BUILDING BETTER BEEF

QMS
Quality Meat Scotland

NOT ALL MEAT IS CREATED EQUAL.
BORN, REARED & PROCESSED IN SCOTLAND,
SCOTCH IS MEAT WITH INTEGRITY.

CONTENTS

BACKGROUND

There is more pressure on suckler beef producers in Scotland than ever to be profitable, to be productive, and to be sustainable. For those reasons, it is more important than ever to adapt and evolve on-farm management to make sure businesses are performing as well as they can.

Over a five-month period, researchers from ADAS looked at 16 different on-farm management practices, assessing as many as 20 pieces of research for each practice. When each practice was assessed, it was looked at with regards to four categories and how it affected them:

- Genetics and breeding;
- Calving and fertility;
- Feed; and
- Management.

The following pages give insight into these practices and how they could – or should – be put into practice in suckler herds.

A full, 93-page version of the report, including detailed methodologies, discussion points, research references and full recommendations for farmers, levy boards and industry can be found at **www.qmscotland.co.uk**

FOUNDATIONS

Eight practices have robust evidence for improving productivity, profitability and environmental performance – these form the **Foundations of efficient suckler management:**

- Breed selection
- Scoring cow condition
- Calving heifers at 24 months
- Breeding for reduced mature cow size
- Conducting a pre-breeding examination on stock bulls
- Using AI and sexed semen
- Breeding for reduced residual feed intake
- Using a sire selection index

NEXT STEPS

A further eight had less research evidence, but are none the less important and should be considered by any suckler business. These form the **Next Steps to improving suckler productivity**:

- Making the most of grazing
- Tightening block calving window
- Appropriately timed culling
- Breeding for improved calving ease
- Using genomic techniques
- Matching nutrition to requirements
- Regularly weighing breeding heifers
- Using a maternal selection index

ADVANCED

This report also looks at the potential for 12 newer or less well researched approaches, and suggests how these could be **Advanced** for use in beef suckler herds:

- Genomics
- Embryo transfer
- Feed additives
- Precision feeding technologies
- Heat detection
- Geo-fencing
- Sperm-sorting technology
- Artificial intelligence

FOUNDATIONS

DAIRY CROSS DAMS

- ✓ **Increased milk yield for calf**
- ✓ **Higher DLWG for suckling calves**

NATIVE BRED DAMS

- ✓ **8% lower calf birth weights compared to continental breeds**
- ✓ **21 to 32% increase in gross margin, primarily driven by reduction in use of concentrates feeds**

CONTINENTAL BRED DAMS

- ✓ **21% more milk than native breeds**
- ✓ **Greater cull cow value**

BREED SELECTION

Ask yourself, if you were looking at your farm with fresh eyes, what beef system would you design to make the most of the natural assets you have, and the markets you want to target, and above all, what system will let you maximise your profit margin?

WHAT IT MEANS IN PRACTICE:

There is no optimum beef suckler cow breed, the best breed varies depending on the production system. Generally, evidence supports the view that native breeds are best suited to extensive systems designed to make the most of forage, and continental breeds to more intensive systems, designed to utilise cereals and concentrates. Alternatively another source of suckler females is from dairy cross dams where there is an increased milk yield for calves, which supports increased daily liveweight gain. However, this comes at a cost of reduced cull cow weights.

WHAT'S THE IMPACT?

Compared to purebred beef breeds, dairy cross beef cows result in higher daily liveweight gains in calves (66-205g/day across several studies), driven by higher milk yields (23-59% across several studies) and superior genetics passed on to the calf, supporting early calf growth. Dairy cross beef cows also have 14-19kg greater weaned calf weights and lower calving difficulty rates. However dairy cross dams may increase disease risk if replacements are bought in as opposed to bred on-farm, and will limit a businesses control over the genetics of bought-in replacements.

Native breeds have, on average, 8% lower calf birth weights compared to continental breeds, which results in reduced risk of calving difficulty. This is likely a key driver in higher lifetime calf production in native breeds, since calving difficulty at first calving was found to decrease lifetime calf production by 30%.

However, continental breeds produce 21% more milk than native breeds, which likely contributes to the improved growth rates of their calves – 75g higher daily liveweight gain and 20kg heavier weaning weights.

Although dairy cross beef cows produced heavier calves, purebred beef cows were significantly heavier, with better body condition scores, resulting in higher cull cow carcass value compared to dairy cross beef cows.

In terms of feed efficiency, the results vary depending on the metric used (total dry matter intake, dry matter intake/kg calf weaned, etc.). However, research has found that native breeds were more profitable than continental breeds, with a 21-32% increase in gross margin, primarily driven by reduction in use of concentrate feeds.

