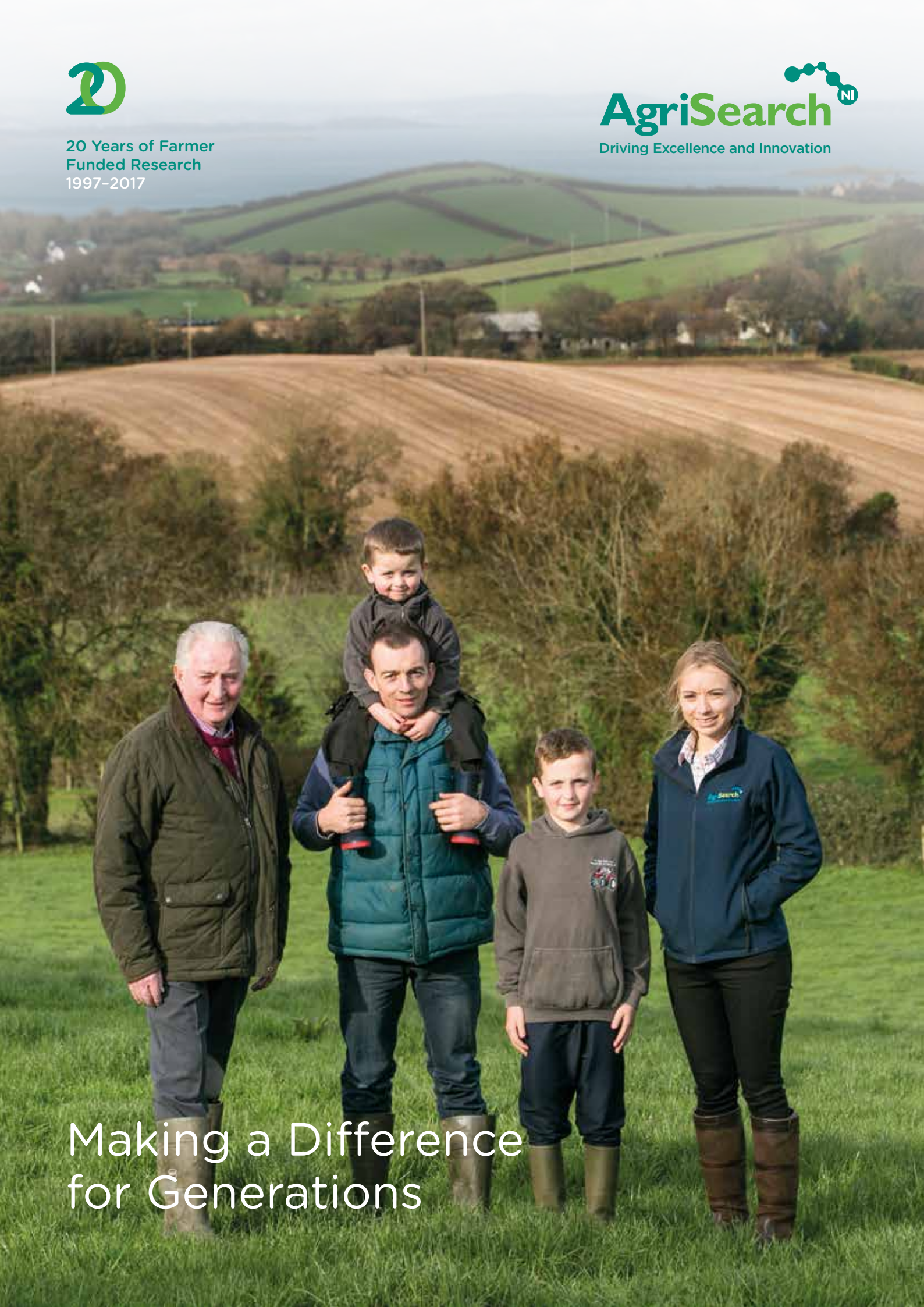
20 Years of Farmer Funded Research
1997–2017

AgriSearch NI
Driving Excellence and Innovation



Making a Difference for Generations

Thomas Moorhead
Beef Farmer Co-researcher,
Broughshane

Michael Bell
Chair, AgriSearch

Introduction

In its first 20 years AgriSearch has committed £7.7 million of farmer levy funds towards 145 projects, with a total cost of £35 million. Based on a five to ten per cent uptake rate by farmers, which is conservative, the value of this research to the ruminant livestock sector is £170 million. By any standards this makes AgriSearch good value for levy payers.

AgriSearch's twentieth anniversary in 2017 is not only an opportunity to look back, but to look to the future and how best AgriSearch can serve the needs of ruminant livestock farmers.

AgriSearch's trustees and executive recognise that these are rapidly changing times for the agri-food sector. Many new challenges and opportunities for the entire food supply chain will emerge. AgriSearch has asked some of the brightest and best minds in the agri-food sector to set out what twenty years of AgriSearch has achieved - and perhaps more importantly how our levy payers can rise to the challenge of changing times.

I believe AgriSearch has a crucial role to play, in helping Northern Ireland farmers succeed in economic, environmental and indeed social growth. I believe this document will drive discussion, debate and learning for us all, and so help accelerate this process.

Thank you for your continued support through levies. Without those AgriSearch could achieve nothing. Twenty years ago AgriSearch was a bold initiative by farmers, and it has stood the test of time. It has delivered an impressive return on levy funds. I believe this document confirms that what we have done, and plan to do, is an investment in the future of Northern Ireland farming and food.

