11

Introducing the concept of farm business management

This chapter presents a *modus operandi* for managing the day-to-day, medium and long-term operations of a successful and profitable dairy farm, small or large.

Dairy farmers are business managers, irrespective of the size of their milking herd. A successful business is based on a good understanding of the technology underlying the production of the end product, in this case raw milk, the ability to run the day-to-day operations at a profit and to make astute decisions regarding investments in its sustainable future. The scale of operation is generally limited by personal asset worth, but even smallholder farmers can make good financial returns on their dairy enterprise.

Smallholder dairy (SHD) farmers often do not have business support so have to learn, by trial and error, the best decisions to make relevant to their dairy enterprise. This chapter will provide them with a *modus operandi* on which to base their business decision-making processes. Large-scale dairy operations would generally have full-time administration staff with accounting skills to support the Farm Manager and senior management team.

Every day we all manage our personal assets when we make household business decisions at the shops, schools and in the wider community. It is the same with the dairy farmer when deciding on today's livestock feeding program, next week's crop agronomy program or the optimal herd size for next year's likely farm gate milk

price. Such decisions are based on the elementary frameworks of farm business management.

Most farmers intuitively think about farm costs and returns. However, greater use should be made of ways to make them become aware of the relative importance of all their financial inputs, in terms of their contribution to the cost of production (COP) per kilogram or litre of milk produced on the farm. In addition, when contemplating changes in their routine farm practices, such proposed changes should be appropriately costed to allow farmers to make more meaningful and timely decisions.

The performance and sustainability of any dairy value chain in the tropics depends on the continued supply of raw milk. Economic pressures, such as those experienced by dairy industries throughout Asia, require each farmer to be more aware of their individual COP. Without such skills, farmers cannot prioritise their management decisions to address the high cost items of their production systems.

In addition, better knowledge of farm business management allows support organisations to more clearly define the key drivers of profit on dairy farms. This information can be used to develop regional and national strategies for government departments and national dairy organisations, such as those overseeing the producer-driven dairy cooperatives, to routinely evaluate and update their industry policies.

For the sake of simplicity, the following discussion uses the male pronoun (he) rather than both gender pronouns (he and/or she). It is clearly understood that on many farms, business decisions are jointly made by the husband and wife team.

11.1 What is good farm business management?

So what encompasses good farm business management for dairy farmers? Makeham and Malcolm (1986) summarised the essence of successful small and largeholder farming in the tropics. Of the eight key areas of knowledge they listed, five utilise skills in business management.

They list these key areas, with the three non-business management areas in italics, as follows:

1. *Crop production and protection.*
2. *Animal production.*
3. *Machinery selection and maintenance.*
4. Economic aspects of farm management (COP).
5. Credit and finance.
6. Marketing.
7. Managing labour and communications.
8. Information gathering.

From lists such as this, a set of key task areas for good dairy managers can be developed, and within each task area progress can be quantified through developing a series of Key Performance Indicators (KPI). The following example list of key tasks are for three major management areas on any tropical dairy farm:

Production technology

- Prepare land then plant, fertilise, weed, water (in some situations) and protect the crop, likely to be a forage crop (see Figure 11.1).
- Harvest, store and market the crop (through livestock rather than in the marketplace) to get the best return with minimum waste.
- Feed animals properly, prevent disease outbreaks and recognise disease symptoms (see Figure 11.2).
- Achieve high reproductive and survival rates.
- Obtain or produce nutritionally correct feed at the optimum (generally lowest) cost.
- Provide the right housing for effective production, protection, hygiene and harvesting of the animal product (see Figure 11.3).
- Where machinery is involved, be able to choose the most appropriate types for the job, ensure they are properly maintained and serviced and, when necessary, find a good mechanic.

Figure 11.1: Throughout the tropical world, Napier (Elephant) grass is the fresh forage of choice for feeding dairy cows in large or small herds. This is a picture of Napier grass grown along the roadside in Kenya, with minimal fertiliser input, either from manure or urea.

Figure 11.2: Biosecurity is essential in the tropics because of the presence of so many wandering stock and contagious diseases. This is a picture of the truck tyre water bath at the entrance to a North Vietnam dairy feedlot.

Figure 11.3: Free stall sheds do not have to be large to be effective. This Vietnamese version is built for a smallholder's herd of just 6 milking cows.

People skills

- Have harmonious relationships with farm workers by giving them a reasonable amount of responsibility.
- Be interested in the welfare of people working with the farmer.

- Establish a clear chain of command so each person knows to whom they are responsible and so does not have several bosses telling them what to do.
- Set up a system of supervision to ensure the work done is of a proper standard.
- Create a system of communication and involvement, so that all know what progress is being made in achieving goals and objectives of the farm operation.

Business management

- Use specialist advisers to help analyse the important production and financial aspects of the farm business.
- Through appropriate records, and other relevant information, be able to work with an adviser to produce annual farm plans, together with budgets, aimed at producing as much food and money as they need or have the ability to do.
- Prepare plans of action in case of abnormal seasons and/or price.
- Plan well in advance so that all inputs are available when required, and in correct quantities.
- Prepare physical and financial reports at regular intervals that are timely, accurate, relevant, brief and clear for the persons who control the farm.
- Determine the most favourable forms of credit that can be obtained for different activities.
- Develop good honest working relationships with bankers, financiers or other credit managers.
- Be able to prepare realistic applications and finance budgets to obtain such credit.
- Have the ability to know when borrowings are too great to be repaid from farm income.
- Assess the different ways of preparing and selling the farm products.
- Work out the best way(s) of marketing (assembling, preparing, transporting, selling) to return the greatest long-term benefit.
- Be able to obtain relevant information on any problem quickly. Information sources could be other successful farmers, extension agents, private agribusiness companies, research workers, libraries, the internet, teachers and friends.
- Develop effective thinking and reasoning skills that should be combined with common sense and even mini 'trial and error' experiments.