There are also environmental differences depending on breed selection. For example, larger cows produce more total output and so have greater overall maintenance requirements; however, cows of smaller mature size are proportionally more efficient. Where native breeds are used instead of continental breeds, this will ultimately lead to a system with lower age at first calving, fewer followers, and faster time to slaughter. All of these will have indirect benefits for greenhouse gas (GHG) emissions, ammonia and water quality through reduced enteric methane and manure being produced. Where there is a reduction in quantity of concentrates used, this will reduce embedded GHG emissions from fertiliser and fuel used to produce these commodities.

More traditional native breeds such as Highland and Longhorn are also often used in conservation grazing systems because of their ability to use low-quality forage. This enables the creation of meadows and other habitats, which can increase biodiversity.

It is also important to consider what market the farm is currently supplying and whether there is a market for any potential new system, as some markets may have preference for certain breeds or characteristics.

SCORING COW CONDITION

WHAT IT MEANS IN PRACTICE:
A simple method of determining livestock condition, body condition scoring (BCS) uses visual and tactile measurements, coupled with a reference chart, to assign a score to each animal. In Scotland, the most common system uses a five-point scale, with 1 being emaciated and 5 being obese.

Calving cows at BCS 2.5-3 is recommended; too low and cows are less able to recover energy reserves after rearing a calf, reducing subsequent fertility, while too high increases risk of calving difficulty and reduced feed intake. Optimum BCS is also aligned with good milk production and calf vigour as well as fewer health issues.

WHAT'S THE IMPACT?
BCS score at calving is thought to be the single most important factor linked to getting cows back cycling post-calving. A summary of eight trials with over 1,000 beef cows showed that cows with a low, medium and ideal BCS at calving had pregnancy rates of 61%, 79% and 90%, respectively. In one study, Angus cows fed a higher energy ration for 55 days before and 40 days after calving had 35kg greater liveweight and a shorter interval from calving to first oestrous than cows fed on a medium nutrition ration. Cows with relatively good BCS at calving also tend to wean heavier and healthier calves, which has important implications for young heifers destined to become replacements.

BCS at calving is likely to be the most important factor affecting subsequent net calf-crop in mature beef cows. Researchers found no difference between cows that maintained sufficient BCS throughout pregnancy and those that were fed a high energy ration to increase BCS within the last trimester.

One US study looking specifically at BCS at calving reported income per calf increased from $359 for calves from low BCS cows to $416 for calves from cows at an ideal BCS – a 16% increase.

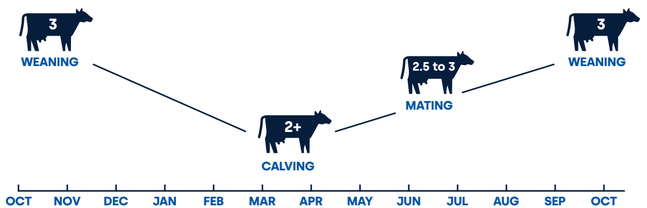
Reducing calving interval, improving the percentage of cows in calf, and culling due to late conception will all support a reduction in herd GHG emissions.

While there are no direct costs involved, BCS does require additional time and labour, dependent on the number of cows being scored and type of handling system used.

Best practice is that body condition should be evaluated and recorded at weaning, 60-90 days before calving, and at calving. Evaluating BCS at weaning allows heifers to be separated into groups with different feeding regimes to ensure that as many animals as possible can reach BCS 2.5-3 by calving, while scoring 60-90 days before calving will identify animals who may need higher energy rations in the last trimester.

Scoring gives the ability to provide higher nutrition such as additional feed or higher quality grass only to those animals that need it.

BODY CONDITION SCORING – SPRING CALVING:



CALVE HEIFERS AT 24 MONTHS

WHAT IT MEANS IN PRACTICE:
Managing heifers effectively so they calve at, or near, 24 months of age has a range of impacts on suckler beef productivity. They produce more calves and wean more weight of calf over the course of their productive lifespan, compared to heifers that calve later. It also increases profit and reduces production costs.

Achieving this is the outcome of several practices done well, including breeding and fertility management practices used on farm, nutrition, and health.

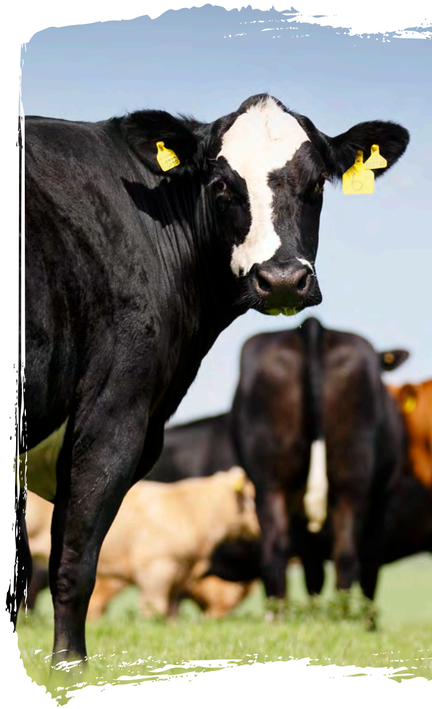
WHAT'S THE IMPACT?
Studies show that earlier calving heifers produce a greater number of calves over their productive lifetime, with one study showing that, up to seven years of age, the cumulative weight of weaned calves at 200 days old born from heifers that first calved at two years old was significantly greater than that of three-year-old calving heifers.