"Farming looks mighty easy when your plough is a pencil and you're a thousand miles from the Corn Field"

Former U.S. President
Dwight D. Eisenhower

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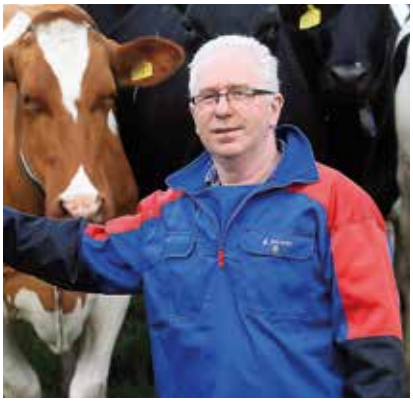


Impact of AgriSearch on Northern Ireland dairy farming

Improving technical efficiency on-farm is essential to Northern Ireland's dairy industry. Through the AgriSearch dairy advisory committee, we aim to provide dairy farmers with the research and knowledge they need to build efficient, sustainable and profitable businesses capable of competing in a global marketplace.

"The real success of any research is when it is adopted on farm."

Over the past twenty years, AgriSearch has funded a wide range of dairy research activities. Subjects have included heifer rearing, dairy cow nutrition, grassland utilisation and dry cow management. Although the dairy levy funds are modest, we have been able to play a key role in large scale research projects.

We have accessed over £20 million of funding by collaborating with industry organisations, government and international bodies. This has brought huge benefit to local dairy farmers. It has helped them access cutting edge, independent research.

As a commercial dairy farmer, getting involved with AgriSearch on-farm trials has proved beneficial to my business. In 2008, our farm took part in a heifer rearing trial on the benefits of two-year old calving. From this we began monitoring heifers more closely, making sure they met targets for live-weight at key stages, such as weaning and mating, to achieve two year calving. This has improved cow longevity and reduced replacement rates. We now have an increased average lifetime performance of over 50,000 litres per cow, almost double the Northern Ireland average.

Similarly, substantial cost savings were achieved by altering our dairy cow diets. This was after getting involved in a research study on transition cow management. This focused on reducing the protein content in dairy cow diets in early lactation. It made me aware of the potential gains from lowering dietary crude protein while improving cow performance. The study provided a sound evidence base, from which to make this change.

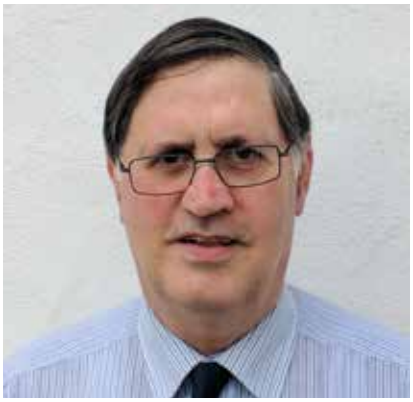
These are two examples of AgriSearch activity that has benefited my farm. They underline that the real success of any research is when it is adopted on farm. All of AgriSearch's work is aimed at providing farmers with the tools they need to run a successful business.

I would certainly encourage all of our dairy levy payers to look at AgriSearch's projects and consider how they can adopt the findings in their farm business.

Looking to the future, research will be the most important thing we as farmers can use to help us meet the challenges of Brexit, demand for dairy produce and the need to deliver sustainably produced food.

AgriSearch on-farm trials have made, and will continue to make, a cost effective contribution to a sustainable and profitable future for Northern Ireland dairying.

Raymond Steen
Beef Specialist



Twenty years of beef projects

Over the past twenty years Agrisearch has co-funded twenty-two research projects relating specifically to beef production. A further twenty have had application to both the beef and dairy sectors or the beef and sheep industries. These projects can be divided into five main areas.

1. Feeding and management to improve output and efficiency
2. Animal health and well-being
3. Genetic improvement of beef cattle
4. Environmental impact of beef production
5. Nutritional value of beef and benefits to the consumer

In category one, research has examined the effects of the level of feeding for suckler cows during mid and late pregnancy. It has shown that having cows too fat or too thin, rather than in the optimum body condition of 3 to 3.5, can reduce profitability by over £50 a cow. Maximising beef output from the suckler herd by producing heavy bulls at a young age increased profitability by £75 an animal. This depends on having a market for the bulls, as there is currently a limited demand for bull beef.

Low input forages such as oats/peas or triticale/lupins proved uneconomical for beef production due to their low yields and the low feeding value of the silages. The optimum rearing systems for Holstein calves from the dairy herd, and the optimum slaughter age for Holstein bulls to maximise efficiency, have also been established. Research is currently examining methods of increasing beef output from grazed grass.

In category two, research has shown that housing cattle on straw bedding rather than slats did not affect animal performance. Cattle however preferred straw or rubber-covered slats over uncovered concrete. These may be an alternative if major retailers decide not to buy beef from cattle housed on uncovered slats.

"More than 40 projects to drive productivity gains for livestock farmers."

In category three, research has quantified the effects of the breed of suckler cows and sire breed on the performance of their progeny and their suitability for different markets. Recent research has also evaluated various synchronisation programmes for use with AI of suckler cows. The aim is to improve the genetic merit of their progeny by using the best AI sires available.

In category four, research has been undertaken to examine the environmental impact of different grazing management systems in a range of LFA environments.

In category 5, research examined the effects of the diet of cattle on the quality of the beef produced, in terms of its impact on human health. This showed that beef from cattle finished at grass has a much higher content of omega 3 polyunsaturated fatty acids and conjugated linoleic acid than beef from concentrate-fed cattle. As both these compounds are beneficial to human health this improves the perception of grass-fed beef as a healthy product.