11.1.1 Recording business data in the farm office

The importance of maintaining good farm records cannot be overstressed. This is much easier in a farm office. An area at home or in the dairy shed should be dedicated to keeping records. It must have a desk and good lighting for night-time work. It must be a quiet place to set up the office files (preferably in a filing cabinet) and computer (if the manager has or needs one) and office supplies. He will need a

system of storing and easily accessing all the financial paperwork. These include files relating to farm production (milk yields, veterinary reports, other stock and forage crop production data) and for each of the vendors (feed suppliers, veterinarians, cooperatives etc.), creditors, milk supply centre and any other farm-related agents. It is preferable to separate files from the dairy enterprise with those from other farm enterprises and it is important to separate these business files from any personal financial files. A file will need to be kept on unpaid bills. A simple recording system for payment of bills (with details of how it was paid) and confirmation receipts from sale of farm produce should be developed.

The 'how and when' of keeping farm records depends on the person recording them. Computers are very convenient but require money to purchase and skills to operate efficiently. As computers can break down, 'hard' (paper) backup copies should be routinely made. Record keeping should be given as high a priority as other farming activities, so it should not be 'put off' until the last job each day when simple bookkeeping mistakes can more easily be made. This topic has been further discussed in Chapter 7 at Section 7.1.

11.2 Breaking down costs and returns on dairy farms

The actual costs of producing milk on SHD and large-scale farms can be broken down into two major components:

1. Variable (or direct) costs that are directly related to the farm's milk output and so to the amount of variable inputs, such as fertilisers, purchased concentrate and forages, and herd costs.
2. Overhead (or fixed) costs that are not directly related to the amount of milk sold by the farmer, as they must be paid whether anything is produced. These include land rent, government land taxes, loan repayments and other finance costs, and living expenses. Labour costs can be categorised either as overhead or variable, but in this chapter all will be considered as overhead costs.

For the purpose of calculating the COP of milk, costs can be broken down into four categories, two variable and two overhead (Moran 2009a) as follows:

1. **Variable** costs. These are broken down to:
- herd and shed costs, to maintain the entire dairy herd and to harvest the milk
- feed costs, to feed the milking herd.

The more milk produced and the bigger the dairy herd, the greater these variable costs.

2. **Overhead** costs. These are broken down to:
- cash overhead costs which involve actual payments, such as for employed labour and interest on borrowed money, rates and other farm administration costs

- imputed overhead costs, or hidden costs because no cash changes hands. Family labour is the classic example where the farmer and his family work the farm but all too frequently don't pay themselves for their labour. Depreciation of farm equipment is another imputed cost that becomes obvious when the equipment must be replaced.

The question often arises, what is the farm manager worth to the business? The answer is either what he could earn if he spent that time being paid to do other work (that is the opportunity cost of his farm labour), or what it would cost to employ someone else to do his job. With regard to the latter, as it requires more skills to manage a large dairy herd (say 500 cows) than a small one (say 20 cows), the bigger the herd and the more complex the job, the greater should be the manager's/operator's allowance or imputed labour costs. This is rarely considered in Asian smallholder dairy farming.

This COP analysis includes finance costs on borrowed money. It is the choice of the farm business adviser as to whether interest on loans is included as a cost of producing milk on Asian smallholder farms. Because they can constitute a major cash outlay each year for smallholder farmers, they should be included in his annual financial commitments and future farm budget projections. Consequently, they have been incorporated into the following COP analyses. This decision highlights the importance of clearly describing the particular components of any financial analyses so the reader is clear as to exactly what is and what is not included in the final 'bottom line' measure of COP. Unfortunately, this is rarely the case, leaving the reader unsure as to how such data can be interpreted and importantly, compared with other COP estimates undertaken by other dairy farm management specialists, probably using different methodologies.

Fuel and oil are normally included in the feed costs although some farm economists consider repairs and maintenance of farm machinery as an overhead rather than a variable cost. It doesn't greatly matter as long as it is only included once.

As dairying is frequently just one of the enterprises on many smallholder farms, it is important to only consider the costs relevant to and the income generated from the dairy enterprise. Such apportioning of farm finances is often not easy because labour units, machinery and farm facilities are frequently used for a diversity of farm enterprises. In addition, if feed for any dairy animals (young stock as well as adult cows) is produced from a cropping enterprise on-farm, such as rice straw or maize stover, it should be given a cost to the dairy enterprise.

The total COP is then the sum of all farm costs included in Table 11.1 and Figure 11.4. Unfortunately one still finds published estimates of COP for SHD operations that do not include family labour and finance costs. These create a false assessment of the true costs of dairy farming and if used to base government