Calving at 24 months has a direct link with increased margin. One Spanish study analysing 7,655 purebred Blonde d'Aquitaine cows from 301 herds showed that reducing age at first calving from three years to two increased profit by €21.50, reduced heifer feeding cost by €17.70 and reduced production cost of €22.10 per slaughtered animal each year over the course of the productive lifespan of a cow.

An Irish study on a high-output, high-efficiency 40ha farm with 53 suckler cows found a €112/ha benefit on net margin when calving heifers at 24 months versus 36 months.

A suckler herd's reproductive efficiency – including age at first calving – also influences the environmental impact, with Irish farms operating at higher levels of efficiency found to have 20% lower emissions when compared to farms operating at average levels.

A target of calving at 24 months works best in systems with good-quality pasture available to support early heifer growth and maturity. Where forage is of lower nutritional value, such as on hill farm systems, reduced age at first calving should remain an ideal but depending on system and breed, calving at 24 months may not be possible. However, reducing age at first calving by a few months can still improve the overall productivity of the system; as the calf is the enterprise's primary output, reproductive efficiency is fundamental for profitability, regardless of the production system.



REDUCED MATURE COW SIZE

WHAT IT MEANS IN PRACTICE:
Breeding for reduced mature cow size involves selectively breeding replacement heifers so they are smaller, lower weight, and at the optimum mature cow size for individual suckler beef enterprises.

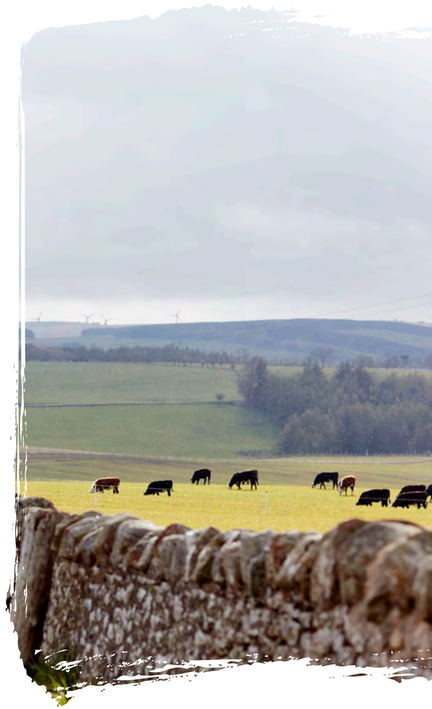
A suckler cow consumes a substantial amount of the dietary energy requirement on-farm, with 50% being required for maintenance alone, so the benefits of breeding for a reduction in cow size to a farm-specific optimum level are clear. Reducing cow size to maintain the same level of production will maximise productivity though a reduction in feed inputs and profitability.

As mature weight increases from 450kg to 650kg for cows 90 days post-calving, requirements for intake, energy, and protein all increase by 23%, 19%, and 13%, respectively, and for each additional 10kg of body weight, about 60kg dry matter (DM) of forage intake is required.

WHAT'S THE IMPACT:
Reducing mature cow size to the farm-specific optimum level, whilst remaining at optimal Body Condition Scores, will reduce feed and forage requirements, while maintaining or potentially increasing productivity by increasing stocking rates.

About 50% of the total dietary energy expenditure in suckler beef production is for maintenance of the suckler cow, with annual feed requirements for maintenance of the whole herd making up 50-75% of total feed requirements. Reducing mature cow size to one for optimum efficiency will mean lower feed requirements and costs across the cow herd, without hampering productive output.

Analysing input costs, plus outputs and market requirements on individual farms should help determine the range of greatest efficiency and identify the optimal mature cow size which will excel within that range.



BULL MOTS

WHAT IT MEANS IN PRACTICE:
While plenty of attention is given to improving cow fertility, there is comparatively little focus on bull fertility, despite the fact they will serve 30-40 cows each. The report covers more detail on the importance of pre-breeding checks.

There is evidence to suggest that a substantial proportion of stock bulls are sub-fertile. Research shows that 29% of UK bulls in a study of 339 evaluations failed either visual assessment, sperm assessment or both. Of bulls that had produced unsatisfactory pregnancy rates, 82% of them also failed the examination. This is aligned to other research which found that 20% of bulls were defective in some way, with 25% of bulls having impaired serving capacity. Failing to identify sub-fertile bulls will result in reduced herd fertility with fewer cows in calf within the desired timeframe.

WHAT'S THE IMPACT:
One study found that bulls with scrotal circumferences of more than 34cm had a significantly higher percentage of normal sperm than bulls with a circumference of 34cm or less. Cows exposed to bulls with smaller scrotal circumference were significantly less likely to be scanned in calf and had a significantly longer interval between first exposure to the bull and calving compared to those exposed to bulls with larger scrotal circumference.