Alistair Carson
Sheep Specialist

Supporting the sheep sector

Sheep production in Northern Ireland is worth around £73 million. It contributes to the income of close to 10,000 farm businesses. This means improvements in efficiency and profitability benefit close to 40 per cent of all farms. Trials funded by AgriSearch have focussed on breeding and management options to increase ewe productivity. Also tackled were other issues such as reducing labour demands and making better use of grass. Research to improve health and welfare and to underpin the environmental credentials of sheep farming were also major themes over the past twenty years.

Information emerged on breeds and breed crosses under a range of local conditions for both hill and lowland enterprises. This highlighted the benefits of cross-breeding and genetic improvement programmes.

Selected cross-breeding for hill farms has increased productivity (+0.17 lambs/ewe), longevity (-3% reduction in replacement rate), feed costs (37% increase in conversion efficiency) and carcass output (+1.6 kg weight).

In the area of nutrition, research focussed on feeding strategies for ewes to produce good-sized lambs and ample supplies of colostrum. This was across a range of forage types. This led to the development of feeding guidelines for grass-based lambing systems and for indoor straw and maize silage-based ewe diets. Improved mineral supplementation strategies emerged from studies on trace elements, in particular selenium.

The recording of animal health and welfare traits has been built into all research projects. In stand-alone projects emphasis was placed on the sustainable control of gastro-intestinal parasites and liver fluke. This highlighted the importance of monitoring faecal egg counts to decide anthelmintic and grazing management strategies. Current work is evaluating the impact that a more targeted approach to all aspects of health planning could have on animal performance, welfare and financial measurements.

Research on grazing for biodiversity in the hills has shown the positive role sheep can play and highlighted the importance of ewe breed type on foraging behaviour.

“Research has delivered information and innovation to help drive forward the sheep industry in Northern Ireland.”

AgriSearch sheep research has delivered important information and innovations to help drive forward the sheep industry. The on-farm research model developed for the sheep sector has proven very effective and has been used as a template across the other livestock sectors. An essential component has been the unstinting enthusiasm and commitment of the sheep farmer co-researchers.

James Campbell
Senior Vice Chair, AgriSearch

Overall impact of Agrisearch

The impact of research and development work funded by AgriSearch depends on it being taken up on farms. On those that implement recommendations the improvements are clear. Returns per litre of milk can be improved by at least 5 pence by implementing research recommendations on heifer rearing, calving at 24 months and altering cow diets as part of transition cow management.

An assessment in 2011 of the recommendations from three projects on sheep production efficiency showed that these could boost annual returns by £15.7 million, if fully implemented across Northern Ireland. Even if just five per cent of these benefits were realised, this would amount to £783,600. That represents a return of over £39 for every £1 invested by AgriSearch in these projects.

Not all projects produce such potentially positive results and not all are aimed to that end.

Agriculture gained from work that helped make the case for a higher stocking rate for dairy farms under the EU nitrates regulation. This is estimated to have saved £5.4 million a year in rental costs for land that would have been needed to support lower stocking rates.

An economic appraisal of the overall contribution to the dairy industry from AgriSearch funded work indicated a return on investment of more than 18 to 1. This is based on the research recommendations being implemented by no more than ten per cent of the industry.

Data from the 'GrassCheck' programme was used to support the case for a £4.57 million 'weather aid' package in 2002. This aid alone was equivalent to more than ten years of AgriSearch levy contributions by farmers. Evidence from 'GrassCheck' was also used to support the business case for the 2013 'fodder transport scheme'. This brought around £1 million to qualifying farms.

"Practical, farmer focused research is a legacy for the next generation to take forward."

Bigger impacts could be claimed but cannot be easily quantified. How, for example, do you value food security that is underpinned by continuous improvement in production efficiency on farms. What is the true value of the 'public goods' that result from more environmentally orientated farming systems?

Twenty years of AgriSearch investment in practical, farmer focused research is a legacy for the next generation to take forward. The goal now is to ensure that both today's and tomorrow's farmers rise to the challenge of implementing research to future proof their businesses.

Sam Chesney
Beef Farmer

Pioneering on farm research

It's not the way my father did it!

It's all right for those boys... they have plenty of help!

They are only making jobs for themselves and we are paying for it!

These are some of the statements we have all heard from farmers when research is presented. AgriSearch is well aware the adoption of new ideas and skills must have a financial benefit on farms in Northern Ireland. There are, however, still some sceptics.

On farm co-research projects have become popular with all sectors. As farmers we like to see what other farmers do. We like to see for ourselves how they walk the walk. Simple changes in everyday management that farmers can relate to yield financial dividends, but change can be daunting.

We are currently producing, on average, around a quarter of the grass yield that is possible; we are achieving less than half the potential carcase gain in beef and output per hectare is pegged at around 60 per cent of what is possible. On farm research can help tackle that.

World population increases, new markets, high costs of production, and greater welfare and environmental requirements are a growing challenge. Well targeted local research that reaches a majority of AgriSearch levy payers is vital.

Its is widely accepted now that paddock grazing is a better method of grazing management, and that calving at 24 months is not only financially beneficial but also helps reduce our carbon footprint. However, left to our own devices, we might well have continued with what we were doing before. That could have seen us going out of business.

