British Cattle Conference

Organised by

The British Cattle Breeders Club

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Lesley Lewin

Secretary from February 2015:
Heidi Bradbury

BCBC

British Cattle Breeders Club
Underhill Farm
Glutton Bridge
Earl Sterndale, Buxton
Derbyshire
SK17 0RN
Tel: 07966 032079
E.Mail: heidi.bradbury@cattlebreeders.org.uk
Web: www.cattlebreeders.org.uk

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A Message from the Chairman

With the 2015 Cattle Breeders Conference behind us, it's timely to reflect on my year as Chairman and pass on the baton to my successor Roger Trewhella.

I am indebted to those involved in the organising committee who again offered real support and worked tirelessly to ensure the success of the conference and together delivered such an interesting programme. This, along with the professionalism of our Secretary Lesley Lewin, aided by Heidi Bradbury, resulted in an incredibly well received event.

The theme 'Meeting market demands through co-operation' gave us the opportunity to consider the current dynamics in the marketplace for beef, both at home and overseas. With growing world population and affluence, comes a desire to consume increasing amounts of protein which is forecast to outstrip supply. That presents both a great challenge but also a great opportunity to satisfy this demand – what industry wouldn't want such a situation at their feet?

The programme over both days offered the opportunity for high quality speakers to present their thoughts of what the sector could or should do to capitalise on the potential. On the beef day, Professor Patrick Wall highlighted the importance of protein in the diet but also the negative image of meat held in some quarters, while Professor Chris Calkins discussed how the US beef industry had addressed consumer demand by developing new cutting methods. Genetic advancement and recording was featured, as was managing volatility and sustainability for the beef sector. Australian Tom Gubbins and Paul Westaway closed the day with an up-beat farmer view on what lies ahead.

The dairy day delivered stimulating sessions on how to develop the sector for the future, using the latest academic research and innovation, while being profitable. Dr George Wiggins discussed what genomics can offer the sector in these goals while Professor Liam Sinclair encouraged the uptake of science at the farm level. The day was closed by farmers Andy Gubb and David Homer sharing their journey and their future aspirations.

I was delighted with the attendance at the Club Dinner and would like to thank our 'Any Questions' panel of Professor Patrick Wall (University College Dublin) Minette Batters (NFU) and farm business consultant, David Alvis who shared their views across a wide range of subjects ably chaired by Paul Westaway.

The BCBC is a club, run by the enthusiasm of its members for like-minded industry professionals to share their knowledge and I hope those who attended got a real sense of that ethos. As I pass onto Roger Trewhella, I would like to encourage you all to join us again next year, 18th–20th January, for the next instalment. Finally, on behalf of the club I would like to express a final thanks to our outgoing secretary Lesley Lewin who retires after some 14 years in the role – we wish her all the very best for the future.

We also welcome our new secretary Heidi Bradbury who will take us forward in 2015.

Phil Hadley

The British Cattle Breeders Club

CLUB PRESIDENTS

1956	Joint Presidents: Sir John Hammond CBE, FRS Mr George Odlam
1965	Professor Alan Robertson OBE, FRS (retired 1987)
1988	Dr Tim Rowson OBE FRS (died 1989)
1990	Sir Richard Trehane (retired 1997)
1997	Mr John E. Moffitt CBE, DCL, FRASE (retired 2005)
2005	Mr W Henry E. Lewis (retired 2011)
2011	Dr Maurice Bichard

CHAIRMEN

(Please note, the year of office would be completed at the conference of the following year)

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1965	E. J. Wynter
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1967	H. N. Haldin
1968	H. N. Haldin/P. Dixon-Smith
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1998	Tony Blackburn
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2009	Rob Wills
2010	Lucy Andrews
2011	Duncan Sinclair
2012	Philip Halhead
2013	Neil Darwent
2014	Philip Hadley
2015	Roger Trewhella

SECRETARIES

1949	R H Holmes
1950–1956	Edward Rumens
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1960–1961	Rex Evans
1962–1993	Colin R. Stains
1994–1998	Malcolm Peasnall
1999–2000	Janet Padfield
2000–2015	Lesley Lewin
2015 *onwards*	Heidi Bradbury

The future is looking good

Patrick Wall
Professor of Public Health, University College Dublin, School of Public Health, Woodview House, Belview, Dublin 4, Eire; patrick.wall@ucd.ie

A growing world population, a rapidly emerging middle class in the new economies and a recovery from recession in mainland Europe and the UK heralds a time of unprecedented opportunities for the British beef and dairy industry. Blips in the upward trends shouldn't distract from the overall objective of growth. The Irish agri sector is optimistic for a bright future and for example, post quota removal, their dairy farmers are tooling up for an increase in output of 50% by 2030. All the ingredients for driving the Irish optimism are the same for their compatriots on this side of the water. Responding to increased domestic and global demand, and displacing imports with home produced product, provides fantastic opportunities for British farmers. Failing to respond to the global changes will herald difficult times for the British farmers as their competitors globally are scaling up and the battle for market share will be intense. Standing still is not an option but for British farmers to compete effectively the entire supply chain has to respond as a unit.

Criteria for Success

Confidence

A key criteria for success is confidence; confidence in the sector, confidence in the range of products produced, and confidence in the capabilities of British farmers and the associated industry to respond to market demands. Crucial to future success will be young people and careers in the agri-food sector, whether on farm or further up the chain, are now attracting some of the brightest and the best young talent. Courses in the agriculture colleges, institutions and universities have never been more popular and with this ammunition, the sector has to be optimistic for a great future. It is important to keep the wind in the sails of the young people as investment in them is an investment in the future. There is no place for negativity, which will only serve to drive many potential stars to alternative careers. The British agri sector needs all the best players on the team if it is to realise its full potential.

Competitive

The dairy and beef business is a global competition, therefore to survive British farmers have to be as efficient as they possibly can and maximize the competitive advantage of the British production systems and the knowledgeable work force. The research institutions must remain focused on research that delivers improvements in efficiency. For dairy farmers, the fortunes of the liquid milk market often dictate the fortunes of the sector but the opportunities for value added dairy products in the domestic and global market are many and innovative research is needed to capitalise on market demands. Similarly more innovation is needed in convenient ready to cook beef products and the sector needs to move beyond mince and burgers.

Reaching, or approaching, total self-sufficiency in existing products like beef, cheese, butter, yogurt and milk powders would result in substantial additional production requirements.

Creative

There needs to be more creativity in how the land, the people, and the products are marketed and promoted. When one sees cows grazing in a field on a carton of milk in China, that's an 'image', whereas dairy and beef cattle grazing in the fields of Britain are a 'reality' for many months of the year. British farmers for generations have owned and worked on their farms and have a pride and passion unrivalled anywhere in the world. However, the EBLEX and the Red Tractor may be well recognised in the UK as marks of product and process quality assurance but internationally there is no recognisable identifier of British products to attract the premium price they deserve.

The traditional British beef breeds have a discernible quality difference and a rich history and some marketing initiatives have proved very successful at positioning them in the very top price range demonstrating what is possible. There are no shortage of high networth individuals globally who could be persuaded to consume the best of British.

The intellectual capability of British farmers is another major point of differentiation that isn't capitalised upon.

Cooperation

The farmers and the other industry players must work together and a way has to be found for a fair share of the profit margins to be evenly distributed to allow everyone who is working efficiently to earn a reasonable living.

Stakeholders in both the beef and dairy sector have ambitious targets and are capable of performing better but it is impossible to plan effectively with the uncertainty, re: the return on investments in terms of infrastructure, livestock and labour. Improved on farm efficiency and value creation in the supply chain can only come from long term trusting relationships and an equitable distribution of margin. A team approach, with individual star performances, is the recipe for success. An un-united dysfunctional supply chain is a recipe for failure.

Compliance

The recent horse meat in beef scandal has demonstrated the adverse consequences for entire sectors of being associated with consumer confidence damaging events. Brands and reputations that take years to build can be irreparably damaged overnight by adverse publicity, therefore, there can be no room for non-compliance.

Food is globally distributed and so is the media with the conventional channels feeding off the social media and vice versa, and both have an insatiable appetite for sensational stories. Truth and fiction can become interchanged in the race to have the most outlandish coverage and generalisations can be made from the substandard practices of one operator that can damage an entire industry.

Credit

There is a clear correlation between investments and productivity gains. Assessing credit requires a demonstrable ability to repay loans, which necessitates milk and beef prices returning a respectable margin to farming businesses and long term supply contracts.

Competencies

In the British agrisector many of the stakeholders work within their confined areas, operating within their sphere of competencies, whether it is genetics, nutrition, animal health, animal welfare or food safety, without realising the real objective of their activities. Phenomenal advances have been, and are being made, in animal genetics and breeding strategies. Relentless selection of production traits has delivered us very different animals from those our forefathers tended. Ruminant nutritionists are far ahead of their human counterparts when it comes to diet formulation. The modern dairy cow is a finely tuned metabolic athlete and nutrition, rumen activity, husbandry practices and milk yield are inextricably linked. Similarly the food conversion efficiency and weight gain for the modern beef animal are very different from heretofore and genomics is contributing to progress in the beef sector as it did, and is still doing, for the dairy sector.

On the dairy side breed types have dramatically reduced individual variability and the high yielding, but more difficult to manage, dairy cow now dominants. On the beef side eating quality and standardising breeds are presenting challenges as different consumers seek different quality attributes. Genetics creates the potential and nutrition delivers on it but suboptimal animal health or welfare can undermine any gains from the former two. Good animal health status is essential for the production of high quality safe food and, in addition to the control of zoonotic disease, the production damaging diseases, such as TB and Johne's, need to be effectively dealt with if efficiency targets are to be achieved. Furthermore, stressed animals are more prone to disease so good welfare is also essential. The production of safe food should be a goal for all engaged in the beef and dairy sectors. Those working in animal genetics, in feed mills and on farms are as much in the food business as those operating processing facilities or hotels and restaurants. However producing safe food is not the final end game.

Food is the fundamental fuel for human health and 'you are what you eat' is a true dictum. Diet related diseases, and obesity related health problems in humans, are major public health issues in both developed and developing countries. Increasingly primary agricultural output is coming under the spotlight in both the scientific and general media for contributing to human health problems. There are many organisations mounting attacks on the beef and dairy sectors and new substitute products are emerging and being promoted. It behoves the industry to address the issues and robustly defend its output.

Fortifying liquid milk with vitamins and minerals to produce 'super-milk' may be moving it from the wholesome natural product that consumers expect and it is a fine line, with the regulatory labelling requirements, as to when milk stops being milk and becomes a processed product. However, increasingly cows are being bred, and micronutrients are being fed, to deliver a healthier final product whether it is less saturated fat, more vitamins or minerals, more omega 3 etc, straight from the cow. Similarly grass fed beef has a different omega 3:omega 6 ratio to grain fed beef and now it is possible to add micro-nutrients to cattle in feedlots to reproduce these grass advantages.

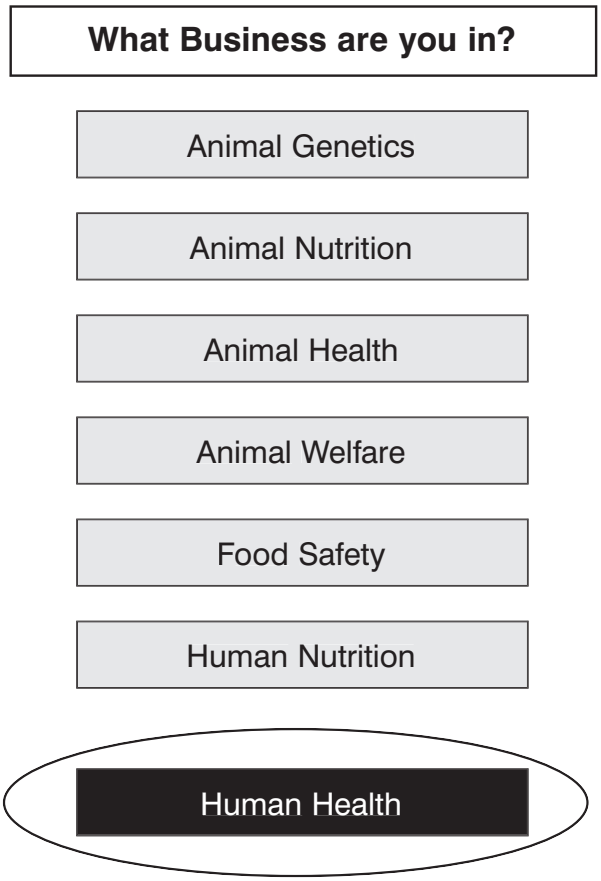
Human nutrition is key to health so the final objective for most activities in the agri sector should be 'improved human health' and all engaged in activities along the food chain should consider themselves in the 'human health business'. Doctors and nurses are not in the health business; rather they are in the sickness business.

Once everyone in the agri-sector accepts that the end game is human health, (Figure 1), consumer protection will become paramount and the rationale for biosecurity in mills and on farms and increased attention to detail along the production cycle and supply chain will be more apparent. A greater understanding of why robust controls are essential at every stage will increase compliance.

Threats

We have to be optimistic for the future, provided we can avoid adverse publicity associated with (i) food safety, (ii) animal welfare, (iii) health and nutrition and (iv) negative environmental impact.

Figure 1



(i) **Food Safety:** Healthy animals are inextricably linked to safe food and the farmer is the first link in the chain and it is their responsibility to hand over safe products to the next custodians of safe food along the supply chain. Our food chain is only as strong as its weakest link, everyone must be on the ball as one shoddy operator can damage an entire sector so everyone at every stage is a custodian of the national brand.

(ii) **Animal Welfare:** There is a disconnect between consumers and modern agricultural practices with, in terms of animal welfare, small being considered good and large being considered bad. However, it is not the size of the operation that dictates the animal welfare status rather it is the management capabilities. Primary producers in their strive for efficiency and scale need to be cognisant that what they may deem as efficient operations may be considered as factory farming by a discerning public.

(iii) **Nutrition and Health:** Increasingly primary agriculture output is being demonised in the media as being unhealthy with headlines like 'red meat causes cancer' and 'saturated fats clog up your arteries' eroding consumer confidence. However primary agricultural output is included in the official Government nutritional guidelines for a healthy diet. When one sees the plethora of obesogenic foods, and products of dubious nutritional value, on our supermarket shelves, one has to say the beef and dairy sectors do a poor job of defending their output.

It is now possible to change the composition of eggs, meat and milk by modifying the rations of the livestock. Heretofore, animal nutrition companies used to state as their mission 'to improve food conversion efficiency, weight gain or egg or milk yield', however now one company has as their mantra '*advanced animal nutrition for the benefit of human health*'. By modifying the composition and micronutrients in livestock rations, the vitamin, mineral, and fatty acid composition of the subsequent human food can be altered. Furthermore research is increasingly exploring how we can enhance the nutritional properties of food to make it healthier and address consumer concerns.

Life-stage Nutrition: The dairy sector's expertise in producing a product that equates exactly to the nutritional requirements of infants of various ages is now the model for addressing the nutritional requirements of a range of consumers. Sports nutrition has been the second category where researchers are adopting innovative approaches to addressing the different physiological requirements of athletes. Major strides are now being made in creating nutritional products for the elderly. Sarcopenia is a condition where we lose muscle mass with age, explaining how we become frail, prone to falls and lose our independence. Combating sarcopenia by slowing down this muscle loss can effectively slow down the aging process and put the agri-food sector in competition with the high margin cosmetic industry. One of the most bioavailable sources of protein is whey, a by-product of cheese historically considered a waste product confined to weaner pig rations where its anabolic properties were seen to good effect. These anabolic effects are now used to build muscle in athletes and similarly to slow down the muscle wasting that comes with aging. Producing innovative products for different live stages and levels of activity is emerging in human nutrition. The concept is not foreign to animal nutritionists where a pig can enjoy 7 or 8 different diets, from creep feed to final finisher ration, during its short life.

One only has to look at the range of diets on display on supermarket shelves for dogs of different ages and different sizes to realise that animal nutritionists are way ahead of their human counterparts when it comes to tailoring particular diets for particular nutritional requirements. The dairy sector has extracted a range of

nutritional constituents from milk and the major processors are in the ingredients rather than the milk business. The challenge for the meat industry is to see if they too could do likewise and mine their products for nutritious constituents. It is interesting that the beef sector controls much of the pet food industry where they have mastered life stage nutrition for dogs but have fallen well behind the dairy sector when it comes to addressing the health and nutritional requirements of their human customers.

(iv) **Environmental Impact:** Sustainable intensification is now the buzz word and many individuals, companies and organisations are developing new sustainability indicators encompassing energy, and chemical use in the livestock sector, as well as impacts on net greenhouse gas and nitrogen emissions and water use. Minimising the impact of production whilst optimising output and quality is the basis upon which British farmers will achieve commercial success, sustainability is about efficiency and not an added cost!

What business are you in?

When people ask you the question 'what is your most valuable asset?' it is not your farm, your house or your stocks and shares but your health that is the answer. There is nobody who wouldn't give the lotto winnings to have somebody they love who is ill well again or somebody they love who has died back. So there is no better business to be in than the health business. So stand proud: working together efficiently is the way forward, you can't change the past but if you make the correct decisions now you can influence the future!

The U.S. beef industry – meeting consumer needs

Chris R. Calkins
Professor of Animal Science, University of Nebraska – Lincoln, A213 Animal Science Dept, Lincoln, NE 68583-0908, USA;
ccalkins1@unl.edu

2014 was a year of profound change in the U.S. beef industry. The long-term effects of a significant drought that began in the Southern U.S. in 2010, moved to the Midwest, and settled in the West were revealed in 2014. A severe cull occurred in the beef herd. The U.S. now has the lowest number of beef cows since 1951. Texas lost 24% of its total beef herd from 2010–2014 and Oklahoma lost 13%.

Although the drought is severe in the Western U.S., the rest of the country has seen some moderation. The result is that more heifers and cows currently are being retained as pastures and feedstuffs once again become available. This has caused a decline in the beef supply with a consequent increase in price. For example, 2014 boxed beef and fed cattle prices average 25% higher than in 2013 and feeder calf prices went up 45% for the year. Heifer slaughter is down 8% in 2014 and beef cow slaughter is down 18%. Beef production dropped more than 5% from 2013 levels. Retail beef prices increased 10% last year. Fortunately, beef demand in the U.S. has actually increased 4% over the past year.

One of the immediate changes to compensate for lower numbers has been a sharp increase in carcass weights during the last quarter of 2014 of almost 10kg, resulting in larger meat cuts. This creates challenges to marketing and merchandising beef.

Ongoing programs over the past few years have sought to ensure the quality of U.S. beef on every level of production, from breeding, feeding and meat cutting. Exports add almost $300 in value for every head produced. With increasing prices the value of quality could not be more important.

Producer Actions

In the U.S., purebred seedstock are used to produce crossbred cattle for commercial beef production. The attention that purebred breeders give to genetic selection, then, flows through the system and impacts the final product. There is growing interest in use of Across-Breed EPD's. Marker-Assisted or Genomic-Enhanced EPD's are a reality. Forward-thinking producers work with economic indexes for sire selection. This focus on economically-important traits continues to improve the U.S. cow herd. Attention to marbling and eating quality is growing in these systems.

U.S. Quality and Yield Grades

When cattle are finished on a high-corn diet for about 100 days, they are marketed to slaughterhouses. To a large extent, value is determined by the weight of the animal and the USDA Quality and Yield grades. As most of our cattle are young, the predominant factor influencing quality grade is marbling. The value of producing sufficient marbling for the U.S. and export market has profoundly influenced genetic selection. Consequently, a growing percentage of U.S. beef meets the marbling requirements for USDA Prime and USDA Choice grades. Similarly, genetic selection pressure has reduced the amount of external (subcutaneous) fat on the carcasses, resulting in leaner carcasses with lower numeric yield grades. Thus, the marketing system provides incentives to produce lean carcasses with high marbling. The collective result is a more desirable product for our consumers.

