



# **Rearing options for Holstein bull calves to 12 weeks**

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**Prepared by Adam Harper & Steve Webster**  
**Delta-innovation Ltd**  
**Bedford i-lab, Priory Business Park, Bedford, MK44 3RZ**  
**Tel: 01234 834707**  
***adam.harper@delta-innovation.co.uk***

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*Note: this report does not include the downloadable spreadsheet that will be available through the on-line guide. A CD version is available on request.*

## INTRODUCTION

This report looks at the current practice and economics behind Holstein bull calf rearing up to 12 weeks of age. It is intended for those who are rearing, or intending to rear, young calves from dairy herds.

- **Current practice** provides husbandry information on, for example, calf selection and procurement, feeding regimes and methods, housing, health and welfare, environment, and performance and targets. In the health and welfare section there are downloadable summaries of key legislation to take into account when considering calf rearing, and of the common ailments of young calves.
- **Market potential** gives a brief overview of why calf rearers should consider Holstein bull calves alongside continental-cross calves when thinking of the end-market for their products.
- **Economics** provides a summary of the key considerations when choosing a calf rearing system along with a downloadable spreadsheet to enable farm-level assessments of economic viability. Variables such as input costs and batch size can be entered within the spreadsheet and comparisons made between Holstein bull calves and continental-cross calves in different rearing systems.

**Further reading** signposts the keen reader to more detailed veterinary and husbandry information, and in the **Acknowledgements** section there are links to some of the organisations central to calf rearing, including livestock marketing groups and research organisations.



## **CURRENT PRACTICE**

### ***CALF SELECTION & PROCUREMENT***

#### **Checklist and tips**

When selecting or receiving young calves it is important to ensure healthy Holstein bull calves are purchased. Important points to consider include:

1. Calves should be over 40kg and never under 35kg. Lighter calves have been shown to grow more slowly and to present more animal health problems later in life.
2. Calves should have received at least two litres of good quality colostrum. Insufficient or poor quality colostrum at birth is a major factor affecting calf health and risk of mortality throughout life, and can lead to significant veterinary and medical costs. If in doubt calves can be tested for immuno-gamma-globulin levels or colostrum testers can be purchased.
3. A healthy calf has a shiny coat, supple skin, a clean damp nose, alert pricked ears and bold bright eyes.
4. Immediate signs of an unhealthy calf are diarrhoea, wet or thickened navels, heavy breathing and physical defects.
5. Be aware of coccidiosis. This is difficult to spot in younger calves but knowledge of the source of calves will give an indication as to whether preventative action can be taken.
6. Illnesses present in one week old calves include navel ill or hernia, heart defects (panting after feeding), scour, joint-ill, diphtheria, pneumonia and congenital cataracts. For further information see [Illness and disease](#).
7. Common conditions in calves between one and 12 weeks of age include all of the above as well as lice, ringworm and pneumonia (very important). For further information see [Illness and disease](#).
8. Enquire about the history of the calves including any vaccinations, antibiotics or vitamin injections previously received.

## Livestock marketing groups

These groups can source and supply week-old calves and are able to provide a market for calves at 12 weeks.

Calves are supplied either within a rearing contract or by direct sale. Rearing contracts vary in detail between the different marketing groups, but there are two typical agreements commonly seen, as shown below.

**Table 1 – Example of two typical rearing contracts**

<b>CONTRACT 1</b>	<b>CONTRACT 2</b>
<ul style="list-style-type: none"><li>• Ownership of calf retained by market group.</li><li>• Market group purchases all inputs (feed and medicines etc).</li><li>• Sets a strict rearing regime with performance targets.</li><li>• Management fee paid to the farmer.</li></ul>	<ul style="list-style-type: none"><li>• Calf owned by farmer.</li><li>• Input costs paid for by farmer.</li><li>• Performance targets more relaxed.</li><li>• Secure forward-price. Payment rates per kg, with payment bands for up to and over 100kg liveweight at 12 weeks, plus a headage payment.</li></ul>

Contracts are generally secured on agreement that calf rearing units comply with the livestock marketing group's specifications on rearing methods, housing and handling procedures and comply with all relevant legislation.

Livestock rearing groups would expect to see a batch system in operation, based on calves being delivered at 10-21 days old (40kgs) and being collected for finishing at 12-14 weeks (100-125kg). Calves are generally grouped by age, breed and gender, and delivered in batches of between 35 and 50.

Vaccination programmes vary between different livestock marketing groups but it is common practice to see strict animal health and welfare protocols in place in accordance with Defra's Farm Health Planning.

### *Advantages of using livestock marketing groups:*

- Provide a trained eye, based on expertise and experience when selecting calves
- Provide a secure sale of calves at 12 weeks
- Offer business and practical advice on nutrition, feeding, housing and general calf management
- Provide a market-voice between calf rearers, finishers, abattoirs or processors and retailers.

## **Colostrum at birth**

Colostrum intake within the first 24 hours after birth provides a calf with the essential antibodies (immunoglobulins) needed to help fight disease and infection at such a vulnerable stage of its life. Good colostrum management at birth is key to helping avoid poor health, low growth rate and high mortality in calves.

A calf's gut can only absorb colostrum between the first three and 24 hours of its life, so feeding good quality colostrum at the right time and in right quantity is essential. As a rule, a calf fed three litres of colostrum over two feeds within three to six hours of birth will have received sufficient to fight against many of the most common illnesses.

A good quality of colostrum is considered to consist of:

- 5.1% fat, acting as a laxative and energy source
- 16.4% protein, containing the essential antibodies
- High levels of vitamins A, D and E. Vitamin A is the most important of these in helping develop a calf's resistance to infection.

Colostrum is naturally available from the dam, but it often becomes necessary to either supplement or replace the dam's colostrum with a commercial substitute, due to colostrum deficiencies that often exist in the dam.

*Note: A colostrometer that can be bought relatively cheaply or may sometimes be free from animal health companies can be used to test colostrum levels to identify where colostrum supplementation is needed.*

## CURRENT PRACTICE

### FEEDING REGIMES AND METHODS

#### On arrival

Calves arriving at the farm or rearing unit, which will have been transported from their source farm and may have passed through a livestock market, may be dehydrated and stressed. Levels of dehydration will be in proportion to the journey length, and the extent of exposure to other infections and diseases during transfer should also be taken into account.

**Tip:** *To minimise stress when sourcing calves under a contract from a livestock marketing group, it can be requested that calves are delivered directly from the farm of origin.*

Calves should arrive to pens and yards that have been thoroughly washed and disinfected. Pens should be well ventilated, dry and contain a well-bedded lying area with an easily accessible water supply. It may be necessary in very cold weather to offer additional heating, particularly to any calves showing signs of weakness. These calves should be identified and isolated in separate pens.