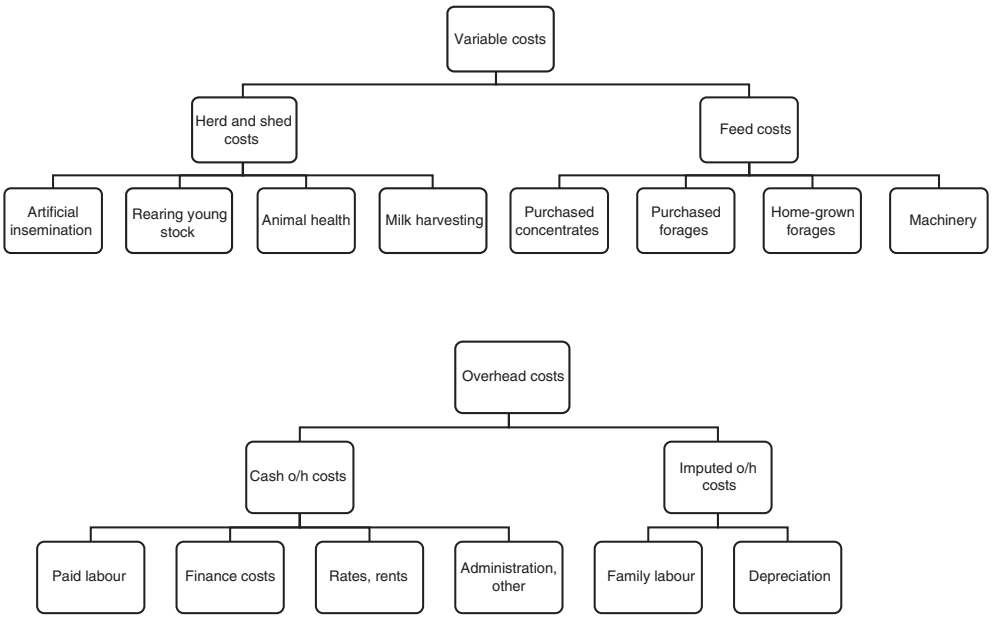

Figure 11.4: Farm costs for smallholder dairy farms.

policies for dairy development and even milk prices (as in some countries), they do not paint the true picture of the economics of smallholder dairy farming.

11.2.1 Quantifying farm profit

In order to improve profit, it must first be measured. Most farmers think of profit in terms of cash or money left over from income after deducting all the costs involved in earning that income. In other words, to them profit generally refers to some surplus of income over costs, or in economic terms, the difference between the gross income and the operating costs. This may be the simplest measure of profit, but it is not necessarily the best. Profit can be expressed in three ways.

1. Cash. Does the farm generate enough cash to pay the bills, repay the loans and reward the farmer for his work? This can be expressed by a range of indicators such as cash operating surplus, milk income less feed costs, milk gross margin or economic farm surplus.
2. Efficiency. How efficiently are the farm resources being used? For a general overview of the business performance, this is expressed as return on assets, however, for a more detailed assessment of what the farmer actually owns (namely his equity), a more suitable measure is return on equity.
3. Wealth creation. Does the farmer own more than he did last year? This is expressed as capital gains or more suitably as the difference between the two years' equity.

Table 11.1. Categorising farm costs and income on smallholder dairy farms.

Category		Details
Variable farm costs	Herd and shed costs	• Artificial insemination; inseminator, semen, drugs associated with reproductive management • Young stock; raw milk or calf milk replacer, concentrates and roughages and herd management to point of calving • Animal health; veterinarian visits, drugs, vaccines and drenches • Milk harvesting; rubber liners, detergents and sanitisers, maintenance of milking machines, hot water, transport to milk collection centre, cooperative commission
	Feed costs (for milking and dry cows)	• Purchased concentrates; formulated or ingredients • Purchased forages; grass, roughage by-products • Home-grown forages; fertilisers, irrigation, processing/ storage, weed and pest control • Machinery; fuel and oil, repairs and maintenance
Overhead farm costs	Cash overhead costs	• Paid labour • Farm rates • Farm administration and insurance • Finance costs; interest, bank fees • Other; such as telephone, professional advice, office equipment, postage
	Imputed overhead costs	• Family labour, such as operator's allowance • Depreciation
Farm income	Milk sales	• To milk collection centre or milk processor (formal marketing) • Direct to consumer or through milk vendor (informal marketing) • Consider value-adding milk
	Non-milk sales	• Sale of excess stock (bull calves) and salvage value from culled milking cows • Sale of forages • Sale of manure as fertiliser or biogas as energy source

Quantifying cash and non-cash profit

The simplest measure of cash profit is cash operating surplus (COS), which quantifies the sum of all the cash flows on the farm.

$$\text{COS} = (\text{farm cash income}) - (\text{farm cash costs})$$

Milk income less feed costs (MIFC) is a useful measure of cash profit because it is relatively easy to measure and provides a guide to how well the cows are being fed. It does not take into account the costs of feeding the non-productive stock on the farm, namely the dry cows and replacement heifers. MIFC is also called Feeding Profit.

$$\text{MIFC} = (\text{milk income}) - (\text{feed costs for milking cows})$$

Another way to quantify cash profit on dairy farms is using the milk gross margin (MGM). This calculates the income from milk sales less the variable costs to produce that milk.

MGM = (milk income) – (variable costs)

The most sophisticated methods to quantify farm profit, first uses non-cash farm income (changes in stock and land values) to calculate gross farm income (GFI) and then non-cash farm costs (imputed labour and depreciation) to calculate net farm income (NFI).

GFI = (Total farm cash income) + (changes in stock inventory)
NFI = GFI – (variable + overhead cash costs {excluding finance costs}) + (imputed costs)

Net farm income is also known as economic farm surplus (EFS) or operating profit. Operating profit does not include finance costs because these are the cost of acquiring the services of the assets used, and are not directly related to their performance. Earnings Before Interest and Tax (EBIT) is sometimes used as a measure of NFI, this being a relatively new term in farm management economics, and is defined as farm revenue less farm expenses before the payment of interest on loans and income tax.

There are three different descriptions of profit that require some explanation. *Operating profit* describes the return to all capital and, by removing finance costs, it becomes the return to the farmer's equity, so quantifies his *net profit*. Finally, subtracting his income tax from the net profit quantifies his *growth in equity* or addition to wealth.

Break-even milk price is another way of expressing farm profit. It is the indicative milk price required to cover the cash costs of production, but not principal repayments and any capital expenditure. It also excludes other farm income, just dealing with milk production. When compared to the farm gate milk price received, the difference provides a measure of the profit or loss incurred by the farmer on a per kg milk basis.