It is estimated that for every 21-day period of the breeding season that a cow fails to conceive, there is a loss of 23-27kg of weaning weight the following year for the calf she finally conceives; evidence that weaning weight is also affected by delayed conception.

Maintaining a tight calving block is critical for herd productivity and profitability. Using sub-fertile bulls results in fewer cows in-calf and/or cows conceiving late, which reduces output and may force sale or culling of animals unnecessarily.

For maximum effect, timing the inspection is important, and it is best done about two months before the breeding season starts. It should be done close enough to breeding that the bull's condition will not change before being put out with cows, but allowing enough time to arrange a replacement if fertility is found to be sub-optimal.

A full bull pre-breeding examination, including sperm motility analysis, is likely to cost about £100 plus VAT. In addition, observing mating – a low-cost screening method – can help determine whether or not bulls are serving cows.

For every 21-day period of the breeding season that a cow fails to conceive, there is a loss of 23-27kg of weaning weight.

ARTIFICIAL INSEMINATION AND SEXED SEMEN

WHAT IT MEANS IN PRACTICE:
Artificial insemination (AI) is already widely used in the dairy sector, allowing use of semen from genetically superior bulls with known traits. In dairy herds, the most genetically superior cows are normally crossed with sex-sorted semen to produce female replacements.

AI has the potential to substantially improve productivity, as it allows access to a wider variety of genetics which can result in more genetic gain. Using sexed semen would provide additional benefits in that sires with improved maternal traits could be used to produce female replacements, while sires with improved terminal traits could be used to produce male progeny for finishing.

WHAT'S THE IMPACT?
AI can allow access to genetics which are sorted to be female or male. Male sexed semen is relatively new to the market and started to be more commercially used. Male calves tend to have higher growth rates, greater carcass weight and improved carcass composition.

Using sexed semen has however been traditionally associated with reduced conception rates, typically 70-90% of that of natural service, this can be minimised with good management practices like accurate oestrous detection, trained insemination technique, correct semen storage, etc.

Research suggests male calves were worth about 22% more per kg of liveweight at weaning than their female cohorts in lowland, upland and hill herds.

Assuming handling facilities are already available, the main costs depend on how AI is carried out. The costs below, based on a 40-cow herd, assume a synchronised oestrous system followed by AI delivered by technicians:

- Time to bring cows in three times to undertake oestrous synchronisation and prepare for AI
  12 hours x 2 staff = £240
- Treatments for synchronised oestrous: £8-10/cow
- Service technicians to AI cows: £20/cow
- Straw cost from £20 to £100 per service

For comparison, estimated figures for natural service are based on a bull producing 40 calves per year, which has a cost per calf of £27 if kept for five years. Assuming 36 calves per year this is about £972 per year. These figures include the cost of the bull less the cull value, plus annual maintenance costs.

Case study: Tightening the calving period

On one of the Borders Monitor Farms, tightening the calving block from nine weeks to six resulted in the need to cull cows that were not able to get in calf within that period.

It was felt that an interim step would be to use synchronisation and AI to 'pull' the later calving cows forward. As a result, 22 cows and 11 heifers were 'AI'd' and they then ran with a bull. The AI bulls were selected for fertility traits and could give a higher genetic quality han could with bought-in live bulls. The cost range of this approach was £50-£80 per calf born, compared with an estimated bull cost at £50-£60 per calf born.

Of those that held to AI, five came forward two weeks, two by three weeks, one by four weeks and three by six weeks, proving it is possible to tighten a calving pattern in this way and reduce the need to cull cows. Empty cows tended to be older and in less than ideal condition.

The following year, cows returned to natural service, while heifers were AI'd to have them calving early in the block, using the best genetics available and easy calving sires. All bulls are fertility tested and inspected prior to mating. They then run with cows for 6.5 weeks, with any heifers not holding to AI having the chance of the bull.

This has led to an increase in calving percentage, from 85% to 94% in a three-year period. Calves are also much more uniform throughout the year, which makes routine work easier as they are about the same weight.

BREED FOR REDUCED RESIDUAL FEED INTAKE

WHAT IT MEANS IN PRACTICE:
Selecting for animals that show genetically superior levels of feed efficiency to help reduce the amount of feed required on-farm; this will also have productivity, profitability, and environmental sustainability benefits. Research in the industry is ongoing to make this more commercially available.

Residual feed intake (RFI) is the difference between an animal's observed and predicted feed intake requirement over a given period. It is the residual figure left after feed has met primary energy demands such as maintenance, growth, and activity, and can be used to identify animals that deviate from their expected intake; lower (negative) values mean greater efficiency. It is independent from growth and body size, which makes it useful for analysing the variation in feed efficiency between animals.

