy facilities and available land has evolved and may not be sufficient for future requirements. Milking herd sizes are very small, generally no more than 5 to 10 cows.
3. *Larger specialist dairy farms,* which were established primarily to produce raw milk. Dairy facilities on these farms have been better planned to satisfy the requirements for a pre-determined number of milking cows. In most cases, land would have been allocated to produce the required fodder for the planned herd size, although in certain cases, agreements would have been made with surrounding farmers to provide the necessary forage base. Milking herd sizes on these farms would range from 20 to 100+ cows.

The contribution of these various farming systems to the total milk produced in each country would vary with population pressures and demands for alternative land use, other than providing livestock fodder. However Categories 1 and 2 contribute the bulk of the raw milk. The majority of dairy farmers are small holders, with average herd sizes often as small as one to five milking cows. In fact, small holder dairy (SHD) farmers produce over 80% of the developing world’s milk, making a significant contribution to the annual world production. Despite their high profile in their dairy industry, there are relatively few large dairy feedlots in any one Asian country.

Dairy farmers around the world produce milk from six different types of ruminant animals:

* large (cattle and buffalo plus camels in Africa and yaks in Asia)
* small (goats and sheep)

Small ruminants are rarely milked in Asia. Of the two buffalo ecotypes, river buffalo are the traditional dairy stock, with swamp buffalo rarely being milked. The majority of milk in Asia is derived from cattle, with some buffalo milk produced in Myanmar, Vietnam, Philippines and Thailand while the large buffalo milk producing countries are India, Pakistan, China and Nepal.

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 profits. In chronological order of their role in ensuring a profitable dairy enterprise, the “links” are presented in Figure 1.

*Figure 1 about here*

It is important to note the important role of women in carrying out many of the key activities in the dairy value chain. With the cows generally located in close proximity to the home, dairying offers more opportunities for females to become closely involved in the day-to-day management than with other farming pursuits. This is important in the village life in Asia, where women have traditionally been the home makers and family rearers. The cultural and religious bonds limiting their contribution to managing the family budget have frequently been loosened in many small holder dairying communities.

In West Java for instance, Innes (1997) has documented gender roles in small holder farm activities in four dairy cooperatives. She reported that women in the farm family were responsible for over 40% of the farm management decisions and spent 52% of their working hours on dairy farm-related jobs. Men were largely responsible for sourcing forages, often from large distances particularly during the dry season. However women frequently milked the cows, transported the milk to the collection centres, cleaned the shed and looked after the young stock. This has important implications in technology transfer, which has traditionally been the male’s domain. Since milking hygiene is largely the responsibility of women, milk quality is definitely an area where extension should target them. Workshops on feeding management and young stock are two others areas where more attention should be given to attracting women participants.

**3 Supporting smallholder dairy farmers**

National governments, international aid agencies or benevolent governments or agencies from developed countries have and are still devoting a lot of resources to improving the productivity, profitability hence sustainability of the SHD industries throughout Asia. The focus is on sustainable intensification of SHD farming. The term “intensification” requires clarification. In general terms, intensification is understood to be increases in efficiency for a unit of a given resource. For advisers and researchers of crop-livestock or pasture based livestock production, the term is often interpreted as increasing productivity per unit of land, usually associated with an increase in stocking rate.

The national dairy development (5 or 10 year) programs in most Asian countries concentrate much of their efforts towards the Category 2 farmers mentioned earlier i.e. smallholder dairy farms. In other words, they are trying to phase out “part time” dairy farmers (in Category 1) and encourage “full time” dairy farmers. National dairy plans provide government support, which often includes the establishment of dairy cooperatives.

Category 3 farmers (larger, specialist dairy farms) are usually less reliant on public support as their establishment is often financed by private investors. However, in recent years there has been considerable interest (and investments) in larger scale, feedlot dairies. This is occurring because governments have struggled to overcome the inefficiencies of current SHD systems, such as low milk yields, poor cow fertility and high young stock mortality rates which drastically limit their ability to greatly increase their dairy sectors to achieve self-sufficiency in dairy production.