Beef Quality Assurance

For commercial producers along the beef production chain, an important national program is BQA – Beef Quality Assurance. This is an educational and certification program focused on beef production practices that impact the quality, wholesomeness and safety of beef. Modules include Animal Care and Husbandry Practices, Feedstuffs, Feed Additives and Medications, Processing/Treatment and Records, and Injectable Animal Health Products. Individual states implement the BQA program, certifying producers. Feeders and packers prefer animals from operators that have BQA certification because it helps to minimize defects and increases the likelihood of high-quality beef.

Meat Industry Changes

Beef producers contribute to a research and promotion program called the Beef Checkoff. Every time ownership of an animal changes, sellers pay one dollar per head to the national Beef Checkoff program. The checkoff is a federal program run by cattle producers (the Beef Board). Funds are used to support advertising and promotion of beef products both

domestically and globally. Research projects are focused on beef quality and safety. The most recent assessment reveals a payback of 11:1 for checkoff funds to the beef industry.

An on-going project has been muscle profiling research conducted by the University of Nebraska and the University of Florida. This project evaluated over 5,500 muscle samples derived from the chucks (shoulders) and rounds of over 140 cattle. The goals of the research were to add value to muscles from the chuck and round and to create a database of traits from each of the muscles.

The outcome of the project was identification of a number of meat cuts from the shoulder clod that were undervalued. New cuts include flat iron steaks, petite tenders and ranch steaks. A second phase of the research investigated the muscles of the chuck roll. New cuts included the Denver cut, Sierra cut, Delmonico steaks, boneless country-style short ribs and America's beef roast. Further work with the round helped to identify additional options to upgrade the value.

Retail Initiatives

This muscle profiling initiative created the impetus for the industry to re-examine how beef is cut and merchandised. Increasing carcass weights have created significant challenges to traditional beef cuts. Consumers desiring to buy an 8-ounce (c. 225 g) steak from the loin are likely to encounter a cut that is very thin (about $^1/_2$ inch; or 1.2 cm). These cuts are difficult to cook to a specific degree of doneness. An alternative retail cutting method, called BAM (for Beef Alternative Merchandising) has been developed by the National Cattlemen's Beef Association. This method encourages meat cutters to make cuts smaller in diameter and thus greater in thickness. Together with muscle profiling, which encourages single-muscle merchandising over multi-muscle cuts, these two initiatives help to meet consumer needs and maintain customer satisfaction. An added is an increase in total beef sales for those supermarkets implementing the BAM cutting technique.

Marketing Claims

Generally, meat from U.S. beef is exceptionally tender. Like any country, however, there is some variation in this trait. A small percentage of U.S. beef does not meet consumer expectations for tenderness. Studies have repeatedly shown that consumers are willing to pay a premium for beef that is guaranteed tender. The U.S. Department of Agriculture has established rules to address marketing claims for tenderness on beef labels. Selected cuts from carcasses with a ribeye proven to be tender are eligible for a USDA Certified Tender or USDA Certified Very Tender label. Only muscles documented to be equal or superior to the ribeye in tenderness can carry this label. In this way, consumers are assured that beef labeled USDA Certified Tender meets the minimum standard for tenderness.

From this sampling of programs and initiatives in the U.S. beef industry it should be clear that there is a great deal of attention paid to eating quality. At virtually every step from production to consumption, industry segments are proactively taking steps to build quality into our beef products. Our performance on this important issue is largely why consumers continue to increase their demand for beef, even while the price is increasing. The importance of quality to domestic and international customers helps to ensure the U.S. beef industry does not lose focus on this critical feature of our beef.

Aspects of suckler cow efficiency on grass-based production systems

Mark McGee and Paul Crosson
Teagasc, AGRIC, Grange, Dunsany, Co. Meath, Ireland;
mark.mcgee@teagasc.ie

Background

Beef suckler cows comprise approximately half (1.1m) of the cow population in Ireland. Late-maturing continental breeds now account for over 75% of suckler cows, of which, 85% are bred to continental sire breeds (McGee, 2012). They are operated within systems where grazed grass is the major dietary input. These cows are predominantly spring-calving with their progeny taken to finish at about 20 (heifers) and 24 (steers) months of age or greater (O'Donovan et al., 2010). Thus, where progeny are taken through to slaughter, there are usually two grazing seasons and one or two indoor winter periods (e.g. Drennan and McGee, 2009). Frequently, the production system may involve selling the progeny as live animals, including shortly after weaning, at the beginning (as yearlings) or end (at 1.5 years old) of the second grazing season. Of the predominant feedstuffs readily available in Ireland, efficiently managed grazed grass is the cheapest, followed by grass silage which, in turn, is cheaper than concentrates (Finneran et al., 2012). Therefore, the rationale for these grass-based production systems is the considerably lower comparative cost of grazed grass as a feedstuff together with its potentially high nutritive value and thus, high animal performance compared to forage-based diets offered indoors. The objective is to maximise financial returns by enabling the genetic capacity of beef cattle to be met within grass-based systems.

Central to the biological and economical sustainability of suckled beef production is an efficient cow. In calf-to-weaning and calf-to-beef systems the cow consumes over 80% and 50%, respectively, of the feed required annually. Consequently, feeding the suckler cow is the major expense incurred in suckled calf production and optimising cow productivity within the context of the production system operated is essential. The lifetime productivity of the beef bred female commences from the onset of puberty and will be dictated by subsequent critical events including age at first calving, duration of the postpartum interval for each successive calving, conception and pregnancy rate and ultimately manifested as length of inter-calving intervals and number of calves weaned over her lifetime (Diskin and Kenny, 2014). Good reproductive performance i.e. producing close to one healthy calf per cow exposed for breeding is critical and ideally cows need to first calve at 2 years old as it is biologically and economically more efficient (Crosson and McGee, 2012).

Likewise, high lifetime live weight gain of progeny i.e. attaining high weight for age during pre-weaning (combining cow milk yield and the animal's own genetic capacity for growth) and post-weaning (genetic merit, feeding management and exploiting compensatory growth) coupled with good carcass traits (high kill-out proportion, good carcass conformation and adequate carcass fat score and meat quality traits), is essential.

This paper will address aspects of suckler cow efficiency (at the animal and system level), including breed types, genetic merit, feed efficiency and cow management in the context grass-based systems of production.

Cow breed types and genetic merit

Within the beef herd in Ireland an increasing proportion of the genotype of both the dams and sires has come from late-maturing breeds such as Charolais and Limousin. The cow breed structure is very mixed, comprising of many breed types and countless combinations of these. The advantages of heterosis or hybrid vigour for reproduction and maternal traits in beef suckler cows have been widely demonstrated (ca. +13% – calf weight weaned per cow exposed for breeding) and there are further advantages in progeny performance from using a sire from a third breed (ca. +8%) (Buckley et al., 2005). The benefits of hybrid vigour from cross-breeding are due to a combination of: enhanced reproductive performance, lower calf mortality and higher calf growth to weaning.

In Ireland the main replacement breeding strategies available to farmers are sourcing replacement heifers from the dairy herd or from the suckler herd. From all the cow breed comparisons carried out at Teagasc, Grange to date, the Limousin × Holstein-Friesian remains the benchmark cow breed type (McGee, 2012). This 'cow type' has a relatively moderate feed intake, good reproductive performance and produces progeny with (i) a high passive immunity (ability to fight-off disease) due to higher colostrum production of the dam, (ii) a high weaning weight due to higher milk production of the dam, (iii) high carcass weight per day

of age, mainly due to higher pre-weaning growth and (iv) relatively good carcass classification traits (conformation and fat score) and carcass composition characteristics. However, crossbred beef breed cows with good maternal traits can achieve almost comparable performance (McGee, 2012).

Although there is a breed ranking for different traits, there is variation within genotype and consequently, a relatively large overlap between genotypes for many traits. Efforts to improve the genetics associated with beef suckler cow production traits need to be based on selection according to individual animal performance (within the breed type chosen). The challenge is, reliably identifying these high performing animals and proliferating their genetics through structured animal breeding programmes.

In Ireland, two new beef breeding economic indexes for use in the suckler herd were launched in autumn 2012 by the Irish Cattle Breeding Federation (ICBF), namely, the 'Terminal Index' and the 'Maternal Index' (now called 'Replacement Index') (Evans and Cromie, 2012). Sires should be selected on the basis of the Terminal Index (and sub-indices) where progeny are produced for slaughter, and on the basis of the Replacement Index (and sub-indices) where replacement heifers – home-bred or purchased – are selected for breeding. The accuracy of the Irish maternal genetic evaluations in beef cattle was assessed using national field data (McHugh et al., 2014) with results indicating that selection of breeding animals for favourable maternal genetic attributes resulted in favourable improvements in phenotypic performance. A research herd comprising two diverse genotypes, high and low 'Replacement Index', was established at Teagasc Grange to validate the Replacement Index (Prendiville and McHugh, 2014). This evaluation study is on-going.

With the advent of the new beef 'Replacement' Index, coupled with higher reliability beef bull genetic evaluations, increased rates of genetic gain and production efficiency within the national beef suckler herd should be possible.

Feed efficiency in suckler cows

Feed provision is the largest variable cost (70%+) in beef production systems. As outlined earlier, the cow herd consumes a high proportion of the annual feed inputs. Since about 70% of the total energy consumed by beef cattle goes towards maintenance requirements, this means that cow maintenance costs are a considerable proportion of the total feed costs of beef production systems. Consequently, feed efficiency (FE) is central to economical and environmentally sustainable production systems. Traditionally, FE of livestock has been expressed as the level of bodyweight or carcass growth attained for a given quantity of feed. It is generally agreed that use of this type of ratio trait, commonly referred to as 'feed conversion efficiency' or its inverse 'feed conversion ratio' (kg feed per unit of gain) in breeding programmes generally leads to selection of faster growing cattle with larger mature size. Consequently, if the gains in progeny growth efficiency are partially or fully offset by an increase in feed requirements of the (heavier) breeding cow herd, there will be little or no change in production system FE. Thus, there has been much interest, worldwide, in examining alternative FE traits. The concept of residual feed intake (RFI), rather than feed conversion ratio, is becoming the preferred measure of FE; this trait is genetically independent of growth and body size. It is calculated as the difference between actual feed intake and predicted feed intake, with negative or smaller values more desirable than positive or larger values; animals with low RFI (efficient) eat less than expected based on their weight and growth (production).

Beef cattle differing in FE consume substantially diverse amounts of feed to achieve the same production. For example, Teagasc research on RFI has shown that in any group of growing cattle there can be up to 20% difference in the feed consumed by the most efficient cohort compared to the least efficient cohort of animals for the same level of growth and performance (e.g. Crowley et al., 2010; Fitzsimons et al., 2013; 2014a; Kelly et al., 2010a, b; Lawrence et al., 2012). Likewise, we have shown that differences of this magnitude are evident within populations of (pregnant) beef suckler cows (McGee, 2009; Lawrence et al., 2011, 2013; Fitzsimons et al., 2014b). Additionally we, and others, have demonstrated significant genetic variance in RFI (Crowley et al., 2010) and that, genetically, it is not antagonistically associated with desirable growth or carcass traits in growing beef cattle (Crowley et al., 2011a) or performance traits in beef suckler cows, with the exception of possibly delaying the onset of puberty (Crowley et al., 2011b). However, the latter can be negated by including measures of body fatness in the base model used to calculate RFI (Basarab et al., 2013). Furthermore, our research has shown that low RFI animals produce less methane daily than their high RFI counterparts (Fitzsimons et al., 2013). Again, the challenge is to reliably and cost-effectively identify these feed efficient animals.

Worldwide, breeding values of bulls for feed intake or FE are typically derived from progeny performance based on *ad libitum* access to energy dense rations whereas, in many countries including Ireland, the lifetime gain of most commercial beef cattle is achieved from diets consisting, to a significant extent, of lower energy density feeds such as grazed grass and/or ensiled forages.

There is evidence from our own work, and that of others, that although somewhat repeatable, ranking of beef cattle for FE offered the same diet is not necessarily consistent over different phases of their lifetime, and this may be further exacerbated when diets differing in energy density are fed successively (i.e. forage versus concentrate based diets), as per commercial practice. This strongly indicates the presence of what is termed a 'genotype × environment' interaction for the trait, in other words

that the relative feed efficiency of a particular animal depends on the type of feed it is offered or management system within which it is reared. For example, our data have shown that growing beef heifers ranked as divergent for RFI on a grass silage plus concentrate diet indoors did not differ in herbage intake (during early pregnancy) when subsequently grazing pasture (Lawrence et al., 2012). However, the existence of such a phenomenon has not been adequately tested to-date.

Recently, a large research programme, funded by the Irish Department of Agriculture, Food and the Marine, has commenced at Teagasc, Grange with the objectives of (i) quantifying the repeatability of performance and FE across different diets and (ii) identifying the key genes controlling the trait so that such information can ultimately be incorporated into the planned genomic selection based breeding programme for beef cattle in Ireland. This should, in time, aid the identification of animals that are most profitable to produce under our grass-based production systems.

Grass-based Production Systems

Grazed grass and grass silage

Due to the considerably lower comparative cost of grazed grass as a feedstuff, maximising the proportion of high digestibility, grazed grass in the annual feed budget is critical. Grassland management revolves around a flexible rotational grazing system, with the objective of providing high yields, of high digestibility leafy grass over a long grazing season. However, due to the seasonality of grass growth in Ireland, an indoor winter period is inevitable. The duration of this indoor period is dictated by factors such as prevailing climatic and weather environments, soil and sward type, and grazing conditions. Providing sufficient grass silage of appropriate digestibility for the indoor winter period is also central to the production system. For the spring-calving suckler cow, grass silage is the primary and usually sole (depending on silage nutritive value and cow body condition score (BCS)), feedstuff offered during this time.

Although the indoor winter period is usually of shorter duration than the grazing season, due to the relative costs of grazed grass and grass silage, on most suckler calf-to-weaning farms, primary feed costs relate to winter. For example, within spring calving, grass-based, suckler calf-to-weaning systems on research farms (ca. 4.5 month winter), almost three-quarters of the feed consumed annually is comprised of grazed grass, with the remainder made up of grass silage (26%) and concentrates (1%). However, when this feed budget is expressed in terms of cost (**excluding** land charge), the outcome is very different, in that grazed grass makes up only 45% of total feed cost, whereas grass silage accounts for 50% and concentrates accounts for 5% of total feed costs. Thus, while grazed grass is fundamental, feeding silage is a key (cost) component of suckler cow nutrition. Consequently, in order to maximise profitability of suckler systems, a long grazing season with a corresponding short indoor winter feeding period is required and provision of the cow's winter diet at a low a cost as practicable, is necessary.

For economic reasons suckler cow nutrition generally involves mobilisation of cow body reserves in winter when feed is more expensive and deposition of body reserves during the subsequent grazing season when consuming lower cost grass (e.g. Drennan and McGee, 2004). The BCS of cows at the start of the winter feeding period has a major effect on the amount and quality of feed required. Where mature spring-calving suckler cows are in good BCS (~3.0+, scale 0–5) at the start of the winter their feed energy intake can be restricted such that some of the body fat reserves are utilised to reduce winter feed requirements. This feed energy restriction can result in a feed saving of up to 25%, equivalent to 1.0 to 1.5 tonnes fresh weight of grass silage (assuming silage dry matter (DM) of 20% & DM digestibility of 65%).

Spring calving date and turnout date to pasture

Turnout of livestock to pasture in spring has to be delayed until grass growth begins and sufficient herbage has accumulated to meet animal demand. Additionally, grazing conditions must be adequate. Commencement of grass growth is largely determined by ambient soil temperatures i.e. a grass growing day is classified as a day where soil temperature is >5°C at 9.00 am (O'Donovan et al., 2010). This is very much location/site dependent. For example, applying this criteria to 4 temperature recorded Teagasc sites in Ireland namely, Moorepark (Cork – South), Ballyhaise (Cavan – North) and Grange (Meath – East) over a 10 year period results in mean grass growth commencement dates of 15 February, 12 March and 25 March, respectively, with large variation between years (Williams and O'Kiely, unpublished). As a result, the degree to which early turnout to pasture can be easily exploited will vary substantially according to geographical location/site, but also from year to year in relation to meteorological, soil, sward and grazing conditions. This means that having a sufficient buffer of winter forage is critical and flexibility in grazing management is required.

Compact calving before turn out to pasture in spring in order to maximise herbage utilisation is an essential component of profitable grass-based suckler systems. Median calving date should coincide with the start of the grass growing/grazing season. Research at Grange has shown that, earlier calving and turnout to pasture (onto the grazing platform) generally improves farm net margins by reducing the proportion of more expensive grass silage (and concentrates) in the annual feed budget and replacing it with cheaper grazed grass (Crosson et al., 2009). Furthermore, slurry handling costs are reduced. However, earlier calving and turnout to pasture in spring will only increase farm net margin where an adequate supply of grass is available and grazing conditions are suitable to facilitate this. In other words, calving

too early leads to a decline in profitability as higher costs, usually associated with autumn-calving systems, start to materialise.

The herbage mass available to grazing livestock during spring can be increased if all the grassland on a farm, including the area destined for first harvest silage, is utilised during the first grazing rotation although grazing spring swards designated for first cut silage may have adverse effects on subsequent silage yield especially when the interval between spring grazing and silage harvesting is relatively short (McGee et al., 2014). This has important ramifications for farm profitability considering the negative relationship between yield and cost of producing grass silage (Finneran et al., 2011, 2012). Where grazing conditions are difficult, restricted / 'on-off' grazing, whereby animals are given limited access time to pasture daily may be used. In a series of studies at Teagasc Grange, earlier turnout to pasture in spring (ca. 3–4 weeks) of suckler cows via restricted (i.e. 6 hours daily – cow only) or fulltime access (cow & calf) to pasture resulted in feed cost savings of between €0.52 and €1.11 per cow per day with no recorded adverse effects on animal performance (Gould et al., 2010; 2011).

Stocking rate

Economic analysis of grass-based suckler calf-to-beef production system comparisons at Grange (e.g. 210 vs. 170 kg organic Nitrogen/ha) has shown that where individual animal performance remains high, stocking rate is the main driver of farm profitability (Crosson et al., 2009). Consequently operating at a relatively high stocking rate is important.

In summary, for lowland grass-based suckler beef systems key principles of profitable production include, operating at a high stocking rate, compact calving before turn out to pasture in spring to ensure maximum herbage utilisation, and high levels of animal performance.

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Interbeef presents new opportunities for beef farmers

Thierry Pabiou
Geneticist, Irish Cattle Breeding Federation, Bandon, Ireland;
tpabiou@icbf.com

M. A. Nilforooshan
Geneticist, Interbull Centre, Uppsala, Sweden;
mohammad.ilforooshan@slu.se

E. Venot
Geneticist, INRA GABI, Jouy en Josas, France;
eric.venot@jouy.inra.fr

K. Moore
Geneticist, EGENE, SRUC, Edinburgh; kirsty.moore@sruc.ac.uk

Introduction

Beef genetic evaluations have usually been developed within country. Increasingly, breeders are seeking to compare domestic and foreign bulls in order to enlarge the choice of animals that best fit their selection needs. As more and more genetic material is traded around the world, the need for accurate comparisons of the genetic merit of bulls from different countries has become increasingly important.
A general survey carried out in 2006 by the International Committee for Animal Recording (ICAR), showed the need of international genetic evaluation for beef cattle to be run by the Interbull Center in Sweden. Prototype results prepared by INRA (France) and ICBF (Ireland) showing the feasibility of this type of evaluation (Venot et al., 2007, 2008, 2009), ICAR decided to establish, in 2008, a new service called Interbeef. Over the past seven years, the different tools and infrastructure have been built to make Interbeef genetic evaluation a reality.