Quantifying change in farm efficiency

The term capital refers to all the production resources of the farmer. The most important are land, buildings, improvements (such as built-up soil fertility and irrigation), machinery, stock, fuel, labour management skills and credit. Many of these could be converted to cash by selling them. The cash sum available from their sale is the farm assets. After paying off any debts owed on the farm, they are the farmer's own capital, his net worth or his equity. Total assets are a good measure to compare the business performance of that farm with others of similar size of operation, however, a more meaningful measure for that farmer relates to his total equity in the farm.

The market value of the total resources on the farm is sometimes known as the total capital of the farm. This is calculated by summing the market value of the land, improvements and animals, plus the machinery and feed reserves. With the numerator net farm income, return on assets (ROA) is calculated as follows:

$$\text{ROA (\%)} = \frac{\text{Net farm income}}{\text{Assets}} \times 100$$

This calculation takes no account of debts owed so quantifies the earning rate of the total bundle of resources employed in the business. In practice, the farmer has to manipulate the total resources under his control, not just those that are debt free. ROA provides a guide to those responsible for the use of capital (this could be an individual, a cooperative or a government department). It also allows the performance of this capital, invested as it is, to be compared with alternative possible investments.

As the farmer probably does not own all the farm assets, he is more interested in how efficiently he is using his own assets. The farmer's equity is calculated by adding the market value of all the resources he owns then subtracting it from a total of all the money he owes (his liabilities). Equity, expressed in monetary terms quantifies the net worth of the farmer. However, it is usually expressed as a percentage, calculated as follows:

$$\text{Equity (\%)} = \frac{\text{Assets} - \text{Liabilities}}{\text{Assets}} \times 100$$

Expressing the farm's annual profit, after paying interest and taxes, as a percentage of this capital is one measure of the effectiveness of the management of the farm's resources. As the calculation does not take into account any debts, it must also exclude the finance costs associated with these debts. The return on equity (ROE) is then calculated as follows:

$$\text{ROE (\%)} = \frac{\text{Net farm income} - \text{finance costs}}{\text{Resources owned}} \times 100$$

The ROE measures the farmer's effectiveness as a combination of annual inputs such as labour, irrigation, fertilisers, machinery and other resources used to operate his dairy enterprise. It also quantifies the rate of earning of his capital committed to his farm relative to the rate of earning if it were used in some other income-generating enterprise.

Calculating his ROE shows the farmer how efficiently he is running the annual operations of his farm business. If it is very low, the farmer should consider alternatives by asking the questions:

- Can he increase his ROE by using better farming methods, borrowing extra money to improve production or diversifying his farm enterprises?
- Should he transfer his capital from this farm and move to a different locality where the ROE is likely to be higher?

- Should he sell up and move into another form of investment?
- Is his ROE low because there has been a large increase in the value of his assets?
- Should he use his increased equity to borrow more money to further develop his farm and earn more income?

The more rapid the annual increase in asset worth, the more difficult it is to maintain a constant ROE. An increase in asset value provides more collateral against which to borrow to invest in the operation to increase farm income. It can also mean an increase in land tax, hence greater farm costs.

Farm profit can be quantified in various ways (see Chapter 11 of Moran 2009a). These are presented as a flow chart in Figure 11.5.

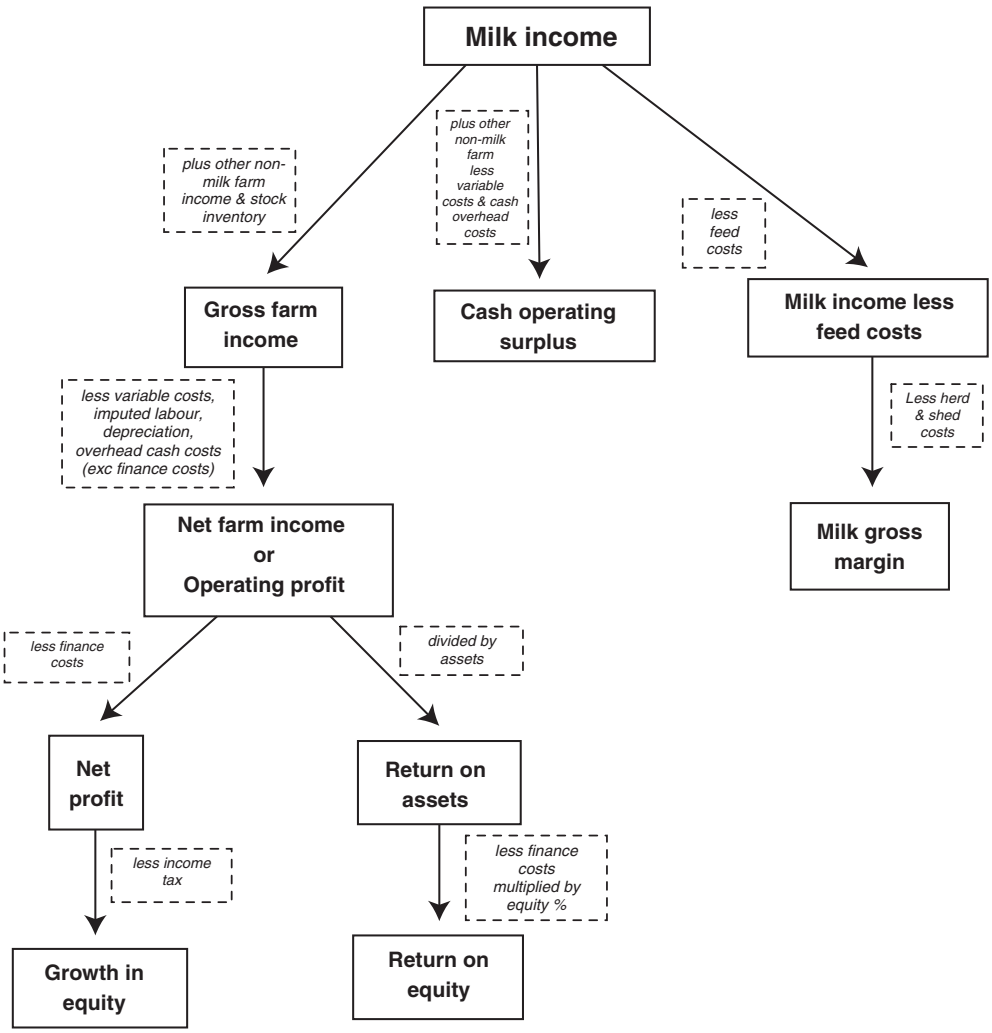

Figure 11.5: Flow chart of measures of farm profit on dairy farms.