After calves have rested for between four and eight hours they can be fed their first feed, although if arriving in the evening they can be left until the next morning. It is common practice to feed two 1.5 litre feeds of proprietary glucose and electrolyte solution at blood temperature (37°C) for the initial feed. This re-hydrates the calf and provides a minimal supply of energy, whilst keeping the gut empty of nutrients until the calf has settled and is ready to digest calf milk replacer.

#### Calf milk replacer

Calf milk replacer (CMR), formulated from by-products of the dairy industry, is a substitute for a calf's intake of natural whole milk. It is common practice to feed CMR to early weaned calves. The cost per unit of milk replacer tends to be less than that of whole milk, and unless waste milk is available from a dairy operation, CMR is generally the most cost effective way of feeding batches of calves.

The two main categories of CMR are termed "skim based" and "zero" or "non-skim based".

**Table 2 – Skim and non-skim based calf milk replacers**

<b>Skim based</b>	<ul style="list-style-type: none"><li>• Contains 50-60% skimmed milk powder, vitamins and minerals</li><li>• High casein (milk protein) content, known for helping reduce digestive upset and the incidence of <i>E. coli</i> scour.</li></ul>
<b>Non-skim based</b>	<ul style="list-style-type: none"><li>• Consists of whey protein concentrates.</li><li>• Generally lower in protein with higher milk sugar (lactose) content</li><li>• Not as effective for digestibility but the high acidic value of whey powder makes the replacer effective against scour.</li></ul>

It is now common to see whey-based CMRs being used which also contain some skimmed milk powder along with soya and wheat proteins, yogurt powder, vitamins, minerals and colostrum powder. Nutritional values are comparable to those of skim based CMRs, while prices are generally lower.

CMR usually comes in bags of between 15kg and 25kg and may be mixed with an acidifier. Acidifiers prolong the life of reconstituted milk products; they aid calf digestion and help defend against scour.

A range of different CMRs are available to suit once a day, twice a day and *ad-lib* feeding regimes.

### Twice-a-day feeding

It is good practice to feed calf milk replacer (CMR) to freshly delivered calves twice-a-day for at least the first week after arrival. Thereafter calves may continue with twice-a-day feeding or be introduced to a once-a-day regime. Twice-a-day feeding is currently the most popular regime in the UK and Ireland. Feeding methods include using an open or teated bucket, a Wydale feeder or milk bar feeder.

**Table 3 – Example of a twice-a-day feeding regime, showing the quantity offered at each of the morning and the afternoon feeds**

	<i>Days 1-4</i>	<i>Day 5</i>	<i>Day 6</i>	<i>Day 7 - weaning</i>
<b>Litres per feed with 100 grams of CMR/litre</b>	1.0	1.5	1.75	2.0

**Note:** This is based on a calf entering a rearing unit at 40kg. Quantities of CMR are proportionately altered according to a calf's size and target growth rate.

<b>Advantages</b>
<ul style="list-style-type: none"> <li>Calves must be overseen twice a day, providing the regular monitoring of health and performance, with a positive impact on reducing calf mortality</li> <li>A simple system to delegate</li> <li>Scope for increasing milk feed intake and live-weight gain</li> <li>Relatively low equipment costs.</li> </ul>
<b>Disadvantages</b>
<ul style="list-style-type: none"> <li>Labour intensive</li> <li>Growth performance limited by the volume of milk fed</li> <li>Feeders need cleaning after every feed</li> <li>Feeding must take place at the same time every day.</li> </ul>

### Once-a-day feeding

Once-a-day feeding provides many of the advantages of twice-a-day feeding, while at the same time reducing labour inputs. Consequently this is a common option for rearing lower value progeny such as Holstein bull calves.

Once-a-day feeding provides a restricted amount of calf milk replacer (CMR), just slightly higher than the calves' maintenance requirements. In this way calves are encouraged to consume a supplementary course of pellets or coarse calf mix to encourage rumen development.

Feeding methods include using an open or teated bucket, a Wydale feeder or milk bar feeder. A CMR specific to once-a-day feeding is used containing a higher proportion of concentrates.

**Table 4. Example of a once-a-day feeding regime based on a CMR concentration of 200g/litre**

		Size at birth		
		Small <37kg	Medium 37kg - 43kg	Large >43kg
Twice-a-day	1-2 days	2 x 1 litre	2 x 1 litre	2 x 1 litre
	3-5 days	2 x 1 litre	1.5 litres	2.0 litres
	6-9 days	2 x 1 litre	1.75 litres	2.25 litres
Once-a-day	10-12 days	1.5 litre	2 litre	2.5 litre
	13-16 days	1.75 litre	2.25 litre	2.5 litre
	17 - 20 days	2 litre	2.5 litre	2.5 litre
	21-24 days	2.25 litre	2.5 litre	2.5 litre
	25-35 days	2.5 litre	2.5 litre	2.5 litre
	36-42 days	2.5 litre	2.5 litre	weaned
	43-49 days	2.5 litres → weaned	weaned	

Source: On Farm Research Ltd, 2005.

#### Advantages

- Reduced labour time
- Requires less calf milk replacer
- Low equipment costs
- Integrates well with other farm enterprises
- Easy to delegate.

#### Disadvantages

- Limited growth performance as volume of milk fed is restricted
- Time dependent (must take place in the morning)
- Requires a high level of stockmanship to ensure that calves are observed with sufficient frequency and care.

#### Ad libitum feeding

*Ad libitum* (*ad-lib*) feeding regimes allow calves to feed on their own accord. There are two forms of *ad-lib* feeding: i) cold *ad-lib*, in which calves consume a high quality acidified CMR that is available to them cold from a container with a teat, and ii) warm *ad-lib*, which involves the use of automatic feeders to provide calves with a supply of warm CMR when required.

Both forms of *ad-lib* feeding share the following advantages and disadvantages.

<b>Advantages</b>
<ul style="list-style-type: none"><li>• Significantly less labour time required to that of the other feeding regimes</li><li>• Calves reach higher growth rates</li><li>• More flexible for working around other farm enterprises</li><li>• Larger numbers of calves can be handled.</li></ul>
<b>Disadvantages</b>
<ul style="list-style-type: none"><li>• Higher feed/CMR costs</li><li>• Requires some technical expertise (warm <i>ad-lib</i> only)</li><li>• Requires a high level of stockmanship to ensure that calves are observed with sufficient frequency and care.</li></ul>






**Note:** - i) Warm *ad-lib* feeding also requires a higher level of investment and ii) cold *ad-lib* feeding is not thought to be as palatable as warm *ad-lib* and has been known to result in lower feed intake.

When feeding on an *ad-lib* system it makes sense to adopt strict good practice measures including:

- Ensuring feed areas are regularly cleaned to prevent the build up of ammonia, an important factor in causing pneumonia
- Regularly bedding pens with fresh straw to compensate for increased wetting and dunging
- Cleaning feeding apparatus to maintain hygiene standards, helping prevent the spread of disease organisms
- Ensuring sufficient time is given daily for careful observation of each calf's health.