WHAT'S THE IMPACT?
An Irish study found that high-RFI Simmental heifers fed grass silage consumed 9% and 15% more than medium and low-RFI heifers, respectively, with body weight, growth, and body composition all being equal between the groups. Another Irish study that fed ad lib silage for 73 days over winter to Simmental and Simmental x Holstein cows observed that the low-RFI group consumed 14% less silage than the medium-RFI group and 11% less than the high-RFI group, with body weight, growth, body composition, milk yield, calving difficulty and calf birth all being equal between the groups.

An Australian study which selected for RFI saw a direct yearly response of -0.125kg DM/day due to selection, compared to the control group.. Another, which looked at its inclusion as part of multi-trait breeding goals – most like farm practice – found a yearly response rate of -0.08kg DM/day.

There is strong potential to improve profitability by selecting for low RFI. Feed accounts for as much as three-quarters of direct costs in a suckler system, so selecting for low RFI, which is directly linked with reduced feed requirement while maintaining the same level of production, will boost profitability.

Reducing resources required to produce the same amount of product alleviates pressure on the environment to provide materials, as well as absorb waste. Selecting for genetically superior cows with lower RFI will reduce overall feed requirement, reducing emissions associated with feed production.

Also, as enteric methane production is directly proportional to feed intake, reducing feed for a given level of production will reduce emissions per unit of product.

Improving a herd's RSI can have a wide range of different suckler beef systems and climatic environments. Increasing herd feed efficiency reduces overall feed requirement on-farm and results in lower embedded GHG emissions from feed. The benefits will be strongest where feed costs are high, where available forage is comparably limited or of lower quality, or where there is high demand for beef produced with a lower emissions profile.

If adopted there would be savings on feed intake, although this would depend on the type of feed and reduction achieved. In the situation where cattle were being fed silage for 73 days over winter, low RFI cattle consuming 11-14% less would be equivalent to saving £14-18/head over winter – based on a cost of £60/t fresh weight for grass silage, DM of 30%, and consumption of about 30kg fresh weight/day for high-RFI cattle.

Once estimated breeding values (EBVs) for this trait are available, incorporating selective breeding for reduced RFI as part of the wider breeding management plan will allow for greatest genetic on-farm improvement in this trait.

TERMINAL SELECTION INDEXES

WHAT IT MEANS IN PRACTICE:
Beef cattle traits can be split into two main groups: maternal traits (including ease of calving, milk yield, temperament, etc.); and terminal traits (growth rate, carcass conformation, weight at slaughter, etc.). The challenge is that these traits are often antagonistic, e.g. breeding for larger calves is associated with increased risk of calving difficulty.

Selection indices are used to select for multiple traits simultaneously and are often grouped into either maternal (with a focus on maternal traits) or terminal (focusing on terminal traits). More can be found about the impact of a maternal index on page 19.

WHAT'S THE IMPACT?
Research on the benefits of using terminal sire selection indices is primarily focused on the impact on the carcass weight and quality of finished calves.

In an Irish study, using a terminal index reduced system emissions intensity by 0.021kg CO^2e per kg of meat, per breeding cow, per year, per € index; which accounted for the benefit of increased meat production through improved carcass weight, conformation and fat levels.

Selection indices can be used by any suckler beef system where the EBV of the sire is known, and is particularly relevant when using AI. Where conventional breeding is used, selecting bulls of known profile using traits highlighted in the index can drive an increase in the genetic quality of purchased bulls.

Using a terminal selection index on herds that breed their own replacements may have undesirable consequences on maternal traits, so is probably most applicable to herds where all calves are sent for slaughter and replacements are bought in.

To get the most out of using either a terminal or maternal sire index, it is important to understand which traits are included, how they interact and how each impacts the production system. Traits that are most desirable need to be identified based on each system. Bulls should be selected that emphasise those traits while achieving a high overall index score.

Studies on over a 100,000 different carcasses, show animals sired by the highest Sire Index bulls can achieve:

- **Averages of 20 - 40kg heavier carcass.**
- **3% better dressing**
- **Finish on average 7 days earlier**
- **Improved condition scores**
- **Reduction in DM intake**
- **13% increase in higher carcass value**

One Irish study grouped over 150,000 carcasses from animals out of the dairy and beef herds into four terminal index groups based on genetic merit. Compared to the lowest genetic merit group, the highest genetic merit group for animals out of the beef herd had a 41.9kg heavier carcass and improved carcass conformation.

A similar study reported that cattle in the high genetic merit group yielded a 25kg heavier carcass, improved carcass conformation, a 3.22% better dressing percentage and seven days less time to slaughter, relative to cattle in the lowest genetic merit group.

Based on the finished carcass rather than weaned calves, the studies reported improved carcass conformation scores (1.82-2.08 on a scale of 15) and reduced fat scores (1.24-1.7 on a scale of 15), as well as 13% higher total carcass value for high genetic merit cattle compared to low genetic merit. There was also reduction in feed intake of 0.46-0.63kg DM intake/day, which will also have secondary effects on reducing input costs.

NEXT STEPS...