11.2.2 Questionnaire for farm business analyses

Appendix 3 contains a questionnaire for the collection of farm data to calculate a full COP calculation and subsequent profit analysis on any farm, large or small. In addition to the necessary data on costs and returns on the farm, the questionnaire includes other useful questions on specific aspects of the farm management.

11.3 A case study of the herd dynamics and farm profits achievable on smallholder dairy farms in Malaysia

11.3.1 Impact of cow milk yields on farm profits

Farm production and business performance data were collected from 30 dairy farms in Peninsula Malaysia during September 2012 by Moran and Brouwer (2013a). Observations of the stock, cowshed, farm facilities and forage production area were made to assess current farm practices and the general state of the stock and the supporting dairy infrastructure. Farmers were interviewed about key aspects of their farm management, the costs of farm inputs and their herd performance to develop a series of KPIs. The business focus covered specific aspects of milk returns and feeding management to calculate total feed costs, feed efficiencies and farm profits. Gross farm profits were calculated, including and excluding imputed labour costs. The farms were split into three groups to quantify the impacts of farm management on cow milk yields and farm profits. The key data findings are summarised in Table 11.2. The unit of currency in the table and following discussion is the Malaysian ringgits or MR, which in September 2015 had an exchange rate of 4.25 MR/US$ or 3.05 MR/A$.

Herds with higher average milk yields contained a greater proportion of adult cows and replacement heifers. The milking cows had higher feed intakes and higher ration quality while the cows had higher feed efficiencies in that they converted more of their feed into saleable milk. Even though the farmers spent more money on feeding their milking cows better, these more productive herds yielded greater feeding profits from milk sales and they had lower costs of unit milk production. The efficiency with which these farmers utilised the farm assets (both gross assets and assets that they actually owned) increased as the cows produced more milk.

The survey provided many valuable insights into why some farms are productive and profitable and why others are not. In essence, higher per cow milk yields and farm profitabilities were recorded on farms that were better equipped and better managed. The more productive and profitable farmers had more reliable electricity and water supplies, provided specific calving down areas, did not graze

their milking cows and did not suckle their calves on milkers. In addition, they used artificial insemination rather than natural mating, used calf milk replacer as part of their milk-rearing program, routinely used dry cow therapy as part of the mastitis control program, kept farm records and had fewer problems with mastitis, lameness and young stock rearing. More of the cows on the most profitable farms had high peak milk yields and fewer had short lactations. Although they invested more in feeding for their milking cows, the resultant greater feed conversion efficiencies on these farms yielded higher feeding profits and higher returns on total farm assets and equities.

Table 11.2. The impact of herd average daily milk yield on farm performance and business data of 30 farms in Peninsular Malaysia. The farms are grouped into either A, B or C (10 farms per group) based on increasing per cow milk yields.

Farm data	A	B	C	Sig
Herd average daily milk yield (kg/cow/d)	7.5	9.7	12.4	*
Size of milking herd (cows)	22	48	27	
% milking cows in adult herd	49	53	61	
% replacement heifers	47	73	80	*
Dry matter intake (kg/milking cow/d)	10.8	12.4	14.6	*
Ration metabolisable energy content (MJ//kg DM)	8.1	8.5	9.0	*
Ration crude protein content (%)	11.6	12.1	12.3	
Feed conversion efficiency (kg DM/kg milk)	0.70	0.82	0.87	*
Total feed costs for milkers (MR/cow/d)	7.44	8.75	11.41	*
Total feed costs as % milk income	78	76	49	*
Milk income less feed costs for entire herd (MR/kg milk)	0.53	0.57	1.24	*
Gross farm profit (MR/kg milk)	–2.01	–0.75	–0.05	*
Cost of production (MR/kg milk)	4.77	3.53	2.82	*
Feed costs (% total farm costs)	38	40	43	
Return on assets (%)	–0.6	–0.4	0.1	*
Return on equity (%)	–0.9	–0.5	0.1	*

MR, Malaysian ringgits.
* Significant difference between herds.

Cowshed designs were generally poor in that roofs were low, shed hygiene had much that could be improved and fans and cooling sprinkler systems were virtually non-existent on any of the 30 farms. In addition, many of the farms suffered from a lack of productive cows in their herds. Future herd management must concentrate on improving reproductive performance and in some instances, reducing young stock mortality as well as improving the nutritional status, hence performance, of the milking herds. Of the 30 farms surveyed, only eight had positive gross farm profits, although this increased to 18 farms if farmers excluded their family labour from the costs of milk production.

11.3.2 Financial benefits of improving herd and feeding management on Malaysian dairy farms

One of the best ways to encourage farmers to consider ways to improve their current management is to demonstrate the economic benefits from such practice changes. Below are five examples (Moran and Brouwer 2013b) of such savings, calculated from economic data derived from this Malaysian survey.