### Transponder targeted feeding

Transponder targeted feeding has come about through the development of computerised transponder feeders, which regulate milk supply to each individual calf. As with other automatic feed systems, transponder targeted systems offer significant labour saving benefits.

Each calf wears a transponder which gives them an individual identity, recognised through the computerised feed system. The system provides a pre-determined quantity of warm calf milk replacer to each calf each day or each part of a day. While calf rations can be set manually, some automated set-ups are capable of weighing calves when they feed and altering their rations accordingly, so optimising daily live-weight gain.

Further, by monitoring individual calf intake and recording daily live-weight gain, these automated systems can provide an accurate indication of any abnormalities in health and growth performance in a batch of calves.

While transponder targeted feeding offers the same advantages as *ad-lib* feeding it is able to offer further benefits including:

- Maintaining lower feed costs than other automatic feeders.
- Accurate monitoring of individual calf intake and growth performance.

However, it should also be noted that transponder targeted feeding requires a significantly higher level of investment than *ad-lib* automatic feeding. Feeders are currently available to buy with a list price of around £6000, or they may be leased over five years, and are capable of feeding up to 40 or 50 calves at one time.

### **Bucket feeders**

Bucket feeders are the traditional method of providing calf milk replacer, used for both twice-a-day, and once-a-day feeding. Bucket feeding can be practiced with either an open or a teated bucket.

When feeding batches of calves metal or wooden feeding stations can be used. It is an option to use clapses to hold calves in position when feeding. This gives stockmen the opportunity to note suspect calves that haven't fed and provides an opportunity for observing each calf, while at the same time preventing stronger calves from stealing the rations of weaker calves.

Studies have shown that open bucket feeding in group housing is a major cause of naval sucking. Using a teat significantly reduces naval sucking, and calves fed from a rubber teat also produce higher levels of saliva, which aids digestion and helps prevent scour.



### **Wydale feeders**

The Wydale feeder is a popular method used for feeding under both twice-a-day and once-a-day regimes.

Milk is poured into the sections at the back of the feeder and delivered to calves through the teats at the front. It is more efficient than bucket feeding and also maintains the ability to alter the amounts of CMR fed to individual calves.



To save labour time calf numbers per pen are normally divisible by the number of teats offered by the Wydale feeder at one given time. If operating in larger pens gates may be used to separate groups of fed and unfed calves.

There is a range of different milk feeding methods that are designed with the principal of feeding larger groups of calves all at one time and from one 'communal' bank. These are efficient in terms of labour but create difficulty in monitoring milk consumption of individual calves.

*Courtesy Wydale Plastics Ltd*

## Automatic milk feeders



Automatic milk feeders have been designed to supply the calf with a pre-set milk powder mix when required by the calf. Milk is mixed automatically and is supplied to calves via a teat. A common size of feeder is capable of feeding 40 to 50 calves via four feeding points or teats.

The calf milk replacers used for these feeders contain silicon, which keeps powder 'free-flowing', and ensure mixing is consistent. Specialist information on mixing concentration and the general use of automatic calf milk feeders is available from machine manufacturers, feed companies and animal nutritionists. Currently, milk feeders are available at a list price of around £2000 to buy, or around £150 per year to hire from a feed company.

One problem, which has been associated with automatic *ad-lib* feeding, is that calves consume less feed and roughage, which is needed for rumen development. To overcome this, the simple step may be taken of switching off the feeder overnight, thereby encouraging the intake of dry feed and roughage.

## Feeds and roughage

Feeds and roughage (pellets or meal mix, hay, barley straw and silage) are vital for healthy rumen development and for achieving greater daily live-weight gains in calves. Introducing roughage to calves early can encourage early weaning, which saves on the cost of calf milk replacer.

Livestock marketing groups have stated that when rearing a calf to meet target live-weight gains they would be reluctant to feed much hay as roughage. Hay is exceptionally palatable to calves, but deters them from eating concentrate feedstuffs that better promote growth, so the availability of hay should be restricted. A good clean barley straw is seen as adequate in encouraging rumen development and may be provided alongside concentrate feeds.

There are a range of dry feed options available offering different nutritional values. As a guide a good benchmark for dry feedstuffs might be as follows:

- **starter pellets** - 4.5% oil, 18% protein, 7.5% fibre and 7% ash
- **coarse calf mix** - 3% oil, 18% protein, 7% fibre and 7.5% ash

High protein pellets can be fed *ad-lib* from a few days of age until 12 weeks old. Some rearers prefer to use a more palatable coarse mix containing a selection of soya, molasses, minerals and vitamins. Alternatively a rolled barley mix may be fed when calves are consuming sufficient high protein pellets. In general, coarse calf mixes have higher cost implications, although this will of course depend on availability and current prices. The advice of a good nutritionist could prove worthwhile.

Dry feed requirements will vary depending on the milk feeding regime and feeding method used. Whatever these may be, it is important that a supply of clean water is

available at all times. Calves will drink around 4.5 litres of water per day and in addition to maintenance requirements this will aid digestion and rumen function.

### **Weaning**

Weaning generally takes place when a calf reaches a live weight of between 63kg and 80kg and is consuming sufficient dry feed to meet their maintenance requirements ie around 1kg of concentrates per day. This stage is normally reached between five and six weeks of age. The general principle in weaning is to reduce a calf's intake of milk so as to encourage it to consume more concentrates.



## CURRENT PRACTICE

### HOUSING



#### Individual pens

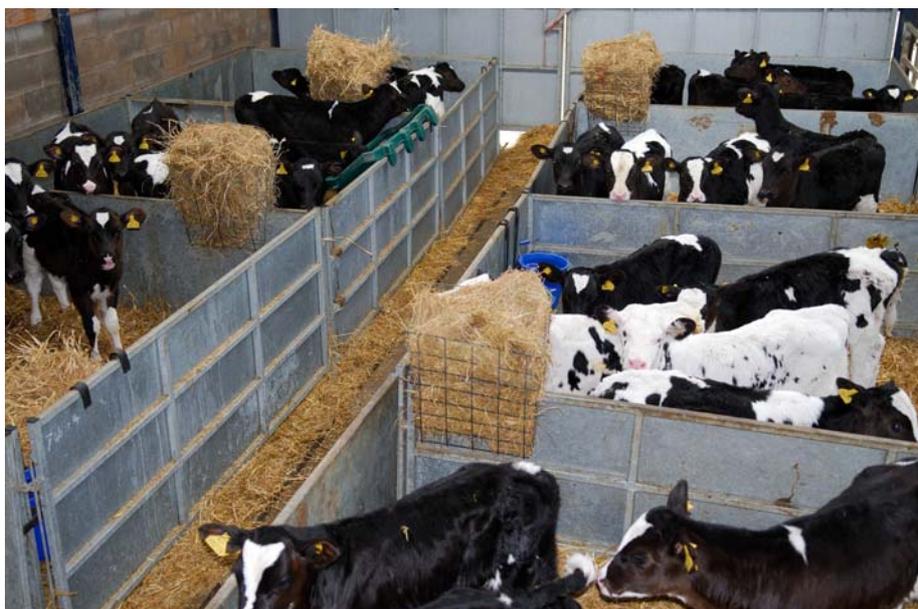
Individual pens are effective as casualty pens for nursing ill, weak and vulnerable calves. They allow for careful observation of calf health and control or monitoring of feed intake, while at the same time provide a way of separating calves to assist in reducing the spread of illness and disease.

