16 Welfare and Health Challenges of 'New Entry' Dairying: a Practitioner's Perspective

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Contents

Abstract

In recent years, increasing household incomes and urbanisation, particularly in Asian countries, have resulted in a greater consumption of dairy products. This

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demand has led to a major expansion in a number of small-scale dairy farms and the development of many large-scale farms. However, in some cases, the appropriate expertise was not in place, leading to a number of major cow welfare issues. This chapter focuses on welfare issues in new entry cattle farming development, especially in countries or regions that are not traditional dairy farming areas. The effect of drivers such as market pressures, implementation of development programmes and social constraints will be discussed. The cow welfare problems that occur in new large-scale and small-scale dairy systems are different. In new large dairy systems, the issues are mainly due to poor feed supply planning, poor building design and poor management of staff and resources. However, most welfare issues in new small-scale developments arise from the adoption of traditional animal housing system design and practices. Each area of animal management is discussed in detail in this chapter, with a focus on health and welfare management including housing, ventilation, feeding, watering and disease and health management across all ages of dairy cattle.

Keywords

Cattle welfare · Cattle nutrition · Developing country · Traditional practices · Foreign aid

16.1 Background

Increasing household incomes and urbanisation in recent years has driven a rise in disposable income, resulting in greater consumption of more expensive protein sources derived from animals, with milk and dairy products being important components (Fuller et al. 2005; OECD-FAO 2022). This is particularly true across the Asian countries, but with particularly marked increases in milk consumption and production in both Vietnam and China (FAO 2009; Fuller et al. 2005). To meet this demand, there has been a corresponding major increase in the number of dairy cows and milk production in these areas (FAO 2009). In some cases, the demand has been met by the construction of large-scale dairy farms, but in other cases, an increase in the number of small-scale family-owned dairies.

However, rapid increases in the number of cows and dairy farms bring many challenges, particularly in countries like China, where dairying and milk consumption in the local population was uncommon before the 1990s (Fuller et al. 2005), and so there is little experience of dairy farming. Dairy farm management is complex, with high-producing dairy cattle requiring managers to have an exceptionally good understanding of feed and nutrition, managing cow body condition, managing the effects of environmental conditions and cow husbandry, comfort and health. In the author's opinion, based on personal experiences in the dairy industries of Britain, Germany, Australia, China, India, Southeast and Central Asia, most experienced farmers are committed to ensure that good animal welfare is achieved, mainly from an animal care perspective. Good dairy animal welfare and health is associated with low stress levels in animals and farmers, and where farmers are rewarded for maintaining good welfare standards, it generally results in higher production and lower costs. However, welfare issues in new entry dairying system developments are mainly the consequence of inexperience in dairy system design, planning, nutrition and appropriate animal management for the region or at the level of production required.

A fundamental issue is that the cows in poorly designed, and managed systems are likely to experience chronic stress (Grelet et al. 2022). Moberg (2000) described chronic stress as occurring when an animal experiences a series of acute stressors whose accumulative biological cost forces the animal into a pre-pathological or pathological state. Chronic stress is very common in many new entry small-scale dairy systems that have little or no cattle experience and rely on local tradition. These stressors include poor nutrition, lack of adequate drinking water, poor staff training in cow husbandry, inadequate facilities to ensure cow comfort, poor disease management and heat stress. Factors such as heat stress and lack of availability of water will result in low voluntary feed intake (VFI) which will result in poor milk production, loss of body condition and consequently low immune responsiveness and increase susceptibility to disease (Kadzere et al. 2002). Poor human-animal interactions can also affect fertility and disease susceptibility (Dobson and Smith 2000; Ivemeyer et al. 2011).

This chapter will start by discussing some of the more global or regional issues that affect cow welfare. The specific issues affecting large- and small-scale dairies will be identified. The housing, management and health issues surrounding mature cows, calves and heifers will then be discussed.

16.2 General and 'Global' Issues

There are a number of wider societal and international issues that have a general influence on the way that new entry dairy farms are constructed and managed, and which have a direct or indirect effect on cow welfare.

16.2.1 Intensification

Intensification in agriculture can be defined as a situation where there is an increase in volume of outputs resulting from higher-grade inputs with an accompanying reduction in other inputs such as labour or time (FAO 2004). Intensification is often seen as a solution to the need to increase agricultural productivity in the face of greater consumer demand. In the dairy farming context, intensification is typically characterised by increasing animal numbers, a drive towards higher milk yields and the adoption of practices that reduce labour costs and increase farm outputs (Alvarez et al. 2008). However, the implementation of these practices often results in more stress on the cattle and people, resulting in poor welfare outcomes.

16.2.1.1 Stocking Density

In an attempt to increase milk output in response to rapidly growing demand, some farms have responded by simply increasing the number of cattle in an existing unit. Increasing cattle numbers in existing farms, both in pasture-based and housed systems, often leads to poor welfare outcomes (Rushen 2017). For example, in Australia, many pasture-based farms recently purchased by one large foreign company have recently come under scrutiny for poor welfare outcomes. The animals were overstocked, underfed and suffered from poor body condition, reflecting a lack of appropriate farm and animal management. In general, when standards of management, health and welfare are good, and cows are fed well, fewer cattle can be kept and still have the same overall farm-level milk production and with lower costs, compared to a farm with large numbers of inefficient cattle.

16.2.1.2 Breed Selection

Many new entrant dairy farms, particularly the large-scale farms, choose the Holstein Friesian (HF) breed of cow because they have the potential for high milk production in intensive systems in temperate climates. This choice of breed has also been made on many northern Australian dairy farms. However, in the hot and humid conditions of the tropics, many of these cows will suffer from heat stress and have poor production, fertility and health (Dairy Australia 2019; Kadzere et al. 2002). This issue is discussed at greater length in Sect. 16.4 (Welfare Challenges).

16.2.1.3 Management Practices

Intensification can result in management practices that compromise cow welfare. These include tail docking to improve operator comfort and calving induction to meet market milk requirements. These were common practices in the Australian dairy industry until recently. However, these practices are now being phased out in Australia. Dehorning of adult cows is now also being phased out in favour of disbudding of young calves with less adverse welfare outcomes. Grazing management systems can also compromise cow welfare. Many farmers using an intensive pasture-based dairy farming system in New Zealand maintain their cows at a relatively low body condition score to encourage good grass utilisation. This is accepted as being normal practice in New Zealand, but many international experts consider these cows to be in chronically poor condition.

16.2.2 Importation and Transport

Many breeding cattle are transported internationally, to develop new dairy farms or expand current dairy systems. The international sea and land transport of live cattle, especially in tropical conditions, has sometimes resulted in poor cattle welfare outcomes during and following transit (Phillips and Santurtan 2013; Hing et al. 2021). This is often related to poor ventilation, heat stress, poor staff training and poor husbandry in sea transport (Phillips and Santurtan 2013). Poor welfare outcomes occur in land transport due to overcrowding and travelling long distances without breaks (EFSA AHAW Panel 2022). Inadequate access to feed and water is a problem in both land and sea (Hing et al. 2021). This is especially the case with sea transit of well-conditioned beef cattle and meat sheep for slaughter in the destination countries, especially when crossing the equator at sea. Poor health and welfare outcomes have also been observed with international transport of breeding dairy and beef cattle. This has sometimes resulted in deaths in transit, mainly from heat stress. Many countries also import pregnant heifers in mid to late gestation, to gain maximum genetic material (i.e. gaining both a cow and a calf), often resulting in abortion and subsequent loss of condition after arrival. Australia has implemented a monitoring system, where government veterinarians must accompany and monitor each sea shipment of live animals (Commonwealth of Australia 2021). New Zealand has now banned the sea transport of live cattle, and Australia is restricting the transport of female cattle more than 190 days pregnant (Commonwealth of Australia 2021).

16.2.3 Market Pressures

Achieving a reliable daily quantity of milk to supply a local liquid milk market often drives new dairy systems to utilize high-producing breeds that are unstainable in their local conditions, especially in tropical Asia (as outlined above and discussed further below). Many large-scale new entry farming systems are developed by inexperienced investors, who underestimate the amount of high-quality feed and level of staff training and experience required to achieve the desired production level in high-yielding breeds. This often results in welfare problems. This is especially evident when attempting to produce a consistent daily supply of drinking milk throughout the year, especially when feed supply is seasonally influenced. This happens, for example, when forage quality is poor in summer in the tropics or during severe winters in more temperate regions. This often results in undernutrition and poor welfare and productivity in large new farms that have not planned well for these feed supply fluctuation scenarios.

16.2.4 Government and Nongovernment Organisations' (NGOs) Cattle Industry Development Programs

Many of these programs have been focused on quickly improving milk supply within the host country, without a comprehensive understanding of the resource requirements and potential risks. Some have been highly successful; however, a number of these programs in Central Asia, South-eastern, Southern Asia and elsewhere have recently caused significant welfare issues and deaths of animals, due to lack of feed, heat stress and poor farmer husbandry knowledge. These issues have generally been due to lack of planning by the importing country authorities and the NGOs. It has typically involved importing high-producing North American or Western European cattle breeds into environments that are unsuitable for them. There is also often little emphasis placed on the supply and cost of appropriate feed, as well as a lack of farmer training in the level of husbandry needed for the imported cattle that have a high genetic merit for milk yield. This is usually the result of the importing governments wanting to achieve a rapid change in cattle productivity through importation, rather than focussing on improving their current cattle over time, using appropriate cross breeding through importation of semen. A recent example of a government-funded project in Sri Lanka resulted in many cattle starving to death, due to insufficient feed and poor feed availability and poor farmer understanding of appropriate animal husbandry practice.