USE AN ALTERNATIVE GRAZING PATTERN

WHAT IT MEANS IN PRACTICE:
Conventional grazing usually involves keeping livestock at a relatively low density for an extended period of time. In contrast, alternative grazing patterns, also referred to as mob grazing, paddock grazing or rotational grazing, see animals stocked at much higher density, but for a much shorter time – sometimes as little as one day – before being moved on to the next area while the previously grazed area is given extensive time to recover.

Alternative grazing patterns have been promoted as a way to improve animal productivity, forage growth rates, soil health and carbon sequestration; however, these claims are not fully supported by scientific literature. Recent research has found no UK evidence for consistent impacts on productivity – either for the grassland or animals – under mob grazing patterns.

Regardless of the specific grazing pattern used, grassland management to improve productivity is important. This mean's optimising nutrition and ensuring soil health is managed to maximise the potential of swards.

TIGHTEN CALVING BLOCK

WHAT IT MEANS IN PRACTICE:
Tightening the block calving window aims to maximise efficiency gains by minimising the amount of time that extra labour is required on-farm. It also means that days spent at grass can be maximised, as well as turnout being aligned with peak grass growth, reducing costs.

Spring calving herds, as compared to all-year-round calving herds for example, have a lower total cost of rearing from weaning to conception, by as much as £300 per heifer reared. There are clear benefits for productivity and profitability, especially reduced labour over the course of a year, with more concentrated labour requirements during calving.

Maximising the number of cows that get in calf within the first 42 days of the breeding period also helps tackle issues that may arise as a result of later-calving cows.

APPROPRIATELY TIMED CULLING

WHAT IT MEANS IN PRACTICE:
The purpose of culling in the suckler beef enterprise is to replace generally older, less-productive cows, that may also be of poor health, with young replacements of higher genetic merit and improved fertility, that will ideally increase the herd's productivity. Cows may also be culled if they fail to get pregnant. The point at which culling is most optimal will depend on the market in which a suckler beef system operates.

For determining the appropriate time to cull, two factors for consideration include: biological efficiency, which is the number of calves weaned per cow, and the weight of calves produced, as well as economic efficiency, which considers the cow's longevity in the herd and how her costs are spread over the number of calves produced.

While there are few UK studies on an appropriate culling strategy, a Canadian study found that increasing dam maturity by 10% gave rise to a large decline in productive efficiency across the herd (as much as 35%, depending on breed).

Brazilian research used a simulated model and highlighted that culling cows at an older age resulted in greater economic efficiency per cow, even in the case of lower biological efficiency, whereas culling cows at a younger age resulted in greater bioeconomic efficiency per unit of land area.

This led to the conclusion that culling cows at an older age is better suited to suckler beef enterprises where intensification of operations is unviable, whereas culling cows at a younger age was optimal in markets that place a greater value on cull cows and where intensification of cultivated pastures is an option.

BREED FOR IMPROVED CALVING EASE

WHAT IT MEANS IN PRACTICE:
Calving difficulty is a major issue in many suckler beef herds, particularly in pure bred continental breeds, with one study estimating that 20% of calves born in UK suckler beef herds require assistance. This is likely to be an underestimate.

A study which looked at lifetime productivity data from 20,541 cows in 2,210 herds in Norway over a three-year period found that moderate or severe calving difficulty at first calving reduced lifetime calf production by 13% and 30%, respectively.

Research in New Zealand found that the main cause of calving difficulty is calf birth weight, followed by the cow's maternal traits such as pelvic dimensions. However, there is a trade-off between calving difficulty and terminal traits (there is an association between birth weight and growth rate). Options such as using AI and sexed semen could be used to ensure that heifers and cows at risk of calving difficulty produce smaller calves.

Case study: Pelvic measurement

On a previous, Moray Monitor Farm, a trial batch of 31 heifers (all put to the same bull) were pelvic measured about two months before bulling, at 15-18 months of age. The measurements were noted and no heifers were removed from the batch based on their pelvic measurements. The animals had been selected for bulling using information such as weight, confirmation, growth rates, etc.

At calving, the stockperson was not aware of the pelvic measurements so did not have any pre-conceived ideas of whether the heifer would be more/less difficult to calf. The stockperson noted the calving ease score and calf size score for all animals at calving. The results were:

- 16% of the first-time calvers required assistance at calving
- Two of these required a caesarean, including the heifer with the smallest pelvic area (kept as the herd owner liked the look of her), and another due to a very big calf
- Some of the heifers with a smaller pelvis area managed to calve with no assistance

As a result, it was felt that it is a useful tool to eliminate heifers which are more likely to have problems at calving time. A decision was made that all heifers with small pelvic measurements will be fattened on-farm, instead of joining the breeding herd. Over the years it is hoped that this will decrease the instances of difficult calving within the herd and particularly in first-time calvers.