1. Reducing age at first calving by 6 months (from 33 to 27 months)
   Additional income: For a milking cow, milk income less feed costs is RM 1.45/kg milk or RM 14.50/d for a milking heifer producing say 10 kg/d or RM 2610 over 180 days.
   Additional costs: Daily feed costs for a milker is RM 9.20/d while for a yearling, it is RM 2.46/d, or RM 6.74/d difference. Over 180 days, this amounts to RM 1213.
   Net profit: RM 2610 additional income less RM 1213 additional costs amounts to **RM 1397**/heifer profit when calving 6 months earlier.

2. Reducing calving interval by 3 months (from 17 to 14 months)
   Additional income: For a milking cow, milk income less feed costs is RM 1.45/kg milk or RM 17.40/d for a milking cow producing 12 kg/d or RM 1566 over 90 days.
   Additional costs: Daily feed costs for a milker is RM 9.20/d while for a dry cow, it is RM 4.54/d, or RM 4.66/d difference. Over 90 days, this amounts to RM 419.
   Net profit: RM 1566 additional income less RM 419 additional costs amounts to **RM 1147**/cow profit when calving 3 months earlier.

3. Increasing the lactation length by 2 months (from 8 to 10 months)
   Additional income: For a milking cow, milk income less feed costs is RM 1.45/kg milk or RM 17.40/d for a milking cow producing 12 kg/d or RM 1044 over 60 days.
   Additional costs: Daily feed costs for a milker is RM 9.20/d while for a dry cow, it is RM 4.54/d, or RM 4.66/d difference. Over 60 days, this amounts to RM 280.
   Net profit: RM 1044 additional income less RM 280 additional costs amounts to **RM 764**/cow profit when milking for an additional 2 months.

4. Reducing the costs of calf rearing by replacing raw milk with calf milk replacer (CMR)
   CMR powder costs RM 6720/t and makes 7690 L CMR solution (at 130 g/L solution), therefore, costs RM 0.87/L solution. Raw milk sells for RM 2.40/kg or RM 1.63/kg more. For a milk-fed calf fed 2kg/d of milk for 12 weeks (or 84 days), using CMR provides **RM 274**/calf savings.

5. Reducing the costs of calf rearing by replacing calves suckling cows for 9 months cost with 4 months of feeding CMR

   From 4 above, CMR costs RM 0.87/L solution compared to RM 2.40/kg for raw milk. Assuming a suckling calf will drink 3 kg raw milk/d for 9 months, or 810 kg over 9 months, this costs RM 1944/suckling calf. By rearing the same calf on 2 L/calf/d of CMR solution and weaning it at 4 months, total CMR costs are RM 146/calf. The daily feed costs of yearlings are RM 2.46/d or RM 369/weaned heifer over 5 months (although this would be for yearling heifers). Total feed costs are then RM 515/CMR reared calf versus RM 1944 for the suckling calf, or **RM 1429**/calf savings. There may be a difference in live weight at 9 months of age between these two calves because of their vastly different rearing programs.

The economic data generated in farm surveys such as this one in Malaysia provides ideal opportunities to more objectively assess how improvements in farm management can be better quantified in terms of improved farm profits.

11.4 A case study of the Feeding Profits achievable on a large-scale intensive dairy farm in Indonesia

Intensive feedlotting of dairy cows is an expensive exercise, but when well managed, it can be very profitable. Once the facilities have been constructed, the stock acquired, the feeding systems developed (that is establishing the forage production area and the logistic of sourcing the ration ingredients) and the day-to-day feeding and herd management set in place, well-fed dairy cows will definitely return a profit. However, to develop a production system up to this point takes several years and a big financial investment. Thereafter cash flows will become positive so the initial investment will be recouped. Once the system has reached some degree of stability, with regard to cow numbers and milk throughput, hence positive cash flows, that is the most appropriate time to assess its long-term profitability.

From the previous section, profitability was quantified in various ways, such as return on investment, net farm income, cash operating surplus, milk gross margin or milk income less feed costs (or feeding profit). The following case study uses Feeding Profit as the measure of profitability. It is based on a large-scale intensive dairy feedlot in Indonesia. For this exercise, the Indonesian unit of currency is the rupiah (Rp) which had an exchange rate in Sep 2015 of 14 300 Rp/US$ or 10 373 Rp/A$.

11.4.1 Describing the farm and the stock

Prior to assigning costs and returns in this case study, a series of assumptions have been made describing the large-scale intensive dairy farm. These were:

- The farm was an established one with a stable number of livestock and an established source of regular forage supplies.
- It is located in the tropical highlands of East Java in Indonesia where the temperatures and humidities are not too stressful for the milking herd.
- The milking herd consists of 400 purebred Friesian cows made up of 100 cows in their first, 100 cows in their second, 100 cows in their third and 100 cows in their fourth lactations.
- Each 410-day entire lactation was split into four phases, namely 110 days in early, 110 in mid, 110 days in late lactation and 80 days dry.
    - ➤ During their 110 days of early lactation, cows were non-pregnant, losing 0.2 kg/day live weight and produced 125% of their average daily full lactation milk yield.
    - ➤ During the 110 days of mid lactation, cows averaged 1 month pregnant, maintained their live weight and produced 104% of their average daily full lactation milk yield.
    - ➤ During their 100 days of late lactation, cows averaged 5 months pregnant, gained 0.2 kg/day live weight and produced 78% of their average daily full lactation milk yield.
    - ➤ During the 80 days dry period, cows averaged 8 months pregnant.
- For cows at different ages:
    - ➤ First lactation cows weighed on average 500 kg and produced 4000 L milk over the 330 days, or 15.6, 13.0 and 9.7 L/day respectively in early, mid and late lactation, with a rolling herd average of 12.8 L/day.
    - ➤ Second lactation cows weighed on average 550 kg and produced 5000 L milk over the 330 days, or 19.5, 16.2 and 12.2 L/day respectively in early, mid and late lactation, with a rolling herd average of 16.0 L/day.
    - ➤ Third lactation cows weighed on average 600 kg and produced 6000 L milk over the 330 days or 24.4, 19.4 and 14.6 L/day respectively in early, mid and late lactation, with a rolling herd average of 19.2 L/day.
    - ➤ Fourth lactation cows weighed on average 600 kg and produced 7000 L milk over 330 days or 27.4, 22.8 and 17.1 L/day respectively with a rolling herd average of 22.4 L/day.
- For calculations on feed energy requirements, the milk contained 3.6% fat and 3.0% protein. Its initial unit sale price was 5500 Rp/L. Following value-adding, a second assessment of Feeding Profit was made with milk valued at 6500 Rp/L.