The objective of this paper is to present the results of the 2014 Interbeef test run for weaning weights performed at Interbull Center and to show the different benefits that can be expected by breeding organisations of the different countries members of Interbeef.

Materials and Methods

Data: Weaning weight was the first trait considered for Charolais (CHA) and Limousin (LIM) pure bred animals in Interbeef joint genetic evaluation. Ten countries are currently members of Interbeef: i) for CHA and LIM evaluations: Czech Republic (CZE), Denmark (DNK), Finland (FIN), France (FRA), Ireland (IRL), Sweden (SWE), Germany (DEU), Switzerland (CHE) ii) for LIM evaluation only: same countries as for CHA plus Spain (ESP) and United Kingdom (GBR). Different trait definitions occurred: several countries used adjusted weaning weight at a specific age (200 or 210 days; e.g., FRA, GBR) based on several weights, while other countries considered weight measured around weaning and correct for age at weighing in the model (e.g., IRL, DNK). Weights sent by SWE were calculated as the difference between adjusted weaning weight and birth weight. Phenotypic records and pedigree data were extracted from the Interbull IDEA database based on the animalís unique international identification number in September 2014. Each member country had uploaded phenotypic performances edited to their respective national genetic evaluation standards. Therefore, data editing at the Interbeef level was thus limited. The final performance dataset edited for genetic evaluation contained 2,672,286 animals from ten countries for Limousin, and 4,224,114 animals from eight countries for Charolais. Back-ancestry, traced back to founders, was also extracted from

the IDEA database and comprised of 2,973,893 and 4,963,270 lines for Limousin and Charolais, respectively.

Genetic evaluation model: The model chosen for the Interbeef joint genetic evaluation is a multiple trait animal model based on raw data and considering each country as a separated trait (Phocas et al, 2005). Along with country specific fixed effects, the model included direct and maternal genetic effects as well as permanent environment effects. Across-country genetic parameters were estimated in 2014 by Pabiou et al. (2014). The MiX99 software was used by Interbull Centre for breeding value prediction (Lidauer et al., 2011) while reliability computation used MTEDC5 package (Sullivan, 2011). The genetic evaluation was run in September 2014. Interbeef breeding values can be published at country level pending the following publication rules: breeding values can be published only i) for animals with Interbeef reliability (reliability= accuracy^2) greater than 0.50 and with more than 25 progenies with records taken into account in Interbeef evaluation or ii) for animals already publishable in the country.

Analysis: In order to assess the benefits of the Interbeef collaboration, pseudo national genetic evaluations were mimicked at Interbeef level by setting between-country correlations to zero in the Interbeef model. That way, only national performances were taken into account in each country breeding value prediction. The comparison of sire ranking and reliability between Interbeef and pseudo national evaluations were used to assess the different impacts of a joint genetic evaluation at country level. The software used to run the analysis was SAS v9.1 (SAS, Cary, NC, USA, 2003).

Results and Discussion

The IDEA web-based database was launched in 2010 by Interbull center and allowed member countries to upload and automatically check for potential error pedigree or performance files. This automatic process ensured that a maximum number of correct records entered the InterBeef genetic evaluation by minimizing errors due to miss-identification or duplicates. As expected for Charolais and Limousin breeds, a large part of the data comes from France (Table 1). The United Kingdom and Sweden had the second largest populations of Limousin and Charolais, respectively. The amount of data sent by Ireland represented only 15% of the data used nationally as the majority of performances are collected on commercial animals.

By taking into account all information available on animals and relatives

Table 1: Interbeef data description in the September 2014 across-country genetic evaluation.

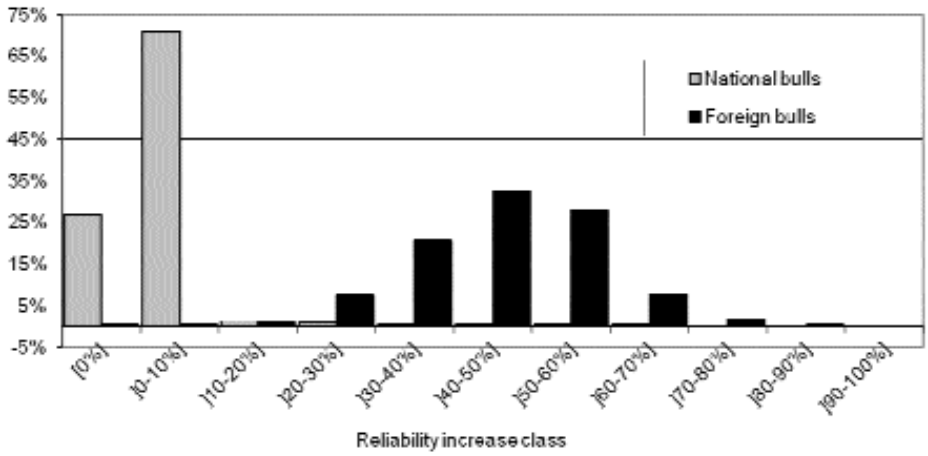
Breed	*Country*	*Number of animals in pedigree*	*Number of records*	*Number of herds*	*Average wean. weight* (kg)*		
					All	*Males*	*Females*
Charolais	CHE	8736	8292	80	240	250	229
	CZE	30055	28261	249	280	293	268
	DEU	90604	75227	966	272	289	257
	DNK	22506	15881	480	296	312	279
	FIN	21282	17186	190	298	315	281
	FRA	4628250	3945975	10002	278	295	262
	IRL	35344	18791	1692	297	311	278
	SWE	122215	114501	1348	235	249	221
	Total	**4963210**	**4224114**				
Limousin	CHE	24800	24978	325	221	233	208
	CZE	8286	7531	97	272	288	258
	DEU	79387	67657	828	251	265	238
	DNK	50511	42179	1084	271	287	255
	ESP	41694	33259	188	257	268	246
	FIN	17427	13036	156	273	288	258
	FRA	2549855	2322300	6420	261	275	248
	GBR	146659	124032	743	270	287	252
	IRL	29709	16190	1010	275	288	258
	SWE	22123	21124	277	213	225	201
	Total	**2973893**	**2672286**				

*wean. weight: weaning weights were defined as i) weights adjusted to 210d in CZE, ESP, DEU, CHE, and FRA, to 200d in GBR, ii) weights close to weaning for IRL, FIN and DNK, and iii) weight gain between birth and 200 days in SWE.

Table 2: Comparison between numbers of national and Interbeef publishable Limousin bulls in each member country.

	National bulls	*All publishable bulls*	*Publishable bull increase %*
CHE	471	20,876	4,332
CZE	3,747	25,214	573
DEU	31,891	51,865	63
DNK	22,033	42,256	92
ESP	17,121	38,226	123
FIN	6,506	26,907	314
FRA	18,557	21,150	14
GBR	66,353	88,286	33
IRL	8,793	31,549	259
SWE	358	20,782	5,705

Figure 1: Increase in reliability for Limousin bulls (with at least 10 progenies – across all scales) in Interbeef genetic evaluation compared to pseudo-national results.



across all member countries, Interbeef can provide more accurate genetic evaluation results (compared to national evaluation) to breeders.

Larger choice of breeding animals: The Interbeef joint genetic evaluation provides breeders of the different member countries with a larger spectrum of breeding animals (Table 2). Every country was offered a wider panel of publishable bulls. On one hand, the country with the narrowest panel of bulls in their national evaluation will see the greatest increase in the size of their publishable bull list (e.g., SWE, CHE). On the other hand, FRA which is holding most of the purebred data in Limousin had a modest input (14%) of foreign sires in its publication list.

Reliability increase: Using all available sources of performances outside the national supply is hugely beneficial in terms of reliability (Figure 1). Across all country, the general median reliability increase was +0.44 and general maximum increase of +0.89. This reliability increase depends on the country and the type of bulls considered. Figure 1 shows that reliability increase concerns mainly foreign bulls but can also occur for local bulls via the genetic linkage between countries. For example, the average increase of reliability for Limousin bulls with at least 10 progenies was +0.47 for GBR and +0.06 for FRA.

Interbeef ranking: Table 3 gives, for Limousin top 1000 best bulls in each country scale, the origin of these bulls associated with the best rank (only for bulls with at least 10 progenies and associated reliability higher than 0.30). In all country scales, a large majority of the top 1000 best bulls comes from France (between 72% and 96%) followed by United Kingdom (4% to 25%). However, bulls from all participating countries can be found in all scales (except in French scale). A direct benefit of Interbeef is to allow breeders to have access to a much larger panel of new favorable bulls selected on EBV specific to their country scale.

More than 90% of the bulls presented in Table 3 originated from FRA across all scales, and the best ranked bull was also FRA across all scales. However, GBR bulls were ranked in the top 10 in CZE, ESP, GBR, and IRL scales, and has a bull ranked 97 in the FRA scale.

Since genetic correlations between countries are not equal to unity (Pabiou et al., 2014), re-ranking between countries will occur. Rank correlations between Interbeef and pseudo national evaluation showed that including data from other countries had a great impact on bull ranking in each country (Table 4). As expected, rank correlation in FRA scale is the largest (0.96) allowing for limited re-ranking of bulls in the French scale. Accounting for all available performances across countries in a single genetic evaluation has had the largest impact on IRL and CZE.

Conclusion

Over the past years Interbeef has met and overcome challenges, and successfully answered several technical and research questions. Interbeef is a relatively new entity offering across country genetic evaluation to its member country and beef breeds. By uploading pedigree and performance files into the Interbeef centralised database housed at the Interbull Center, the participating countries enjoy full benefit of data sharing through pedigree consolidation and an access to a large database of phenotypic records.

Table 3: Distribution of the top 1,000 Limousin bulls* (as well as the best rank between square brackets [ ]) on direct weaning weight breeding value in each country scales by country of origin of the bulls.

	CHE	CZE	DEU	DNK	ESP	FIN	FRA	GBR	IRL	SWE
CHE	15 [259]	12 [288]				3 [617]				1 [936]
CZE	3 [373]	7 [107]				1 [632]			1 [686]	1 [593]
DEU	12 [209]	21 [81]	17 [132]	3 [576]	9 [390]	10 [419]	4 [649]	7 [480]	5 [602]	8 [353]
DNK	5 [217]	9 [82]	1 [492]	2 [270]	3 [263]	5 [209]	2 [594]	2 [372]	3 [165]	1 [490]
ESP	6 [41]	10 [9]	5 [184]	4 [262]	8 [18]	4 [130]	3 [534]	7 [58]	7 [37]	6 [165]
FIN	8 [31]	8 [52]	4 [226]	4 [314]	6 [169]	10 [19]	2 [373]	6 [163]	6 [176]	6 [108]
FRA	922 [1]	862 [1]	945 [1]	964 [1]	924 [1]	938 [1]	970 [1]	927 [1]	923 [1]	933 [1]
GBR	23 [58]	58 [5]	23 [39]	21 [109]	44 [4]	25 [60]	16 [97]	47 [2]	49 [4]	37 [16]
IRL	3 [426]	8 [129]	1 [504]	1 [242]	2 [352]	2 [582]	1 [730]	2 [295]	4 [149]	2 [373]
SWE	2 [348]	3 [314]	1 [854]		2 [656]	1 [282]	1 [717]	1 [578]	1 [545]	4 [172]

*Limited to bulls with more than 10 progenies and reliability for direct weaning weight greater or equal to 0.30.

Key to reading ex: on CHE scale, 922 bulls originated from FRA, 23 from GBR; the best ranked bull for FRA was 1; the best ranked bulls sourced from the UK was 58.

Table 4: Rank correlations between pseudo-national and Interbeef direct weaning weight breeding values for Limousin bulls*

	CHE	CZE	DEU	DNK	ESP	FIN	FRA	GBR	IRL	SWE
N bulls	41618	34081	42595	42862	42632	42517	42932	42826	42352	42198
Rank correlation	0.44	0.32	0.56	0.48	0.49	0.39	0.96	0.59	0.27	0.42

*Limited to bulls with more than 10 progenies and reliability for direct weaning weight greater or equal to 0.30.

The 2014 genetic evaluation showed large benefits of Interbeef genetic evaluation collaboration in terms of individual animal reliability increase but also by providing member country with a bull ranking accounting for country specificities.

Interbeef will help the breeders to better choose their breeding animals in their own country but also abroad on the same scale. It deals at the moment only with pure bred animals and weaning weights. However, research is ongoing to include cross-bred animals and expand Interbeef trait list to calving, slaughter and female fertility traits.

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Next steps to sustainability

Pearce Hughes
Agricultural Development Manager, ASDA, Southbank, Great Wilson Street, Leeds, LS11 5AD; pearce.hughes@asda.co.uk

Sustainable beef production and profitable beef production go hand in hand and in many instances the aspects that make a business sustainable are also those that make it profitable.

Asda is committed to working with its BeefLink producer group farmers to help them deliver increased profits as that is to the benefit of both farmers and consumers.

Profitable farm businesses are able to invest for the future which, in turns deliver sustainability at both a farm and retail level.

Without sustained profitability productivity drops and that means there is less British beef for Asda to sell.

Increasing beef sales are good for Asda and good for farmers and at a time when the UK beef retail market is largely static Asda has, through innovation, been able to boost sales significantly.

By moving to skin packs for all steaks Asda has increased steak sales by 20% ahead of its competitors and by 32% overall on a market which is declining by 4.7%.

This has been achieved by increasing quality, through 21 day maturation and also through new promotions, such as two 8oz steaks for £7. Importantly skin packs mean steaks can be on the shelf for 10 days, giving steaks two weekends on the shelf, greatly reducing waste.

And, while steak has traditionally been a seasonal seller, the switch has seen winter sales as strong as summer sales, when traditionally it had been very hard to sell in winter.

Additionally, the introduction of 'Roast in the Tray' beef joints had defied the market too, lifting sales and resulting in increased demand for British beef.

This innovative way of packaging and selling beef had been introduced as a result of customer feedback which suggested a lot of shoppers were nervous of cooking beef.

'Roast in the Tray' joints take 30% less time to cook, putting beef in the same league as chicken and ready meals for cooking time and convenience.

As a result of the new 'Roast in the Tray' packaging beef joint sales have jumped by 19.1% at a time when the market is declining by 5%.

But all of this wouldn't be possible without the beef to sell and that's where our BeefLink scheme really comes in to its own, providing significant benefits to both our farmers, our dedicated processor ABP and ourselves.

Through a range of initiatives BeefLink has returned more than £39m back to the industry since it was set up in 2007 and it continues to support and inspire farmers every day of the week.

This is done in a number of ways, not least through providing access to discounted semen, grass seed and a variety of other inputs at the same time as opening the market and allowing our farmers to produce beef in the most efficient way possible.

The biggest limitation in suckler beef production is the amount of land you have. Therefore, to increase farm productivity we have to measure and increase output on a per hectare basis with a target of 750Kg live-weight per hectare being the goal. BeefLink farmers are encouraged to achieve this through a number of ways, with the production of young bulls a central theme.

Young bulls have a superior feed conversion efficiency and that, coupled with having cattle on-farm for less time can mean farmers can carry up to 30% more cows on the same land. Also, provided it is slaughtered at under 16 months old, there is no detrimental effect on eating quality, in fact many of our Asda steak competitions, judged by leading chefs such as James Martin, have been won by beef from young bulls.

Asda also accepts carcasses from heavy cattle, that is cattle with carcass weights of between 450kg and 550kg, thus allowing our farmers to get the maximum benefit from the elite genetics we are offering them through BeefLink.

On a BeefLink National Suckler Strategy Group study trip to the USA in 2013 a number of our beef farmers saw first-hand what composite breeding and improving feed efficiency could mean to a suckler herd.

Looking at the suckler herd itself it is important to ensure cows are as efficient as possible. Selecting for Net Feed Efficiency in the maternal line will be hugely important going forward as will a stronger focus on longevity and fertility.

Sustainability and profitability in a volatile market place

Nick Allen
Director, EBLEX, AHDB, Stoneleigh Park, Kenilworth, Warwickshire, CV8 2TL; nick.allen@eblex.ahdb.org.uk

It is impossible to go to a conference these days without it being pointed out that the world population is going to grow to 9 billion by 2030 and that this is the most promising time to be in agriculture in a generation, if not two. We are constantly being urged to embrace innovation, see the big picture, and be entrepreneurial. We need to feed this growing population. From a beef perspective, we are told that the middle class will grow in the Far East and in Africa and, with that, will come an increased demand for our product. The world is our oyster!! So why is it, when I look around at the industry in this country and the rest of the world, do I see so many gloomy faces? Why so much uncertainty? Why is it that every survey I see tells me that farmers have not got the confidence to invest and embrace this brave, exciting new world that is just around the corner.

It is in fact due largely to the other main topic of conversation at every conference you go to. Volatility. Prices are up and down like a yo-yo and it does not matter what line you are in, the vagaries in the market cause problems and uncertainty.

In the last 12 months, we have seen the beef market go through a crisis but recover, cereal prices fall dramatically and are now showing signs of recovery and, at the time of writing this, the Dairy sector has now been plunged into crisis. Small shifts in supply and demand are having a dramatic effect.

Reducing the impact of volatility

Trying to reduce the impact of this volatility is one of the reasons why, in recent years, EBLEX has put a large chunk of resource into expanding export markets. The more markets we have available to us, the greater the chance that, somewhere in the world, the price will be holding up either because of demand or due to exchange rates. We are now seeing huge volatility in the oil market, a product we all have a huge interest in, and ups and downs in the oil market have huge consequences for us all.

Of course, in times gone past, some of this volatility would have been levelled out by government intervention of some type, but with most economies in the world struggling, there is neither the finance nor the will to try and intervene. The likelihood going forward is that markets will be left to their own devices – and that will mean volatile markets.

So every business in the land needs to think hard about how it can cope with these vagaries. They will have to learn to live with margins at times being tight for prolonged periods. To be fair, banks are already starting to recognise this and are increasingly taking a view over a three-year period, rather than annually, about the viability of a business. It does mean that business managers will have to have a much greater handle on costs of production going forward. I make no apology whatsoever for pointing out that the business with lower overheads and a lower cost base will stand a much greater chance of surviving – and even thriving – in the topsyturvey world we now have, much more so than the business with high overheads.

The role of genetic improvement

This is where breeding can play such an important part in our industry going forward. Good breeding is the bedrock of efficient production. It does not matter how good a grass producer you are, how switched on you are to using alternative feeds or how good your facilities are. They are all a waste of time if the genetic material you are working with is not up to scratch.

Breeders today are well versed in the use of Estimated Breeding Values to improve their livestock, but as an industry, if we really want to move forward a pace, we are missing the opportunity to use data on a wider scale. To use the buzz terminology, we need to start looking at the opportunities that big data may give us.

I think it is worth looking at some projects EBLEX is involved with to highlight some of the work and the potential in this arena.

Carcase trait evaluation

In 2013 Tracey Pritchard reported on the Pilot project on carcase trait evaluation.