BETTER USE OF GENOMICS

What it means in practice:
Conventional genetic selection relies on EBVs, which measure the expected difference in a trait between a genetically superior animal and an average animal. For example, if a bull has an EBV of +10kg 200-day weight, it would be expected that this bull would be 10kg heavier than the average at 200 days. Half of this improvement would be passed on to the bull's progeny.

Genomics represents the largest potential opportunity to harness the information we can obtain from our beef herd. Genomics uses an animal's DNA to predict genomic estimated breed values (GEBVs), rather than relying solely on recorded pedigree and trait measurements. This has a number of advantages, particularly for traits that are difficult to measure. GEBVs can be determined at birth, so breeding decisions can be made without having to wait until the traits are expressed.

It has huge potential to improve suckler beef productivity, but the sector has been slow to implement the technology. While any bull or cow could be genotyped, it is not standard practice and so breeding animals tend to be selected based on the parent average of EBVs if they are available, or on observed phenotype (what it looks like) rather than genetic potential.

On-farm genomic analysis, both of stock bulls and of female cows, would require DNA being sampled on-farm and genomic analysis being performed to identify the most genetically superior animals for breeding replacements. It is also important to maintain a robust performance recording strategy in order for genomics to remain effective.

"Genomic EBVs can be determined at birth, so breeding decisions can be made without having to wait until the traits are expressed. This reduces generation intervals and results in more rapid rates of genetic gain."

MATCH NUTRITION TO ANIMAL REQUIREMENTS

What it means in practice:
Ensuring cows have adequate nutrition is essential to maintain optimal body condition at calving, maximise fertility and health, and to produce adequate volumes of milk to ensure optimal calf growth.

To achieve adequate nutrition, it is essential to know the ration's nutritional content and the stock's nutritional requirements. Forage makes up most of the suckler cow ration, so it is advisable to test nutritional quality of grass and silage, in terms of dry matter, energy, fibre and protein content.

REGULARLY WEIGH BREEDING HEIFERS

What it means in practice:
Heifer management dictates future lifetime productivity and fertility. Adequate nutrition to achieve optimal growth rates will allow earlier age at first calving and support good fertility.

Regularly weighing heifers can identify whether they are on track to reach the required weight at service. If sub-optimal growth rates are detected, the ration can be adjusted to meet these growth targets.

A range of options are available for weighing, from simple scales to advanced handling systems with automatic recording linking with cattle ID numbers. Regularly weighing heifers can be challenging to implement due to the need for handling facilities and increased labour requirements.

Additionally, weighing on its own does not actually ensure correct weight at service. It is the actions taken in light of this information, such as splitting the herd into groups with separate rations, that can help to ensure weight at service.

USE A MATERNAL SELECTION INDEX

What it means in practice:
While sire genetics are often the main focus of genetic selection within suckler beef herds, there is also a huge opportunity to improve genetic selection of female animals.

Recording the following in your own herd will allow you to find those maternal cows and potentially create selection pressure on those who do not meet your maternal criteria:

- Calving Ease
- Maternal instinct at calving
- Fertility – including calving interval/number of days bred
- Weaning weights/weaning efficiency

When purchasing sire genetics or stock bulls there is limited opportunity to select from a maternal index today.

A recent piece of QMS-led research established that a national Cattle Genomics programme could have the potential to improve on farm productivity and profitablility, reduce the impact of GHG emissions, guarantee traceability, as well as improve animal health and welfare.

WHAT'S ON THE HORIZON?

GENOMICS

Genomics is well established in the dairy sector and is increasingly being applied to the suckler beef sector, although there are challenges to its uptake.

Genomics involves DNA profiling of individual animals at birth by directly testing tissue or hair samples which can generate breeding values, parent verification and identify genetic defects. This can result in greater selection pressure due to increased reliability of key breeding values which can result in faster genetic gain to reach breeding goals in the suckler herd. Genomics is becoming more commercially available in the suckler industry.

EMBRYO TRANSFER

Embryo transfer unlocks the opportunity to get more progeny from genetically superior dams. It involves implanting a fertilised embryo from the donor cow to a recipient cow or heifer. Embryos can be implanted into recipients as; fresh following a successful flush from the donor or stored frozen then thawed and implanted on a later date. Embryos which are to be stored are stored in Liquid Nitrogen, like AI, but they must be stored in a licensed facility.

There are two types of flushing:

- Multiple Ovulation Embryo Transfer (MOET)
- In-Vitro Fertilisation (IVF)

MOET involves the donor cow being super ovulated then the cow is inseminated and the embryos are flushed the following the week from the cow's uterus. Whereas IVF is a newer service where the donor is super ovulated but the eggs will be fertilised in a petri dish by selected semen and cultured for a week before the embryos are implanted or frozen. Both methods can be performed on maiden heifers and adult cows. IVF can be performed more regularly than MOET and can be performed whilst the cow is pregnant.

FEED ADDITIVES

A range of feed additives are available and in development that claim to reduce methane emissions and potentially improve livestock productivity.