Actual farm data were collected on the local Indonesian costs and the nutritive values of the most common feeds likely to be fed in an intensively managed

feedlot dairy in East Java. These have been called the 'preferred feeds' because they were assumed to initially form the basis of the feeding program at the dairy feedlot. Table 11.3 presents the assumed costs and nutritive values of these preferred feeds.

Table 11.3. Unit costs and nutritive value of preferred feeds for Indonesian intensive dairy system.

Feed category	Preferred feed	Unit cost (Rp/kg fresh)	DM (%)	ME (MJ/kg DM)	Crude protein (%)	NDF (%)
Forage	Young Napier grass*	250	16	8	12	60
	Maize silage*	600	28	9	8	50
	Rice straw	250	90	5	6	80
Energy rich	Formulated concentrate*	4000	90	12	16	25
	Maize grain*	3100	90	13	10	10
	Molasses	2700	79	13	4	1
Protein rich	Soybean meal*	6000	90	13	45	15
	Wheat pollard*	1700	90	12	15	30
	Brewers grain	800	22	10	25	55
Additives	Limestone*	500	100	–	–	–
	Salt*	1500	100	–	–	–
	Vitamin/mineral mix*	8000	100	–	–	–

* Feeds used in the following farm financial analyses.
Rp, Indonesian rupiah; DM, dry matter; ME, metabolisable energy; MJ, megajoules; NDF, neutral detergent fibre.

11.4.2 The Feeding Profit for milking cows

Using international nutrient requirements and feeding tables for milking cows (previously discussed by Moran 2005), various scenarios were developed of intensive feeding systems for dairy cows of different ages, live weights (LWT) and lactation milk yields. This allowed the calculations of how much of these 'preferred feeds' were required to form nutritionally balanced rations to achieve target daily milk yields at any particular stage of lactation. The calculations also took into account changes in the cows' body reserves (hence their LWT) and the growth of the foetus during pregnancy. The conventional way to quantify lactational changes in daily nutrient requirements of milking cows is to divide the lactation cycle into the four phases described above. The calculations were then based on cows with four ages or LWT and producing different volumes of milk in each of the three milk-producing stages of lactation.

The nutrient requirements and quantities of feeds required per cow per day were calculated from a computer program developed by the senior author called INDOFEEDPROFIT. This program is freely available to interested readers.

Computer programs for ration formulations (INDOFEEDPROFIT and INDOFARMPROFIT)

Several years ago, the senior author developed a computer program to calculate Feeding Profit. INDOFEEDPROFIT is a simple Excel spreadsheet in which the operator:

- Specifies the type of cow; namely its live weight, stage of lactation, pregnancy status, milk yield, milk composition and any changes in live weight over time.
- Develops a database of up to 17 feeds, with for each feed, its unit price in Indonesian rupiah (or any other selected foreign currency unit) and contents of dry matter (DM), metabolisable energy (ME), crude protein (CP) and neutral detergent fibre (NDF).
- Formulates a ration describing the number of kilograms fresh weight of each selected feed to provide sufficient nutrients to satisfy the cow's demand to achieve that predetermined level of cow production.
- Given the unit milk return (in this case 5500 Rp/L then 6500 Rp/L), the program then calculates the total feed costs, the total milk returns, hence derives the Feeding Profit for that scenario, in local currency units.

A second Excel spreadsheet, called INDOFARMPROFIT, was developed to summarise the INDOFEEDPROFIT various scenarios, based on the Table 11.3 'preferred feeds' ingredients, for both the milking cows and the growing heifers.

The programs allowed the selection of certain weights of fresh feeds and their formulation to provide sufficient ME then calculated the protein and NDF contents for each ration. The target protein contents were 16–18% in early, 14–16% in mid, 12–14% in late lactation and 10–12% during the dry period. The target NDF contents are 40% throughout lactation. Maximum DM intakes are based on 3% LWT, equivalent to 15 kg/day in first, 16.5 kg/day in the second and 18.0 kg/day in the third and fourth lactations. INDOFEEDPROFIT calculated the daily cost of each ration, then the associated Feeding Profit.

To ensure adequate roughage supplies in the ration, the amounts of maize silage and Napier grass were maintained at 10 and 20 kg/cow/day respectively during lactation and 10 and 30 kg/cow/day respectively during the dry periods. The allocations of energy sources, namely formulated concentrate and maize grain, varied from 2 to 6 kg/day and from 1 to 2.5 kg/cow/day respectively, with more being fed to the older, higher yielding cows. The allocation of protein sources, namely soybean meal and wheat pollard, varied from 1.5 to 2.5 kg/cow/day and 1 kg/cow/day respectively, to maintain protein levels at 15 to 16% throughout lactation to guard against possible protein deficiencies adversely affecting cow performance. The total feed costs also took into account the inclusion of additives

in the ration, at the rate of 1.8% of the DM and costing on average for all the additives, 3360 Rp/kg. The resultant data are summarised in Table 11.4.