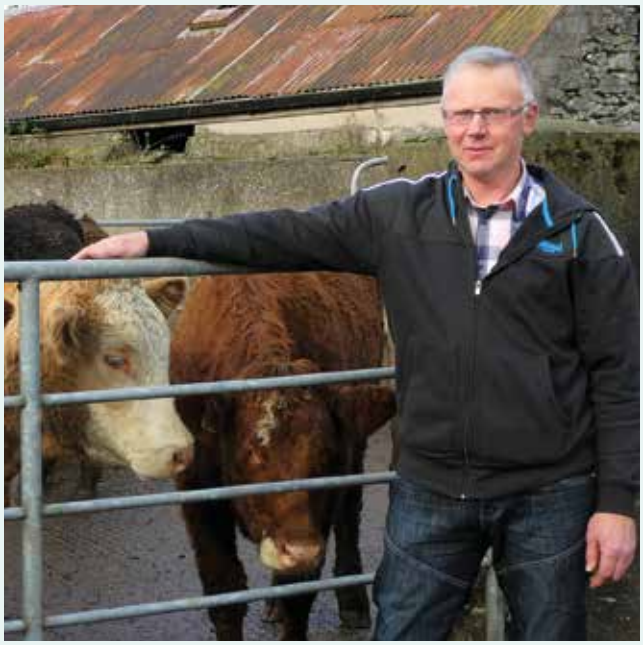
Without on-farm research would many of our 'doubting Thomas' farmers have gone to the big shiny institutes and listened to usually quite young scientists. A few would have done so, but not in sufficient numbers to drive the change, which is vital for future prosperity. This grass roots approach has been very successful here and in other countries that, dare I say it, are ahead of us. Examples are New Zealand and the Netherlands. Success breeds success and peer pressure is a wonderful thing. People adapt because their neighbour is doing something different with a cost benefit.

Farmers always want value for money. As agriculture faces its biggest change since the Second World War the small levy we pay is perhaps is not enough. We have to drive our businesses forward. Innovation, research and promotion are what we need. On-farm research is an excellent delivery method to get our message out to farmers, processors – and more importantly the consumers who ultimately pay for everything we produce.

We want to be the jewel in the crown of food production, with the environmental credentials and welfare policies to match. Research is a vital link in that chain that will help us as farmers meet market needs profitably.

"Shiny boots and paper bio-suits – persuading farmers to listen to researchers is a challenge for both."

Meet some of our innovative farmers



BEEF FARMERS

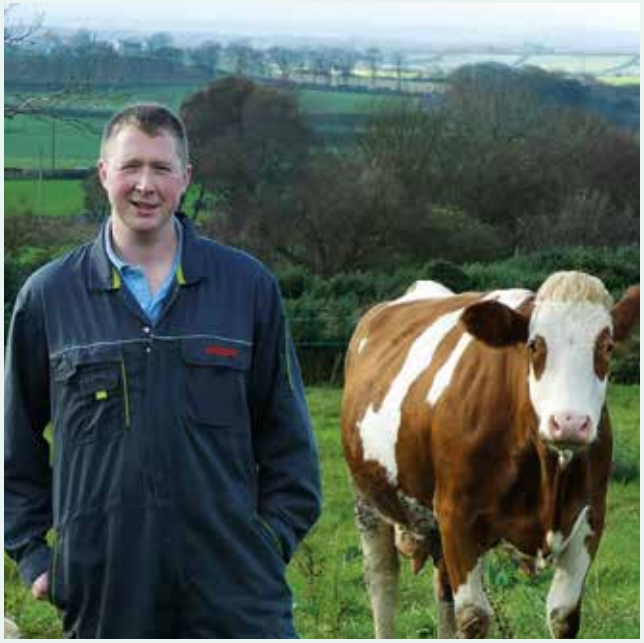
John Egerton
Rosslea, Co. Fermanagh

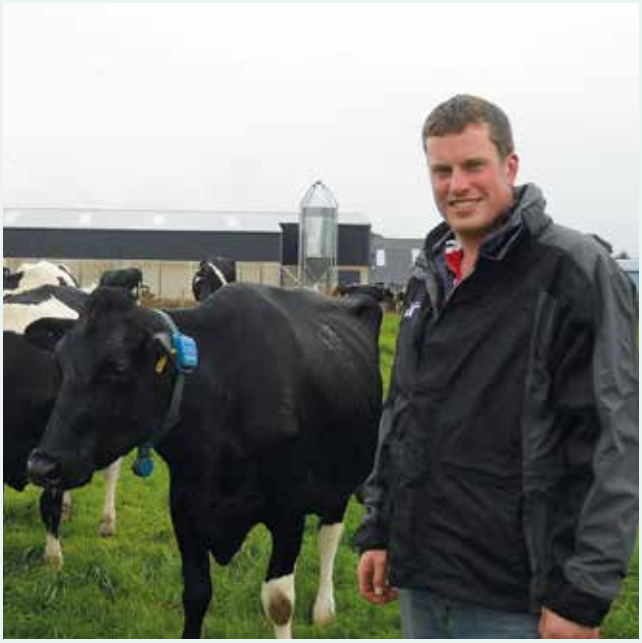
John Egerton operates an impressive suckler and sheep farming enterprise. His closed herd of 80 suckler cows is spilt into spring and autumn calving groups. With all cows bred to high genetic merit sires through the use of AI. All calves are finished through to beef or reared as replacements heifers. John is a firm advocate of AgriSearch's on-farm research programme, taking part in projects investigating beef breeding and grass utilisation. "Taking part in these projects has allowed me to increase the efficiency of beef production and develop a more sustainable beef system", says John. John is dedicated to knowledge exchange of Research and Development findings writing regular newspaper articles and hosting many farm walks for other farmers.