Four feed additives have robust evidence bases to support claims of reduced methane emissions. These are:

- 3-NOP, an enzyme inhibitor, which has shown a methane reduction of 21%;
- Unprotected lipids, that change rumen chemistry, and reduce methane by 9%;
- Essential oil blends, which interact with the rumen microbiome and cut methane by 10%; and,
- Nitrate, which has been shown to reduce methane by 10%.

Early experimental data for some seaweed extracts used as feed additives have shown promise in reducing enteric emissions; three in vivo studies on red seaweed reported 80-95% reductions in methane in sheep, beef and dairy systems. However, weaknesses in the experimental data (e.g. small sample sizes) means the evidence is not as robust as for the other feed additives.

PRECISION FEEDING

Bespoke and precise diets can ensure that animals are being fed to the optimal levels of nutrition. Several studies are exploring the opportunity to reduce Nitrogen (N) and Phosphorus (P) excretion from cattle through diet formulation.

Protein levels of 11.5–13% have been found to be optimal, suggesting that high-protein rations are to be avoided. However, protein levels that are too low run the risk of delaying growth, requiring more time on-farm, and increasing overall N excretion.

HEAT DETECTION

Optimising mating, either natural or AI service requires close monitoring of animals to detect oestrous which is time consuming, along with the need to bring cows and heifers in when bulling. Some of this could be addressed by using heat sensors to identify when animals can be inseminated.

A wide range of ever evolving technologies now exists to monitor the health and welfare of livestock. These will inevetably become essential in optimising the productivity of breeding livestock. Heat detection data can be transmitted from a live animal through a range of technologies including; boluses, pedometers and eartags. Quite often these technologies also unlock data about general animal health resulting in multiple benefits for the suckler herd.

A developing option, but one which may be cost-prohibitive at present with an estimated price tag of €1,500, are pheromone sensors. This serves the same function as a bull's nose by being able to detect the specific sex pheromones secreted during oestrus which would normally be a signal for the bull to know that the cow is in heat. While expensive at present, the price of technologies generally reduces with time.

GEO-FENCING

Geo fencing could allow suckler producers to create a virtual fence using GPS technology. Often this technology uses satillite signal, mobile data or wifi to connect to a device on the animal (such as a collar). As the individual cattle beast approaches the virtual fence boundary there is often a warning then a subsequence mild electrical impulse which discourages the animal from exiting the area.

The key opportunity with this technology is to optimise grazing strategies due to the opportunity of moving the virtual fence regularly. This could massively reduce labour for a rotational system.

Geo-Fencing technology usually can give precise location of animals and can alert producers if an animal has not moved in a given time - giving piece of mind between daily stock checks.

This technology will require significant investment, where currently it can cost up to £200 per GPS collar, with potential additional costs with annual subscriptions.

ARTIFICIAL INTELLIGENCE IMAGING

AI Imagining utilises cutting edge camera and AI learning to estmate a more accurate picture of the weight and BCS of animals. Weighing and BCS require equipment and labour, and BCS also relies on subjective scoring criteria that may not be consistent between scorers.

Using artificial intelligence imaging offers an objective, robust method of estimating these traits automatically with minimal time or equipment costs. Most current research on this uses 2D sensors to determine body size and shape, but they cannot be used on moving animals; using 3D sensors, which would produce 3D models, could help with decision making in growth monitoring. In future, multi-spectral cameras could be used to begin to understand fat and muscle composition to provide detailed nutrition recommendations.

RECOMMENDATIONS

WHAT NEEDS TO HAPPEN NEXT?

Recommendations from this review are industry-wide, and adopting them will help boost suckler productivity, profitability and environmental performance.

FARMERS:

Implementing practices in this review will enable an increase in on-farm productivity.

Improving herd genetics through targeted breeding offers several routes to improved productivity. There are resources available to support developing the best herd genetics, which should be applied in the context of what is most appropriate for the farm type and constraints of the system (e.g. lowland and upland herds require different genetics).

The report highlights several practices to help with decision making (e.g. body condition scoring). Incorporating these into standard practice on-farm, alongside an overall level of attention to detail, can bring about productivity gains.

Some of the other reviewed practices have the potential to improve productivity, but there are insufficient resources to implement these practically (e.g. breeding for reduced residual feed intake). For these, more evidence and support is needed.

INDUSTRY:

There is a continuing need to develop technologies to support improved productivity in the suckler sector.

Genetic techniques, such as the use of EBVs, are an important means of breeding more efficient animals and driving productivity gains. Developing indices through increasing the data available on current traits as well as adding additional traits (e.g. residual feed intake) will further assist farmers.

As farmers become more aware of the value of these approaches, and the levy bodies further promote them, there is a market opportunity for genetics companies to develop products to support improved genetics in the suckler herd.

Within some of the genetic sections, much of the evidence base came from Ireland, which has been successful over the last two decades in building a world-leading genetic database. This enabled the development of relevant selection indices that have been studied and proven to be effective. Working towards a UK-wide database would empower all stakeholders to improve the genetics of cattle in the UK.

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