Table 11.4. Changes in average daily intake, feed costs, milk incomes and feeding profits of cows at different ages and stages of lactation in an Indonesian intensive dairy system. Calculations for entire lactation take into account the 80-day dry period.

Lactation	Stage	DM Intake kg/day	Feed cost 000 Rp/day	Milk income 000 Rp/day	Feeding profit 1 000 Rp/day*	FCR kg milk/kg DM intake	Feeding profit 2 000 Rp/day*
First	Early	12.3	40.1	85.8	45.7	1.25	61.1
	Mid	11.4	35.5	71.5	36.0	1.12	48.9
	Late	10.9	33.1	53.3	19.9	0.87	29.5
	Entire	**11.1**	**31.9**	**56.5**	**24.6**	**0.94**	**34.7**
Second	Early	14.8	46.3	107.2	61.0	1.29	80.3
	Mid	13.9	42.2	89.1	46.9	1.14	62.9
	Late	13.0	38.8	67.1	28.3	0.92	40.4
	Entire	**13.1**	**36.7**	**70.7**	**33.9**	**1.00**	**46.7**
Third	Early	16.6	54.4	128.7	74.3	1.38	97.5
	Mid	15.7	50.3	106.7	56.3	1.21	75.6
	Late	14.3	44.7	80.3	35.6	1.00	50.0
	Entire	**14.5**	**42.9**	**84.7**	**41.8**	**1.08**	**57.1**
Fourth	Early	17.9	61.5	150.7	89.2	1.50	116.3
	Mid	17.0	56.5	125.5	68.9	1.32	91.4
	Late	15.2	47.9	94.0	46.2	1.11	63.1
	Entire	**15.5**	**47.2**	**99.3**	**52.1**	**1.19**	**69.9**

* Feeding profit 1 calculated for 5500 Rp/L milk return, Feeding profit 2 for 6500 Rp/L milk return.
DM, dry matter; FCR, feed conversion ratio.

Table 11.4 presents average daily data for the various ages and levels of milk production. It also presents average daily data for entire lactations, taking into account the dry period. In addition, it presents a measure of feeding efficiency called Feed Conversion Ratio or FCR, which is the amount of milk produced from each kg of feed DM consumed. It is also assumed that heifers first calved down at 28 months of age with calving intervals averaging 13.7 months, and were culled after four lactations at 6.9 years of age.

Clearly there is considerable money to be made from intensively feeding and managing cows in Indonesia, following the establishment period of such a new intensive dairy venture. Granted the Feeding Profit does not take into account all production costs but dairy specialists usually consider that feed accounts for 70 to

80% of the variable costs of such a system. At 5500 Rp/L milk return, the Feeding Profit increases from 25 000 to 52 000 Rp/cow/day as cows progressed from their first to their fourth lactations, while at 6500 Rp/L milk return, this increases from 35 000 to 70 000 Rp/cow/day. Once the system has stabilised, each milking cow then returns an additional 9 to 25 million Rupiah per lactation, depending on her unit milk return and lactation number. This is equivalent to Feeding Profits of 650 to 1800 US dollars per cow per lactation respectively.

These data highlight another very important point, **namely you get back in milk what you feed out in the trough.** Under such feedlot systems, cows fed only 11 to 12 kg/day of DM will only produce 4000 L over a full lactation, which means their highest milk yield is likely to be only 15 L/day with a rolling herd average of only 12 or 13 L/day. To achieve 5000 L over a full lactation requires feeding 12 to 15 kg DM/day while 6000 L requires 14 to 16 kg DM/day and 7000 L requires ensuring milking cows can access 15 to 18 kg DM each and every day. All too often, managers of conventional 'high input' dairy cow systems in the tropics can only achieve milk yields of 12 to 14 L milk/day in their cows purely and simply because they do not provide enough dry matter for their forever hungry milking cows. There are other factors in this, such as poor quality fodder (thus reducing potential appetite due to slow rates of feed passage through the stomachs), poor young stock management (thus producing stunted heifers) and lack of attention to cow comfort (namely providing a comfortable soft bed for cows to relax on and ensuring adequate shed ventilation).

11.4.3 Feed costs for rearing heifer replacements

For simplicity, young stock in this case study were fed on a mixture of Napier grass, maize grain and soybean meal with a target growth rate of 0.57 kg/head/day throughout their growing phase. Increasing amounts of Napier grass were fed as they grew (from 8 to 20 kg/head/day), as with maize grain (from 1.6 to 5 kg/head/day) and cottonseed meal (from 0.2 to 0.6 kg/head day). The protein content was maintained at 16% until they reached 6 months of age, after which it was reduced to 12%. They are being managed to conceive at 15 to 18 months of age.

Table 11.5 presents the feed intakes and costs to achieve 0.6 kg/head day growth rates from replacement heifers. This clearly shows that for an investment of only 10 000 to 23 000 Rp/head/day, dairy replacement heifers can be fed and managed to become productive highly productive milking cows. Furthermore, it is important to have heifers calving down at 24 to 27 months of age, rather than the 30 to 33 months of age that is all too common in tropical dairy systems, even the supposedly intensive ones.

Table 11.5. Live weights, feed intakes and feeding costs of dairy heifers growing at 0.57 kg/day.

Stage	Age (months)	Live weight (kg)	DM intake (kg/day)	Feed cost (000 Rp/day)
Weaned	3–6	141	3.6	10.6
	6–9	194	4.1	10.4
	9–12	246	4.9	12.1
	12–15	298	5.9	13.9
Pregnant	15–18	349	6.6	16.1
	18–21	402	6.9	16.7
	21–24	450	7.4	19.2
	24–28	502	8.5	23.5

The major conclusion that can be reached from the above case study is that well-managed, intensive dairy systems can be very profitable in humid tropical countries such as Indonesia.