Existing industry (abattoir) and government data were used to produce a consolidated dataset of carcase traits for beef and dairy cattle. The overall aim of this feasibility study was to assimilate, cleanse, salvage, validate and characterise abattoir and British Cattle Movement Service (BCMS) data, followed by descriptive statistics for the resultant dataset. The subsequent use of this data is expected to be for genetic evaluations, and so analyses

undertaken in this study were designed to reveal information on the suitability of the data for genetic evaluations. Initially, three million individual carcase abattoir records (from three abattoirs) and approximately 48 million BCMS animal records were made available for this project. Using intelligent string matching, 82% of the individual carcase records could be matched to a BCMS individual animal record, resulting in a dataset of 2,435,875 for further investigation. The three traits available from abattoir records were net carcase weight, conformation and fat class. Matching to BCMS data provided information on animal movements, breed, dates of birth and death, in addition to dam and sire identities. Sire, which is not compulsory to record, was recorded for approximately 23% of animal records and the level of recording was generally higher in more recent years (11% in 2001 and 23% in 2011).

Dates on animal birth and death in BCMS enabled us to determine age at slaughter, and the average daily gain for net carcase weight. Across all breeds, the averages for the slaughter population aged from three to 36 months for net carcase weight, days to slaughter, average net carcase weight daily gain, conformation and fat class, were 323.7kg, 743 days, 0.45 kg, −R, and +3 respectively.

A refreshed BCMS database was obtained which included movement records. The herd identity was encrypted, which meant that no information was available on the holdings themselves although animals could be grouped by holding by time, and contemporary groups formed. This was a significant improvement on the data expected to be available to the project, particularly compared to a previous extract, which only included holding of birth and death and the number of movements. The average number of locations for an animal to be reared (for a period of at least two months) was 1.7.

Beef farming in the UK is extremely diverse, with many breeds and crosses that are used to suit the many environments, systems, and markets. The major breeds present in the carcase population (with over 100,000 animals) were described as Limousin, Aberdeen Angus, Holstein Friesian, Charolais, Hereford, Simmental, and Belgian Blue, and these accounted for 92% of the animals present in the matched abattoir/BCMS dataset. A major proportion of animals described as beef breeds were cross-breds and generally take the name of the sire breed. Dam breed records emphasise that dairy cows are a major component of beef production, with Holstein Friesian being the most common dam breed, accounting for 46% of the slaughter population.

A pedigree file was created for BCMS records by matching to other national data sources and to itself. This resulted in a (super) pedigree file of over 50 million animals going back a maximum of 13 generations, and sire was available for 25% of the slaughter population (an increase of 2.3%). The super pedigree tended to lead to greatest improvement in sire records for dairy breeds, which were generally low in BCMS. The across beef and dairy super pedigree can be used to explore additive and non-additive (heterosis, recombination losses) genetic effects for traits relevant across both breeds (where data exists), such as carcase and product quality and safety traits, but also cattle health/disease traits.

Genetic analyses were performed on a subset of the data for animals with a Charolais sire, which consisted of 17,125 records after editing. Heritability estimates for net carcase weight, conformation and fat class were 0.31, 0.24, and 0.14. Similar results were seen in a within-Limousin breed parameter estimation analysis. These results provide strong indication of the existence of genetic variation in the studied traits. This, in turn, suggests that improving carcase quality traits through genetic selection is entirely possible, thereby warranting more detailed investigation of their genetic background, particularly their relationship with other traits of importance and within, between and across breeds.

The results of this feasibility study indicate that genetic analysis for carcase traits is realistic, particularly for breeds which make up a major part of the carcase population and have sufficient information on the sire. Encouraging the recording of sire identity by farmers in BCMS would further improve the usefulness of future data.

EBLEX with HCC and DairyCo are funding a project to lead to implementation of EBV's for carcase traits from abattoir data.

Feed efficiency project

We have just been granted funding from Defra to embark on a further project on feed efficiency evaluation. A Defra-funded scoping study (IF0207) showed that continued selection of purebred beef cattle using the currently available tools will deliver a substantial positive impact on the economic and environmental sustainability of beef cattle production in the UK. At the current rate of uptake, ten years of selection considered over a twenty-year time horizon is expected to result in a cumulative increase in profit at the commercial farm level of around £31 million, whilst also reducing greenhouse gas emissions by around 726,000 tonnes.

Recording feed intake to enable feed efficiency to be included in selection indices is expected to increase the realised benefits in farm level profit by around 39% and in GHG reduction by around 22%. The study recommended the establishment of agreed industry standards for recording of feed intake and for the measure of feed efficiency to be included in selection indices, as an important step in minimising confusion and simplifying knowledge transfer.

Genetic improvement will play a pivotal role in developing sustainable beef production systems. It is particularly cost-effective, producing permanent and cumulative changes in performance. In addition, livestock breeding is recognised in the UK Low Carbon Transition Plan as a key, cost effective, tool to help UK farmers achieve target reductions in green-

house gas emissions of 6% by 2020. Improving adoption, and continued development, of genetic improvement tools will help farmers be more efficient and profitable, while reducing the impact of beef production on the environment.

This project, led by AHDB and SRUC (Scotland's Rural College) will bring together an industry-wide consortium to deliver a lasting infrastructure for the measurement of feed efficiency in beef cattle and its incorporation into breed improvement programmes.

The project will hopefully leave a legacy of the tools required for the whole UK beef industry to adopt breeding for feed efficiency. This will initially be by a continued flow of animals through the facilities installed during the project, but the business models will explore means of enabling new facilities to be installed on a financially viable basis, accelerating the improvement in feed efficiency of beef cattle across the UK industry.

Data hub

Thirdly, we have currently submitted a bid under Agri Tech. The ability to conduct real-time, risk-based trading for important endemic diseases of cattle would be a major advancement in the livestock supply chain. Currently, there is no comprehensive system in place which brings government and industry data sources together to give this level of insight on herd and/or individual health status. The objective of this project is to develop a data exchange hub, to an industry-agreed specification, accessible at key transaction points in the food supply chain. If successful, the system developed would be taken forward to full implementation by industry collaborators. This would be the first time that such capability was created for use across GB, enabling data to be shared securely by commercial data providers and end-users. The benefits will be increased efficiency in data handling, new infrastructure to support national disease control programmes, and stimulus to further innovation based on a fully functioning data exchange hub.

This application is made by a consortium, which is fully reflective of the UK livestock supply chain, in order to make a significant step change towards better, broad-based sharing and exploitation of livestock food chain information.

I firmly believe that if we are to improve the genetic potential of the British herd we must leave no stone unturned in exploiting all the information we have available to us. This will require unprecedented cooperation, but the technology is there for us to do this, while most of the barriers are political ones.

Applications of genetic technology in breeding better beef cattle

Tom Gubbins
Director and Co-Principal, Te Mania Angus,
1830 Woolsthorpe-Hexham Road, Hexham, Vic 3273,
Australia; tom@temania.com.au

Background

Te Mania Angus is built on a gene pool already 85 years in the making. It provides Angus bulls, semen, embryos, elite stud cows, ET recipients and commercial females for the premium beef industry.

The Te Mania Angus philosophy is to breed sound, quiet, highly fertile cattle with calving ease, high growth rates and exceptional carcase quality which will enable its clients to meet strict market specifications and optimise value.

With national and international markets, Te Mania Angus is backed by Team Te Mania, a coalition of 40+ beef cattle herds across SA, Victoria and NSW for progeny testing its cutting-edge genetics and fast-tracking commercial production.

Te Mania Angus holds two annual bull sales – one on-property at the Mortlake, Victoria, headquarters each autumn, and one at Walgett, NSW, each spring. Semen is retailed through AI resellers.

The Mortlake property is 2,600 hectare, with an annual rainfall of 610mm. There are 3,500 head on the property, with cattle running in large contemporary groups to achieve more effective progeny data which can then be compared in one environment.

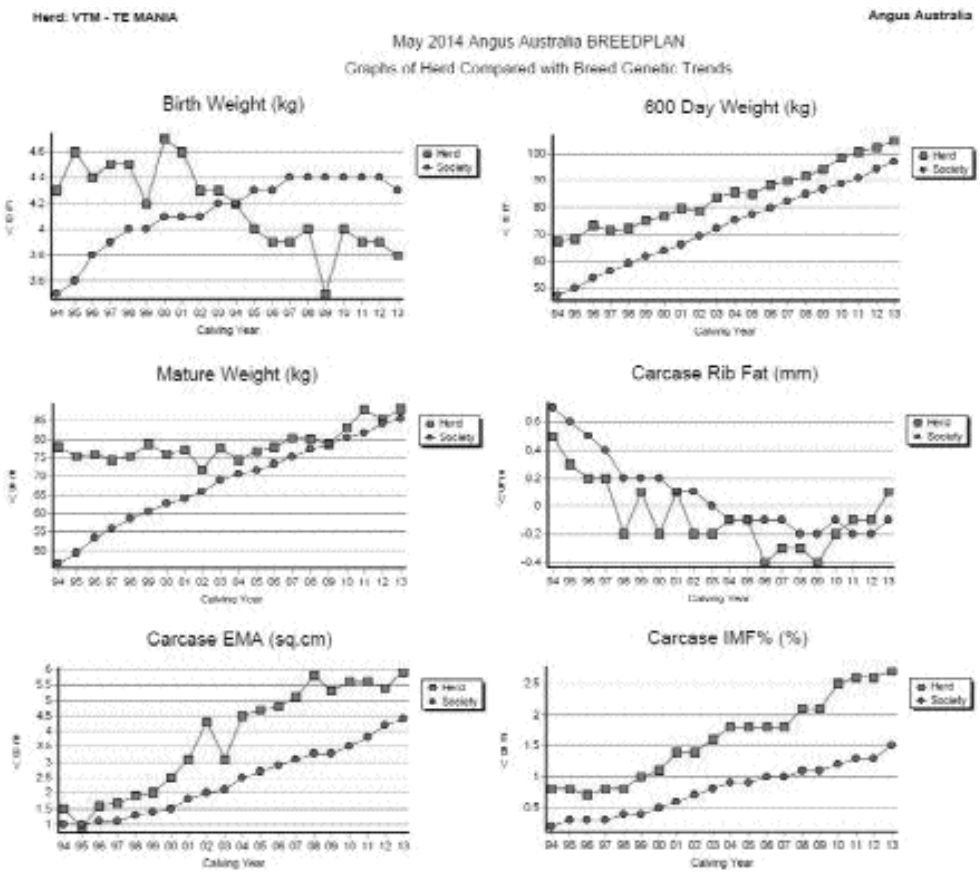
The Te Mania Angus herd has been performance recording since the early 1950's and was one of the founding herds to join Breedplan in 1971. Today, performance recording is the backbone of the breeding strategy and management program at Te Mania Angus.

Performance Recording

Australia's beef industry must demand more from its seedstock sector when it comes to the application of genetic technology.

The pig and chicken industries have made significant genetic gain in the past 50 years. For example in litter sizes in the pig industry and weight gains in both industries. On the other hand, the beef industry has lagged behind in the adoption of the very technologies which made this happen (EBVs). Consumer demand for pork and chicken has risen at the same time at the expense of beef.

Figure 1.



Objective measurements have made a huge difference to the genetic gain of the Te Mania Angus herd (see Figure 1).

With the use of performance recording, Te Mania Angus has dominated the breed's EBVs for many years – with more than twice as many Angus Group Breedplan trait leaders as any other stud.

Te Mania Angus runs cattle in large contemporary groups which increases the chance of having more effective progeny data for each sire being used, more effective progeny, means more accuracy and more accuracy means more genetic gain. Genetic gain comes from defined goals, animal selection and mating allocation.

All the mating's at Te Mania Angus are computer generated. We use a program called Total Genetic Resource Management (TGRM) to mate each animal. All the cows in the Te Mania Angus herd are mated to sires to increasing profitability and to reduce inbreeding. The iterating computer program makes tens of millions of calculations to statistically compute the best mating's over the entire herd to all the sires available to Te Mania Angus in the world that have Australian Angus EBV's.

There is still some confusion between phenotype and genotypes of animals out in the industry, which is holding back progress in the cattle industry.

One of the core problems within the industry is that many commercial breeders are happier to choose their breeding stock by eye – subjectively, rather than using performance information to help make these decisions objectively.

Seedstock suppliers need to offer these traits and work closely with their commercial clients to improve the acceptance of performance data.

There is a huge amount of information and research which has been done, literally tens of millions of dollars has been spent on genetic tools for the industry but there is a real problem with their uptake. The tools are sitting in the cupboards of our research institutions.

Team Te Mania

Team Te Mania was formed in 1995. It is a national alliance of 43 progressive commercial beef producers who are testing and utilising the best practices in beef production and sharing the latest genetics from the same performance-based gene pool.

Team members lease their bulls from Te Mania Angus and obtain semen at cost price. In 2014 Team Te Mania submitted 3000 carcase records to Angus Group BREEDPLAN, the largest single entry since the Beef CRCI in the early 1990's. A further 700 records were added later in the year.

It is understandable that there is a reluctance by processors to make carcase feedback available due to its commercial sensitivity, but it is invaluable to breeding higher quality animals. The beef seedstock industry needs to push to obtain similar valuable feedback.

Stud breeding is really about identifying economic traits and then working on a genetic solution to enhance them. You need to define it, collect it and select it to improve the genetic merit of these animals. The relationship between cost of production and consumer demand is very high so the more efficient we become and better our product is, the larger the market and the more profitable we all become.

When we trade our product on the world market the product will be better and cheaper than our overseas competitors.

Progeny Testing

Selected team herds are committed to the progeny testing program of young Te Mania Angus bulls. Approximately 12 bulls per year are test mated in six fully BREEDPLAN recorded herds. Sires are selected annually for testing based on their index values plus a visual inspection for structural soundness. Some attempt is made to use a wide representative of sire lines in the young bulls. Sires are repeat mated across years to ensure across year linkage and linkage across herds is by AI from some of the young bulls.

In the progeny test herds all male calves are castrated and the full compliment of weights (including birth weights) are recorded along with scans taken on both sexes. Heifers are fully recorded for calving ease and days to calving. The majority of steers are followed through to slaughter and carcase records submitted for BREEDPLAN analysis.

Conclusion

It is very important for progressive seedstock herds to be early adopters of technology, as it gives them the opportunity to maximize benefits from new technology in their breeding operation. The result is faster genetic improvement and more profit for their clients. But faster genetic progress will only eventuate if the technology is implemented in a well organised business.

However, being early adopters of technology comes with some risks as the technology has not been rigorously tested in practical breeding herd situations to iron out any unforeseeable 'bugs'.

While implementing scientifically sound breeding theory, seedstock herds must be mindful of the need to evaluate the theory under practical conditions. To do this seedstock cattle need to be kept in a management system that will instantly report if any theory has been applied to the system which in practice will not work. In part this is to check that the theorists have not missed an important genotype by environment interaction but also to demonstrate to commercial clients that the genetics will perform under conditions similar to their own production systems.

The genetic technologies that are being developed by our industry's scientists and others, can make a positive and profitable contribution to farmers, feedlotters, processors and to the economy of Australia but they must be effectively applied in seedstock herds.

Starting from scratch, you can do it!

Paul Westaway
Farmer Owner, Gamage Hall Farm, Dymock, Gloucestershire, GL18 2AE; paul@sterlingsires.co.uk

It is a great honour for me to speak to the conference today, I first attended the Cattle Breeders Conference in Cambridge in 1992, and I remember vividly there were 8 people in the beef section! To see close to 300 today is great. I have been asked by your chairman Dr Phil Hadley to finish today with my story of how we started farming in 2006, with no more than a wheelbarrow and an overdraft (which we still have both), to where we are today having close to 250 head and winning Beef Farmer of the year last year. I am living proof that you can start from scratch and build a profitable rural business but you are going to need to follow some simple steps on the way, surround yourself with good people, use every bit of science you can and find out what your customer wants and make it.

As young farmers in the UK we have a huge opportunity as in our working lives the global population will increase by another 2 billion people. This is a huge opportunity but also a challenge as the pressure on land and water resources will only increase, this means cows in our case must become more efficient in creating protein from as few inputs as possible. As a UK farmer we must stick to what we are good at, I can't compete in a commodity beef market with a guy in Brazil with 50,000 head of cattle, low labour costs and better climate. However, I can produce a grass fed Angus sirloin steak for a customer to enjoy on a Friday night, and more importantly it can and will be the same next Friday!

My background is a bit different, I grew up on a dairy farm on the Devon/Somerset border where my Dad and Uncle were herdsmen, I didn't like school much so left at 16 with almost no qualifications and spent some time in a Heavy Metal band, this was great fun but unfortunately we weren't very good. I then got a job in a butchers shop but the cow bug in me was too strong so after a year I started working on a 300 cow dairy farm near Shaftesbury that was a flying herd running Lim bulls. From there I worked on various other dairy and beef farms before going to Lackham College to study Agriculture. After college I worked for a couple of semen import/export companies and spent a lot of time in mainland Europe buying cows to bring back to the UK for customers. In 1997 I got asked to go and work for Supersires in Dartington and in 2000 I got headhunted to work for Genus ABS, I had a great 10 years at Genus and was lucky to get Director level in the UK Business.

In late 2005 having collected a wife and two kids we, as a family applied for the Tenancy of a 103 acre Gloucester County Council Farm and were lucky enough to get it and took it over in March 2006. The farm in those days was 103 acres of docks, thistles and chick weed! No gates and a house that needed some love. We also inherited a Ford Capri on the lawn on bricks, rubbish everywhere and a good selection of 'guests' in the house. However all the farm needed was a bit of love and today it is one of the best farms around which we are proud to show to around 25 farm walks a year.

We very quickly realised we needed to get off-farm income so have started several successful businesses alongside including 'Sterling Sires' which is an AI business that retails semen in the UK, 'British Angus.com' which is a business that markets Angus Genetics all over the world and 'Your Perfect Night In' which is an online steak and wine gift business. Today the Melview Group employs just shy of 40 people all based at a little council farm in Dymock.

The keys to our success are quite simple.

1) Attitude

Don't walk away from negative people . . . run! We have a team of people around us including a brilliant landlord, a great bank manager, one of the best agronomists and nutritionists in the UK, a forward thinking accountant and an awesome farm consultant. All of these people are positive and full of great advice. I speak to them all the time.

2) Learn from the best

I have been lucky to spend some time with some of the best farmers in the world, I urge any young farmer to identify the area they need to work in and go and speak to the best farmers in the world you can. Today at the conference Tom Gubbins gave a great paper; in my view, Tom is the smartest beef farmer I have ever met so anyone that wants to do beef in the future make sure you grab Tom and buy him a drink!

3) Find out what your customer needs and why

This is the key to any successful start-up business and particularly in agriculture, you cannot afford to start in a commodity-price driven market so find something that is added value and go there.

4) Grow your own Protein

If you are a livestock producer you must get your cost of production down as low as you can, we grow lucerne and red clover, as the most expensive things you have to buy are protein to feed cows and fertiliser to feed grass. Homegrown protein can cut your cost of production in half and there are protein crops that will grow anywhere, ignore your neighbours and get on with it!

5) You are feeding a rumen

In livestock particularly beef, you are not a beef farmer you feed a rumen. If your cows have a full rumen that has the correct balance of carbs, protein and fibre in it anything is possible! If your cows aren't happy, full and content they won't be fully efficient and be able to maximise their genetic gain and you will lose money.

6) Use every bit of Science you can

There are piles and piles of great science you can use, most of it is free and can help you be the best you can be in every aspect in your business, we use everything from genomics in bull selection to cling film on our silage pit. It's mostly simple stuff and can have a huge impact.

7) It's your job to do the marketing

Make sure you market what you do, we use social media and the web as simple and cheap ways of communicating with our customers. We go to selected shows to engage with new customers and show them what we have and we host as many people at the farm as we can.

In conclusion I firmly believe my generation of beef farmers have the best opportunity in 50 years to build profitable, sustainable businesses for themselves and their families, however you must use every bit of science, market-understanding and good advice you can get.

I would like to thank BCBC again for the invitation to speak today and would welcome anyone to come and visit the farm at any time to chat about my paper in more detail.