Frank Turley
Downpatrick, Co. Down

Frank Turley is one of the youngest farmers in AgriSearch's 'Beef from Grass' project. He farms a suckler beef and dairy calf to beef enterprise with his father, Paul. They run 190 Angus / British Friesian suckler cows and 100 bucket-reared Angus / Holstein cattle. They calve 95 per cent of their cows over a six week period, from late-January. This allows the Turleys to follow the grass growth curve and coordinate peak feed demand with peak grass growth. Suckler origin cattle are finished at 17/18 months without concentrates and dairy origin cattle at 19/22 months off grass with no concentrate feeding. Frank believes in weekly grass measuring and budgeting and says "it allows me to not only grow more grass but to utilise grass more efficiently, which in-turn lowers the production costs of my beef system".

Meet some of our innovative farmers





DAIRY FARMERS

Ian Henry
Armoy, Co. Antrim

Ian Henry is one of twelve dairy farmers involved in AgriSearch's GrassCheck programme. Ian, who farms with his cousin David, runs a 95-cow dairy herd with a split autumn-spring calving profile. The goal is to maximise milk production from forage. As part of the project, Ian carries out weekly grass measuring and budgeting. "This is essential to maximise the value of grass. I know what's in front of the cows and I can manage grass surpluses much better," he says. The herd is a mix between pedigree Fleckvieh, Montbelliard and Friesian cows, moving towards 100 per cent Fleckvieh.

David Hunter
Newtownstewart, Co. Tyrone

David Hunter farms in partnership with his father John and runs an 80 cow spring block calving dairy herd. The herd consists of Holstein Friesian and Jersey-cross cows averaging 6250 litres per cow, with 3,750 litres produced from forage. Accessing the latest research findings has helped him transition into dairying over the past five years. David says achieving high levels of grass production and utilisation is paramount to the success of his dairy business. From GrassCheck, David has seen huge benefit from monitoring local weather and grass growth conditions. He finds monitoring on-farm conditions allows him to manage his grazing platform more efficiently to get maximum milk from forage.

Meet some of our innovative farmers

LOWLAND SHEEP FARMERS

Roger and Hilary Bell
Kells, Ballymena, Co. Antrim

Roger and Hilary farm 550 Texel cross mule ewes in a mid-season lambing flock, with all bred to Suffolk rams. Grassland management and animal data recording are seen as essential to benchmark performance and drive efficiency. The farm is one of six taking part in AgriSearch's 'Lamb from Grass' project. This is investigating the effects of grazing strategies on grass production and the resulting animal performance. Also being looked at is how different breeds respond to grazing strategies. The Bells found that weekly grass measuring and budgeting, as part of this project has already allowed them to increase grass production and utilisation despite challenging ground conditions at their farm.

Isaac Crilly
Castlederg, Co. Tyrone

Isaac and Elizabeth Crilly farm 400 Belclare / New Zealand Suffolk cross-bred ewes. The system focuses on maximising lamb output. Breeding policies include the introduction of New Zealand Suffolk genetics, which Isaac found delivers lambs with good vigour at birth and high growth rates. He is a firm believer in practical farmer focused research, and for more than 15 years has taken part in AgriSearch on-farm research projects. This, he says, has given him more confidence in making informed decisions about breeding, nutrition and flock health.

Meet some of our innovative farmers

HILL SHEEP FARMER

“James is passionate about monitoring and increasing animal performance and flock productivity.”

James Davison

Harphall Farms, Carnlough, Co. Antrim

James farms a mid-season lambing flock of 750 breeding ewes on his hill farm. Breeds include pure-bred Scottish Blackface, Swaledale and Lleyn. These are all good maternal breeds well adapted to the hill environment. James is passionate about monitoring and increasing animal performance and flock productivity. He is one of five hill farms involved in AgriSearch’s ‘Lamb from Grass’ project. He believes research is fundamental to the continued development of sustainable hill farming systems in Northern Ireland.

John Henning
Vice Chair, AgriSearch

Maximising benefits in research – the multi-actor approach

A number of key principles underpin AgriSearch's decision making. Central is the need to act as careful custodians of levy funds collected from beef, dairy and sheep farmers for research to improve their businesses. AgriSearch recognises the need for a 'bottom up' approach. It works with farmers to ensure research is relevant and likely to be adopted.

Today this thinking is known as the multi-actor approach. This is about working with a wide range of actors or players: each has a clear role from planning through research, dissemination and demonstration. This is about all the actors ultimately being part of knowledge exchange. This delivers projects that are better targeted to the needs, problems and opportunities that face the ruminant livestock sector.

This approach generates more innovative solutions to problems and ensures better application of research findings. This stems from the cross-fertilisation of ideas between all stakeholders. This has allowed AgriSearch to lever considerable additional spending. In 2015/16 spending of below £500,000 by AgriSearch delivered a total research spend of more than £5 million to benefit dairy, beef and sheep farmers.

Examples of research projects which utilised the multi-actor approach include:

BVD prevalence study with a wide range of stakeholders which led to Animal Health and Welfare NI and the BVD Eradication Programme.

Suckler synchronisation involving farmers, scientists and vets along with pharmaceutical and breeding companies to establish practical working protocols for the suckler herd.

On-farm research on early lactation feeding of dairy cows with farmers, scientists, nutritionists and feed compounders working collaboratively to deliver optimum feed rations.

"I not only use all the brains I have, but all that I can borrow"

US President, Woodrow Wilson

Jason Rankin
General Manager, AgriSearch

A changed landscape for R&D funding

In its early days AgriSearch was a 'back seat' co-funder of research. ARINI (Agricultural Research Institute of Northern Ireland) would come to the advisory committees with proposals that would be accepted, rejected or tweaked. ARINI then took care of getting the necessary co-funding from DARD. The creation of AFBI (Agri-Food & Biosciences Institute) changed how research was commissioned.