Small holder farms generally yield low outputs of milk per animal. However, on a cost-benefit basis, the use of by-products or other waste as feed, and multiple outputs such as calves and meat production, the continued efficiency of small holder systems can outweigh the apparent efficiencies of dairying mono-cultures. Application of current technologies will allow increases in the production and efficiency of milk production by better understanding the nutrient requirements for milk production, in addition to those for growth and meat production.

There are many benefits in improved productivity and profitability of 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:

* 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

A recent industry study of SHD farming in the tropics 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 1, presented below, was undertaken specifically for Indonesia’s SHD industry by Anon (2005), 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 1 about here*

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 in developed countries. It is essential that any production technology being transferred is relevant to the needs of these small holders 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 small holders 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 cooperative 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
* Ready access to information
* Farm management systems which ensure adequate feed throughput the year
* Management of animal wastes
* Disease control measures
* Adequate hygiene for milk collection

**4 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 produced sophisticated dairy production systems (such as those described by Little 2012). Herd sizes have grown, efficient feeding systems have evolved and many farmers routinely monitor test results on their cows for milk production, composition and quality and for mastitis. They then use this information for making decisions on culling 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 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). Numbers of cows has greatly 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 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, 2012).

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 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 appetite, reproductive efficiency, performance of young stock and animal health (Moran 2005).

In addition, many of the farmers, usually small holders with less than 10 milking cows, have not been able to develop the skills of 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 small holders 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. In the early 2000’s a series of strategic planning workshops were conducted in Indonesia to identify and prioritise the key constraints for milk production and to develop action plans. Burrell and Moran (2004) summarised these as follows.

The following were the priority industry issues in East Java, together with some of the action plans for industry development:

1. *Low cow productivity*: improve management of feeding, reproductive management 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. *Co-operative management*: reduce management structure and merge small co-operatives, 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, stimulate farmer motivation, work towards autonomy of co-operatives 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 co-ordination amongst service providers, introduce better control over milk quality, improve efficiency of administration in institutions

There were other industry issues 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 dairy production technology in tropical Asia are many and varied. Thirty five of the key ones were summarised by Moran (2013) and are listed in Table 2. They are categorised using the nine key activities from Figure 1 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.

*Table 2 about here*

**5 Benchmarking performance**

The dynamic nature of dairy farming makes it difficult to develop a simple set of criteria with which to assess current management skills and performance. The term Key Performance Indicators (KPI) has been derived to describe a series of measures of dairy farm performance with which to provide realistic targets following improvements in feeding, herd and farm management. Such a set of KPI for SHD farming have recently been published by Moran (2009b). All these KPI 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 simplest, and most commonly used, single measure of SHD farm performance is the average 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 milking cows, which on any one day 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 (Moran 2012). 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, it is often quoted by government officials when summarising the stage of development of their national dairy industries. Table 3 attempts to describe the adequacy of the farm’s dairy farm management practices using the rolling herd average.

*Table 3 about here*

There are other factors and KPI to consider when interpreting such data, as follows:

* It is important to differentiate between rolling herd averages and peak milk yields
* It is important to consider milk composition as indicators of feeding management, for example:
	+ low milk fat can indicate possible subclinical rumen acidosis
	+ high milk protein can indicate good dietary energy intake
	+ however milk lactose levels are fairly constant
* Excessive body weight is indicative of low protein diets, due to:
	+ inability of cow to partition nutrients from body reserves to milk synthesis
	+ poor fertility as cows cannot easily cycle hence conceive
* Very poor body condition is indicative of low energy intake as:
	+ High genetic merit cows preferentially partition body reserves to milk synthesis
	+ Cows will not cycle due to excessive weight loss
* Herd dynamics can also indicate adequacy of dairy farm management
	+ Excessive number of dry non-pregnant cows can indicate very poor farm management
	+ Low percentage of lactating adult cows can indicate poor farm management

**6 Case study: cow colonies**

In many tropical Asian countries, considerable attention has been given to large scale investments in “cow colonies”. These consist of large dairy sheds, holding 50 or more cows that are owned by a number of SHD farmers, and presumably nearby development of large areas of forage production. Although small holders still own and manage their own herds in these large sheds, the perceived benefits of cow colonies lie in the magnitude of size of the total herd management. Such an approach can overcome many constraints to production but may introduce others as listed below.