Applying research at a farm level

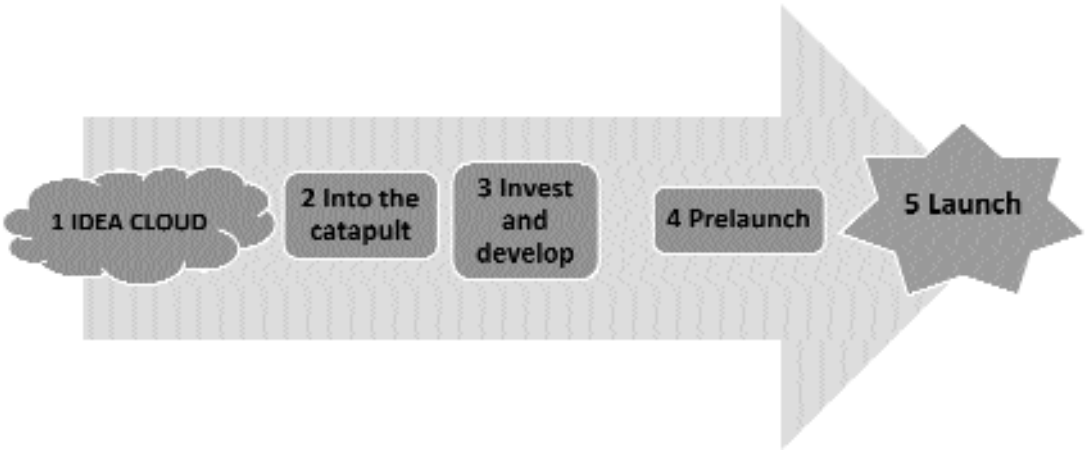
Morgan Sheehy
Ruminant Director, Devenish Nutrition Limited, Lagan House, 19 Clarendon Road, Belfast, BT1 3BG

Devenish, formerly known as Devenish Nutrition, was founded in Northern Ireland in 1952. Devenish Nutrition provided the Irish agricultural sector with products and services primarily through home mixers and the feed industry. The current management team bought out Devenish Feeds in 1997, and the company became Devenish Nutrition Ltd. At this time, the company employed 23 staff with a turnover of £5 million, with 60% of the sales in traded products. Presently, over 90% of sales come from Devenish manufactured products. In 1998, two US feed companies in Minnesota and Iowa were acquired and amalgamated under the Devenish Nutrition brand. By 2012, Devenish Nutrition International had been established, which increased sales in markets outside the UK, Ireland and the US, and the company's turnover had increased to £95 million, employing 165 staff globally. In 2013, two sites in England were acquired – Hi Peak Feeds, an organic compound feed manufacturer, and a food grade quality facility in Widnes. Most recently, A-One Feeds in England was acquired in the latter half of 2014. Devenish's mission is to '*create value by developing and supplying quality nutrition products and solutions, new technologies and distinctive customer support to the Agri-Food sector*'. One of the company's core strengths is continual innovation which allows consistent delivery of high quality products. Additionally, Devenish is privately owned and not shareholder driven, allowing the company a high degree of independence, focused on building long-term, mutually beneficial relationships with customers.

Idea to launch via the Innovation Catapult

The research and product development cycle followed by Devenish can be viewed as an 'innovation catapult' with five stages, as shown in Figure 1. Ideas are generated at the 'front end' of the business, by the persons dealing directly with customers, be they in sales, technical support or from a research and development function. Engagement from all sectors of the business are encouraged and supported. The product or idea enters an initial evaluation conducted by a team who represent a cross section of the business, with representatives from each sector. Products are thoroughly assessed for both technical and commercial feasibility, whilst taking into consideration the company's brand values and the core values of research and development. For example, a project which would have a positive impact on the environment (such as CO_2 mitigation) would score higher than projects which are concerned solely with profitability. If considered viable after initial evaluation, the product will enter the innovation catapult for further consideration. At this time, a basic proof of concept, marketing plan and 'freedom of operation' plan are required, and from this a decision will be made whether the product will be invested in and developed. The product is evaluated to scientific publication standards at universities and research facilities, followed by an evaluation on Devenish commercial trial farms through full scientific trials. Once fully assessed at Devenish trial facilities the product will be tested on

Figure 1: Innovation catapult.



commercial farms, after which it will be placed back within the relevant business sector with an established launch team. The launch team will be responsible for bringing in to place and finalising details such as technical documentation, planning and logistics, after which the product can be launched and become available to customers.

Devenish has four ruminant research facilities; a commercial dairy research farm, a specialised dairy heifer rearing unit, bull and heifer finishing units. In addition to this, Devenish conducts collaborative research with University College Dublin (UCD) at the UCD Dairy Innovation Centre. The dairy research farm has 250 milking cows split into three feeding groups, which are rotated around the housing after each milking to minimise environmental effects. On all trials, each treatment diet is packed into a specific colour-coded bag in order to ensure the trial is blind to the operator. Each pen of animals on all trials is colour-coded to match the treatment diet they are being fed, and on the beef units this has been taken one step further by tagging each animal with coloured 'management tags' to ensure complete accuracy.

Innovation on the Dairy Farm

There are three main foundations to a profitable livestock enterprise – farm management, nutrition and health. The performance and profitability of the entire system will be negatively affected if any of these aspects are compromised. In dairy cows, one of the most important aspects of nutrition is the prevention of hypocalcaemia (low blood serum calcium levels). The two main causes of hypocalcaemia are high levels of potassium in forage (which decreases calcium absorption and subsequent utilisation) and the increased demand for calcium immediately after calving. During the dry cow period the demand for calcium is relatively small, but at calving calcium is mobilised into the milk, and a substantial amount of calcium is needed for uterine contractions during calving.

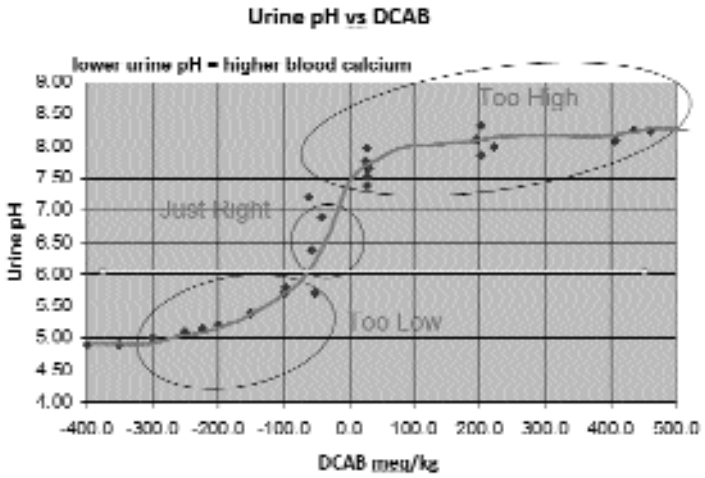
Hypocalcaemia is detrimental to milk production, immunity, fertility and milk quality. It will cause rumen contractility to be depressed, insulin resistance to increase and can lead to a displaced abomasum. These are contributing factors to reduced dry matter intake which will cause milk production to deteriorate, and in severe cases can lead to ketosis (negative energy balance). Calcium is responsible for maintaining muscle tone and function; a lack of circulating calcium can cause muscle weakness, which in turn can have a negative impact on the contractility of the teat sphincter and the uterus, leading to increased incidence of mastitis and retained foetal membranes. Hypocalcaemia also increases the risk of metritis, dystocia and uterine prolapse.

Designing a Solution to Hypocalcaemia

Manipulating the dietary cation-anion balance (DCAB) of a ration is a common way of reducing the risk of hypocalcaemia. DCAB diets balance the minerals found within the feed, to create favourable conditions for calcium mobilisation. This is achieved by reducing the DCAB, creating slightly acidic conditions in the blood which stimulates the utilisation of calcium by increasing Vitamin D3 production, which has a positive impact on calcium release from bone and absorption from the intestines. A positive DCAB value indicates a more alkaline diet (more cations present) while a negative value suggests a more acidic diet (more anions present). Feeding acidified diets which are high in anions (e.g. chlorine and sulphur salts) has been shown to reduce the prevalence of hypocalcaemia, by inducing mild acidosis and acidifying the blood. SoyChlor™ is a product that has been developed specifically as a palatable anion supplement. Transition cows can be fed either a full DCAB or partial DCAB diet. The optimal DCAB (meq/kg) for a full DCAB diet is between −100 and −200, and between −50 and +50 for a partial DCAB diet. A commercial mineral which has balanced levels of anionic salts is used in full DCAB diets, whereas partial DCAB diets focus on minimising potassium and sodium levels and supplementing the diet with magnesium chloride. Urine pH can be monitored to ensure the diet is effective (Figure 2).

There are many other aspects that must be taken in to account in order for a nutritional solution such as SoyChlor™ to be effective in providing a solution to hypocalcaemia, so practical advice is of utmost importance. Therefore, selecting feedstuffs with a low potassium content, avoiding feeding sodium and potassium buffers, correctly balancing dry cow rations for calcium, phosphorus, magnesium and sodium and supplementing the diet with

Figure 2: Urine pH vs DCAB



(Oetzel, 2000)

Vitamin D3 are all crucial for SoyChlor™ to be successful.

'Grass roots' innovation

Farm management involves the relationship between the amount of pasture utilised and the profit per hectare, and using agronomy to produce a feedstuff of a higher quality. In recent years, there has been a lot of emphasis on soil improvement programmes; improvement of soil fertility by physical, biological and chemical means. Physical fertility is impacted by soil compaction, biological fertility by earthworm population within the soil and microbial activity, and chemical fertility by mineral balance, nutrient availability and the pH of the soil. A study by Teagascin 2014 found that only 11% of dairy soil samples in Ireland are of satisfactory quality (Teagasc, 2014). A compacted soil will reduce the earthworm population, which in turn will have an adverse effect on biological fertility. Soil compaction will also predispose plants to stress during both dry and wet periods through the restriction of rooting depth. The earthworm population within a soil is one of the main indications as to how biologically active that particular soil is. An active population of earthworms in a soil will improve overall farm productivity by improving drainage, soil aeration and structure, and availability of nutrients.

Based on the principle that a soil rich in microbial activity will also be beneficial to productivity, Devenish recently began a programme to trial soil and slurry improvement agents. The product which was successfully tested is commercially available as Digest-It™, and is a preparation of natural composting micro-organisms, enzymes and nutrients. Digest-It™ stimulates the activity of aerobic microbes by digesting suspended solids in slurry and converting them in to liquid nutrients which can be utilised by plants. Initial trials using Digest-It™ have resulted in significant increases in grass dry matter yield (11%), and a 34% reduction in ammonia release. As with SoyChlor™, practical advice must also be taken in to account in order for this innovation to be a success. Devenish is involved in various other cutting-edge innovations across the agricultural sector, such as the use of chlorophyll as a fluorescent marker during meat processing to extend shelf life and reduce pathogens, and LiDar scanning to analyse and determine the sequestration of carbon by plants during growth.

Innovation is at the core of continual development within the agricultural industry. Innovation is '*the process of translating an idea or invention into a product or service that creates value*'. In some situations, innovation means improving something that already exists – in other cases something completely new will be created. Striving to further refine existing products, and create new ones if the need arises, will be the driving force behind the continual improvement of this industry. Devenish has an unrivalled innovation pipeline for both the livestock sector and the agricultural industry as a whole, and will continue to provide practical solutions to on-farm problems through the use of state-of-the-art methods.

Innovation, collaboration and making things happen

Nick Green
Farm Operations Director, Alvis Bros Ltd, Lye Cross Farm, Redhill, Somerset, BS40 5RH; nick.green@lyecrossfarm.co.uk

Introduction

Many surveys have been conducted over the years which include questions about the perceived view of farmers and their importance or otherwise to the nation's economy and security. There have been many positive descriptors applied; hardworking, honest, salt of the earth, good at ensuring high standards of animal welfare, custodians of the countryside etc. However, I am yet to hear a high profile proclamation that farmers are innovators, collaborators and able to make things happen when they want to make things happen. But think about it. As far back as anyone can remember and many years previously, farmers have demonstrated their ability and willingness to do each of these things.

Innovation

The 2nd Viscount Townsend, more commonly known to us as 'Turnip' Townsend developed the Norfolk Four Course Rotation that transformed land use from the early 18th century onwards. The son of an Irish farmer, Harry Ferguson took the already invented tractor and added the three point linkage. This transformed the use of tractors and remains in constant use on farms around the world today. The current Duke of Westminster, through his breeding company Cogent, instigated and developed the process of sexing semen which is having a major impact on the cattle industry both at home and abroad. And my neighbouring farmer and cattle breeders club member Mary Mead and her late husband Roger founded the Yeo Valley yogurt business from their kitchen table which as we know is one of the major success stories in the British dairy industry over the last couple of decades. They are all innovators that have had a massive impact on our industry. They are a few of the higher profile ones. If you look at those you know and our wider industry you will see innovators aplenty. It appears second nature to farmers and those involved in agriculture who appear to have a natural ability to think outside the box and be in a position where they can try to develop their bright idea. Their reason might not be for the greater good. It might be to save money or make things easier on their own farm. Nevertheless, for whatever reason they are innovators.

Collaboration

The definition of collaboration as found in the Oxford English dictionary is 'the action of working with someone to produce something'. The terminology makes the definition somewhat vague but if you think about it, the phrase is very apt to our industry or indeed our sector. There aren't many things you can do totally on your own to produce something. The majority of milk producers rely on someone to supply concentrate. Beef producers rely on inputs to grow top quality forage and so it goes on. If you 'Google' collaboration models, there is a plethora of diagrams to demonstrate the complexity of collaboration. However, there is one very simple model that speaks absolute volumes. Two overlapping circles. In the left hand extreme it says ME, in the right hand extreme it says YOU, in the overlapping bit in the middle it says US. So very simple but a really powerful message that can be visualised by linking arms and going forwards. Working together makes us stronger and it's something some in our industry need to think more seriously about.

Making things happen

We all know farmers are resourceful. The majority of us have flexibility and capacity in our businesses to give us the opportunity to give our bright ideas a chance of becoming reality, at least to try it out in private before telling the next door neighbour about our new found route to future prosperity.

So, bearing these three things in mind and the request for me to deliver my paper within the bounds of 'farming as part of a growing agri-business family enterprise' I will attempt to explain how Innovation, Collaboration and Making Things Happen fits into the Alvis Bros business.

By way of introduction Alvis Bros is a family owned west-country farming and cheese making business. It was formed by John and Sam Alvis in 1951 in response to being fed up with receiving what they thought was not enough money for their product which was milk. Instead they sought to add value to their milk by making it into cheese. As a consequence of the cheese making they encountered the bi-product of whey which they fed to pigs, manure from the pigs was applied to the land to grow the crops for the cows and so the virtuous cycle of integration was introduced to the Alvis Business. This has stood the test of time and with the exception of

some minor change the only variation to date has been scale.

So, to put my presentation in context we need to consider integration, being market led rather than production driven, devolved responsibility and accountability, quality, traceability and transparency which any food business needs and the Alvis effort to promote communication and education.

Before we get carried away with that, the one thing that underpins everything we do is Profit with Integrity. We are not embarrassed about trying to make a profit. That's what we're in business for. That said, we are not prepared to pursue profit at all costs. Whatever we do, we want to be able to stand by it and by virtue of that integrity welcome suppliers and customers alike to trade with us year after year.

As far as the company's ownership goes it remains wholly with the Alvis Family. The third generation of Alvis Brothers are currently in executive control with Peter Alvis being Managing Director, Johnny Alvis being Company chairman, their father John Alvis whom many will know being recently retired MD and chairman still sitting as a Director with his brother doing likewise. John Alvis's wife Pauline is Company Secretary. Very much a family business as far as ownership goes.

As far as operational directors, roles are divided between four of us. Peter Alvis as well as his MD role has day to day responsibility for dairy operations, I am responsible for the farming part of the business and the estate, Ian Bugg is responsible for cheese sales and marketing and John Watts is responsible for the finance of the business. As you can see, ownership doesn't necessarily mean the family want or need to manage the business and are prepared to import expertise where required.

The division of responsibility within the business is made clear by the split in activity. It is very simple, the dairy side includes everything to do with cheese whilst the farms covers all aspects of the farming side of the business.

Within this simple split there are a number of departments across each part of the business. For example, in the cheese side of the business there are separate entities for the Cheese Dairy, Finished Goods, Sales and Marketing, Farm Shop and Local Sales and Quality Assurance. Each is the responsibility of a working manager. Each is on the ground and empowered to make the decisions that affect the quality of their output. Each department is separately costed and a monthly profit and loss account drawn up for each. This ensures that as well as the relevant manager doing as good a job as possible with whatever he or she is engaged to do, nothing gets paid or banked without them agreeing to it. In that way, physical performance is optimised and financial control ensured. Further encouragement is provided in the form of profit related pay in addition to salary. By a combination of physical performance measured by various key performance indicators and financial performance measured by regular accounting the manager is encouraged to try things out to improve their part of the business. Obviously there have to be boundaries and we wouldn't expect the dairy manager to sell all the milk and sack his staff but he is entrusted to innovate and try different things. Alongside that, with the integration in the business the others working upstream and downstream are instrumental in deciding whether something is worth trying and quick to point out if it is having a detrimental impact on their part of the business.

Likewise in the farming division the business is split into separate entities. Again, we have separate farm departments; we have Regilbury Park Farm, a 650 cow dairy with Johnny Alvis responsible for its day to day operation. In addition he has responsibility for beef production using his land mass. Next we have Box Bush Cotel which until just before Christmas was a 300 cow dairy farm. Unfortunately due to TB it is now a 150 cow dairy farm in the midst of a strategic change. Ham Green is our 250 cow organic dairy farm which is 15 miles away from base, the piggery which we will look at in a bit more detail later, arable and estate maintenance and property. Again each have individual P&L accounts each month so we can see exactly what is going on financially with each farm manager knowing what is going on physically on farm and key performance indicators being published.

To put the Alvis business in context we will produce, mature and sell 4,500 tonnes of cheese in the coming year. We have BRC Grade A accreditation across the whole cheese business, are Soil Association registered for organic cheese and West Country Farmhouse PDO accredited for non-organic production.

Customers include a number of the major retailers, various outlets in the organic retail sector, export to 40 countries and a variety of local outlets serviced via our own van delivery service. You can see we cater in one way or another to a whole cross section of customer size and type.

With regards farming, we farm 4500 acres split almost equally between forage and arable. 500 acres is managed organically within a stand-alone ring fence. Half of the total acres are owned with the remainder being a mix of tenancies and contract agreements. A collaborative approach with our landlords goes a long way to delivering what both parties want out of the particular arrangement.

Pigs are contract reared using whey permeate from the cheese dairy mixed with supplied cereals and protein. It is a simple collaborative system with Alvis Bros providing buildings, labour, water, permeate and land to put the manure on and the pig owner supplying everything else.

We also have a 50% share in an agricultural contracting company. The limited liability partnership was set up with the manager of what was formally an in house contracting business. He wanted a slice of the

financial action so ten years ago we spun this off from the main company and to date it has performed very well and satisfied the aspirations of both partners. Again a collaborative effort that took some innovative thought in setting it up.

As mentioned earlier we have a farm shop. Historically, and to a degree to date the shop has acted as a public relations tool rather than being an out and out profit generator. We sell our own produced cheese and meat and have no aspiration to compete with supermarkets in Bristol or indeed Budgens a few miles down the road. What we try to offer if something a bit different that isn't readily available from those types of retailers.