AgriSearch now links with other bodies to share resources and work collaboratively. It is a member of the joint red meat R&D committee which links the UK levy bodies. It has also developed a close working relationship with AHDB dairy (the dairy division of the Agriculture and Horticulture Development Board). As a result we are now involved in a number of joint projects. UK national funding is channelled mainly through the Agri-Tech Strategy / InnovateUK. AgriSearch's engagement with the Centre for Innovation Excellence in Livestock helped secure £3.6 million in capital funding for AFBI.

EU projects involve joint research teams and industry. AgriSearch is currently a partner in EuroDairy, which is half-way through its three-year programme. The Agri-Food Quest Competence Centre has opened up another funding stream for R&D projects. With this there must be at least three industry partners. They contribute staff, expertise and other practical resources. The AgriSearch contribution is staff time, the recruitment of farmers and knowledge transfer.

Collaborative projects are now more common and this trend will continue. AgriSearch's levy income on its own would commission very little in the way of research. Its real value is not its pot of funds for R&D, but the industry engagement it brings and in particular ability and experience in on-farm research.

AgriSearch continues to adapt and grow to respond to the challenges facing the ruminant livestock sector. It does this in a very different operating environment to 20 years ago. It has evolved from being only a funder of research to become an active participant in a wide range of innovative projects. AgriSearch provides a means for farmers to have a voice and role in these projects that will deliver the tools and information.

"AgriSearch is an active participant in a wide range of innovative projects."

Challenges and Opportunities

Ian McCluggage
CAFRE

Twenty years of change in the dairy industry

"Efficiency and cost control will remain key to future success."

The last twenty years have seen huge changes in the Northern Ireland dairy industry, both at farm and processor level. Structural rationalisation has brought increased scale and specialisation. Today we produce and process over 800 million litres more milk each year than in the 1990s.

In 1997 the UK was dealing with the challenges of the fall-out from the BSE crisis. Disruption to both dairy and beef markets was a fact of life, with many countries rejecting UK dairy products. Cull cows and over 30 month cattle could not enter the food chain and the live trade in calves and surplus dairy stock was disrupted.

At the same time the dairy industry was coming to terms with market deregulation, as processors sought to secure their own milk supply base. Competition for milk drove prices to record levels, but by 1997 they had fallen sharply from their peak, with a 14 per cent year on year reduction.

The UK was very much in Europe and operating under the milk quota regime. Managing milk production against available quota on farm was a real issue. This is something we easily forget today. In 1995 and 1996 Northern Ireland dairy farms had a superlevy bill of almost £13 million and faced a further £1.2 million fine in 1997. Farmers spent

Changes In The Northern Ireland Dairy Industry 1997 to 2016

	1997	2016
Number of Dairy Farms	5785	3529
Number of Dairy Cows	279,191	317,146
Average Herd Size	48	90
Number of Dairy Replacements	41,700	62,500
Average Milk Yield (litres per cow)	5,540	7,150
Average Milk Price (pence per litre)	20.63	20.55
Total Volume of Sales Off Farm (million litres)	1491	2209
Value of Output of Milk (£m)	308	452
Percentage of Raw Milk Exported	13	32
Percentage of Total Volume going into Milk Powder	48	16
Percentage of Total Volume going into Cheese	22	31

an estimated £250 million to buy in milk quota from mainland UK. This was over and above the cost of short term leasing.

EU market support measures were in place through intervention, export refunds and aid to private storage – a very different market place from today. Volatility was not a word then used in the dairy sector. But as we now know, that move away from support measures to a global dairy market has been the greatest change and challenge of the past 20 years. It brought the challenge of coping with volatility in an industry once known for its price stability.

In 20 years the number of dairy farms has fallen by 2256 (close to 40 per cent). Herd size has almost doubled to 90 cows, with 317,000 cows on farm, an increase of 14 per cent. Today 65 per cent of dairy cows are on the third of farms milking over 100 cows. The most striking figure is the huge increase in milk production to just over 2.2 billion litres, an increase of almost 50 per cent. No other region in the UK has recorded such growth. For farmers the striking figure in the table is a 2016 milk price slightly below what it was in 1997. This confirms the challenge of volatility.

Northern Ireland has always had a small liquid milk market, taking less than 15 per cent of its milk. There has been a change in the product mix since the 1990s, with a greater emphasis on cheese and specialist niche products. A dramatic change since then has been the volume of milk going south of the border for processing. This will add to the complexities of Brexit. What is certain is that the dairy industry is dynamic and change will continue over the next twenty years. Whatever those years bring the fundamentals of efficiency and cost control will remain the cornerstones for future success.

“The move away from support measures to a global dairy market has been the greatest change and challenge.”

Phelim O'Neill
Beef Specialist

Beef industry – twenty years of challenges

When Agrisearch began the beef industry was reeling from the impact of the BSE export ban. At a stroke, valuable export markets built up over the previous decade were wiped out. This effectively ended Northern Ireland's beef branding – Greenfields, with the Albert Heijn supermarket group in the Netherlands. The ban depressed beef and lamb markets for the decade it took to have it lifted for the rest of the EU. Even today it remains for some other parts of the world.

BSE triggered a crisis in beef confidence throughout Europe. That led to the European Commission introducing compulsory beef labelling, creating the opportunity for 'Red Tractor' branding for beef. This brand has pushed UK beef into the highest end of the market in the EU and Northern Ireland has benefited. Red Tractor beef to the UK supermarket and food service sector has fully replaced export markets lost with the BSE ban.