16.2.5 Social Constraints

What is accepted as good welfare practice in one country or community may not be considered necessary in another. The commonly quoted example is the Indian situation where cows are considered sacred. This means that older cows cannot be culled or slaughtered, and so these animals and many unwanted male calves, find their way onto the streets and become feral (see Chap. 14). Feral cattle in India are often fed scraps by the general public and survive this way. Many are now taken into cow shelters (Gaushalas) (see Chap. 14 for more detail), which are mainly supported by charities and government funding. Euthanasia of injured cattle is often forbidden, and cattle are generally expected to die of *natural causes*. Some states now give veterinary officers permission to euthanise injured or sick cattle, but many other cattle, in the author's opinion, suffer an inhumane death. Large new dairy farms in India generally keep nonproductive cattle, and sometimes these animals are poorly fed to save money. In Southeast Asia, family status within the community is often dictated by the number of cattle the family owns. This is an incentive to retain chronically diseased or nonpregnant cattle, at the expense of space and feed that could be used to keep fewer, more efficient cattle under better welfare conditions. In Indonesia, cattle are also considered a liquid asset, so many farmers keep chronically ill cattle, until they need some funds, especially in small new farms.

16.3 Large-Scale vs Small-Scale Dairy Farming

The development of new dairy farms is happening in one of two ways. Large-scale farms are being developed that are owned by large organisations which employ staff to run the farm (see FAO 2009). These farms are being developed across the world, but particularly in China and Southeast Asia (e.g. USDA 2020). New small-scale farms are generally being established in areas that currently have family-run dairies (traditionally known as small-holder dairies) but which are taking on some Western concepts. There are many of these new small-scale dairy farms being developed in Southeast Asia and India. There are welfare issues that are particular to each type of farm, and this section will describe the welfare issues for each system.

16.3.1 Small-Holder Systems

Small-holder systems are generally family farms that contain from 2 to 20 cows (e.g. Devendra 2001), and are very common in India, Africa and Southeast Asia (www.fao.org/dairy-production-products). Most farms tether cattle by the head on cement flooring, often without matting, in low-roofed sheds with little ventilation (see Fig. 16.5). Most use the milk primarily for family consumption and then sell excess milk locally, either processed in the home or as fresh milk. Most farms have no refrigeration and deliver fresh milk daily to local cooperatives for refrigeration and further processing. Much of this milk has high bacterial loads and a short shelf life. Consequently, most milk in India is historically boiled before consumption. This results in a reduction of the risk of zoonotic disease transmission (e.g. brucellosis and tuberculosis).

General welfare issues in small-holder systems arise from the following:

(i) Economic and social drivers that compromise cow welfare. The drivers for small farmers in keeping dairy cattle are variable and include supplying the household, status, tradition in the family or region or having social/religious significance, as well as income from selling cows and some dairy products. These cattle management systems are generally based on old traditional approaches that are not focused on cow comfort or welfare.

(ii) Continuing local dairying traditions (particularly the practice of tethering). Local tradition often dictates that farmer practices in new farms remain the same when new dairy units are built in the same region, irrespective of whether they are good for cow welfare and productivity and without reference to the latest knowledge. The continued practice of tethering of cattle by the head on cement floors with no opportunity for exercise is, in the author's opinion, the greatest cattle welfare issue in the world and is only changing slowly. These are common farming practices in Southeast Asia and India. These cattle are often tethered by the head, confined on concrete, often with no matting in poorly ventilated sheds with low roofs and solid walls. There is often poor nutrition, resulting in poor body condition, and water is often only provided 1–2 times daily. The lack of opportunity to exercise also contributes to poor hoof health. Cases of lameness are often not diagnosed, as most cattle are unable to walk freely. Many of these cattle have not calved for more than a year, are not pregnant and producing less than 2 l of milk daily. In Indonesia, recent effort from trained extension officers is convincing some small farmers to improve husbandry, record production, oestrous and calving dates. This allows farmers to identify and cull nonproductive cows, feed the remainder better, allow them to exercise and have free access to water, resulting in improved profitability.

(iii) Lack of farmer knowledge. Many farmers lack knowledge of appropriate record keeping, feeding, good management, reducing animal stress and maintaining good health. In many new and older dairy industries in Central Asian countries, knowledge in areas such as cow, heifer and calf nutrition, husbandry, health, and disease management planning is often severely lacking. Production and reproduction records are often lacking, which means that culling of unproductive animals to allow herd improvement is not facilitated. This results in available feed being spread across more cows and poor body condition.

(iv) Poor resourcing. Poor resourcing is often a problem and includes lack of design and operating skills and capital and operating funds. For example, many farmers lack the ability to treat lameness, mastitis and other conditions. There is also a lack of appropriate infrastructure. This includes the lack of well-ventilated housing, continuous water supplies and access to adequate nutrition, exercise areas and appropriate bedding and flooring for cattle.

(v) Lack of support. For example, in Central Asia, there is a complete lack of diagnostic veterinary and agronomic support services, resulting in poor animal health planning, health and disease management, a lack of vaccination programmes, high levels of lameness, poor mastitis control and lack of advice on animal nutrition. There are very few veterinary animal health management services available. This results in extremely poor animal growth and health outcomes, and high prevalence of chronic disease, low productivity and high death and culling rates.

16.3.2 Large-Holder Systems

Large-holder systems generally involve 100 s (family owned) to 1000 s (corporate owned) of cows. In China, most farms now have more than 1000 cows, with some farms owing up to 17,000 cows (FAO 2009). These farms either process their own product or sell to large corporate processors. The farm planning concepts for new farms are generally developed by businesspeople, who engage designers and construction companies to build their systems. The final design and construction rely completely on the level of experience of the consultants, and this is sometimes lacking.

General welfare issues in large-holder systems arise from the following:

(vi) The drivers for larger farmer development often have little regard for welfare and are variable. These include existing small farm gaining economies of scale, investment of surplus funds, status, profit and return on investment. Increasing the scale of small-holder farms often results in maintaining the farm's previous poor management systems and potentiating welfare issues, including poor nutrition, record keeping, husbandry and ventilation.

(vii) Poor planning of large-scale sites. Poor planning, especially in the development of greenfield sites can very often have welfare ramifications. Commonly, issues arise due to lack of experienced input into the planning phase of building and site construction, including lack of appropriate feed supply, poor ventilation and heat stress management, inappropriate breed for the climate and lack of health management planning.

(viii) Lack of specialised veterinary training. A lack of personnel with specialised veterinary training and knowledge can result in very poor welfare outcomes. For example, many new large farms in developing countries employ local veterinarians with suboptimal training and experience in dairy, resulting in a high prevalence of metabolic disease (especially ketosis), hypocalcaemia, acute mastitis, left displaced abomasum and fatty liver disease.

(ix) Lack of a reliable supply of quality feed in the region. This is a common occurrence and is a major issue in Northern Asia in particular, where most small farms have disappeared, and new farms are generally a minimum of 1000 cows. Some of these farms have been very successful; however, many of these farms often have limited land for cropping and depend on many of the surrounding farms to supply corn for silage and grass for green-chop and hay. The quality of the fresh forage is variable, which sometimes results in the conserved forage made from it being too wet, mouldy and of poor quality, leading to digestive upsets. These feeds supplied by local farmers feeds also often contain pesticide and herbicide residues.

(x) Unsuitable housing. Many new dairy buildings in developing countries are designed by upscaling the small farm model, often resulting in buildings with low roofs, solid walls and poor ventilation. This will often result in poor air quality and can cause pneumonia in the cattle (see section below for further detail on housing and welfare issues).

(xi) Lack of staff training and management. Many large-scale farm owners prefer hiring staff with educational qualifications rather than experience. This lack of practical experience has negative consequences for cow health and welfare that is discussed further in Sect. 16.4. Also, the demise of small farming dairy systems in Northern Asia has led to a lack of experienced stock people in the countries concerned.

Additionally, many managers of new large-scale farms neglect the importance of planning and monitoring and fail to implement appropriate action planning and standard operating procedures for staff. This often results in staff not understanding their role in animal health management, especially in detection and reporting of disease and taking appropriate preventative and corrective action.

(xii) Inappropriate genetics for the climate. Many governments and companies developing new large dairy production systems are swayed by the high production rates of HF cattle from temperate climates, especially those from North America. Cattle or semen is imported from these countries, and the new farmers in Asia expect similar production levels in their hot and tropical climates. The effects on the welfare of the cattle will be considered in more depth below.

16.4 Welfare Challenges

There are a number of specific cow housing and management issues that are associated with poor cow welfare outcomes in new entry dairying systems. The details of the source of the problems and their impacts on cow health and welfare are discussed in the sections below. This is followed by a discussion of the specific animal health and disease issues that are problematic in new entrant dairying and a consideration of calf and heifer management.

16.4.1 Provision of Feed and Water

16.4.1.1 Drinking Water

Important considerations in the provision of water for dairy cattle include factors that influence the amount of water needed, such as the prevailing weather conditions and the age and stage of lactation of the cows (e.g. Moran 2005). Water quality and palatability must also be considered, as well as providing enough watering points to allow all animals to access water freely, with minimal competition (www.ahdb.org.uk). Many new farm managers underestimate the water requirements, trough access space and flow rates necessary to satisfy a large herd of lactating cows. In hot weather, an individual lactating dairy cow can drink over 200 l of water/day, and most want to drink at the same time especially just after milking. Poor water intake will result in low VFI and lower production and immunity.