Although individual pens have their purpose, they are an inefficient way of utilising valuable production or farm space and require more labour time, so when appropriate it is common to change to or revert to using group pens.

Some pens can feature outdoors, like the calf kennel seen in the picture. They make use of any available outdoor space and are effective in isolating illness. Calf cages or hutches are also used outside for penning and sometimes rearing calves individually.

#### Group pens

Group pens are a labour efficient way to rear batches of calves. On a twice-a-day or once-a-day feeding regime it is common to see calves being reared in smaller numbers up to weaning and then 'mixed' into larger group pens after weaning. Larger group pens are commonly used for both *ad-lib* and non *ad-lib* automated feeding systems. When operating a group housing system, good husbandry and observation skills are vital so as to spot calves needing attention, and to identify any signs of disease or illness that should be addressed.



Outdoor housing using calf hutches may also be used for rearing smaller groups of calves. They are a good way of avoiding overcrowding in existing buildings, although they may require higher labour inputs, dependant on their setup.

*Note: calves are sensitive to extremes of temperature and humidity and for this reason calf hutches should be avoided through the winter and care taken in their use from mid-autumn onwards.*

## Health and hygiene

Health and hygiene measures with calf housing will help prevent illness and disease:

- Yards should be cleaned between batches to prevent ammonia build up
- Pressure washing and disinfecting buildings as well as the periodic resting of facilities will prevent disease build up
- Store muck and waste where effluent or slurry will not run into calf pens.

## Design and layout

Calf health, welfare, ease of handling, feeding, bedding and cleaning efficiency should all be taken into account when designing calf housing.

When considering calf health the following guidelines present a healthy living environment:



- Individual pens should be at least 1m wide and ideally 1.8m long
- Pens should be large enough to provide separate areas for lying, drinking, eating and exercising
- Each calf should have at least 1.5m<sup>2</sup> individual space per pen
- Lying areas should be protected from draughts
- Plenty of bedding should be used to keep areas dry
- A slope of at least 1 in 20 will allow urine to drain from bedding areas
- Barns or sheds should be high roofed with a natural inlet or flow of air that can be controlled. Supplementary ventilation may be necessary if air movement is a problem
- Natural light should be available
- Water bowls should be easily accessible and offer a constant supply of water  
A minimum of one water bowl for every 10 to 12 calves should be provided
- Roofs should be leak proof and lying areas sheltered from wind and rain
- Pens should be injury risk free for both calves and farm staff.

## CURRENT PRACTICE

### ***HEALTH & WELFARE***

#### **Illness and disease**

There is generally a 5% mortality rate in Holstein calves, slightly higher than the 2.5-3% mortality rate in continental breeds. Around 75% of these deaths occur in the first month.

Good health in calves can be promoted by adopting the 'prevention is better than cure' approach, with a good living environment and husbandry, and appropriate preventative medicine.

Adopting a good health and welfare protocol prevents potentially large increases in veterinary and medicine costs, saves labour time and maintains efficient growth performance, thus helping to protect profit margins.

While strict hygiene measures will help to prevent disease, many farmers also vaccinate. The main diseases subject to vaccination or a medical course of prevention are:

- **Calf pneumonia** – it is estimated that affected calves will increase costs by £43-£84 a head. Vaccinations against pneumonia are available and can be given from two to four weeks of age to address multiple strains or can be strain specific eg, vaccines which specifically address IBR, PI3 and RSV types of pneumonia.
- **Coccidiosis** – research has shown that young stock infected at two months of age show reduced growth performance thereafter. There are approved preventative medicines that can be administered as a feed additive or in drinking water as a two-day oral dose given before any predicted date of an outbreak.
- **Bovine Virus Diarrhoea (BVD)** – although primarily seen in cattle aged between four and 18 months, the BVD virus can exist in calves that have been exposed to it through the dam. These calves are said to be 'persistently infected' and they act as a reservoir of infection as well as potentially developing the fatal condition of 'mucosal disease' later in life. Concurrent infection with BVD leads to reduced calf immunity, which dramatically increases its susceptibility to other serious infections, such as pneumonia, *E.coli* (scour) and *Salmonellosis*. Vaccines are available to be given to cows to prevent transfer to their calves. Marketing groups may insist on BVD vaccinations in the source-herd to ensure the health of calves beyond three months.

## COMMON AILMENTS OF YOUNG CALVES

For advice on any of the diseases/conditions, vaccines and treatments which appear in this table, always consult with your veterinary practitioner.

CONDITION/ILLNESS	BACKGROUND, SYMPTOMS & SIGNS	PREVENTION/CONTROL	TREATMENT/CURE
<b>Scour</b>	<ul style="list-style-type: none"> <li>○ The main cause of calf mortality in the first month of life. There are four main causes of calf scour including: bacterial (<i>E.coli</i> and salmonella, typically 0 – 4 days old); viral (rotavirus and coronavirus, typically 7 – 12 days old); protozoal (cryptosporidia and coccidiosis) and nutritional.</li> <li>○ Symptoms include severe diarrhoea (leads to dehydration), increased respiratory rate, sunken eyes and lethargy, reduced appetite and inclination to suckle.</li> <li>○ Be aware that dehydration is the most common cause of calves dying from scour, followed by acidosis in which a calf's blood pH falls below its normal pH of 7.4.</li> </ul>	<ul style="list-style-type: none"> <li>○ Good colostrum management.</li> <li>○ Good hygiene of living environment – cleaning and disinfecting regularly.</li> <li>○ A clean and dry bed.</li> <li>○ Vaccination - it is important to identify the cause of the disease so that vaccines can be given to a dam during pregnancy. There is an effective vaccine that acts against rotavirus, coronavirus and K99 <i>E.coli</i>.</li> <li>○ Feed milk replacer of a good quality and at the correct strength and temperature.</li> </ul>	<ul style="list-style-type: none"> <li>○ Antibiotics if bacteria are known to be the cause. <b>Note:</b> some antibiotics may be given as a preventative course in the form of an injection or an oral dose at birth.</li> <li>○ Feed electrolytes, glucose, minerals and vitamins in liquid form to rehydrate affected calves.</li> <li>○ Feeding probiotics is an option after a course of treatment.</li> <li>○ Separate infected calves immediately.</li> </ul>
<b>Navel-ill and joint-ill</b>	<ul style="list-style-type: none"> <li>○ A bacterial infection resulting from dirty conditions in the living environment. It can spread from the navel to the joints (joint-ill), liver and lungs, causing inflammation and is mainly seen in the first week of life.</li> <li>○ Symptoms include constantly wet and swollen navels, pus discharge from navels, reduced appetite and possibly high temperatures.</li> </ul>	<ul style="list-style-type: none"> <li>○ Ensure early housing is disinfected before arrival and kept clean when in use.</li> <li>○ Dip navels at birth with iodine or use an antibiotic aerosol. A product that dries the navel is important.</li> </ul>	<ul style="list-style-type: none"> <li>○ Daily antibiotic injections depending on severity.</li> <li>○ Bathe the moist end of the navel cord in a warm dilute antiseptic or deep flush (with vet supervision).</li> <li>○ Apply a local dressing to the navel.</li> </ul>