The potential benefits of cow colonies are:

* Greater investment potential since cooperatives have more borrowing power than individual farmers
* Use of mechanical forage choppers and milking machines
* Employing contract labour to rear young stock
* Growing large areas for forages, such as maize, for livestock feeding
* Less wastage in recycling manure to forage production area, through building effluent ponds to minimise volatilisation of nitrogen from urine
* Bulk handling of conserved forages using large scale silage bunkers
* Easier communication between advisers and farmers and between farmers themselves
* Easier implementation of training programs involving practical skills as well as technical theory
* Easier monitoring of post training application of new skills
* Better motivation of farmers to improve management practices
* Easier monitoring of individual farmer’s milking hygiene practices and hence individual remuneration for better quality milk
* The concentration of farmers in the one place provides an ideal opportunity to introduce other motivation techniques such as regular awards for best management practices
* Better coordination of forage production, cow feeding, insemination, animal health, milk handling etc.
* Training of farmers in specialist skills such as machine milking or calf rearing
* The installation of cooling units on site
* More rapid cooling of milk and greater availability of hot water for more effective cleaning and sanitising equipment
* Increased likelihood of sufficient milk production to justify small value adding operations to benefit small dairy cooperatives
* Greater potential returns to the local dairy cooperative, hence the farmers themselves

Unfortunately these impressive facilities go hand in hand with high profile projects such as stocking them with imported pregnant Friesian heifers. The high mortality rates so far experienced in countries such as Indonesia suggest that the current colony feeding and herd management has yet to be improved to benefit from these high genetic merit animals.

Potential problems with cow colonies are:

* The sheds are constructed and filled with cows before the forage production area has been developed, leading to many poorly fed cows
* Insufficient attention placed on growing out non-revenue generating, young stock
* Poorly planned forage production areas, e.g. with minimal water for irrigation during the dry season
* Insufficient land allocated to forage production, partly because of provision of insufficient daily forage allocations to achieve target milk yields
* Incorrect perception that rice straw, sugar cane tops and over mature maize stover are suitable forage sources for milking cows, particularly when target milk yields are 15 L/cow/day or more
* Lack of understanding of the potential of forage and tree legumes as important forage sources for high yielding cows
* Potential spread of disease because of variable management between individual farmers, e.g. during calf rearing, mastitis if using milking machines
* Poor concept of the need for more sophisticated milking hygiene when using milking machines, e.g. regular replacing of milk liners and testing of machine performance
* Continual breakdown of machinery, choppers and milking machines
* Need for highly trained and well skilled labour for year round supply of quality forages
* Need for senior managers to develop both short term and long term views on development program
* Difficulties of regularly sourcing finances for completion of these large scale capital development projects, such as provision of milking equipment, durable forage choppers
* Inherent problems of passing over responsibility to individuals within small management teams. The larger the operation the more essential that skilled individuals be given more responsibility in specialist areas, such as forage production, animal health, milk quality
* Management teams for large scale cow colonies should not be expected to oversee that of any nearby small holder farms
* Need for senior managers to find and keep quality staff with capabilities of solving both day to day small management problems as well as contribute to large scale development. This problem could be addressed by employing bright young animal science graduates who would be prepared to live as well as work in villages near cow colonies.
* With the penalties imposed by milk processors, returns on these large capital investments are markedly reduced because of the low unit milk returns through poor quality milk. Small investments, such as steam cleaners, small hot water units become even more effective in light of the large capital costs of sheds, silage bunkers etc.
* As with all small holder ventures, it is more profitable to “feed fewer cows better”

Poorly resourced SHD farmers, whose businesses are often in “survival mode”, can become very individualistic and take time to develop the cooperative, sharing nature required for successful cow colonies. This has been given as a common reason for their poor success rate in countries with relatively new SHD industries such as Indonesia. The problems associated with cow colonies show the need to take a holistic view which accounts for each step in the dairy value chain.