In small-holder farms in the tropics, cattle often do not have continuous access to water, with water being bucketed to cows twice daily, and often not sufficient for satiation. This is obviously a significant welfare concern.

In large herds, cattle must have adequate trough space to minimise the effects of competition for water and bullying by dominant cows. In these herds, cows tend to drink large volumes of water immediately following milking, and sufficient trough space to allow cows to drink undisturbed and sufficient water flow to replenish troughs quickly are important. Water quality, temperature and taste can also influence voluntary water intake, with cows preferring cool, clean and fresh water, with a low-salt content. A period of acclimatisation is sometimes required when cattle are offered water from a new source. Forages with high water content will reduce voluntary water intake, but water must always be on-offer. Cows that are injured and unable to walk to water need to be offered water often, especially in hot weather.

If the ability of a cow to access water is chronically reduced, she will have lower voluntary feed intake, reduced production, may suffer from dehydration in hot conditions and have reduced immune system responsiveness to disease (Dahl et al. 2020).

16.4.1.2 Feed Supply: Quantity and Quality

Depending on the level of production and feed quality, cows will consume between 2 and 5 percent of their body weight on a dry matter basis per day (e.g. www.ahdb.org.uk). Some managers of new large-scale farms underestimate the amount of feed required or that is available on a year-round basis, for a large herd of lactating cows. Low levels of dry matter intake (DMI) can occur when the moisture content of green feed supplied is underestimated. This is especially the case in many new small-scale farms, where grass is cut and carried to the cows, resulting in high water intake in the feed. Diets low in dry matter content are not optimal as the animal is ingesting excess moisture and insufficient dry matter. Supplementary high dry matter content feed should be supplied (www.ahdb.org.uk). As for access to feed, it is important to provide sufficient trough/bunk space to allow all animals access to feed. It is not unusual in large new housed systems for too little trough space to be provided for both feed and water, often resulting in injuries, low feed intake, low body condition score and low productivity. See Fig. 16.1 for an example of good feeding system.

It is also not uncommon for large new dairy farms that have imported cattle to exhaust feed supplies quickly, resulting in low production, loss of body weight and low levels of immunity. Incidences of deaths from starvation have been recorded in poorly planned and implemented large- and small-scale dairy development programs, where large numbers of cattle are imported to a new area, with insufficient planning for continuous feed supply and staff training.

The development of a 3-year rolling feed management plan is essential in new large and small dairy systems to ensure there is adequate feed availability to meet the continuous demands of a growing and productive herd. These plans are often

Fig. 16.1 Example of plenty of feed in front of healthy cows

poorly developed, with inadequate assurance of supply, resulting in poor production and animal health and sometimes death.

16.4.1.3 Diet Formulation, Feeding Management and Body Condition Score

Dairy cow nutrition is extraordinarily complex, and details will not be given in this chapter. In summary, however, dairy cows need a diet that is balanced for energy, protein, fibre, vitamins and minerals (e.g. Moran 2005). This is often misunderstood in new farming systems. Energy (from carbohydrates) and protein are the most critical components, especially in the tropics, where the forage quality is often poor and especially lacking energy. A lack of energy in the overall diet often results from not providing concentrate feed. High-yielding cattle in peak lactation typically require to be fed concentrate feeds (e.g. www.ahdb.org.uk). Cows need energy for maintenance, activity, pregnancy, production and gaining body condition. A diet low in energy will result in low body condition, production, poor reproductive rates, weight loss and an increase in disease susceptibility (see Moran 2005). Low reproductive rates often result in overstocking on the farm, due to farmers keeping nonpregnant cows, with the attitude that 'they will eventually become pregnant', whilst these cows drain feed reserves that could have been fed to the other more productive cows. This affects welfare but also reduces farm profitability.

On many new large-scale dairies in developing countries with a high level of production, different formulations of diet are often not made on the farm to fit the requirements of the different stages of lactation. This means that late lactation cows and dry cows are often fed a diet best suited to early lactation cows, resulting in an intake of excess energy. This results in over-conditioning at calving and high rates of dystocia (difficult birth), hypocalcaemia (milk fever), ketosis, retained placenta and uterine infections. The longer-term results are often poor body condition, poor production, poor reproductive efficiency and higher death rates, as well as weakness and poor growth rates in the calves born (LeBlanc 2010; Mee 2008; Vanholder et al. 2015). Cows may become over-conditioned if they have taken an extended period to become pregnant (see also Vanholder et al. 2015).

The most useful tool in assessing the adequacy of the level of the nutrition supplied, especially energy, is body condition scoring. Body condition score (BCS) is a reasonable indicator of long-term energy balance (i.e. energy in the feed, minus energy for growth, maintenance, reproduction and production). A number of BCS scales exist worldwide, but the most common international BCS scale is 1–5, where 1 is extremely skinny, and 5 is very overweight and 2.3–3 is an average BCS (Roche et al. 2004). There are optimal average BCSs for each stage of lactation (Ishler et al. 2016). Cows that are underconditioned in late lactation are generally underconditioned at calving and then often lose further condition in early lactation. This results in low immune responsiveness, and cows often develop metritis (uterine infection), lameness, mastitis, metabolic disease and have low reproductive rates (Roche et al. 2009).

Many new large and most new small dairy systems do not have staff trained in BC scoring, resulting in high levels of dystocia, ketosis and culling from the herd.

A monthly sample of cattle from each stage of lactation in large herds, and all cattle in small herds, can be BC scored, and this is a great aid to understanding if feeding quality and quantity is appropriate or not, and dietary change can be implemented quickly. This process is simple and trains farmers and staff to observe cattle well. BC scoring is not difficult and greatly facilitates the management of the cows and is fundamental to achieving a productive and healthy herd.

16.4.1.4 Forage Availability and Quality

The aspects of the forage that are important include the palatability, digestibility, nutrient content, continuous availability and quantity.

In large dairy systems, where cattle are housed and rarely have access to pasture, feed is usually supplied in the form of conserved forage (silage and hay) and concentrates (e.g. crushed grain, by-products, minerals and vitamins). This is often also supplemented by fresh cut grass. This supply of feed needs to be planned 18 months in advance, so that crops can be planted, grown, harvested and stored, or supply contracts developed for advanced purchase. Back-up supplies also need to be identified. Large new dairies, with little experience in growing or advanced purchasing of feed, especially in areas where forage growth, is seasonally dependant and sometimes exhaust their feed supply prior to next season's supply becoming available. If alternate supplies cannot be sourced quickly, this can result in poor nutrient intake, loss of condition, starvation and death, and there are examples of this occurring quite recently.

Many managers of large new farms in nontraditional dairy regions also lack experience in growing, harvesting and storing forage crops, often resulting in mouldy conserved feed being used, causing digestive upset and illness. Specific mycotoxins may also be present in this feed and can be tested for (including aflatoxins) and counteracted using antifungal additives (Galvano et al. 2001). Old harvesting equipment is also often utilized by many large new farms to reduce capital costs. However, many old harvesters drop small metal fragments into the feed, and fencing wire may also be taken in, chopped up and included in the silage or hay, resulting in 'hardware disease' where metal penetrates the stomach wall and enters the heart, causing a painful death. It is important that fencing wire scraps are not left in fields that are to be harvested for cattle feed.

In many small herds, including newly established small farms, the feed ration is often based on the manual collection of grasses by the farmers. Many farmers cut the grass when it is overmature, as this has a greater weight. However, much of the mature grass, especially in the tropics, has very low nutritive value. Farmers should be encouraged to cut the grass when it has the greatest nutritive value, rather than at the greatest weight. Also, many of these farms do not keep good farm records, resulting in an excess of nonproductive cattle being present in the herd. These should be culled, and fewer cattle fed well, including addition of concentrates in the diet. Record keeping is essential, to be able to understand individual cows' production and pregnancy status and coordinate it with the optimal grass cutting periods.

16.4.1.5 Feed Management

Some large new systems buy harvesting, storage, mixing and feed-out machinery with insufficient capacity. This can result in poor mixing, with some cows receiving a slug of high-energy feed, which may cause acute rumen acidosis. Also, if urea is used as a source of nonprotein-nitrogen, this can be toxic and cause illness and death if an excess is ingested (Austin 1967). The cattle should be fed at least twice daily, with feed that moves beyond the cows' reach pushed-up between feeds. In early to mid-lactation, continuous feeding of a diet with excess energy and a lack of fibre may result in chronic acidosis and chronic laminitis (lameness). This is often subclinical, where symptoms are not observed early in the condition. However, subclinical laminitis may result in in prolonged standing time, lameness, a reduction in feed intake and consequently, poor body condition. Where laminitis is due to poor management of feed, this may affect a large percentage of the herd.