	<ul style="list-style-type: none"> <li>○ Joint-ill is mainly seen between two and four weeks of age. Calves become lame, lethargic and reluctant to move. Hocks and knees are commonly affected with heat and fluid swelling.</li> </ul>		<ul style="list-style-type: none"> <li>○ Provide clean and dry bedding.</li> </ul>
<b>Umbilical Hernia (Navel rupture)</b>	<ul style="list-style-type: none"> <li>○ Can occur in calves at birth when blood vessels from the placenta (cleansing) pass through a larger than necessary hole in the skin and muscle of the calf's abdomen, which fails to close at birth. This allows a length of intestine to prolapse through and lie between the skin and the muscle, producing swelling in the naval region. A hernia is soft and fluctuating and can normally be pushed back into the abdomen manually and will not result in a temperature or illness (do not confuse with navel ill). It is however more vulnerable to infection.</li> <li>○ It should not be confused with a rupture which is a split in the body wall at an <b>unnatural site</b>.</li> </ul>	<ul style="list-style-type: none"> <li>○ No specific preventative action.</li> <li>○ - Antibiotics administered to prevent infection.</li> </ul>	<ul style="list-style-type: none"> <li>○ Small hernias (orange sized) can be left.</li> <li>○ For a medium hernia vets can anaesthetise a calf and apply a metal or plastic clamp to the loose fold of skin covering the hernia.</li> <li>○ - Large hernias require surgery.</li> </ul>
<b>Diphtheria</b>	<ul style="list-style-type: none"> <li>○ A bacterial infection that leads to ulcers and soreness in the mouth including on the tongue or a swelling on the cheek. Calves may lose appetite, develop coughing, have a high temperature and appear 'depressed' or withdrawn. If left untreated it may pass into the lungs and cause a fatal pneumonia.</li> </ul>	<ul style="list-style-type: none"> <li>○ Ensure good hygiene of living environment – cleaning and disinfecting regularly.</li> <li>○ - Avoid factors that lead to trauma of the oral cavity such as hay containing thistles or other sharp material.</li> </ul>	<ul style="list-style-type: none"> <li>○ A wide range of broad-spectrum antibiotics are available.</li> <li>○ - Separate infected calves immediately.</li> </ul>
<b>Heart defects</b>	<ul style="list-style-type: none"> <li>○ A failure of the heart at birth to bypass blood sufficiently through the lungs to collect oxygen. Calves pant, have a</li> </ul>	<ul style="list-style-type: none"> <li>○ - No specific preventative action.</li> </ul>	<ul style="list-style-type: none"> <li>○ No specific preventative action other than using heart stimulants and</li> </ul>

	<p>racing pulse during or after feeding or mild exercise, and are more susceptible to pneumonia.</p>		<p>antibiotics to treat any consequent pneumonia.</p> <ul style="list-style-type: none"> <li>○ Some cases slowly resolve with age.</li> </ul>
<b>Coccidiosis</b>	<ul style="list-style-type: none"> <li>○ A parasitic organism known as coccidia, which form spores (eggs) known as oocysts that can live outside the animal for many months. When ingested, oocysts hatch into coccidia that damage the large intestine, which causes watery diarrhoea, sometimes with blood, mucus and straining. It is particularly seen in calves between three and six months of age.</li> <li>○ Calves become depressed, lose appetite, lose weight and become dehydrated</li> </ul>	<ul style="list-style-type: none"> <li>○ Separate calves displaying diarrhoea to stop the spread of oocysts.</li> <li>○ Thoroughly clean the environment between batches of calves. Be aware that oocysts resist hot and cold conditions and many disinfectants.</li> <li>○ Incorporate anticoccidial agents into milk and feed as a preventative measure as well as a cure.</li> </ul>	<ul style="list-style-type: none"> <li>○ Most minor cases recover without treatment. If treatment is to be administered then it is more effective to apply to calves that have not yet started showing signs. A suitable treatment includes the use of sulphonamides.</li> <li>○ In severe cases, feed electrolytes, glucose, minerals and vitamins in liquid form to rehydrate affected calves.</li> </ul>
<b>Salmonellosis</b>	<ul style="list-style-type: none"> <li>○ The two most common species affecting calves include <i>Salmonella typhimurium</i> and <i>S.dublin</i>. Calves may die so rapidly that no symptoms are seen. However symptoms may include: severe scour and dysentery, pneumonia, arthritis, jaundice, nervous symptoms, septicaemia, loss of appetite and possibly some coughing.</li> </ul>	<ul style="list-style-type: none"> <li>○ Thoroughly disinfect the living environment between batches.</li> <li>○ Vaccination – this is given to the dam if farm of origin is known to be infected.</li> </ul>	<ul style="list-style-type: none"> <li>○ Treatment must be given urgently. Antibiotics are available, but with careful consideration, as there is evidence to suggest that they are not fully effective as they reduce the chance of self-cure and increase the risk of an animal becoming a carrier.</li> <li>○ Calves must be isolated with adequate warmth and general nursing.</li> </ul>