Communication and Education is something we are passionate about. There is a considerable lack of understanding about where food comes from, how it is produced and the potential impact consumer decisions have on the environment. We were approached by a local head mistress in 2000 to address these issues with the pupils at her school. From the initial contact with the 400 pupils at that school our original effort has developed into FarmLink, a company limited by guarantee with charitable status, we deliver curriculum based lessons covering all key subjects related to food, farming and the environment, we work with five other providers, it has a Board of Trustees, employs a part time chief executive and in this academic year would have had contact with 27,000 pupils either in school or on farm. It is an innovative way of telling young people what farming is all about.

As stated earlier, our management team is a working management team. Each of them is in a position to understand completely what is happening in their part of the business and are empowered to act accordingly. The role of the operational directors is to support the manager to ensure the best possible performance, stimulate and make a collaborative effort to improve the business.

For example, in the cheese dairy considerable effort has been invested to recover heat from wherever possible to reduce the amount of power required to pasteurise the milk. Previously, it took 405kW of energy to raise temperatures to pasteurise the milk for each tonne of cheese made. Now, after capturing heat off the bi-products of manufacture we have reduced our power requirement to 161kW per tonne.

A PV array has been installed on the cheese store roof which supplies all our electricity requirement for the cheese store and packing hall.

We use that electricity to refrigerate the cheese store. From the refrigeration plant we capture the heat generated to heat 50,000lts of water to 55°C everyday.

Some of these are big ticket items but there are others such as multiple use of water on the dairy units that took very little capital investment. Heat recovery off vacuum pumps, combined with heat exchange from milk cooling goes some way to pre heating wash water for the milking parlour. Innovative work practices often thought up by those doing the job often aids output, makes the job easier and as a consequence can make the operation more efficient.

The list goes on and no doubt is common practice in many parts of the food industry. What we have been doing is introducing technology into a proven situation and then adapting for wider use in the Alvis business. We break down whey from its original form into whey protein concentrate for human consumption, lactose permeate for animal feed and water for re-use in the dairy. We have recently been granted planning permission for an anaerobic digester to be fed with the lactose permeate currently fed to pigs. Could absolute self-sufficiency in electricity from bi-products be the next innovation in Alvis Bros?

To summarise, innovation doesn't have to be expensive. Consider work processes, plant employed and be willing to think differently from how you have thought up to now.

Collaboration really does mean working with others. Work with your neighbours, your suppliers and your customers. Think back to ME and YOU combining to form US. You can't go into a rugby scrum without the pack binding together. It's no different in business. You need to communicate and work together.

When it comes to making things happen, give yourself and your staff the freedom to allow things to happen. Create the structure that allows things to happen. That said, make sure you have key measures in place that shows to what level you are succeeding.

Many of us in this room are already doing these three things to some degree or another. For those of you who aren't I'll leave you with this message.

Change isn't compulsory, survival is optional.

Supporting innovation in agriculture

Calum Murray
Programme Leader – Agrifood, InnovateUK, North Star House, North Star Avenue, Swindon, SN2 1UE;
calum.murray@innovateuk.gov.uk

Innovate UK (the new name for The Technology Strategy Board) is the UK's innovation agency. Taking our 2011–15 strategy, Concept to Commercialisation, as the start point, our role is to help accelerate economic growth through the stimulation and support of business-led innovation. We are business-focused and business-led; our governing board and our staff have strong experience of R&D and innovation and the commercialisation of technology. We work across business, academia and government, helping companies take concepts through to commercialisation. This means supporting business innovation through: –

- tackling the barriers to innovation
- reducing financial and technical risk
- promoting collaboration
- helping knowledge exchange
- encouraging open innovation
- creating a more effective innovation environment, using our convening power and connections to bring different partners together

We aim to act as an 'innovation architect', shaping and tilting the innovation ecosystem toward those opportunities where particular challenge exists and where the UK, either through its supply chains or know-how, is well placed to 'make good' on the opportunity. Our work to identify the market and technology areas with the greatest potential for growth has been complemented by new strategic thinking in central government on growth drivers. In 2012 the Government, led by the Department for Business, Innovation and Skills, began to develop a new long term approach to industrial strategy, this included a UK Strategy for Agricultural Technologies, which was published in July 2013.(https://www.gov.uk/government/publications/ukagriculturaltechnologies-strategy).

The reason for this support from government is clear.

Nearly four million people in the UK are employed in the food, feed and drink industry. These supply chains connect researchers, agro-chemical providers, machinery manufacturers, farmers, producers, manufacturers, wholesalers and retailers – providing the food and drink that sustains us. The sector contributes around £96bn to the UK economy or 7% of GVA. And with exports of £18bn per year, we are already one of the top global exporters of food, feed and drink. The UK already has recognised centres of excellence across the agri-food supply chain, and we plan to further support the sector, to help it grow further. Providing a sustainable food supply chain is a societal challenge. In the UK the population is expected to grow by 10–15% by 2030. On top of this there is competing demand for land – whether from a growing built environment or competition from energy-based fuel crops such as for biomass or transport fuels. And, as we have seen, the changing climate can wreak havoc on crops and livestock. In a global context, the world population is expected to hit nine billion by 2050; around a quarter more people on the planet. Diets are changing too, towards a greater intake of meat and dairy foods, and developing nations are expecting similar levels of choice and nutrition as developed countries. It is estimated by The United Nations Food and Agriculture Organisation (FAO) that at current consumption levels, 60% more food will need to be produced globally by 2050. Simply put, there are huge pressures to increase the amount of food produced owing to growing populations, whilst resources are dwindling, and the climate is changing. We need to find new ways of providing food to our societies, and the need is pressing. The barriers to innovation include: – a fragmented supply chain with many small players with low capacity for innovation, and the slow spread of ideas – skills shortages – conservatism, particularly among many small and medium-sized primary food producers – insufficient applied research on the key challenges identified in the strategic research and innovation agenda – slow uptake of ideas from other areas of industry and from the knowledge base.

Focusing our investment, our programme seeks to increase the productivity of crops and animals and, simultaneously, decrease the environmental impact of the industry. It has focussed on four interlinked areas:

- Crop productivity: we are looking at two areas of crop productivity: crop protection, and crop nutrition and management
- Sustainable livestock production (including aquaculture): development of livestock production solutions that are environmentally and commercially sustainable and meet regulatory requirements
- Waste reduction and management: farm storage and food processing: a whole-chain approach to waste

reduction, and post-gate food processing and packaging for retail and food distribution.

- Greenhouse gas reduction: technologies and methodologies to tackle by far the biggest sources of greenhouse gas emissions in agriculture – nitrous oxide from fertilisers in soil and methane from livestock.

This strategy is currently being reviewed and the priorities will see some fine tuning, but for now this gives a flavour of the current drivers.

As part of the UK Strategy for Agricultural Technologies, the Government has set up the Agri-Tech Catalyst to further support science and innovation in the sector, with the vision to make the UK a world leader in agricultural technology, innovation and sustainability. Through the Catalyst £70m will be made available to businesses and academia over the next five years. The Technology Strategy Board is running the Catalyst, with support from the Biotechnology and Biological Sciences Research Council. The Catalyst will fund proposals relating to: – primary crop and livestock production, including aquaculture – non-food uses of arable crops (for example, for biomass) – food security and nutrition challenges in international development – challenges in downstream food processing provided the solution lies in primary production. In the financial year 2014/2015 the agriculture and food action plan will have included:–

From the core funding available to the Sustainable Agriculture and Food Innovation Platform:

- Crop and livestock disease challenges: A Collaborative R&D competition with up to £16.5m available (incl £6.5m co-funding) to support the development of effective solutions to control agricultural diseases to realise the yield potential of crop and livestock production systems.
- Resource efficiency in the food supply chain: A Collaborative R&D competition with up to £5m available to support projects that aim to improve the use of resources and minimising post-farm-gate waste generation in food production supply chains.
- Agriculture and food supply chain: knowledge transfer to improve the competitiveness, resilience and responsiveness of the agriculture and food supply chain.

In addition, on behalf of Government and as part of the UK Strategy for Agricultural Technologies we will continue to deliver the following:

- Agri-Tech Catalyst: Further rounds of this catalyst competition to advance the sustainable intensification of agriculture and deliver economic impact for the UK agri-tech industry.
- Centres for agricultural innovation: Working with BIS, Defra and BBSRC and by engaging with key sectors across the agricultural community we will support the delivery of a mechanism to establish these centres as part of the implementation of the industrial strategy. The first centre planned is the Centre for Agricultural Informatics and Sustainability. Other potential Centres, as defined by the needs of the industry will be identified in due course and established over the coming months.

These are exciting times; we are moving into a new era where the importance of the agriculture sector has been recognised by government and appropriate support mechanisms have been established to help drive innovation forward. The livestock sector has a crucial part to play in this process. It is vital that the beef and dairy sector take this opportunity to accelerate improvements cross the national herd. Together, we have made a start to this process with the adoption of successful new technologies and in my presentation to the conference I have highlighted some examples of the type of applied research projects that have been supported by Innovate UK and our co-funders. It will, however, be important for both cattle breeders and the wider agricultural community to make the most of the opportunities currently available, and demonstrate the potential for real impact to the national economy if the industry is to continue to receive ongoing support from the public purse.

Genomics and where it can take us

George R. Wiggans
Research Geneticist, Animal Genomics and Improvement Laboratory, Agricultural Research Service, US Department of Agriculture (USDA), Beltsville, Maryland 20705-2350, USA;
george.wiggans@ars.usda.gov

Introduction

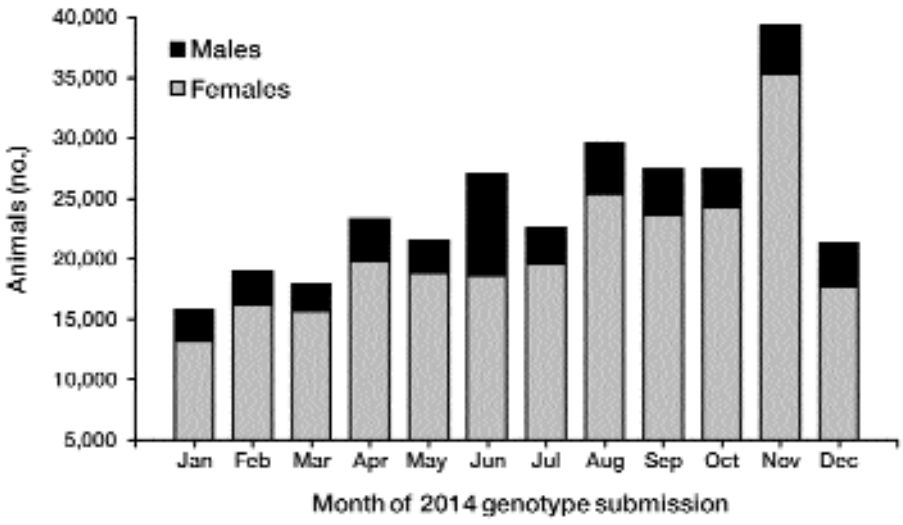
Genomics has revolutionized dairy cattle breeding by dramatically shortening the generation interval and increasing the rate of genetic progress. The US–Canadian database includes over 850,000 genotypes, which are used to evaluate Holsteins, Jerseys, Brown Swiss and Ayrshires. Parentage validation based on genotypes improves the accuracy of pedigrees and, therefore, traditional evaluations. Once a genotype has been obtained, it can be used in genomic evaluations for all traits. To maintain prediction accuracy in current conditions, continued collection of performance records is needed for existing traits so that the effects of genetic markers can be re-estimated frequently. The cost of genotyping has decreased as new genotyping chips have become available. Later versions of existing chips usually include more markers at the same price. In the future, genomic evaluation will be available for more traits, which will allow better tracking of profitability. Weekly genomic evaluations have become available in the Netherlands, Germany and the US to support efficient culling (Wiggans et al., 2015). Accuracy of genomic evaluations will improve as causative genetic variants are discovered and included in the calculations. Variants discovered in the Holstein and Jersey breeds may be useful for breeds with few genotyped animals. Tracking of individual variants holds great promise for avoiding harmful effects and promoting beneficial ones.

US genomic evaluation program

In the US, the Council on Dairy Cattle Breeding (CDCB; www.cdcb.us) is responsible for the genomic evaluation program. USDA provides research support through the Animal Genomics and Improvement Laboratory (formerly the Animal Improvement Programs Laboratory, aipl.ars.usda.gov). CDCB has authorised 16 organisations (nominators) to submit animals for genomic evaluation. Nominators include breed registry associations, AI organisations and genotyping laboratories. Four genotyping laboratories provide most of the genotypes. Figure 1 shows the number of animals submitted monthly for genomic evaluation for the past year. Each genotype is compared with every other one to confirm or discover parent-offspring relationships. Breed and sex also are validated. The identity of the maternal grandsire is checked, and bulls are suggested if the grandsire is unknown or the reported grandsire appears to be incorrect. This validation minimizes the chance that the genotype was collected from the wrong animal and enables correction of pedigree information.

The genomic evaluations are based on 60,671 genetic markers called single nucleotide polymorphisms (SNP). Most of the genotypes are from genotyping chips with a lower density of SNP, which reduces the cost of genotyping. The current low-density genotyping chips provide 6,787 to 13,218 SNP that are used in evaluations. Any missing SNP are filled in through a process called imputation, which uses genotypic information from ancestors and

Figure 1: Numbers of animals with genotypes submitted in 2014 by sex and month.



offspring to infer the missing SNP. Bulls that have both genotypes and traditional evaluations are the most informative source of information for estimating the difference in performance from having one variant (allele) versus the other. Cows with US traditional evaluations and genotypes also are used to estimate these SNP effects. The alleles are represented as A and B. The direct genomic component of an evaluation is calculated by summing the number of A alleles for each SNP and then multiplying by the estimated SNP effect. Between 10 and 15% percent of genetic merit is assumed not to be captured by SNP effects, and that portion is estimated as a polygenic (controlled by more than one gene) effect. To create the final evaluation, the estimates for SNP and polygenic effects are combined with information from traditional evaluations that is not captured by genomics.

In the US, genomic evaluations are calculated for yield, functional, calving and type traits. Yield traits include fat and protein percentages as well as milk, fat and protein yields. Functional traits include mastitis resistance (somatic cell score), fertility (heifer and cow conception rates and daughter pregnancy rate) and longevity (productive life). Calving traits include calving ease and stillbirth. The specific type traits included vary by breed. In addition to genomic evaluations for Holsteins, Jerseys, Brown Swiss and Ayrshires, the possibility of calculating them for Guernsey's is being investigated.

Predictions for traits affected by single genes are generated as part of the imputation process and can be used to track carrier status. These include haplotypes (DNA sequences inherited from one parent) for recessive conditions that affect fertility and other traits (Cole et al., 2014). For Holsteins, the haplotype tests include bovine leucocyte adhesion deficiency (BLAD; haplotype HHB), complex vertebral malformation (CVM; haplotype HHC), deficiency of uridine monophosphate synthase (DUMPS; haplotype HHD), mulefoot (syndactyly; haploptype HHM), polledness (haplotype HHP) and red coat colour (haplotypes HBR, HDR and HHR). Brown Swiss haplotype tests include spinal dismyelination (SDM; haplotype BHD), spinal muscular atrophy (SMA; haplotype BHM) and Weaver Syndrome (haplotype BHW). Two Jersey haplotypes (JH1 and JH2) affect fertility, and Ayrshire haplotype (AH1) affects conception rate.

Generation interval

Genomic evaluations have been widely accepted by dairy cattle breeders. In the US, bulls with only a genomic evaluation are used to breed over half of the cow population. Additionally, AI organisations frequently use genomic bulls and virgin heifers as parents of the next generation of bulls. These changes have led to a progressive reduction in the generation interval (Figure 2), which has led to an increased rate of genetic gain (Figure 3).

Accuracy

The confidence that breeders have in genomic evaluations is supported by investigation of historical data. Bulls with a high rank for their genomic evaluations generally retain their rank when they receive an evaluation based on progeny. Net merit in December 2012 and December 2014 was compared for 642 Holstein bulls

Figure 2: Parent ages for marketed Holstein bulls by bull birth year.

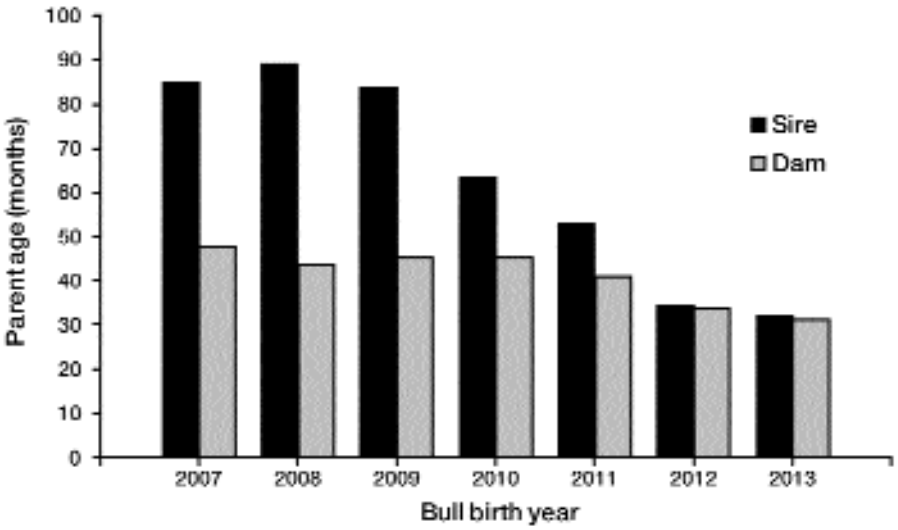
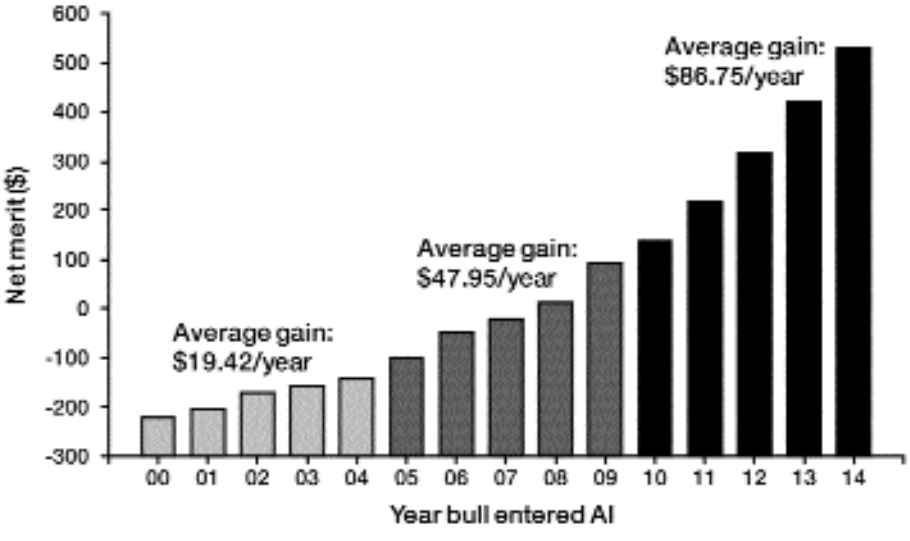


Figure 3: Genetic merit of marketed Holstein bulls as indicated by the net merit index by year that the bull entered AI service.



that received their first evaluations based on daughter records in August 2014 and had 50 daughters or more in December 2014. For the top 100 bulls in 2012, the average change in rank was 9.6. For all 642 bulls, the 2012 and 2014 evaluations were correlated by 94%. The net merit differences between bulls in December 2012 generally were similar in December 2014.