16.4.2 Breed/Type Suitability and Replacement Strategies

Cattle that are genetically suited to the prevailing climatic environment are much less likely to suffer from thermal stress (Santana et al. 2017), be healthier, reproduce better and require lower input costs (Polsky and von Keyserlingk 2017). Holstein Friesians (HFs) are well suited to temperate conditions. However, many large new farms and industries in the tropics are often blinded by the very high production levels possible from HF genetics derived from temperate regions of North America. Many new farmers in warmer climates assume that such production levels are achievable for them, but do not take their local conditions into account when purchasing cattle, semen or embryos to establish or grow their herds. For example, in tropical dairy industries, it is still common to utilize HF cows and attempt to keep them cool and comfortable; however, this is often not always possible without extremely good technology and management. There are often severely negative welfare outcomes when temperate breeds are used in tropical, hot and humid conditions. Many HF-type cattle will lose excessive body condition, develop severe lameness and suffer from mastitis and other diseases, despite attempts to cool them (see Fig. 16.2a). Other breeds (e.g. Jersey, Brown Swiss, Danish Red, local breeds, and cross-breeds between local breeds and a European breed) generally require lower input costs and manage hot conditions better than pure HF (see Fig. 16.2b). Under ideal temperate conditions, these alternative breeds generally produce less milk. However, under tropical conditions, whilst HF cows may have a high milk yield in their first lactation in the new situation, they may take long periods to become pregnant, so are dry for long periods of time. They are often more stressed and more susceptible to lameness, mastitis and local diseases. Consequently, under tropical and subtropical conditions, HF type cattle are often less profitable over a 3–4-year period, compared to more tropically adapted breeds (e.g. Marshall et al. 2020). For example, purebred HF in India are much more susceptible to theileriosis (a debilitating and often fatal tick-borne protozoal disease) than local breeds or crossbreds, which are well adapted to local conditions and diseases. With the use of appropriate

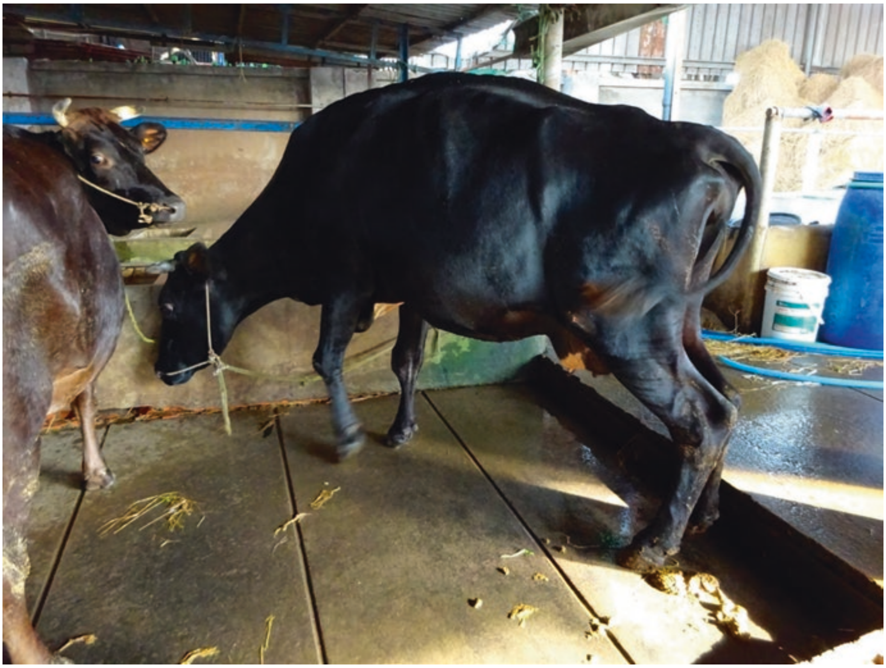

Fig. 16.2 (a) Holstein Friesian-type cow in the tropics (upper photograph); (b) Holstein Friesian × Jersey crossbred cow in the tropics (lower photograph)

genetic selection and cross-breeding programmes, these breeds can contribute valuable traits for hardiness, longevity, productivity, low levels of disease and good reproductive performance, despite the lower genetic potential for milk yield.

Small-scale and large-scale farmers are also often heavily influenced by the marketing pressures of semen-selling companies. For example, in a tropical coastal SE Asian country (hot and humid all year), a new farmer with 20 cows was asked by the author which was his best cow. He identified a 6-year-old HF-type cow, on her second lactation, which was severely lame on multiple legs, and had a BCS of 1.5 (very thin—see Fig. 16.2a). She had last calved over 1 year ago, was not pregnant and producing only 5 l of milk/day. In contrast, a 6-year-old HF × Jersey crossbred cow in the same herd was on her third lactation and healthy, with a BCS of 3.0. She had last calved approximately 6 months ago, was 3 months pregnant and producing 15 l of milk/day. When asked why the HF was better than the HF × Jersey, the farmer said that 'HF are better, as they give more milk'. This statement highlights the influence of inappropriate genetics sales company marketing.

However, that is not to say that HF type cattle do not do well in any part of Asia. HF cattle are better suited to temperate regions and have been observed by the author to thrive and produce well in the sub-zero conditions in north China and

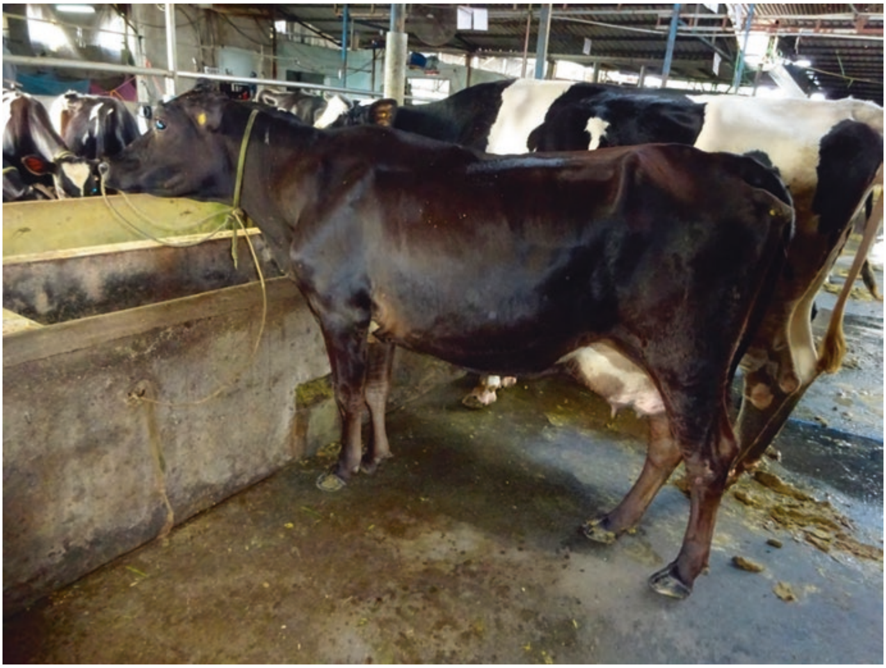

Fig. 16.2 (continued)

Central Asia, as well as the very-high-altitude regions in Southeast Asia, if they are managed well.

Cross breeds, often utilizing local breeds or strains, have often been proven to be more robust than pure breeds, as they also possess hybrid vigour. Hybrid vigour is where the traits of the offspring are superior to the average of the parent generation (Simm et al. 2021). Some hybrid vigour can be maintained using a three-way cross in specific situations, with superior welfare and productivity outcomes being maintained in each new cross (Simm et al. 2021). An example of a three-way cross producing cow genotype suitable for use in tropical areas is, firstly, Holstein Friesian (Breed A) × Breed B (typically Jersey) with the offspring mated to Breed C (typically a Nordic Red type). Crossbred cattle are generally hardier and more productive in situations of lower management capacity.

The drive for high milk yields combined with a lack of knowledge of the cow development and longevity can also have adverse consequences for welfare. In developing countries, milk production in the first lactation is often used as a measure of animal performance or ‘success’ and is used to select animals for breeding. However, a good milk yield in the first lactation is not a guarantee of good production later in life, particularly in systems that pose nutritional and thermal challenges. Many animals that have a high milk yield in first lactation have poor longevity as they are culled due to poor health and reproductive performance prior to, or during their second lactation. The additional costs and consequences of early culling are often not considered when using high genetic merit (for milk yield in temperate regions) breeds in tropical climates. Where these cows do manage to produce a calf, this only serves to perpetuate a genetic line with poor resilience and longevity in the new environment. Realistic cost/benefit analyses on these farms, however, generally reveal that hardier breeds of cattle, especially crossbreds, are more profitable over a 3-year period, as they have shorter dry periods and have lower maintenance costs even though they have lower genetic merit for milk yield. These cattle generally manage nutritional and heat stress better, become pregnant faster, lose less condition, require less feed, have less disease and stay in the herd longer (Marshall et al. 2020).

In the author's opinion, crossbred cattle generally have better health and welfare outcomes in tropical environments, especially in new farms, where dairy farm management experience is often lacking. It must be pointed out that there are examples of large-scale purebred HF herds being successfully managed in the tropics, where very efficient barn cooling is achieved. However, these are very expensive systems to build and run; the level of operational management must be extremely high and continuously maintained. However, the risks for welfare are high if there is mechanical or management failure.