<p><b>Pneumonia</b></p>	<ul style="list-style-type: none"> <li>○ The most common disease seen in calves. Initially caused by a range of viruses, but also by secondary bacterial infections, which can strike more easily when forms of stress occur that weaken immunity.</li> <li>○ Pneumonia leads to reduced growth performance in calves even after recovery. Calves generally cough, pant, discharge mucus, become depressed and have a high temperature of over 39.6°C. Further signs include sweating backs and a loss of appetite.</li> </ul>	<ul style="list-style-type: none"> <li>○ Reduce stocking densities (1.5-2m<sup>2</sup>/calf).</li> <li>○ Ensure there is adequate air space and ventilation.</li> <li>○ Avoid damp and draughty laying areas.</li> <li>○ Clear muck from yards and feed areas regularly to reduce ammonia build up.</li> <li>○ Minimise dust and moulds.</li> <li>○ Vaccinate once the type of infection is known. There are vaccines available that prevent specific strains, such as the viruses IBR, PI3 &amp; RSV, and Pasteurella, the most common secondary bacterial invader.</li> </ul>	<ul style="list-style-type: none"> <li>○ Antibiotics can be given in the form of long-acting injections and in milk for pre-weaned calves when more than 20% of a group are infected. A wide range of antibiotics are available to help control secondary bacteria. Use anti-inflammatory products to reduce lung inflammation and congestion.</li> <li>○ <b>Note:</b> <i>antibiotics do not give the longer term protection that is provided by vaccines.</i></li> <li>○ Isolate sick calves to stop further spread.</li> <li>○ Treat severely ill animals with respiratory stimulants and anti-inflammatory drugs.</li> <li>○</li> </ul>
<p>Lice</p>	<ul style="list-style-type: none"> <li>○ There are two sorts - sucking lice and biting lice (most common). They mainly affect calves during winter, as lice thrive on cooler skin temperatures and in denser winter coats. Lice spread through direct contact of calves housed in groups. Calves scratch and/or rub and hair will disappear in some areas. Lice congregate around the shoulders, base of neck, head and root of tail. There is a loss in condition and performance, and a marked increase in susceptibility to pneumonia.</li> </ul>	<ul style="list-style-type: none"> <li>○ Avoid mixing uninfected calves with those which are infected.</li> <li>○</li> <li>○ Carry out routine preventative treatments over the winter.</li> <li>○</li> <li>○ Ensure calves are receiving their full nutritional requirements as poor nutrition increases susceptibility to lice.</li> <li>○</li> </ul>	<ul style="list-style-type: none"> <li>○ - Insecticides can be applied in a liquid form with residual affects that kill un-hatched eggs.</li> <li>○</li> <li>○ - Vitamin A, D, E injections may help.</li> <li>○</li> <li>○ - After treatment, refresh bedding, clean housing equipment and avoid calves making contact with untreated animals.</li> </ul>

		<ul style="list-style-type: none"> <li>○ Maintain careful observation of calves and treat immediately to stop the transfer of infection.</li> <li>○</li> </ul>	
<b>Ringworm</b>	<ul style="list-style-type: none"> <li>○ Extremely common skin disease caused by a fungal infection that is capable of surviving for long periods in the farmyard. Infected animals develop bald areas which become inflamed and form a grey to yellow-white crust. Ringworm is seen the most often on the head and neck of calves.</li> </ul>	<ul style="list-style-type: none"> <li>○ Thoroughly clean and disinfect the environment between batches of calves, disinfecting buildings and objects that could house fungal spores.</li> <li>○ Vaccinate – only if there is a severe problem.</li> </ul>	<ul style="list-style-type: none"> <li>○ Remove crusts with a soft wire brush and apply an imidazole preparation (always wear rubber gloves).</li> <li>○ Natamycin can be applied as a spray to all parts of the animal and to all calves in a group.</li> <li>○ Ensure a high standard of general health and nutrition.</li> </ul>

For more information on calf illness and disease refer to **Further reading**.

## UK and EU legislation

EU and domestic legislation relevant to rearing calves up to 12 weeks

*For further detail and guidance on any domestic or EU legislation highlighted below refer to Defra's health and welfare guidance available from:*

*<http://www.defra.gov.uk/farm/livestock/cattle-dairy/healthwelfare.htm>*

### Domestic legislation

#### **The Welfare of Farmed Animals Regulations 2000 (amended 2007)**

- Lays down general rearing conditions that calves should be kept under, such as requirements for inspection, feed and water, accommodation and other good practices and measures.
- Sets out calf specific requirements, such as the provision of bovine colostrum as soon as possible after birth and no later than six hours of life, and also requirements for iron and fibre.

#### **The Cattle Identification Regulations 2007 (SI No. 59 & SI No. 1046)**

- Stipulates the requirements for registering and ear tagging calves under the British Cattle Movement Service (BCMS) within 27 days of birth.
- States that calves cannot be moved from the holding of birth until a valid passport is obtained unless transporting for disposal, fostering or an emergency (fire and flooding).

*For further information on identifying and registering calves see the BCMS's 'Cattle Keepers Handbook' available from:*

*[http://www.rpa.gov.uk/rpa/index.nsf/vContentByTaxonomy/BCMS\\*\\*Publications%20and%20Guidance\\*\\*Cattle%20Keeper%27s%20Handbook\\*\\*?OpenDocument](http://www.rpa.gov.uk/rpa/index.nsf/vContentByTaxonomy/BCMS**Publications%20and%20Guidance**Cattle%20Keeper%27s%20Handbook**?OpenDocument)*

#### **The Welfare of Animals (Slaughter or Killing) Regulations 1995; and amendments 1999, 2000, 2001, 2003, 2006 and 2007**

## **The Welfare of Animals (Transport) Order 2006**

This relates to the enforcement of the regulation 1/2005 – see Council Regulation Number 1/2005 on the protection of animals during transport and related operations.

Sets out clear requirements for:

- Protection of animals from injury and suffering while in transport.
- Appropriate construction and maintenance of vehicles fit for transporting animals.
- Maximum time and lengths of journeys before further certification is required.
- Competence of attendants and livestock handlers.
- Documentation accompanying animals in transport.
- 

## **The Animal Welfare Act 2006**

- Particular reference given to the needs of the animal being met through 'good practice', which incorporates the Farm Animal Welfare Council's five freedoms.

## **Codes of recommendations and Cross Compliance for Single Payment Scheme**

- Reference is made to the Welfare of Farmed Animals Regulations and to the requirements for good practice and supply of colostrum to calves after birth.

## **Statutory Management Requirements (SMRs) for cross compliance relating to calves**

- SMR 16 refers to the welfare of calves and lays down various requirements relating to their husbandry. Particular emphasis is given on colostrum management at birth.

## EU legislation

### **Council Directive 98/58/EC concerning the protection of animals kept for farming purposes**

Delivered through the implementation of the UK's Welfare of Farmed Animals Regulations

- Sets standards for staffing, inspection of animals, record keeping, freedom of movement, buildings and accommodation, protection from adverse weather and other health risks, inspection and maintenance of equipment, feed and water and other substances, mutilations and breeding procedures for all species on farm.

### **Council Directive 91/629/EEC laying down minimum standards for the protection of calves**

- Refers to 'calves confined for rearing and fattening'.
- Implemented through the UK's Welfare of Farmed Animals Regulations.

### **Council Regulation (EC) number 1760/2000 of the European Parliament – identification, registration and labelling**

- Its purpose is to establish a system for the identification and registration of bovine animals and the labelling of beef products.
- Implemented in the UK through the Cattle Identification Regulations

### **Council Directive 93/119/EC- protection of animals at time of slaughter and killing**

- The directive specifies how animals killed both inside and outside of slaughterhouses must be kept, with points particularly relevant to 'bobby calves'.
- Implemented in the UK by the Welfare of Animals (Slaughter or Killing) Regulations.

## **Council Regulation Number 1/2005 on the protection of animals during transport and related operations**

- States that calves cannot be transported until their navels have healed sufficiently and that calves should be no less than 10 days old if travelling more than 100km. The first of these does not apply if a farmer is transporting their own animals in their own vehicles for a distance of less than 50km.
- Time limits are set, regulating 10 to 14 day-old calves to journeys no longer than eight hours, unless accompanied by their mother.
- Implemented in the UK through the Welfare of Animals (Transport) Order.