**7 Summary and future trends**

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. With regards to young stock management, heifer ages at first calving are more commonly 30 to 36 months rather than the 24 to 28 months commonly found in temperate, more developed dairy industries. This clearly shows the low levels of farm productivity in tropical Asia. Many technical solutions are available (as in Table 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 worker must be able to understand factors influencing the acceptance when transferring such technology to farmers. Scientific knowledge alone cannot solve small scale farm problems (Falvey and Chantalakhana, 1999).

Policy makers should resist the all too common assumption that development efforts should move from small holders 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 (Ahuja *et al* 2012).

If well organised, SHD can compete with large scale, capital intensive “high tech” dairy farming systems as practiced in both developed and developing countries. However SHD development plans must include strategies to increase competitiveness in all segments of the dairy industry chain, namely input supply, milk production, processing, distribution and retailing (APHCA, 2008, Otto *et al* 2012). 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.

**8 Where to look for further information**

A standard introduction to the subject is J. B. Moran, *Tropical dairy farming* (see Moran 2005 in the References and further reading section for full details).

The best single source of information on smallholder dairying in Asia is the Asia Dairy Network jointly established by the FAO and the Animal Production and Health Commission for Asia and the Pacific (APHCA) (<http://www.dairyasia.org/>). The site includes information resources and key contacts.

Centres of expertise include:

* The International Livestock Research Institute (ILRI) (<http://asia.ilri.org/>)
* The National Dairy Research Institute in India (<http://www.ndri.res.in/>)
* The author’s own consultancy, which has undertaken numerous projects to support smallholder dairy farmers in countries such as: Indonesia, Malaysia, Thailand, Bangladesh, Myanmar and India (<http://www.profitabledairysystems.com.au>).

There are a number of current research projects designed to support dairy farmers in Asia which identify current problems and ways of tackling them, including:

* The CGIAR’s Research Program on Livestock and Fish which includes improving the dairy value chain for Indian smallholders (<http://livestockfish.cgiar.org>; an overview can be found in Rao *et al.* (2014))
* The Smallholder Dairy Development Programme coordinated by the FAO and others, focussing on Bangladesh, Myanmar and Thailand (<http://www.dairyasia.org/projects>)
* The Market Access for Smallholder Farmers (MASF) Project, coordinated by Practical Action, which supports dairy farmers in Nepal (<http://practicalaction.org/region_nepal_masf_project>)

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**Figure 1. The nine steps in the supply chain of profitable dairy farming**

**Table 1 Findings of a SWOT analysis of Indonesia’s SHD industry (Anon. 2005)**

|  |  |
| --- | --- |
| **Components of SWOT** | **Findings** |
| Strengths | Low production costsHigh farm income marginsLow liabilitiesRelative resilience to rising feed pricesSHD farmers are then cost competitive and resilient to market fluctuationsThey thus provide a competitive source of milk supply to imported dairy products |
| Weaknesses | Lack of knowledge and technical skillsPoor access to support servicesLow capital reserves and limited access to creditLow labour productivity (small herd sizes and low output per cow)Poor milk qualitySHD farmers are often unable to take advantage of existing market opportunities |
| Opportunities | Growing demand for dairy products in developing countriesLikelihood of increased milk returnsMajor potential to increase labour productivityGreat potential to increase milk yieldsEmployment generationSignificant opportunities to improve the demand (quality and milk price)Significant opportunities to improve the supply (improving production technology)  |
| Threats | Policy support in developed countriesExposure from competitive business forcesUnderinvestment in dairy chain infrastructureUnsuitable dairy development plansEnvironmental concerns such as a high carbon footprintIncreasing consumer demand for food safetySuccession of dairy farmsIncreasing local wageSHD rarely meets its full potential because of many threats, particularly the last four  |

Please note that Table 2 is presented at the end of this manuscript, that is following Table 3. Because of its size, Table 2 is presented in Landscape orientation.