16.4.3 Housing and Environment

16.4.3.1 Housing and Management Principles

Dairy cow housing systems are designed to protect cows from adverse weather conditions and also to provide easy access for farmers to manage and feed the cows. Good housing facilities provide dry areas for lying, thermal comfort and good access to feed and water (e.g. Rushen 2017). Likewise, pasture systems must provide enough grass but also preserve enough clean pasture to allow cows to lie down and rest. Water and shelter must also be provided at pasture (Mee and Boyle 2020 and see Chap. 5). The concept of cow comfort is central to the provision of a living environment that is good for cow welfare. Cow comfort has many definitions, but generally occurs when the cow is at peace with her perception of the world and is thought to be suffering from minimal stress (Moran and Doyle 2015). As stated above, some stress is necessary (eustress) for learning and animal adaption (e.g. if stressed by the hot sun, cattle will learn to seek shade and cool areas). However, the effects of excessive stress (distress) are generally negative, and if continuous (chronic), poor welfare outcomes are the result (Grelet et al. 2022). In general, positive cow comfort will result in better welfare and higher productivity (e.g. Moran and Doyle 2015).

Cattle grazed on pasture are generally easier to manage, as diseases do not spread as quickly as they would in housed cows, the animals get exercise and display oestrous signs readily. These animals have the choice of what and where they graze, rest and are able to seek shade (Mee and Boyle 2020). However, they will suffer heat stress in fields with no shade available, often damaging pastures and creating muddy conditions during wet periods. Cows then often suffer a high degree of lameness and mastitis from this mud; consequently most large herds are held in housed and feedlot conditions.

The objective of housing cows and of intensive cow management is to control variables to achieve high production, with the lowest level of stress possible. This allows closer management of the animals, but farmers are then responsible for ensuring that animals' nutritional, thermal, physical and other welfare needs are met. This requires that the building design and facilities within it as well as staff training and skills are optimized. These aspects will be discussed in more detail below.

16.4.3.2 Heat Stress, Ventilation and Air Quality in Housing

The major stress that housing seeks to abate is environmental stress, e.g. heat, cold, rain, mud, etc. However, housing animals in poorly designed and sited buildings is a major contributor to heat stress (Toledo et al. 2022). Heat stress in dairy systems is a major issue across Asia. Heat stress occurs when the production of heat from the body (e.g. from digestion, metabolism, pregnancy, milk production and muscular activity) is greater than the body's capacity to lose heat. Heat stress results in reduced food intake, reduced body condition, lowered reproduction and productivity, lowered immune responsiveness, poor health and higher levels of disease (Kadzere et al. 2002). The ability to lose heat is more difficult when ventilation and air exchange are poor, especially when environmental heat and humidity are high. The temperature humidity index (THI) is used as a measure and predictor of the cattle's ability to lose heat (e.g. Habeeb et al. 2018) (Figs. 16.3 and 16.4).

Many new large dairy systems in Asia have often not been designed well to combat heat stress. Sheds have been built away from prevailing winds or in valleys. In other cases, they have been built too close together, with roofs that are too low or made of heat-conducting material such as corrugated iron or with solid walls that do not allow sufficient air movement (see Fig. 16.5). These location and design factors result in poor airflow, ventilation and air exchange. Poor ventilation and air flow can result in pneumonia because of poor air quality or heat stress when air flow is low.

Increasing air flow across cattle by having open-sided buildings to take advantage of the prevailing winds and the installation and use of fans will assist in heat loss. The use of water misters to cool the air in low humidity situations, or water sprays to wet cattle in high-humidity situations, can be effective in reducing heat load. However, these cooling systems have their limitations and must be managed by experienced staff. Unlimited access to cool drinking water is also necessary in managing heat stress. Heat-stressed cattle tend to stand for longer, and this is a major cause of poor welfare in tropical Asia. Heat loss is also compounded when cattle are held closely together, radiating heat to each other and reducing air flow between cattle, so stocking density should be considered.

As an example of poor new construction, the author visited a small new farm in tropical Southeast Asia, where the farmer had built solid 2.5-meter-high concrete walls, with no windows, and bought in HF-type cattle. When asked why, that farmer explained that the solid walls were necessary for security, and he was not aware that heat stress was an issue (see Fig. 16.5 for an example) and that HF give more milk.

Fig. 16.3 Cows on rubber mats with open walls in a shed in India

Many cows on this farm were panting excessively, even though the THI was below 70. A comparison was a new 20 cow farm in Vietnam, with the barriers around the edge of the shed consisting of rails instead of walls, built from locally sourced bamboo (Fig. 16.6). Steel mesh could be used if security is an issue.

In some cases, both heat and cold are climatic factors that need to be considered in the design and location of the housing. Some areas of northern and central Asia have very hot summers and very cold winters. When low-roofed sheds are used in these climates, the ventilation is poor causing heat stress as discussed above. However, they are usually closed-up in winter to stop water, urine and faeces freezing. The lack of ventilation results in poor air quality because of high concentrations of ammonia. This often contributes to the occurrence of pneumonia in adult cows, heifers and calves.

Holstein Friesian animals are more susceptible to heat stress because of their high metabolic heat production. This breed is used in many of the new farms across Asia. In the summer these cattle often suffer from heat stress quite quickly, stand for longer periods, resulting in weight loss and impaired production, lameness, reproductive ability and immune responses. Many large farms in the Middle East can successfully cool and maintain high production from HF cattle in hot dry conditions. However, in humid tropical conditions, especially in Southeast Asia, cooling is much more difficult due to the ambient humidity, which reduces the possibility for evaporation and its cooling effects. Sufficient cooling in tropical and subtropical conditions is often not achieved, resulting in poor welfare and productivity of

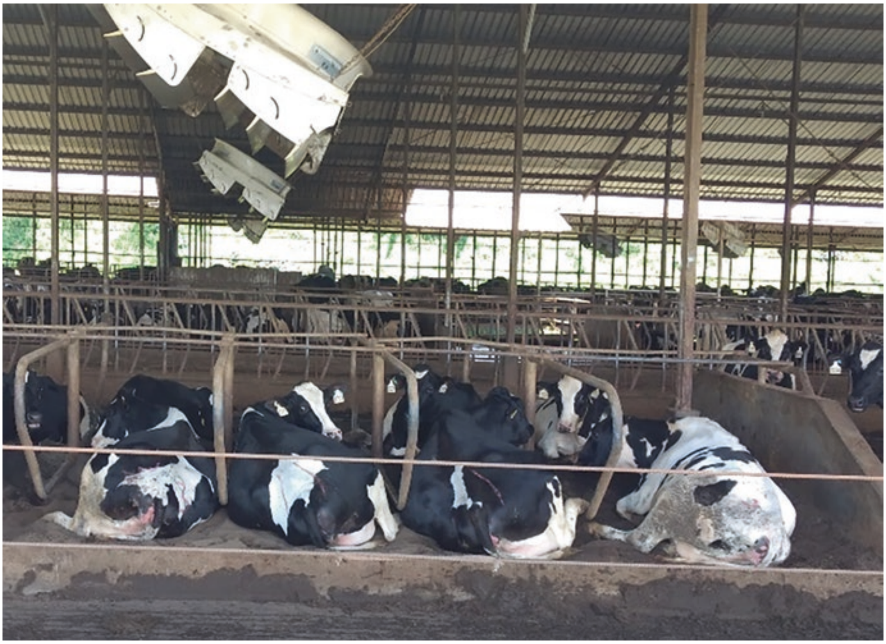

Fig. 16.4 Cows in free stalls on sand bedding with open walls in Indonesia

temperate breeds of cattle, especially in HF cattle. Certain breeds and crossbreeds can withstand higher maximum daily THI levels. The Indian website Agri-Farming provides a good guide to dairy cow housing in tropical areas that has very good sections on ventilation (Agri-Farming India 2021).

16.4.3.3 Concrete Walkways

In cow housing, large areas of cement are generally necessary for flooring and walkways. Many new large dairy systems install rough cement laneways and walkways wearing down the cow's feet and causing lameness. Newly laid concrete is also more abrasive for the feet than older concrete (McDaniel 1983). Many staff, especially in new systems, are not trained to move cattle slowly along concrete paths, resulting in damage to legs and hooves. This is especially the case when cattle are forced to turn corners on concrete. Many floors are also not cleaned appropriately, allowing for foot infections and diseases (e.g. foot rot) to spread. To maintain the quality and integrity of the flooring, regular maintenance and repair is required.

16.4.3.4 Lying Areas and Bedding

A housing system that requires cows to stand for excessively long periods is not compatible with the concept of cow comfort. If the bedding/lying area is not well designed and maintained, cows will stand for excessively long periods. Cows may lie down for up to 12 h/day (Tucker et al. 2021). Standing for long periods can result

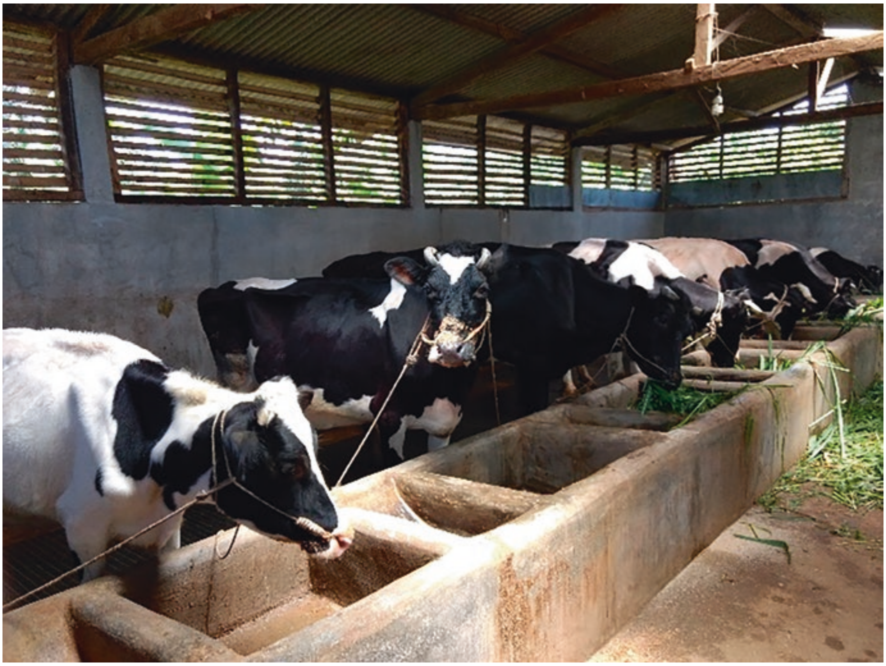

Fig. 16.5 Poorly ventilated housing with solid walls and tie stalls in Indonesia

in poor voluntary feed intake as cows will then prioritise lying over feeding (Tucker et al. 2021), poor rumen movement, low saliva production and rumination, laminitis and lameness, rumen acidosis, indigestion, loss of body condition, poor immune response and ill health.