Genomic mating programs

Mating programs for genomic selection can minimize genomic inbreeding by comparing genotypes of potential mates. In the US, files of genomic relationships between genotyped females and bulls likely to be used for breeding are available so that breed associations and AI organisations can use them in mating programs. In addition, methods have been developed to consider dominance effects of individual markers when assigning mates to improve offspring merit further (Sun et al., 2013). Mating programs that include genomic relationships are more effective than those using pedigree relationships because they improve the expected value of offspring as well as decrease expected offspring inbreeding. The expected decrease in inbreeding currently is worth over $3 million annually for US Holsteins. That economic value will grow as more cows are genotyped.

DNA sequencing

The technology for determining the exact identity of DNA nucleotides (sequencing) has improved in recent years, and a bull's DNA sequence now can be determined for around US$1,000. This affordability provides great opportunities for research because the actual causative genetic variants can be discovered for traits of interest. That knowledge should aid in improving the accuracy of genomic evaluation because the current problem that results from decay in the association between the genetic marker and the causative mutation would be overcome. Another possible benefit of DNA sequencing is that across-breed evaluations would be more practical because the problem of breed differences in the association of markers with causative variants would be eliminated.

Whole-herd genotyping

In the US, over 80% of genotyped animals are female because many herd owners genotype all their animals. The genomic information allows them to classify their heifers into (1) those to flush, (2) those to breed with sexed semen, (3) those to use as embryo recipients or breed to beef bulls and (4) those to cull. This use of the information for management decisions justifies the cost of genotyping. The evaluation system overall benefits from widespread genotyping because pedigree errors are corrected, which makes traditional evaluations more accurate. The development of low-density genotyping chips was critical for the increase in genotyping of females. Investigation continues on ways to reduce the cost of genotyping, specifically through developing chips with approximately 5,000 SNP. A reduction in cost would increase the number of herds that find whole-herd genotyping profitable.

The future

Genotyping provides a powerful tool for determining the genetic potential of dairy cattle. Economic performance can be improved while avoiding expression of harmful recessives. With increased evaluation accuracy and reduced generation intervals, dairy cattle can be adapted for changing environmental conditions, such as increasing temperatures as the result of climate change. Precision selection for milk with characteristics required by niche markets will become more practical. Genomics increases the value of phenotypic data while removing the need for its collection just to get an evaluation. The industry must provide incentives to generate phenotypic data for new traits (such as feed efficiency) as well as current traits, which still need up-to-date information so that SNP effect estimates remain accurate for the current population under current conditions. Genomic mating programs offer a way to determine the best bull to use for a specific cow with interactions of their genotypes considered and harmful recessives avoided.

Improvements in genotyping technology are expected to provide low-cost genotyping chips for first-stage screening, intermediate-density genotyping chips with more SNP for the same cost and full-sequence data to support discovery of more informative SNP. Because a genotype provides information for all traits, it can be used to estimate genetic merit of traits for which the animal does not have a performance record. Thus, the benefit of recording performance for additional traits that affect economic merit is increased because evaluations can be generated for all genotyped animals. All relevant traits can be included in an index to enable selection of the most profitable animal. As understanding of the value of phenotypic data increases, some herd owners may specialize in the collection and sale of data. For example, some traits (such as feed intake) have such a high cost for data collection that it cannot be justified for the management of a single herd.

Conclusions

Genomic evaluation has been very successful in providing accurate predictions of genetic merit. Participation in the US increases nearly every month. Ongoing research along with larger predictor populations for estimating effects of genetic markers is expected to increase accuracy. The discovery of causative genetic variants will improve avoidance of undesirable recessives, contribute to accuracy of genomic evaluation and possibly make across-breed evaluation more practical. Using genomic information in mating programs has the potential for significant financial gain. Continued improvement in genotyping technology may reduce the cost of genotyping and make whole-herd genotyping financially attractive for most dairies. The extension of genomic evaluation to more traits will enable more accurate selection for overall genetic merit and for traits of interest to niche markets. The capability that genomics provides for

more rapid genetic change will enable more rapid adaptation to changing requirements.

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Nutrition of the contemporary dairy cow: research into practice

Liam A. Sinclair
Professor of Animal Science, Harper Adams University, Edgmond, Newport, Shropshire, UK, TF10 8NB;
lsinclair@harper-adams.ac.uk

Introduction

To meet the anticipated increase in world demand for dairy products over the next 10–12 years, it is predicted that world milk production will need to increase by 29% to over 1,000 billion litres of milk (IFCN 2013). It is forecast that this rise in production will be met by a further 47 million dairy cattle, resulting in a global population of 406 million dairy cows and buffaloes. To put this in context, the UK has 1.8 million dairy cows, and the increase in world population will therefore be approximately 25 times the current UK herd. Milk production is anticipated to increase in Europe, North America and Australia/New Zealand, but the greatest percentage increase is expected to occur in regions such as Asia that are traditionally not considered as being strong in dairying. In these regions a pastoral system of milk production is less common, and it is more likely that increases in production will occur via housed systems that rely on purchased feeds such as cereals, cereal by-products and protein feeds such as soyabean meal. In short, the demand for many feeds that UK dairy farmers currently consider as key in their rations will increase with consequent effects on price. Added to this is the increased demand for many traditional dairy cow feeds such as cereals for fuel production. For example, currently approximately 40% of the corn (maize) grown in the USA goes towards bioethanol production rather than human or animal feed.

Future increases in milk production will also have to be met using less resources (e.g. human edible feeds, water and fossil fuels), less land, with a lower environmental impact, using less antibiotics, drugs and pesticides, to higher welfare standards and producing a higher quality product, both in terms of safety, microbiological quality and the impact on human health (e.g. coronary heart disease and cancer). In short, we will have to produce more milk of a higher quality from less resources.

Challenges to concentrate feeding

World average milk yield currently stands at only 2100 kg/animal, a figure that is predicted to increase to 2400 kg by 2023 (IFCN 2013). This production level is considerably lower than in traditional dairy countries such as the UK, USA or New Zealand, but has implications for world feed demand. For example, a milk yield of 2100 kg/d equates to approximately 6 kg/cow/day. To increase this to 8 kg/day (an extra 33%) requires an additional 10% of purchased feed. In contrast, in the USA where daily average yields are closer to 30 kg/d, an increase in milk yield of 33% will require approximately 25% more feed. In short, it is more economic to purchase feed to increase milk yield when current yield is low, as in developing countries, than in the UK.

The principal advantage of ruminants is their ability (via the bacteria, protozoa and fungi in the rumen) to digest feeds that are high in fibre, and to convert sources of non-protein nitrogen into high quality protein for human use. This allows cattle to utilise by-product feeds from the human food and fuel industry, and to exploit poor quality pasture. However, many ruminant diets, particularly in western countries, routinely include raw materials such as cereal grains, which could be eaten directly by humans. For example, work at Nottingham University (Wilkinson, 2011) has calculated that approximately 36% of the ingredients used in dairy cow concentrates in the UK are human edible. With an increase in demand for feed for human use, it may be less economic (and ethical) to include such high levels in dairy cow rations.

Research has shown that a greater inclusion of some by-product feeds such as distillers dark grains, can support high levels of milk production. Other by-products (particularly straws) are more problematic: the use of chemicals such as alkalis to increase their energy value has long been established, but is expensive and presents certain health and welfare issues. Considerable research has therefore been focussed on areas such as feed enzymes, although to date the results have been somewhat disappointing. Greater use of metagenomics, metatranscriptomics, and proteomics however, offer the potential for identifying novel enzymes that can be used in ruminant nutrition.

Challenges to protein nutrition

There have been considerable fluctuations in the price of protein

feeds such as soyabean meal, with a 3 fold increase being witnessed in the last several years. Additionally, the dairy cow is somewhat inefficient in utilising dietary protein, converting only around 25% of its dietary intake into milk protein. One of the most effective means of improving this efficiency is to reduce the dietary protein level. An added advantage is the subsequent reduction in N excretion, which is of particular relevance to dairy farmers within Nitrate Vulnerable Zones. A recent review funded by DairyCo (Sinclair et al., 2014) has shown that dietary protein levels can, through careful rationing, be reduced to 160 g/kg DM without affecting intake or milk yield. Levels below this are unlikely to have many negative effects on health and fertility, but will often result in a decrease in intake and milk yield, and research is on-going to investigate means of reducing dietary protein levels whilst maintaining milk yield.

Studies by Law et al., (2009) have reported that reducing dietary protein from 173 to 144 g/kg DM had a relatively small effect of dry matter intake, but reduced yield by 3.8 kg/d (Table 1). Reducing dietary protein levels to 114 g/kg DM had a more dramatic effect on both intake and yield, with a 2 kg/d reduction DM intake, and a milk yield reduction of 10 kg/d. Interestingly, when dietary protein concentration was 173 g/kg DM for the first 150 days of lactation and then reduced to 144 g/kg DM for the following 150 d, milk yield was similar to animals fed 173 g/kg DM throughout lactation. This resulted in a more efficient dietary N use and saving in feed costs. Other research studies are underway at Reading University to investigate the long-term effects of feeding low protein diets on animal performance and health, and at Harper Adams University and Nottingham University to examine dietary means to maintain performance at low dietary protein levels. Preliminary results indicate that dietary protein levels can be reduced to 140 g/kg DM without a major reduction in milk yield if diets can be formulated to maximise rumen microbial protein synthesis.

Table 1: Effects of dietary protein concentration on the intake and performance of dairy cows in early lactation (Law et al., 2009).

	Dietary protein g/kg DM				
	173	*144*	*114*	*s.e.d.*	*Significance*
DM intake, kg/d	18.6	18.0	16.5	0.35	<0.001
Milk yield, kg/d	35.4	31.8	25.4	1.14	<0.001
Milk fat, g/kg	38.1	38.3	42.0	1.40	<0.05
Milk protein, g/kg	32.4	32.3	31.4	0.41	NS

One option to reduce the reliance on purchased feeds such as soyabean meal is to increase the use of home grown protein forages. Legumes such as red clover, forage peas and lucerne are particularly suitable as they are high in protein, and being legumes have a low fertiliser N requirement. Recent studies at Harper Adams University funded by DairyCo (Sinclair and Birch, 2014) has shown that the inclusion of lucerne can successfully replace grass/maize silage, reducing purchased protein requirements (Table 2). Similar studies at SRUC have shown that lucerne can successfully replace grass silage only diets.

In addition to the total amount of protein in the diet, is its quality. A proportion of feed protein is broken down and available to the rumen microbes to grow: this is referred to as rumen degradable protein (RDP). The cows protein requirements are met by the flow of this microbial protein from the rumen and dietary protein that has not been broken down by the rumen microbes (referred to as undegraded protein (UDP), or by-pass protein). Most home grown forages such as grass silage or legume silages, are very high in rumen degradable and low in undegraded protein. In contrast, purchased feeds such as soyabean meal have a higher proportion of UDP. As milk yield increases, the ability of the rumen microbes to meet the cows protein requirements decreases. Therefore at higher levels of milk production, the requirement for UDP increases, resulting in a requirement for higher UDP sources such as soyabean meal. Research is investigating ways to reduce the degradability of the protein in home grown forages, by for example, using tannins. Tannins are natural compounds that bind with protein making it unavailable in the rumen, but is then subsequently released at the lower pH of the true stomach. Previous studies (e.g. Sinclair et al., 2009) have reported that tannins can reduce the proportion of rumen degradable protein in forages, and studies are under way to examine their effects in high yielding cows.

Challenges to mineral nutrition

The importance of minerals in the diet of dairy cows is well documented, and dairy cows have traditionally been supplemented with minerals to avoid deficiencies, although the effects on animal health, fertility and product quality are of increasing importance (NRC, 2001). A recent survey of mineral use during the winter on UK dairy farms and funded by DairyCo has revealed however, that the majority of dairy farms are feeding at levels well above requirements (Sinclair and Atkins, 2014; Figure 1).

There is however, little experimental evidence to support an increase in performance or animal health from feeding such high levels. For example, recent long term dairy studies in the UK using grass silage based rations have reported no adverse effects on intake, performance, bone strength or fertility from feeding P at a the recommended rather than commercial level (Ferris et al., 2010a,b; Table 3). Indeed, the only major impact of over feeding P was to increase both the cost and environmental impact, with the higher

Table 2: Intake and milk performance in cows fed diets differing in their inclusion of lucerne (Sinclair et al., 2014).

	Control	*L20*	*L40*	*L60*	*s.e.d.*	*Significance*
DM intake, kg/d	24.5 [b]	24.9 [b]	24.5 [b]	23.4 [a]	0.40	0.004
Milk yield, kg/d	42.2	40.7	40.2	40.5	0.90	0.133
Milk fat, g/kg	41.1	40.6	40.4	41.8	0.97	0.470
Milk protein, g/kg	30.9	30.8	31.0	30.8	0.33	0.953
Live weight change, kg/d	0.21	0.23	0.13	0.05	0.207	0.814

[a]Means with a different superscript differ by $P<0.05$.
All diets were 45:55 forage to concentrates (DM basis).
Control=40:60 grass to maize silage (DM basis); L20=20:20:60 lucerne: grass to maize; L40=40:60 lucerne to maize; L60=60:40 lucerne to maize silage.

Figure 1: Intake of selected minerals during lactation on UK dairy farms compared to requirements (Sinclair and Atkins, 2014).

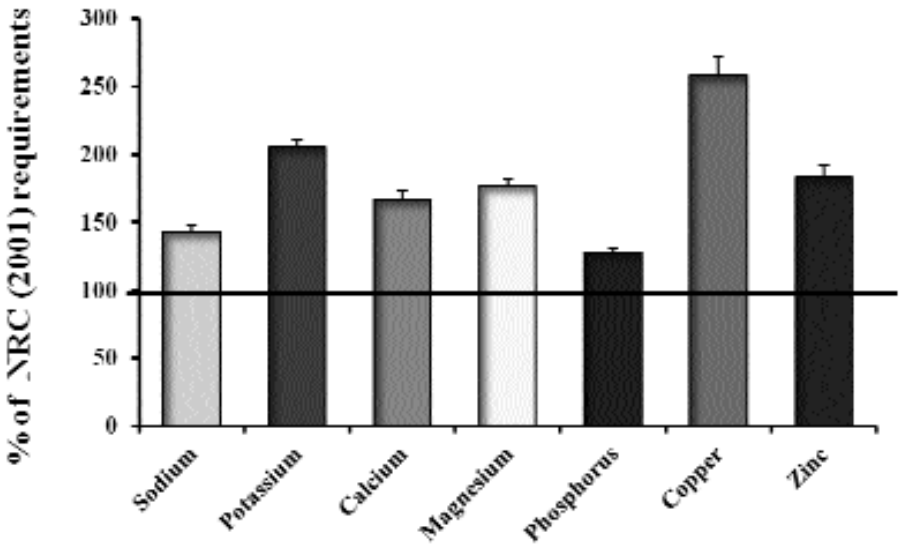

Table 3: Effect of feeding P at the UK average or recommended level on performance, P excretion and health and fertility of dairy cows (Ferris 2010a,b).

	4.4 g/kg DM	*3.6 g/kg DM*	*s.e.m.*
Yield, kg (year 4)	9002	8976	394.0
Fat, g/kg	39.9	40.7	1.26
Protein, g/kg	32.7	33.2	0.56
Depth of rib, mm	12.0	11.4	0.36
Faecal P output, g/cow/d	75.0	41.2	1.31
Calving interval, days (av. 4 lactn)	383	392	ns

feeding level resulting in an extra 10 kg/P/ha being excreted.

For minerals such as Cu, over feeding can lead to cow deaths with an average of 26 cases of cattle deaths per year reported between 2005 and 2012 (AHVLA 2014).

Despite this, of the 50 farms sampled in the survey of Sinclair and Atkins (2014), 6 were feeding Cu above the EU maximum limit of 40 mg/kg DM, 32 feeding above the recent industry maximum guideline of 20 mg/kg DM and all were feeding substantially above the nutritional guideline of 11 mg/kg DM. Often farmers are not aware of the mineral levels being fed, or the impact on the environment or animal health, do not take into account minerals from all sources (including free access sources, boluses and water), or do not analyse their forage for minerals. Additionally, recent research has indicated that the metabolism of minerals such as Cu differ on grass compared to maize silage (Sinclair & Mackenzie, 2014), further emphasising the requirement to consider all dietary ingredients.

Challenges to forage and grazing management

Milk yield in the UK has been increasing by approximately 100 kg/cow/annum for the last 25 years, a trend that is likely to continue. In contrast, yield from forage has been at best static, with yield from grazing generally decreasing, putting greater reliance on the proportion of milk obtained from concentrates and subsequent fluctuations in commodity prices. Grazed grass is generally regarded as the lowest cost forage available to UK dairy farmers, and the public perception of dairying is often improved if cows are able to graze. However, high yielding cows are unable to consume sufficient grass to maintain yields much above 25–30 kg/d, and therefore some form of supplementation or housing is required. On-going studies at Harper Adams and SRUC have been investigating both the welfare implications of housing vs. grazing, and strategies to increase the intake of grass in high yielding dairy cows. Giving cows a choice to be inside or out can improve welfare and maintain

or increase milk yield (Moutapalli et al., 2014), but may not be practical on many farms. Mufungwe et al., (2013) reported that milk yield could be maintained at around 40 kg/d and methane production per litre of milk reduced if cows had access to pasture between morning and afternoon milking if they also had access to a TMR at pasture: removal of the TMR resulted in a decline in milk yield (Table 4). Further studies funded by DairyCo to investigate the effects of cut and carrying grass to cows, time of access to pasture and pasture presentation are on-going.

Challenges to reducing the environmental impact of dairy cows

One of the primary methods of improving the efficiency of feed utilisation is to increase output. An increase in milk yield also reduces the environmental impact of dairy production, with lower N and methane emission per kg of milk. The targeted use of feed additives or oils can also be utilised to improve N efficiency and reduce methanogenesis. An added advantage of oils is their ability to enhance the polyunsaturated fatty acid content of dairy products, with subsequent benefits on human health such as cardiovascular health. Additionally, dairy products are high in ruminal biohydrogenation intermediaries such as conjugated linoleic acids that have been demonstrated to have a range of human health benefits. Reducing the saturated fat content of milk and improving the nutritionally beneficial fatty acids such as very long-chain omega-3 polyunsaturated fatty acids has and is receiving considerable research attention, and interest from milk purchasers.

Conclusions

In conclusion, the greater demand for dairy products, in association with the changing availability of feeds, may result in the use of higher quality home-grown forages supplemented with an increasing amount of by-products in association with the targeted addition of minerals and vitamins and use of additives to improve rumen function, digestion, metabolism and performance. Such advances will be driven by evidence based research, but it must be ensured that the results are translated to dairy farmers in a practical and relevant form.

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Table 4: Influence of grazing during the day without (DG) or with (DGT) access to TMR in the field compared to continuous housing (C) on the performance and methane output of high yielding dairy cows.

	C	*DGT*	*DG*	*s.e.d.*
Grass intake, kg DM/d	—	1.1	0.8	0.45
Milk yield, kg/d	38.6	38.0	35.3	1.21
Milk fat, g/kg	37.0	37.9	35.4	2.68
Weight change, kg/d	1.1	0.45	−0.11	0.437
Methane, g/kg milk	14.6	12.8	12.7	0.906
Milk 18:3*n*-3, g/100g	0.40	0.42	0.51	0.056

Back to the future – a 26 year journey

Andy Gubb
Barnacott Farm, Brayford, Barnstaple, Devon, EX32 7LL;
contact@carolannejewellery.co.uk

On the 12th October 1988 the Kimland Herd of pedigree British Friesians was sold, I hadn't quite understood at the time the impact of the sale. At 19 years of age I was studying Agriculture at Nottingham University and it really hadn't clicked that my opportunity to become a dairy farmer had just vanished. In any case, I was far too busy with the social side of University to worry about the sale of a few cows. How wrong I was.