*For guidance on this – see Defra’s guidance, available from:  
<http://www.defra.gov.uk/animalh/welfare/farmed/transport/eu-transportreg.htm>*

### **Five freedoms**

The Farm Animal Welfare Council have produced the following ‘five freedoms’ as a guideline for ‘good practice’ when rearing any animal, including rearing calves up to 12 weeks, whether on farm, in transit or at a place of slaughter.

#### **1. Freedom from hunger and thirst**

- by ready access to fresh water and a diet to maintain full health and vigour.

#### **2. Freedom from discomfort**

- by providing an appropriate environment including shelter and a comfortable resting area.

#### **3. Freedom from pain, injury or disease**

- by prevention or rapid diagnosis and treatment.

#### **4. Freedom to express normal behaviour**

- by providing sufficient space, proper facilities and company of the animal’s own kind.

#### **5. Freedom from fear and distress**

- by ensuring conditions and treatment which avoid mental suffering.

## **CURRENT PRACTICE**

### ***ENVIRONMENT***

#### **Pollution control**

##### **Storage and spreading of manure**

Ensure that manure is stored in a place where run-off and effluent are not able to reach a watercourse and cause water pollution. If there is risk of runoff to a watercourse then measures should be taken to contain it within the area of storage.

When spreading muck, avoid spreading any closer than 10 metres to a ditch or watercourse, and keep 50 metres away from a spring, well or borehole. It is also important to be aware of nitrate vulnerable zones which regulate manure applications to an amount that contains no more than 250kg of nitrogen per hectare per year for grassland and 170kg of nitrogen per hectare per year for arable land.

##### **Handling of calf milk and substitutes**

Milk has a significant polluting effect on water if allowed to reach river or streams. Likely causes of milk and milk substitutes reaching a water course on a calf rearing unit include pressure washing buildings and yard floors, steam cleaning, cleaning feeding facilities and apparatus and disposing of waste milk or calf milk replacer.

The main preventive action is to prevent cleaning agents and cleaning effluent from entering a surface water drain or soak away and to act considerately. It is better for cleaning effluent to drain into a public foul sewer where any milk solution will be dealt with accordingly and under controlled conditions rather than for it to enter a water course untreated. When handling milk and calf milk substitutes it is good practice to consider the Environment Agency's Pollution Prevention Guidelines (PPGs).

#### **Key guidance and legislation to be considered:**

Cross Compliance:

Good Agricultural & Environmental Conditions & Statutory Management Requirements

*Available from: <http://www.crosscompliance.org.uk/cms/2008-guidance-documents/>*

Minimising Pollution from Agriculture & Nitrates Manure Management

*Available from: <http://www.crosscompliance.org.uk/cms/minimising-pollution-from-agriculture/>*

**Environment Agency** – 'Best Farming Practices: Profiting from a good environment'.

Downloadable from: [http://www.environment-agency.gov.uk/commondata/acrobat/bfpeng2003\\_1\\_28\\_798944.pdf](http://www.environment-agency.gov.uk/commondata/acrobat/bfpeng2003_1_28_798944.pdf)

PPG 17 –Dairies & Other Milk Handling Operations

Available from: <http://publications.environment-agency.gov.uk/pdf/PMHO0301ANNB-e-e.pdf>

PPG 13 – Vehicle Washing & Cleaning (if operating pressure washers and/or steam cleaners)

Available from:

<http://publications.environment-agency.gov.uk/pdf/PMHO0307BMDX-e-e.pdf>

### **Climate change**

The UK beef industry is highly dependant on the dairy sector with around 55% of beef production being dairy progeny. It is estimated that around one third of energy used in beef production is invested in breeding, while two thirds of energy use is in finishing.

Without calves from the dairy herd this figure would be reversed and the majority of energy use would be invested in breeding. That is, the beef industry in the absence of dairy offspring would be considerably less efficient in terms of energy use.

However, Holstein bull calves which are not finished for beef still represent an energy cost to the dairy sector, but with no benefits to the dairy or beef sectors. Rearing these Holstein bull calves for meat would drive up the energy efficiency of beef production and help support UK agriculture in reducing its environmental footprint. Further, by increasing the volume of home-produced beef it would drive down the need to transport beef across the globe to the UK, with commensurate benefits in energy reduction.

## CURRENT PRACTICE

### PERFORMANCE & TARGETS

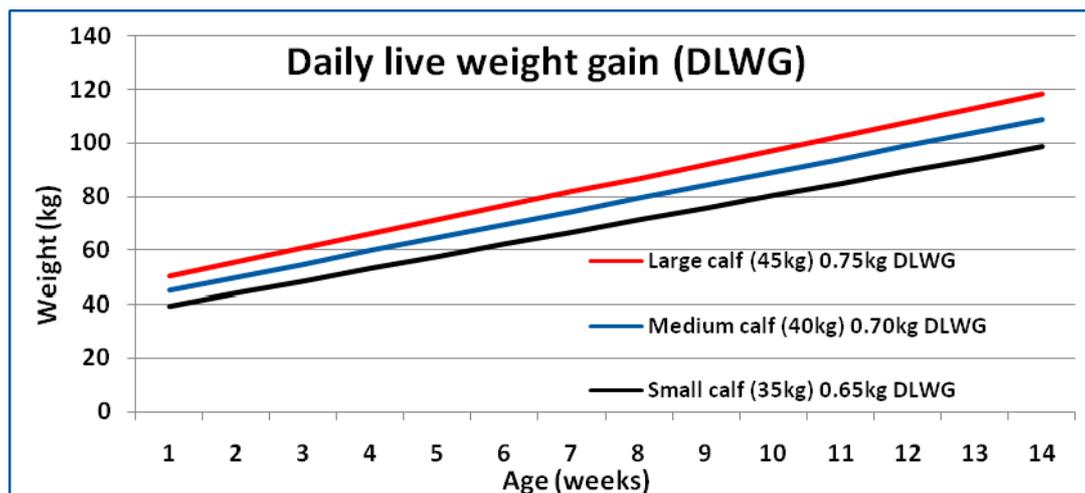
#### Targets at 12 weeks of age

It is good practice to monitor calf weight as an indication of any health abnormalities or to identify the need for diet or feeding alterations to be made in line with growth performance. It is common practice to weigh calves pre and post weaning to keep track of growth rates.

A calf's growth rate is a hugely variable factor that will alter with breeding, feeding regimes and methods, housing environments and health. On average a strong Holstein bull calf will achieve a daily live weight gain of between 0.65kg and 0.75kg.

Livestock marketing groups indicate that a weight range of between 100kg and 125kg is a desirable and achievable benchmark for selling 12 week old calves.

The graph below shows the growth of a Holstein bull calf based on three different initial weights and daily live-weight gains. The graph also shows how final weights will vary according to initial weights, which can have a proportionate impact on daily live-weight gain.