As discussed above, tethering cattle by the head is a major welfare issue in smallholder systems. New-build large farms are often installing free-stall (or cubicle) systems where cattle can choose a stall to lie in. However, the lying area for cattle is often not designed well and is not comfortable, with stalls being too long for the size of the average cow, resulting in defecation and urination in the bedding and a higher incidence of mastitis. Sometimes stalls are built too wide for the average size of the animal, allowing cattle to lie across the stalls, often resulting in neighbouring cows standing on and damaging teats and udders of other cows.

The bedding that is provided is also important in terms of cow comfort (Tucker et al. 2021). If the bedding is not comfortable (i.e. either hard or wet), cattle will tend to stand for longer periods. Lying surfaces should be comfortable, dry and not a source of bacteria or ammonia that can cause mastitis and pneumonia and soft enough to cushion the cow when she is lying down (Rushen 2017). In free-stall systems, a range of bedding can be used, with the most common being sand, wood dust/shaving, dry manure solids (DMS) and rubber mattresses or mats, with dry sawdust spread regularly on top. If the bedding is not comfortable (i.e. either hard or wet), cattle will tend to stand for longer periods. If cattle are soiling the beds, the

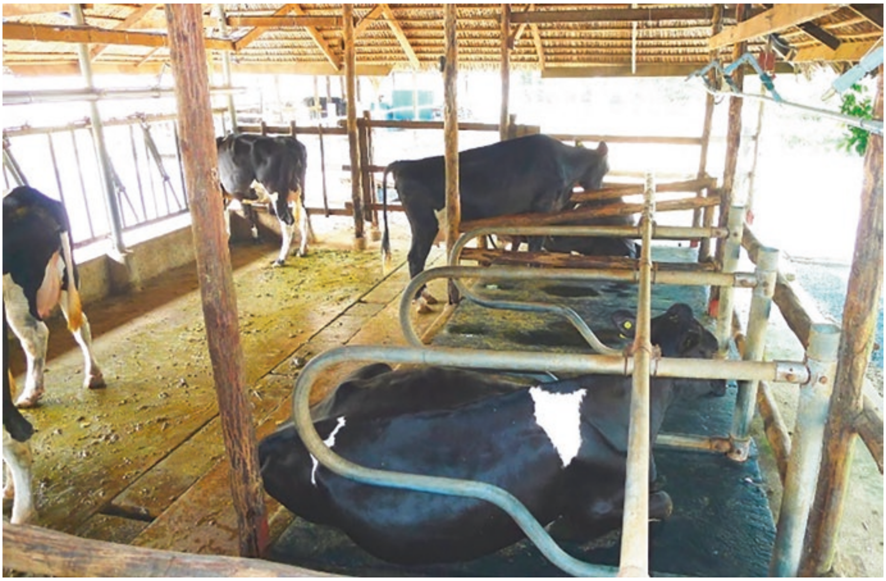

Fig. 16.6 Small, cheap and efficient housing with free stalls in Vietnam. Note the open sides of the shed that allow good air flow

lying areas need to be cleaned of faeces regularly. Water should not be allowed to contact bedding areas, especially if DMS is used, as these wet areas become a source of bacteria. It is not uncommon to see the bedding areas thoroughly wet from water leaks or severe storms. These wet beds are a common source of infection, including mastitis in cows and navel and joint ill in newborn calves.

In open-barn systems, where cattle are held in groups in a large, covered pen, the bedding provided can also be sand, wood dust/shavings or composting bedding systems (CBS) (see Fig. 16.7). CBS (including composting DMS) systems must be tilled by machine twice daily to allow air to infiltrate and bacterial degradation to occur at lower depths. These CBS systems require constant assessment and management (Dairy Australia 2020). It is common to see these systems being attempted and failing due to poor management in large new dairy systems in Asia, resulting in very high levels of mastitis and other diseases. The main reason that CBS fail is the lack of organic fibre, excessive moisture and lack of tillage.

In conclusion, a lack of attention to issues affecting cow comfort is common in large- and small-scale new farms, especially in tropical Asia, with the major issues being poor shed design, cow poor management and the use of pure HF genetics in tropical environments. Lessons are being learned, with some of the new dairy farms being designed with health and welfare in mind. However, some large new systems are still being built without sufficient planning resulting in inappropriate cow housing and inadequate or inappropriate feeding areas, leading to poor cow comfort, welfare and productivity.

Fig. 16.7 Cows on compost bedding (CBS) in India

16.4.4 Staff Hiring and Training

Many new large dairy systems in Asia have a preference for hiring staff with formal qualifications rather than experience and a positive attitude towards animals and dairying. Many new large, corporate-owned dairy systems in developing countries do not have any incentives to encourage staff loyalty. Few have staff training or career development programs in pace. This often results in a high staff turnover, staff not having the skills to be able to recognise developing animal health issues, not understanding their role or failing to implement appropriate animal management and husbandry practices. This often results in disease or poor health not being recognised promptly, poor animal husbandry and cattle movement practices and poor feeding and milking management leading to poor welfare outcomes, especially in relation to high levels of lameness, mastitis and metabolic disease. An appropriate Staff Management Plan for new farms must be based on employing staff with good attitudes, inducting them into their role, training them in animal husbandry, observation and recording of health and welfare issues and supplying them with standard operating procedures for actions to take when issues arise. In some cases, farms rely on technology, such as robotic milkers, but do not have the skills to repair this equipment themselves or the service agreements in place for maintenance, meaning that equipment remains unrepaired often resulting in poor welfare outcomes.

16.5 Animal Health

In large herds, good herd health and good welfare outcomes are usually a result of appropriate health management planning and must be specific to that region. Poor outcomes usually result from inadequate planning and poor staff training and attitude. Health planning has many aspects discussed below.

a. **Nutritional and feeding plan**. As discussed above, a primary driver of good health is the delivery of sufficient quantity of a well-balanced diet for each class of stock and stage of lactation. This program must be defined and planned for. As discussed above, many large new farms do not have an adequate feed-sourcing program in place. The testing of individual ingredients and of the mixed ration is generally considered necessary to determine if the diet is of sufficient quality to meet the animals' requirements. Many new large farms in Asia do not test feeds for nutrient balance, resulting in inappropriate BCSs, poor health and welfare outcomes.
b. **Health management planning**. This is often missing in large new herd development programs. This comprises health and disease risk identification for that region/area, and a plan to reduce risk through the development of written protocols, including:
    i. **Disease control, vaccination and parasite control plan.** For that region and farm. The risks of specific diseases must be assessed and control programs set in place to prevent or control these diseases. Many new farms do not have appropriate plans in place, and consequently disease and poor welfare often occur. For example, a high incidence of theileriosis was seen in a large new farm in India, due to lack of planning for control of ticks.
    ii. **Biosecurity and disease risk minimisation.** Biosecurity plans are necessary for each farm, especially for larger farms. These define that the disease testing and vaccinations required before animals are purchased and the necessary quarantine prior to introduction. The farm biosecurity plan should also define the protocol for people, vehicles and feed entering the farm, to prevent disease being imported onto the farm by these routes. A lack of biosecurity has been the cause of foot and mouth disease outbreaks in large and small farms across Asia. A similar case occurred when local cattle with *Brucellosis* were imported onto a new farm in India, causing abortions in the cows and transmission of the disease to people. Many mastitis outbreaks can also be traced back to older cows entering the farm, instead of importing healthy heifers.
    iii. **Staff training in animal husbandry.** Staff capacity is probably one of the biggest challenges and cause of animal health/welfare issues in dairy systems worldwide. A Staff Management Plan is often not in place, usually resulting in poor health and welfare outcomes. Large new dairies that involve staff in decision-making and that recognise staff for their work and feedback generally have better animal management and welfare outcomes. Many examples of staff not recognising loss of body condition, ill health or disease

early have resulted in large disease outbreaks, especially of ketosis and mastitis. This could have been controlled quickly if appropriate staff had been employed, trained and BCS and observational training had been implemented.

Staff need to be trained well to recognise what is normal behaviour and in animal body language, to be able to recognise when animals are not well. Sick animals generally have reduced appetites, are losing body condition, are often separated from the herd, have droopy ears and dull eyes and often have fever, breath quickly and are nonresponsive.