Dairy farming gets inside you. It eats away at you. It becomes a drug, and you can't shake it off. Having graduated with a respectable 2:1, two extra stones in weight and a much reduced bank balance, I returned to the family farm, which at that stage was attempting to carve out a living farming suckler cows and sheep. But it wasn't the same. The pace of life was in my eyes too slow. There was nothing to really get your teeth into. So I applied for and got a job with W J Oldacres working initially out of Calne in Wiltshire. Back with dairy cows again life was good. I was then lucky enough to join ADAS and work under John Allen and David Levick on my home patch in North Devon. This time spent with two industry heavy weights was invaluable in shaping my views on the future of dairy farming, and confirmed that the dairy industry was where I felt most comfortable.

Hence the next career change was a complete shock to all involved, me included. As the break-up of ADAS loomed, rather than join one of the many fledgling consultancy businesses that were attempting to fill the ADAS void, I took a sharp about turn and accepted a position as general manager in a jewellery wholesale and design company owned by my brother and sister in law. After progressing to become operations director in a then multi million pound turnover business, I left to join forces with my wife as an independent jewellery retailer, a business we have been successfully running for the past 9 years. In the meantime I also became co-owner and director of a children's daycare nursery (long story). And so a variety of business interests have kept me fully occupied. So why return to farming?

There had always been a private joke between me and my brother, that I was never interested in coming back to the family farm unless it was into dairying. This was a dead cert – no way would he be interested in converting back to a dairy from a beef and sheep enterprise. Simon was just 12 when the herd was sold in 1988, and so the bug hadn't bitten him. He had been spared. And then one night in January 2014, whilst calving a suckler cow, he hit me with the killer question, 'How about it then, fancy having a go at dairying?'

And so here we are almost 12 months on, a fully fledged dairy farmer milking 253 mainly Dutch and German imported heifers, and loving it. We started milking on the 7th October 2014 and the first 8 weeks were absolute hell. I am currently living in Glastonbury, a 90 minute drive from the farm, and so I seem to spend most of my time either in the parlour, on the M5 or on the phone, as well as keeping in touch with the jewellery and nursery businesses. I have managed to lose 2 stone in weight (the 2 stone I gained whilst at University), but I cannot recommended stress related weight loss as an answer to the looming obesity crisis in the UK. But yes, I am still loving it, and here are my reasons why I decided to go back into the industry and why it was the right move for me and my family.

1. Passion/Opportunity

You have to do something you love. I have seen far too many people in dead end jobs where they are marking time, getting from one week to the next, just to survive. Some are in well paid roles as well, so it is not all about the money. I had wanted to do this all my life and here was my opportunity. Could I risk spending the rest of my life wondering if I could have been a successful dairy farmer? Time to put up or shut up.

Many long standing dairy farmer friends gleefully reminded me of the long hours, 365 day per year commitment, loneliness and weather induced depression. It is true that dairy farming is a 24/7 commitment, but there are also very attractive reasons for joining the dairy industry which as a high street retailer, I can fully appreciate.

Firstly you have just one customer, as opposed to many hundreds of customers. The customer tells you the price he is prepared to pay for your product and you can sell him as much of it as you can produce. He doesn't stipulate stringent QC control on your product, but is happy to pay more for quality. Not a problem with that. He is also happy to come and pick it up in his own lorry so that you do not have to arrange or pay for transport and he then puts the money direct into your bank account on the 15th day of the month following, without you having to chase for it, and best of all you don't even need to send him an invoice.

Your customer doesn't ring you up a week after you have delivered your product and tell you that the product is broken or that the customer doesn't like it any more and wants a refund. Nor does the customer stand in the middle of your yard and tell other customers, farmers and your staff how disgusted he is at the way he has been treated and that he is never going to deal with you again.

Now much of this is a little tongue in cheek, but we should all try and remember that farming and dairy farming in particular has its challenges, but these are no more stressful than those faced by many independent businessmen and women up and down the country who are trying to carve out a living.

2. Family/Labour

My father is now 71 and still works an 8 day week. He has been and continues to be a valued member of the team, but could not contemplate lambing 600 ewes and calving 120 suckler cows as well as the additional workload of finishing 600 head of beef cattle each year. If we had to replace him with another employed member of staff this would put further pressure on the financial viability of the farm in its current form.

3. Finance

When considering the future of the farm before taking the plunge back into dairy farming, we carried out a 'what can I earn before I get out of bed' test. It was clear that with strong demand for quality land driven by NVZ restrictions, and a general shortage within the area, that by liquidating the livestock and dead-stock, clearing all or most of the debt and then letting the land, our income was similar if not a little higher than had been achieved over the previous 5 years (averaged) through farming. This is never easy to come to terms with, as farmers pride themselves on the quality of their workmanship, and my father is no different. But the reality is that on many family run livestock farms, the profit per acre does not cover the opportunity cost of land rental. In order to sustain long term viability something had to change, and doing nothing was not an option (Dad's words not mine).

4. Inheritance

Dad and Mum are traditional farmers, and would cite their aims in life to farm and then pass the farming business onto the next generation. Sadly, as land prices continue to rise to levels beyond commercial viability, the chance of siblings spreading their wings to farm additional acres has almost disappeared amongst traditional livestock farms. We are a family of 3 siblings and the reality is that the farm as a beef and sheep farm could only sustain two families at best (my parents and my brother). It is also highly unlikely that the farm could survive being saddled with additional debt should one or more siblings wish to receive an inheritance (should one be available!).

I am sure this is the position that many farmers now find themselves in. The only way forward for us was to find a way of farming that afforded us the opportunity to generate sufficient profit to either pay down debt, or make provisions so that all current and future generations could benefit in some way from the capital asset. This was clearly not possible with the current enterprise mix.

5. Control

Having worked outside Agriculture, and used modern technology to fine tune stock management systems or plan childcare ratios and staffing, it was clear that the combination of technology and agriculture should go hand in hand. In the livestock sector the use of technology is limited and therefore the skill of the stockman is still paramount. However in the dairy industry technology has a much bigger role to play. Managing large numbers of cows as individuals is now possible using RFID ear tags, electronic milk meters, pedometers and various other tools that are now widely available. Fine tuning diets almost daily allows the feedback loop to work seamlessly.

When we were finishing suckler calves we would weigh them every 3 weeks during the finishing period, and then hold our breath as the computer gave the magic DLWG numbers. If gains were good, everyone was smiling. If gains were bad, we had just lost 3 weeks of growth, and we weren't quite sure what had caused the slowdown – weather, change in silage, disease challenge etc. Now we can make a change today and measure the effect tomorrow. We can focus on identifying the cause and implementing the effect.

The dynamic nature of the dairy industry means you are faced with daily choices based upon a whole range of factors. Ultimately the decisions taken are done so in the light of the net margin per litre of milk produced taking into account the guaranteed price you are receiving for the product being sold. And so the level of concentrate being fed (the main input cost) can be adjusted to reflect this. Adjustments can also be made on other input costs, but invariably there is much less flexibility here to influence net margin signifi-cantly. You tend to feel in Dairy Farming that you have a degree of control, something that is definitely missing in the livestock sector.

And so to the present and what of the future. At the moment we are farming approximately 475 acres with 253 cows in milk. Clearly we will have to increase cow numbers in order to maximise our total farm margin and we already have the accommodation (housing and slurry) for another 150 cattle. Our only limiting resource at present is silage accommodation, which I am sure can be dealt with reasonably quickly and efficiently.

We have taken the decision to run a flying herd and hence all cattle will be served to Belgian Blue. That isn't strictly true as we have some spare cattle accommodation and 40 acres of land that is not suitable for silage, so as a Christmas present my brother has bought 120 straws of sexed semen for me to play with, and we are selecting our top 45 cows to be bred to Cogent Genomic sires.

We have been very impressed with the quality of cattle we have been

able to source from Holland and Germany at extremely competitive prices. This may not be the most politically correct part of my speech to the BCBC, but I cannot see a commercial reason for breeding our own replacements. I accept that we will have a ceiling on yield per cow and the truly amazing figures that some of the best breeders in the UK are currently achieving will be outside our reach. However, we cannot dismiss the lost income from the Holstein bull calf. The additional semen costs and lost output in calf sales amount to £160 per head and whilst I may lose £70 in cull cow value over a 3 year lifespan, the £36,000, or 1ppl net profit gained on a 400 cow herd is too large to ignore.

The advent of sexed semen in the dairy industry will I feel in time put immense pressure on the UK suckler industry, or certainly condemn it to a niche position in the market, unless the consumer recognises and ultimately is prepared to pay for beef reared in the traditional way. As the pregnancy success rates for sexed semen increase and ultimately price per pregnancy decreases, then high quality beef as a by-product of the dairy industry could be enough to supply the UK market with much of its demand. Current figures suggest there are just over 250,000 holstein bull calves that do not enter the traditional beef finishing cycle each year compared with 300,000 male cattle from the suckler herd (Eblex 2008). It will not take long for farmers to realise that those 250,000 calves represent £45 million per annum in lost revenue to the dairy sector.

Cows are being fed on a basic diet of grass silage Trafford Gold, home grown cereals and a protein blend. Maize and whole crop do not feature in the diet and are unlikely to in future years. We have our own small contracting business which allows us the luxury of a New Holland self propelled forager. With land running to 1,000 feet above sea level we cannot grow Maize or wheat successfully, but we can make high dry matter 11.5 ME grass silage consistently, which when costed at £17 per tonne fresh weight in the clamp versus Maize at £45 per tonne (bought in) makes the decision to stick with grass silage even easier. The Trafford Gold seems to have a positive impact on intakes and we have been able to keep total feed costs down to 8.5ppl (including forage).

As you can see, many decisions being made about the direction of the business are driven by the need to generate profit first and foremost rather than trend or personal preference. This is not to say that farmers shouldn't follow their heart and gain personal satisfaction from the way they farm. But in tough economic times, the cost of producing a litre of milk has to be the number one focus.

Milk price – the hot topic of conversation. I am happy to say that with the help of John Allen, we saw this one coming and prepared our budgets back in March 2014 at 28ppl Oct-Dec, 27ppl Jan-Mar and 26ppl Apr-Jun. Let's hope that even these don't prove to be too optimistic. As to why we felt prices were going to be so low, it seems with the benefit of hindsight so obvious. No threat of UK super levy, high milk prices, good quantities of good quality silage and hey presto a recipe for record milk production. The part of the equation that we couldn't predict and the other half of the supply and demand perfect storm was the significant reduction in global demand, not helped by political turmoil in Russia. Whether we like it or not, we are part of the world market and our market cannot be insulated form the effects of world demand and world supply. It is likely over the next 10 years that demand is going to outstrip supply, and hence many commentators view the medium term future as bright for the world's dairy farmers. But this will not be a journey without its ups and downs.

So why as a new entrant to the industry do I remain confident that we have made the right decision after 28 years in the wilderness. Many in this room will see me and others like me as part of the over supply problem, and they would be correct. There has been significant movement out of livestock and into dairy production over the past 12 months, adding to the oversupply problem. But it seems to me that we have a clear case of the haves and have not's. Whilst we are hearing of prices for liquid milk of 21.7ppl for January deliveries, we still have farmers on gold plated cost of production contracts of around 30ppl for January supplies. We also hear that the cost of milk production is around 32ppl, whereas some of the best UK operators will be producing milk this winter at 24ppl (including family labour costs) and so the variation in profit margin could be as much as 16ppl between the worst and best operators in the UK. This may be a rather crude analogy and the variation may lie somewhere in the middle, but even with a differential of 8ppl between the best and the worst performing farms in the UK, we can soon see that the best farmers will continue to invest and expand and the worst performers will cease to produce milk. In the UK only 2% of herds have more than 500 cows (2013 census) and average herd size is 156 whereas according to the New Zealand Dairy Board, average herd size in 2013/14 was 413. The UK has a great deal of consolidation to consider over the next 10 years if it is to compete on the world stage.

It is critical that a degree of stability returns to the milk market so that good businesses can plan ahead and invest. In the words of a famous soon to be retired politician, there can be no return to the days of boom and bust. But in an unregulated marketplace this will remain very difficult. I can see a return to some form of milk quota, not imposed by governing bodies but by processors, who despite our cries of unfair play have also been at the end of some difficult times in recent months. The recent well documented proposal of a return to processor led A and B style quota may well be the system we end up with, and if that is the case, we will need to make sure that we are producing as much milk as possible when that day comes.

So yes I am confident that we will be successful dairy farmers but first and

foremost successful businessmen. Having come back into the industry from a commercial background, the concept of a lifestyle business is not an option. This business has to be highly profitable. We will focus on all aspects of milk production to make our cost of production as low as possible and continue to invest in areas where the return on capital investment is high. In the famous words of Sir Clive Woodward, 'winning the rugby world cup was not about doing one thing 100% better, but about doing 100 things 1% better'. Successful dairy farming should be no different.

We will look to build a strong relationship with a processor who is committed to adding value to the milk we produce. We will need to compete, not only with other UK producers, but with our European neighbours and yes with producers across the world. And most of all we will try and have as much fun doing it as possible.

Balancing family aspirations with business objectives

David Homer
Chisbury Lane Farm, Chisbury, Marlborough, Wiltshire, SN8 3JA; david@chisburylane.co.uk

Introduction

Balancing the family's aspirations and harnessing the enthusiasm of the next generation led us to change from all year round calving to block calving. In addition we took on two additional farms through joint venture agreements and breeding cows to suit the systems, all whilst satisfying the needs of our customers for milk and calves.

We are currently farming 1350 acres on four farms with a lifetime tenancy, two contract farming agreements and an FBT with 520 cows in two herds and 300 replacements.

I have been farming within the Homer family all my life; I grew up in Warwickshire with my four brothers and parents. My mother and father retired 25 years ago in 1989 when Jane and I successfully tendered for a tenancy in Wiltshire. We started with 247 acres and 100 cows producing 600,000 litres, it was a real struggle to start with as all our working capital was swallowed up in milk quota. In 1996 we asked ourselves 'should we carry on?', we were highly geared financially as we were heavily borrowed with interest rates at 16% at the peak. Having sought advice we developed a business plan to increase output by having 200 cows producing 2,000,000 litres. At the same time 15 years ago we were invited to supply Waitrose, this gave us the confidence to implement our plan as the proposed scheme offered us added value and security. Whilst all this was happening we were rearing our own human replacements, (although we didn't know it at the time) Chris, Geoff and Anne. In 2009 we took on another 380 acres where we reared dairy replacements and grew cereals, this was another important turning point for the business and we did very well for a few years. In 2011 the farm changed ownership and we thought we were going to have to put the business into reverse just as our sons wanted to come home and take an increasing role in the business. However, the situation changed again quite quickly, the new owners of the young stock farm asked us to continue farming it on their behalf, at the same time a friend who farms next door asked us to work with him to draw up a joint venture agreement. Warren Farm is a 480 acre dairy/arable farm which was being run as a 200 cow, high yielding, all year round calving system with loose yards and all employed labour. We decided between us that this system was not viable long term due to high costs and the dairy infrastructure required considerable investment to make it profitable.

Strategy

With opportunities for the development of the business we needed to identify and implement strategy for both the business and the people within it. The family members discussed our individual skills, aspirations and the strengths and weaknesses of our existing farming systems. This provided us with our strategic objectives and a platform to design the business plan. The common aspiration among all of us was to be a pasture based business as a basic foundation. We then realised we would have to make some considerable changes to the way we farm, to realise our ambition.

Change management

Before actually making changes it is of course very important to ensure everyone else who is important to the business agree and support our ideas, our proposed changes would impact on them also. The first port of call we decided had to be our customers Waitrose, Dairy Crest and Dovecote Park. Our ideal plan would involve a change in our ability to provide a level supply of milk and calves, to soften the impact we proposed that our herd at home would revert back to its roots autumn calving and set up a new herd next door spring calving. We also sought advice and guidance from our bank manager, accountant, consultant and vet, we are not sure if it was an advantage or disadvantage that we did not have much time to make these decisions, a lack of time helps to focus the mind and raise determination which certainly makes things happen.

The People

For the family business to succeed and enjoy the challenge of fulfilling our strategic objectives we clearly defined our roles and responsibilities. Bearing in mind we have already identified all our strengths and weaknesses and learnt to respect them, (which we think is very important by the way). David managing partner, Jane finance and admin, Chris livestock and grazing, Geoff soils forage crops and mechanisation, Anne calf rearer. Chris and Geoff

each have an assistant which they are responsible for on a day to day basis. The family meet weekly and we have a full team meeting monthly, this is fairly formal with me acting as Chairman, we keep minutes and record action points to monitor progress which means individuals within the team have responsibility for specific jobs and can then report back. This provides accountability but also creates the opportunity for praise to be given and encourages team playing. This is a way of harnessing enthusiasm, a great way of motivating the team and individuals within it. These meetings are an opportunity for new ideas and proposals and of course discussing things which are not working so well. We identify KPI's and then monitor progress at the meetings.

The Cows

The Chisbury Lane herd at home was started by my father in Warwickshire during the early 50's and we still have several family lines within the 220 cows and followers today. We started with a 50:50 Friesian Holstein and during the 90's bred more Holstein into the herd increasing yields to over 10,000 litres but keeping a focus on longevity traits. In the last five years I felt that I had bred a proportion of the herd too extreme for our system as we were trying to increase more milk from grazing. These cows have a phenomenal capacity for forage dry matter intake from a trough but not so keen on harvesting it for themselves in the form of fresh grazed grass. This shouldn't really be a surprise to us as for decades we have been importing genetics from parts of the world where the majority of this type of cow would never see pasture, so surely evolution would eventually influence their diet and behaviour. For several years we have cross bred some of the most extreme Holsteins with Scandinavian reds to introduce hybrid vigour and reduce stature but have not necessarily introduced the grazing gene! What has certainly helped is ensuring all our replacements graze for as much of the two years up to calving as possible. More recently we have been cross breeding with Kiwi Friesian and have witnessed the difference in heifers straight away, they are much more aggressive grazers and happy to be outside on pasture particularly on the shoulders of the grazing season, it will be very interesting to witness how they perform when they join the milking herd.

The Warren Farm herd we imported from Ireland in December 2012, 150 Cows and 150 Heifers. This herd of Irish cross breeds certainly have the grazing gene and are definitely the outdoors type! These cows are very suited to the spring calving milk from grazing system it is definitely in their DNA, it has been fascinating for us getting know these animals they are like different species. Their general demeanour and behaviour was not what we were used to, we are not sure if it's just because they are Irish after all! They have much more determination to leave the milking parlour and arrive at the fresh paddock after every milking they are certainly not TMR junkies. Although they are crossbreeds it doesn't mean they are not of high genetic merit, Irish dairy farmers have been following the Teagasc research work at Moorepark (which incidentally is where many of our cows came from) for many years focussing on the mix of genetics to suit the specific system of spring calving and producing as much milk as possible from pasture. We imported the first year's replacement heifers again from the same source and we will be calving in our own replacements from this herd in February.

Conclusion

I know we are not unique as a family farming business, but we are often asked how it is that all three children following education, working elsewhere and travelling, have become such enthusiastic farmers where we all get on so well, whether it be happily out working on the farm together or off duty. Jane and I think it may be because we never made any assumptions either persuaded or dissuaded them from following whatever career path they chose. We are also not the sorts that sit around the farmhouse kitchen table with our heads in our hands constantly complaining about how difficult farming is. Running any business in any sector has its every day challenges, but working together as a team finding solutions and driving forward creates a positive motivational atmosphere which the next generation have clearly demonstrated they wish to be part of. This is how the family is today, it will be interesting to see how the dynamics change as additions to the family are made in the form of daughter or son in laws.