### **Table 3 Interpreting the adequacy of dairy farm management from cow milk yields.**

### Range in average herd milk yields on tropical 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 excellent 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 |

**Table 2 Key constraints to improved milk production on tropical Asian small holder dairy farms and possible approaches to solutions**

|  |  |  |
| --- | --- | --- |
| **Key activity** | **Key constraints** | **Approaches to solutions** |
| 1. Soils and forage management | a. Low yields of forageb. Poor forage qualityc. Shortage of dry season forages | Use inorganic fertilisers as well as manureReduce nitrogen volatilisation of shed effluent by directing it into water storageOptimise forage agronomy (soil preparation, weed control)Use inorganic fertilisers as well as manureUse most appropriate forage species for regionConsider other forages such as tree legumesReduce harvest intervalsConsider silage making of wet season foragesPlan year round forage supplies |
| 2. Young stock management | a. High calf mortalityb. Poor post weaning growth ratesc. High wastage rates(from birth to conceiving in 2nd lactation) | Better parturition management to minimise likelihood of infecting new born calfEnsure use of semen or bulls with low calf birth weightsImprove colostrum feeding program (Quantity, Quality, Quickly)Pay greater attention to navel dipping with iodineBetter shed hygieneDevelop skills in identifying potentially sick calvesBetter health managementIdentify causes of death or sickness and change management accordinglyImprove calf housingMinimise stress in calf shedConsider feeding less milk to encourage concentrate intakesBe more aware of fluid replacers v antibiotics for treating calf scoursFeed adequate amounts of concentratesEnsure calf concentrates have 18% proteinFeed less forages to stimulate concentrate intakesBetter health managementEnsure routine Clostridial vaccination program Monitor post weaning growth ratesDairy cooperatives could consider heifer farms |
| 3. Nutrition and feeding management | a. Low quality of by-products and formulated concentratesb. Poor performance of cows during early lactation (poor peak and daily milk yields, delayed cycling) c. Cows (particularly high genetic merit cows) do not cycle for many weeks after calvingd. Seasonality of milk productione. Little profits in milking cows | Routine laboratory testing of ingredients and formulationQuality control during formulationUse coop system to bulk purchase quality by-productsEnsure best forages for cows in early lactation, never rice strawEnsure enough forages are fed (30 to 50 kg fresh grass per cow per day)Monitor total dry matter intakes and increase if insufficientConsider wilting fresh forages to stimulate intakeEnsure at least 16% protein in total rationEnsure all feeds are palatableEnsure adequate drinking waterProvide Ca & P supplements in formulationCheck if sufficient rumen buffers in concentratesDo not make concentrates and water into a slurryChop forages to reduce selection and wastageAddress any heat stress issuesEnsure sufficient forages and concentrates are fedCheck to see if rapid loss in weight or body conditionEnsure at least 16% protein in total rationConsider vet checking for ovarian or uterine healthPlan year round sourcing (growing or purchasing) of quality foragesEnsure year round supplies of by-products and formulated concentratesEnsure adequate supplies of drinking (and washing) water throughout the dry seasonEnsure adequate cow comfort throughout the yearCheck Milk Income less Feed Costs (MIFC)Be aware of marginal milk responses if feeding too muchSet realistic target milk yields and feed to achieve themEnsure ration is balanced for nutrient contentsMaybe feeding too many cows for available feed suppliesFeed fewer cows better |