Additionally, a lack of mating records and identification of cows that are due to calve is also an issue in many new large herds, leading to cows calving unmonitored in the dry cow herd. Lameness and poor welfare are often the result of staff not understanding how to move cows quietly and at their own pace, resulting in hoof and leg injuries.

iv. **Metabolic diseases**. Besides transmissible diseases (bacterial, viral, protozoal and parasitic), metabolic (body metabolism imbalance) diseases are common in high-producing dairy cattle. Examples of these diseases include milk fever (hypocalcaemia), ketosis, displaced abomasum and fatty liver. Metabolic disease is often a consequence of inappropriate body condition and feeding, especially in late lactation and in the dry period. Metabolic disease outbreaks are common in developing countries in many large new herds, due to a lack of implementation of an appropriate Health Management Plan, Feed Management Plans, BC scoring and staff capacity building programs.

v. **Reproductive disorders**. Good reproduction outcomes result from healthy animals, being fed and managed properly. In many large new farms, cattle take long periods to become pregnant, often the result of stress, poor BCS and poor oestrous detection Many of these cattle then have long dry periods and gain excess body condition prior to calving. This often results in calving difficulties and ketosis following calving, as well as long inter-calving intervals and over-conditioning prior to the next calving.

vi. **Chronic disease and culling**. Most large dairy herds in worldwide cull at least 25% of the herd annually, to remove cattle with chronic disease (e.g. lameness, mastitis and reproductive disorders) and maintain genetic improvement. Most of these culled cattle go for slaughter. However, in India the cow is held as sacred, and slaughter of older cows and male calves is not permitted. Some of these chronically ill cattle find their way into Gaushalas (see Chap. 14); however, many remain on-farm and take up valuable space and consume valuable feed and often suffer from chronic lameness or mastitis. In many Asian cultures, social status is often linked to the number of cattle a farmer owns. Consequently, many cows with chronic mastitis or those that are not pregnant are kept in the herd, at the expense of other potentially more healthy and productive cattle. In India, the greater use of sexed semen would reduce the number of male calves born and roaming the street.

In smaller herds, the same animal health planning principles apply; however, many small new farms commonly adopt local traditional farming practices, due to a lack of contemporary knowledge based on science. This is most evident in the continuation of poor nutritional and animal husbandry practices in new farms, as mentioned previously. The use of pure HF genetics is also increasing in many of these regions, compounding the issues. Many new smaller herds also do not keep mating or production records, or understand health management planning, often resulting in significant disease and poor health/welfare outcomes.

16.6 Calf and Youngstock Rearing and Management

Calves in new entrant dairy systems, both large and small, are generally separated at birth from their mothers, as is the case in developed countries. Calves are notoriously susceptible to disease, often resulting in chronic illness or death. Internationally, the goal for preweaning calf mortality rates is less than 6% (Santman-Berends et al. 2019). On many new dairy farms in tropical areas, however, preweaning calf mortality rates are more likely to be 15–25% and can often be as high as 50%, which is an indication of extremely poor calf management. There are a number of management issues that contribute to this mortality and morbidity including overcrowding of calf housing, poor housing design, lack of colostrum feeding and poor observation and monitoring. Good calf management will usually result in a well-grown calf at weaning, giving the animal every opportunity to become a well grown and healthy heifer and eventually a milking cow. However, a major issue is that farm staff in these new dairy systems often have minimal calf-rearing experience. The key factors are discussed below.

16.6.1 Calf Management

There are a number of calf management practices used in new entrant dairying that result in poor calf health and welfare. Quite a common issue in new systems is attempting to rear too many calves, even bull calves, as they see these as a potential source of income. However, disease, death and heifers with poor growth rates are often the result. Cost-benefit analyses indicate that it is far better to rear a smaller number of high-value female calves properly. Male calf-rearing facilities are generally more successful when they are specialised units, even at the village level, that focus on calf rearing and nothing else.

16.6.1.1 Health Monitoring

Good staff training and experience is critical for effective calf rearing, especially in recognising the early signs of poor health. The staff involved in calf rearing need to be well-trained, observant and preferably experienced. Calves develop disease very quickly, and early detection is therefore essential. Early signs of disease include being separated from other calves (if in groups), low responsiveness, lying down above normal levels, abnormal lying postures, having droopy ears, a rough coat, fast breathing, diarrhoea, nasal and eye discharge and increased body temperature (e.g. Bell et al. 2023). Targets need to be set for growth rate and weaning times. The most common predisposing factors to health and welfare issues observed in calf-rearing systems in new farming systems include the following:

i. **Insufficient feeding of colostrum.** Calves that receive insufficient colostrum, and/or are weaned prior to appropriate rumen development has occurred, generally lose weight following weaning. These poorly grown calves often develop chronic health conditions, especially pneumonia, often resulting in death or poorly grown heifers (Lopez and Heinrichs 2022). Colostrum is the first milk from a cow that has just calved. It is recommended to feed 3–4 l of colostrum, divided into in two feeds within the first 12 h of birth (Dairy Australia 2020). This provides high-quality nutrition but more importantly antibodies (passive immunity) for the calf. Calves are born with very few antibodies (immunoglobulins (IgG)) in their blood (Lombard et al. 2020). Calves will produce their own IgG, as part of the active immunity system, but this requires exposure to pathogens and takes time to develop. Thus, facilitating the uptake of antibodies through colostrum feeding is vitally important in providing calves with some defence against disease in the first few months of life (Lopez and Heinrichs 2022). However, a lack of adequate colostrum feedings and the consequential failure of IgG transfer often occurs in many new farming systems, both large- and small-scale, due to inexperience of the farmers, leaving the young calf highly susceptible to infectious disease. In the author's opinion, this is the major cause of poor health, chronic disease and death in calves and heifers, as well as poorly grown heifers entering the milking herd and early culling of cows in their first lactation. First calving heifers often have insufficient colostrum for their calf. Frozen colostrum banks are essential to ensure all calves have access to sufficient, high-quality colostrum.

ii. **Nutrition and weaning**. A lack of understanding of calf nutrition is also a major cause of some of the welfare issues and poorly grown heifers that are seen in many new large and small farms. Calves need to be fed milk at approximately 10% of their body weight/day, preferably in two feeds. Many inexperienced new entrants do not feed enough milk to young calves. Also, many new entrants wean the calves before they are eating enough concentrate (e.g. 800 g/day) to promote the development of the rumen. This will result in a rapid loss of body weight following weaning.

iii. **Calf Housing**. The aim of housing is to protect the calves against the elements (heat, cold, rain, snow) and to provide a clean and comfortable environment. However, many new calf-rearing systems are poorly designed and managed; with poor ventilation; lack of drinking water and overcrowding; with resulting welfare issues including heat stress, poor growth, diarrhoea and pneumonia; and consequently high death rates. Calves need to be kept clean, dry, be able to breath good quality air, be well fed, have access to water and be in an environment with a low risk of disease transmission. Calves can be held in group pens

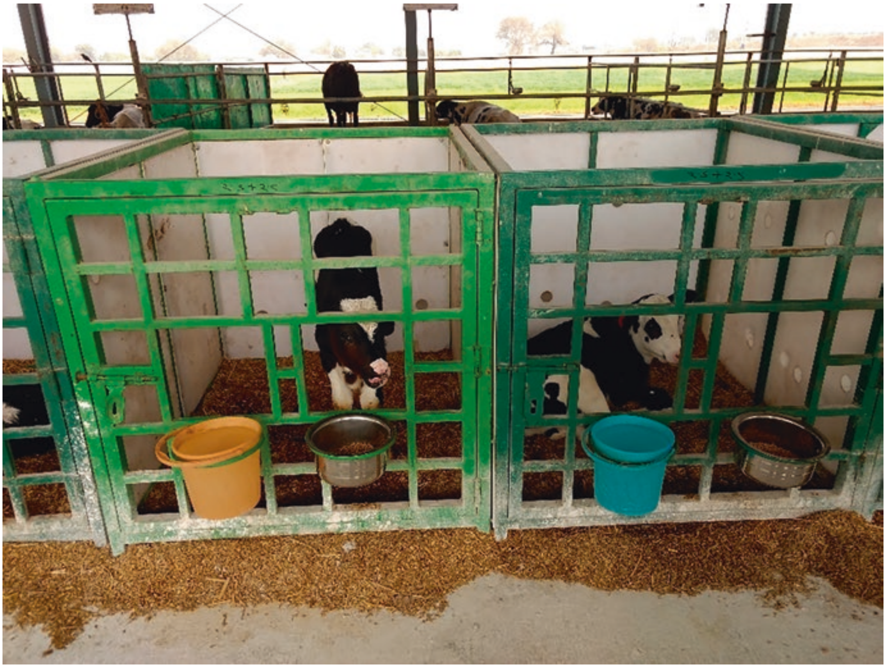

Fig. 16.8 Clean individual young calf-rearing boxes, with access to water in India

from the first day of life, but disease often results from this close contact, requiring exceptionally good management. Most farms keep calves separated for the first 4 weeks of life, to reduce disease transmission risk, as well as being separated from their faeces. This can be achieved in calf hutches, raised slatted floor pens, or on straw, that is cleaned daily and renewed often. Individual calf hutches that are kept clean and separated by an airspace are generally successfully used now by many large herds in new entrant systems (see Fig. 16.8). Recent research indicates that rearing calves in pairs allows for more appropriate social skills to develop (Van Os 2020).