Ironically when the BSE ban was introduced, UK supermarket business was loss-making, such was the attraction of the continental markets. Now with seven out of the top ten supermarkets dedicated to UK-only beef, it is the most lucrative market and Red Tractor access is the envy of the beef industry outside the UK.

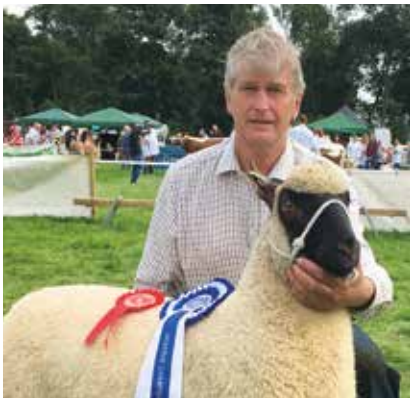
"Prices are at the top end of the EU price league, but more can be achieved."

While beef prices are at the top end of the EU price league, more will be achieved with the re-opening of markets still closed because of BSE. If Northern Ireland could add these countries to its customer portfolio, along with the Red Tractor supermarket trade, it would further strengthen our industry.

There are challenges ahead, particularly what shape Brexit takes and the level of access the UK gives countries like Brazil and Argentina as sources of cheaper beef. There is also the issue of exports of still significant quantities of beef to the EU and the 400,000 lambs a year sold south of the border. The key to living with Brexit is the negotiation of favourable trade terms. Another big challenge is climate change and the role of livestock in producing emissions. Science and technology need to deliver cost effective ways to produce the maximum volume of beef with the minimum of emissions.

Photograph courtesy of Aris Oikonomou – Irish Farmers Journal

Edward Adamson
Sheep Specialist



Sheep – pursuing the three Ps

Twenty years ago, sheep farming was a lot simpler. We had a basic template that everyone worked off, breeding pure hill sheep on the high ground and crossing them with terminal sires on the lowland to produce quality lambs.

This limited opportunities for progress, but work by Agrisearch has showed that cross-breeding can substantially increase output per farm. Many flocks were however too small to make a realistic contribution to farm profits, and research on labour requirements confirmed this. In 1997 labour inputs could be up to 6.6 hours per ewe per year. For a flock of just over 300 ewes that would involve 40 hours a week, but that flock would not generate a full time income.

That 'good pasture and production should lead to profit' is a well-used saying. The easiest of these three P's to dissect is profit, but the difference between outputs and inputs may not always be a positive figure. In a still traditional enterprise like sheep we need research and development to prosper.

We know further development in the sheep industry is needed and technology transfer was never more appropriate and necessary than now to move the sector forward.

Pasture begins with good soil management. This is sometimes neglected, but only if we keep our soil in optimum condition can we expect to grow the forage we need. For sheep, this can be grass, brassicas or other new green crops that may be developed.

"We make a reasonable job of producing lamb, but few of us succeed as marketeers."

It is all very well growing these crops but we must learn to use as much of what we grow as possible and not let it go to waste. Methods of grassland management, grazing regimes and stock control all need kept up to date as more becomes known about optimum methods of utilisation. This is the road to profitability.

As sheep farmers, we make a reasonable job of producing lamb but few of us succeed as marketeers. We need to rely on those best equipped to do that job and we are lucky to have a ready market for our lambs in the rest of the UK. But as a region that needs to sell up to 80 per cent of what we produce elsewhere, we need to look to global markets.

In a world of volatile prices and fickle consumer demand we must be ready to always be supplying the best possible market. This means being ready to deal with whatever specification a market demands. We cannot expect people to simply buy what we want to produce. We need flexibility in our production systems to do this – and that depends on having access to research that will allow us to better tailor the quality and cost of what we produce to what the market wants and what it will pay.

Nigel Scollan
Queens University Belfast

Northern Ireland farming in a global context

The farming sector in Northern Ireland supports a Food and Drink sector worth £5 billion. Food and Drink from Northern Ireland is exported to over 70 countries and is the region's largest manufacturer and a leading exporter. Over the last 20 years there has been much change in the farming sector in Northern Ireland. The global context for agriculture, food and bioeconomy is changing rapidly presenting both challenges and opportunities over the next 20 years.

Frequently we hear about the big challenges facing us all, health, education, climate change, biodiversity loss, environmental, energy and food. One key connector between all these issues relates back to agriculture and land management and use. With a rapidly growing world population (9 billion by 2050) it is estimated that we will need to produce more food over the next 50 years than we have done over the previous 500 years !! For example, cereal production will have to increase by almost a billion tonnes from 2.1 billion today and meat production will have to grow by more than 200 million tonnes to reach a total of 470 million tonnes in 2050.

Our "consumer-driven society" continues to rapidly evolve and there are expectations on food increasing with significant implications at farm level. Consumers continue to demand convenience foods and foods which are "natural" and "sustainably" produced. Food also needs to positively impact on health and well-being (at various life stages) and minimise impact on the environment. Health challenges in society including obesity, diabetes and heart disease against the backdrop of an aging population. "Nutrition for health" is a very important matter and will be more significance as we move towards personalised nutrition and health.

The increased demand for food must be addressed through (1) increased production, (2) reduced waste at all levels of the supply chain and (3) consumption patterns. Locally and globally the increased need to produce more food must be achieved against the backdrop of global climate change and increasing variability in our weather across the world. This volatility in weather is increasing variability in grass/crop yields and quality on farm with knock on impact on animal productivity – both yield and efficiency. Undoubtedly climate change relates to green-house gas (GHG) emissions and agriculture will need to continue to drive both mitigation and adaptation measures to help maintain productive capacity in agriculture.