| 4. Disease prevention and management | a. Problems with lamenessb. Problems with mastitisc.High calf and heifer morbidity and mortalityd. General animal health problems  | Check floors for ease of walking on themConsider foot bath for all stockCheck ration if too much concentrates causing laminitisUndertake locomotion test and treat affected cowsIdentify subclinical cases with California Mastitis TestEnsure one towel to wash only one cow policyTreat every infected cow with antibiotics ensuring withdrawal period is followedMilk infected cows lastInitiate routine dry cow antibiotic therapyConsider culling chronically infected cowsFollow procedures as in Young stock managementDevelop skills in identifying potentially sick stockRoutinely inspect stock for external parasitesIsolate sick stockImprove routine use of vaccinationsRoutinely use quality and viable pharmaceuticalsReduce the degree of exposure by improving shed hygieneConsider testing for internal parasite egg countsReduce any overuse of antibioticsFind better trained and more practical veterinarian |
| 5. Reproductive management | a. High age at first calvingb.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)c. High number of services per conceptiond. Low % mature cows are milkinge. Increasing the proportion of heifer calves | Follow procedures for poor post weaning growth rates in Young stock managementBetter feeding management during early lactationCheck AI techniquesCan veterinarian confidently undertake pregnancy diagnosis?Pay closer attention to heat detectionImprove AI techniques or check that technician is sufficiently skilledPay closer attention to heat detectionConsider vet checking for ovarian or uterine healthThis is a simpler measure of poor reproductive performance so follow procedures aboveThere may well be a role for sexed semen in well managed dairy farms |
| 6. Genetics | a. Poor milking cow qualityb. Most suitable genotype for the systemc. Difficulty of collecting robust data from genetic improvement programs | 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.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 performanceSome countries will not allow Jersey crossbreds to be imported hence the imported Friesians limit the dairy production to the highlandsIf Jerseys are allowed to be imported, they may well prove the more profitable breed in lowland regions More emphasis on permanent identification of heifers Pay greater attention to maintaining cows in milking herds for relatively lengthy periods |
| 7. Environmental management | a. High incidence of heat stress during the 24 hour periodb. High incidence of animal health problems due to poor shed hygienec. Reduced forage quality due to high temperatures and rainfall | Count respiration rates to quantify degree of heat stressPay closer attention to heat dissipation-Check shed design for ventilation-Consider artificial cooling (sprinklers and fans)Feed cows during the evening, when coolerConsider outside area for night time cooling and heat (cycling) observationsFeed better quality forages to reduce internal heat productionImprove shed hygieneRemove manure more frequentlyIsolate sick stockUnfortunately 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 |
| 8. Milk harvesting management | a. Poor milk composition (fat and protein contents)b. Poor milk quality (bacterial contamination) | Address any limiting feed nutrient deficienciesEnsure sufficient forage intake to maintain milk fat contentMaximise cow comfort so cows will maintain their appetiteImprove milking hygiene (hot water, detergent, sanitiser)Ensure machine milkers are operating effectively (short milking times, correct pulsation rate)Ensure rubber liners are correctly replacedAddress any mastitis problemsEnsure rapid milk coolingCould be a post farm gate issue hence outside farmer’s control |
| 9. Value adding milk | a. Poor milk returns | Consider value adding to improve unit milk returns |
| 10. Other on-farm constraints | a. The small farm size restricts development potentialb. Poor profitability of dairy farmingc. Low capital resources for investing in farm infrastructured. Poor dairy farming skillse. Underdeveloped entrepreneurial skills in dairy farmersf. Poor farmer-management dairy coop relationships | Dairy cooperatives could develop cow colonies (see next section)Quantify profitability over 6 to 12 month periodQuantify 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 incomeDilute fixed costs with higher farm cash throughputSeek alternative low interest loansInstitutional support to improve farmer trainingWork closely with potentially successful farmers to help develop these skillsProvide training in farm business management and developing farmer business skillsBecome more vocal to improve them  |