16.6.1.2 Common Calf Diseases

i. **Joint Ill (Navel Ill).** In the first few days following birth, calves are very susceptible to bacterial infections via the navel, usually causing a swollen navel. The infection can develop into a bacteraemia (blood infection), with bacteria infecting the leg joints (infectious arthritis). This arthritis often becomes chronic, causing chronic pain and joint swelling, weight loss and sometimes death. If noticed early on, antibiotics may control the condition, but this is not always the case, with chronic navel and joint infection often resulting (see also www.nadis.org.uk). The risk is reduced by calving cows in clean and dry conditions, preferably on new straw. The navel of the calf should not be touched or tied-off, as this will introduce bacteria. Dipping or spraying the navel with 7% tincture of iodine, 2–3 times in the first 48 h, is recommended. Navel ill and joint ill is commonly seen in many new farming systems, where cows give birth in unhygienic conditions and staff are inexperienced in calf rearing.

ii. **Diarrhoea** (scours) often begins with nutritional scours and then progresses to viral and/or bacterial scours that spreads between calves. Calves dehydrate rapidly. The most common precursors include a lack of IgG transfer from colostrum, unhygienic housing environment and too many calves in a small area (Medrano-Galarza et al. 2018). Treatment includes fluid replacement, but antibiotics are sometimes necessary. However, prevention is best. Bloody diarrhoea in older calves (2 months and older) is often caused by coccidia from calves accessing older animal faeces. Chronic diarrhoea is common on new farms and will often result in poor growth and death.

iii. **Pneumonia.** This lung condition often results in calf death. Calves that recover often have reduced lung capacity and do not grow to their full potential (Bach 2011 and see Fig. 16.9). The most common precursors include a lack of IgG transfer from colostrum and poor air quality (especially high levels of ammonia and humidity) (Mahendran et al. 2017; Bonizzi et al. 2022). Calves must always breath fresh air, even if it is cold, but without being directly affected by draughts (Lago et al. 2006; Lorenz et al. 2011). Urine in bedding and poor ventilation quickly result in ammonia production, contributing to pneumonia. Treatment includes the use of antibiotics and good nursing, but as for calf diarrhoea, prevention measures are best.

Many cases of pneumonia, due to ammonia build up, are commonly seen in new farm calf-rearing systems that have poor ventilation. This often occurs when there are walls (particularly low walls) blocking air flow, especially if the system is overcrowded. Calves will tolerate cold conditions, especially if lying in fresh and clean straw.

16.6.2 Heifer Rearing and Management

The same issues apply with young heifers as they do for calves, with many new farmers rearing too many heifers poorly, resulting in deaths and small heifers entering the milking herd. Poorly grown (small) heifers often experience dystocia and are often culled from the herd in the first or second lactation, due to loss of condition, bullying by older cows, disease and failure to conceive again following the first calving. These effects are due to their low immune response status and their experience of chronic stress.

16.6.2.1 Welfare Outcomes of Poor Heifer Management

Calves that have recovered from diarrhoea or pneumonia often have chronically damaged lungs and gastrointestinal tracts (GIT) and grow poorly as heifers (Bach 2011). Poorly grown heifers tend to become pregnant much later than their healthy counterparts, and therefore are often over-conditioned at calving. This leads to a higher incidence of dystocia, and the associated pain and distress when they calve.

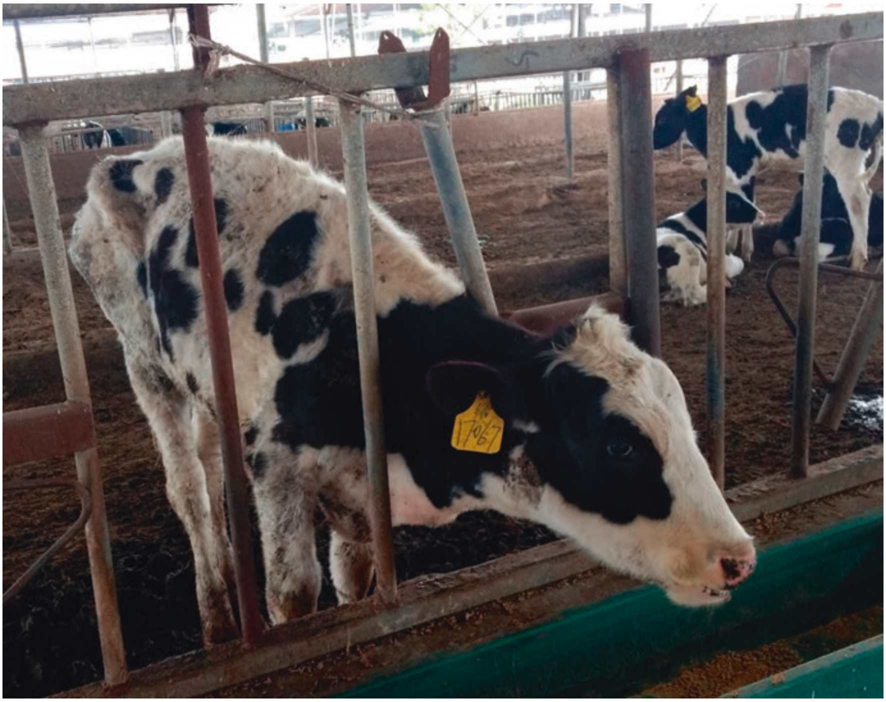

Fig. 16.9 Heifer with chronic pneumonia in North Asia. Note the poor coat and body condition, open mouth and extended neck

The result is weight loss in these newly calved heifers and higher rate of culling during their first lactation, due to disease and infertility. This confirms the need to rear a smaller number of heifer replacements well, rather than a large number poorly.

16.6.2.2 Health, Growth and Reproductive Management and Planning in Heifers

This is often overlooked in new dairy systems, both large and small. A regionally specific vaccination and parasite control program should be developed and implemented in new entrant dairying areas. Internal parasites are of particular concern if heifers have access to grazing or chopped green forage, especially if effluent is used to irrigate these forage crops. Tick control is also essential where tick-borne diseases (e.g. theileriosis, babesiosis, anaplasmosis) are endemic.

16.6.2.3 Targets

Each farm needs to set targets for mortality (death) rate and weight/age at mating and calving. Heart girth measurements can also be used as an indicator of weight (e.g. Sherwin et al. 2021). This, combined with body condition scoring, will give an indication of the effectiveness of feeding and health management programs. Heifers should be mated at a target weight, rather than age, to ensure they are well grown at calving. Well-grown heifers become pregnant faster, are healthier, generally produce more milk and stay in the herd longer. Many new dairy systems do not have adequate targets in place or ability to measure against these targets, resulting in inadequate growth, health and poor welfare.

16.7 Conclusion

In conclusion, the most important aspects to consider when implementing a new dairy system, include the development of the following:

- An appropriate business plan
- A feed management plan for sufficient feed supply and nutrition
- A housing system that allows adequate ventilation, cow cooling, cow comfort and efficient effluent collection and management
- Use of an appropriate breed to manage the local environmental conditions
- An appropriate animal health management and biosecurity program
- A calf and heifer rearing and management plan
- Appropriate staff training program and standard operating procedures
- Appropriate record collection program and use
- Appropriate monitoring to ensure cow health and welfare, especially using observation and BCS

In general, good animal welfare is central to a productive and sustainable dairy farm and dairy industry, and in general, farmers care greatly about their animals. New entrant or rapidly developing dairying farming systems, whether they be small-holder systems or large intensive farms, face many challenges. Many new entrants are very successful in achieving good health and welfare outcomes; however, many are not as successful.

Poor welfare outcomes in new or developing diary systems can be summed up as follows. In small-holder systems in developing countries, most new dairy farmers adopt the traditional farming practices from the region and often don't seek expert advice. These traditional practices often include cows being held by the head, under low roofs with poor ventilation, lying areas based on cement often with no matting, feeding of poor-quality forage, given water only 1–2 times daily. Problematic practices extend to calves and typically consist of poor colostrum feeding and poor general calf/heifer rearing management practices. There is usually a lack of understanding of the most appropriate breed for the region; records are not kept of key information on calving date, pregnancy status and production. There is also a general reluctance to cull animals. This commonly results in high rates of disease and death of calves, chronically ill and undergrown heifers entering the dairy herd and many nonpregnant and nonproductive cows consuming a high percentage of the available feed resulting in low body condition scores and poor health of the productive animals. Recent training programs, especially in Indonesia, are having some influence in changing current farmer attitude, with a focus on improving management practices and farm profitability, also resulting in improved welfare outcomes.

There are many examples of large new dairy systems being developed and successfully managed. However, especially in warmer climates, the welfare issues that become evident in new large-holder systems are generally a result of poor understanding of what resources are required and poor planning, prior to construction. This is often related to poor infrastructure and design, poor planning of feed supplies (affected quantity and quality), poor breed suitability and staff sourcing, poor staff training and management, improper health planning and veterinary care availability. This can result in lack of feed, heat stress, poor air quality, loss of body condition, poor health, poor husbandry, high rates of disease and very poor welfare outcomes. These issues are most commonly seen when corporates build large-scale systems, without adequate due diligence and planning. Farmers do not want their animals to suffer; however, poor welfare outcomes can be the result of a lack of understanding of the complexities and what is required to build, expand and manage dairy cattle farming systems.

Notes on Photographs All the photographs were supplied by the author.

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