When selling a batch of calves at 12 weeks old traits that will increase their value to buyers and finishers include:

- Batches of even size and weights
- Calves that stand strong and show signs of good skeletal development
- Calves that have been vaccinated and dehorned
- Calves that show a good coat bloom
- Calves that look alert with pricked ears and bold bright eyes
- Batches in which there are no indications of current or possible re-occurring health issues.

## **MARKET POTENTIAL**

### ***MARKET ATTITUDES***

#### **Market potential for producing Holstein bull beef**

Holstein bull beef produces a product suitable for the beef supply chain and which abattoirs and processors will support as a way of helping to fill the slaughter capacity in the UK and increase volume to reduce the current shortfall of beef. When reared correctly by producers and handled correctly by abattoirs and processors, Holstein bull beef has the potential to present good quality meat that will compete with traditional beef, and is capable of fulfilling some supermarket premium ranges. This, and current price rises in beef alongside increasingly integrated supply chains between producers, processors and retailers, gives the Holstein bull beef market a positive outlook.

# ECONOMICS

## *DECISION SUPPORT*

### Decision guidance

When choosing an appropriate calf rearing system for rearing calves up to 12 weeks of age there are four key considerations:

For further guidance on costings, download the spreadsheet.

- **The end market:** Is the intention to sell calves at 12 weeks or to take them through to finishing? If the intention is to sell them on at 12 weeks, how will calves be marketed?
  - Livestock auction – variable trade and market forces
  - Direct to a finisher – control of a privately agreed deal
  - Livestock Marketing Group – guaranteed rearing payment per head or a guaranteed forward price.
- **Labour:** Different systems will vary in the type and amount of labour they require. Some systems will require greater expertise and sophistication, while some will rely more heavily on the availability of man hours. Take into consideration:
  - Labour force – availability, adaptability to change and skills offered
  - General practice – integration with other enterprises, hands required and ease of delegation.
- **Buildings and facilities:** Many redundant farm buildings and current housing layouts from past enterprises will adapt to rearing calves. However, is a system being chosen to be based around what already exists or is there a willingness to adapt buildings and facilities around a desirable system? When considering current or projected facilities, think:
  - Pens – ventilation; space (base on a minimum of 1.5m<sup>2</sup> / calf)
  - Muck – handling efficiency and storage including drainage of urine
  - Straw – supply and storage
  - Utilities – water and electric availability
  - Handling – facilities and efficiency
  - Feeding equipment - second hand, new or hired; feeding efficiency and output.
- **Input costs:** These are hugely variable and will vary on an individual basis:
  - Feeds and concentrate – performance versus cost, suppliers & nutritional advice
  - Veterinary – services available, vaccination possibilities, potential medical/health costs
  - Purchase of calves – purchase prices, source of purchase (own, private or dealer), dairy or beef breed, transport and fuel prices
  - Utilities – water and electricity usage
  - Straw – delivered in or domestically supplied and volume required
  - Labour – time and wages.

## FURTHER READING

### Books and guides

*A Veterinary Book for Dairy Farmers*, R. W. Blowey. Old Pond Publishing, 3<sup>rd</sup> edition, 1999.

*Calf and heifer rearing*, edited by P. C. Garnsworthy. Nottingham University Press, 2005.

Calf Management Guide, Volac.

(Available from: <http://www.volac.com/content/Calf.asp>)

*Farm Management Pocketbook*, John Nix. The Andersons Centre, 38<sup>th</sup> edition, 2008.

*Holstein Bull Beef Production*, R. M. Kirkland, T. W. J. Keady and D. Anderson.

AgriSearch, 2006. (Available from:

<http://www.agrisearch.org/projectsdetails.php?ResearchID=8&ProjectID=9&MenuID=5>)

*Livestock Housing*, C. M. Wathes and D. R. Charles. CABI Publishing, 1994.

### Websites

*Beyond Calf Exports Forum* – Report on Conclusions and Recommendations.

<http://www.calfforum.org.uk/ForumReport.pdf> Department for the Environment, Food and Rural Affairs – Animal Welfare.

<http://www.defra.gov.uk/animalh/welfare/default.htm>

Department of Agriculture and Rural Development of Northern Ireland – Calf Rearing.

[http://www.ruralni.gov.uk/index/publications/information\\_booklets/heifer\\_rearing\\_system/calf\\_rearing\\_index.htm](http://www.ruralni.gov.uk/index/publications/information_booklets/heifer_rearing_system/calf_rearing_index.htm)

EBLEX – Beef Producer

<http://www.eblex.org.uk/beefproducer/index.php>

*National Beef Association* - Background summary of current issues facing Holstein bull calf production.

[http://www.nationalbeefassociation.com/fact\\_sheets\\_details.php?FactSheetCatID=3&FactSheetID=4](http://www.nationalbeefassociation.com/fact_sheets_details.php?FactSheetCatID=3&FactSheetID=4)

Northern Ireland Red Meat Industry Task Force

<http://www.niredmeattaskforce.co.uk/>

*Red Meat Industry Forum* - A guide to the red meat supply chain.

<http://www.redmeatindustryforum.org.uk/supplychain/>

## **ACKNOWLEDGEMENTS**

The development of this website was supported by a wide spectrum of industry representatives. Thanks are due in particular to all the farmers who contributed and to the following:

### **Abattoirs and processors**

Anglo Beef Processors

<http://www.anglobeef.com/pages/home.asp>

*St Merryn Meat Ltd*

### **Agricultural services**

*Cirencester Livestock Market*

<http://www.voycepullin.co.uk/salesandmarkets/cirencestermarket.htm>

*Cox & Robinson Limited*

Countrywide Farmers

<http://www.countrywidefarmers.co.uk/pws/Home.ice>

*Roger Blowey MRCVS*

Wood Veterinary Group

Thrapston Livestock Centre

<http://www.bletsoes.co.uk/>

Volac International Limited

<http://www.volac.com/content/Default.asp>

### **Colleges**

Myerscough

### **Government and associated bodies**

Department for Environment, Food and Rural Affairs

<http://www.defra.gov.uk/>

Meat and Livestock Commission

<http://www.mlc.org.uk/>

## **Livestock marketing groups**

Blade Farming South West Ltd  
*<http://www.blade-farming.com/>*

Meadow Quality Ltd  
*<http://www.meadowq.co.uk/>*

Peter Jones Livestock Ltd  
*[mailto: info @peterjoneslivestock.co.uk](mailto:info@peterjoneslivestock.co.uk)*

## **Research institutes**

The Agri-Food Biosciences Institute  
*<http://www.afbini.gov.uk/>*

*Professor Jeff Wood, Head of the Division of Farm Animal Science, University of Bristol.*  
*<http://www.vetschool.bris.ac.uk/about/>*

## **Retailers**

ASDA  
*<http://www.asda.co.uk/corp/home.html>*

Waitrose  
*<http://www.waitrose.com/>*