Agriculture will need to embrace and adopt new technology to handle the challenges ahead. Supporting the leadership and development of new technologies to increase productivity and sustainability (with a strong emphasis of "environmental sustainability") delivering first-class management practices is paramount. Widespread adoption of best management practices by all farms is vital. To deal with the challenges requires partnership both locally, nationally and globally. Farmers, advisors, scientists and a wide range of stakeholders across the agri-food chain must collaborate to embrace and adopt new science, technologies and tools, make effective use of data which will underpin next generation farming. There is a great opportunity for farming in Northern Ireland to become a leader in sustainable food production and processing and continuing to build capacity to deliver high quality, sustainable, safe, traceable and nutritious food, demanded by consumers.

"Consumers continue to demand convenience foods and foods which are 'natural' and 'sustainably' produced."

John Bailey
AFBI

Increasing production while protecting the environment

A major challenge facing agriculture is how to halt the deterioration in water and air quality caused by nutrient emissions from agriculture, without reverting to old 'low input – low output' farming systems.

AFBI has researched how farming can minimise phosphorus (P) and nitrogen (N) excretion and leaching, and ammonia and greenhouse gas (GHG) emissions. The challenge is to achieve this while striving for increased productivity and profitability. As a result it became possible to challenge and modify the Nitrates Action Programme to deliver significant improvements in water quality without unnecessarily restricting farm production.

Research helped persuade the European Commission that....

- **High-yielding dairy cows here excrete less N than their GB counterparts, so allowing more farmers in Northern Ireland to maintain organic N loadings below the derogation threshold of 170 kg N/ha/year.**
- **The 'closed period' for manure spreading should not extend into February.**
- **The soil P index 2 range should be split into 2- and 2+ for grassland and higher rates of P applied in the 2- range to prevent P limiting production.**

"Helping to keep Northern Ireland competitive in global markets."

Since 2009, Northern Ireland has had the fastest rate of improvement in river and lake water quality of any region in the UK and Ireland. However more research is needed to ensure gains in water quality continue and are not reversed.

Research is needed to:

- Evaluate optimum farm P balances for dairy, beef and sheep enterprises and provide practical ways to achieve these.
- Identify cost-effective technical interventions to strip P from manures and/or blocking nutrient entry into streams and rivers.
- Establish and verify ways to identify where risk of nutrient and sediment run-off is greatest at field, farm and in catchments. This would allow better targeting of ways to tackle this.

Research has identified potential strategies to help meet greenhouse gas (GHG) and ammonia emission reduction targets. Evidence shows that...

- **Using stabilised urea fertiliser in place of calcium ammonium nitrate can dramatically reduce GHG (N_2O) emissions after fertiliser application.**
- **Carbon sequestration in grassland soils has the potential to offset 25 per cent of GHG (CO_2) emissions from intensive livestock farms.**
- **Band-spreading coupled with slurry separation and aeration can significantly reduce ammonia emissions and enhance the N fertiliser value of slurry.**

Eileen McCloskey
CAFRE

Ruminants deliver ecosystems services

Northern Ireland has a land area of 1.4 million hectares of which just over 75 per cent is used for agriculture. This is mainly ruminant livestock. This sector is worth around £950 million a year to the local economy. This makes it financially important, but it is also inextricably linked to the environment. Agriculture has not only shaped the landscape, but plays a vital role in providing public good for the benefit of everyone.

The large area that supports grazing livestock provides a wide and often overlooked range of benefits,

- **Carbon sequestration.** Soils play an important role in carbon sequestration with 386 million tonnes stored in local soils. Peaty soils store 42 per cent of the total carbon.
- **Water catchment.** Hills and uplands provide a large water catchment area. This area of naturally low nutrient soil provides high quality water that requires less treatment.
- **Recreation.** Recreation and tourism are heavily reliant on well managed landscapes which showcase the diverse range of plants and animals that co-exist alongside farm animals.
- **Rural life.** Members of the farming community are a fundamental component of rural life, supporting businesses and schools, providing employment and maintaining rural traditions.

The farming, environmental and social links are very significant in hill and upland areas. In Northern Ireland, 70 per cent of agricultural land is classed as Less Favoured Area (LFA). It has long been recognised that these sensitive areas must be farmed in an environmentally sustainable way for the benefit of everyone.

> **"LFAs must be farmed in an environmentally sustainable way for the benefit of everyone."**

There is no single blueprint plan for the diverse range of land type, habitats and livestock systems. We must focus on farming systems that make best use of the resources available, while meeting environmental objectives. This requires a range of skills and a sound understanding of land capabilities and how to match grazing livestock types to those resources.

Heather moorland supports a huge and diverse range of plants, mammals, birds and insects, such as the Irish hare, large heath butterfly and red grouse. It is a huge carbon sink with the ability to take more. It shapes our landscape and is important for recreation. This is why it is internationally recognised, with three-quarters of the global area of this type of land found in the UK and Ireland. Hill and upland areas are also a resource of food for grazing animals and livestock are fundamental to the management and preservation of moorlands. Given the focus on food security we must use these areas to their full economic and environmental potential.

The goals for everyone involved in livestock production are similar. Improve efficiency, increase profitability, maintain and enhance biodiversity. We must recognise the twin roles of grazing livestock in food production and the delivery of public good through the environment. Sustainable systems must be underpinned by quality research that can be integrated into farm businesses.

Aileen Lawson
Ulster Farmers' Union

The sustainability challenge

The agricultural sector in Northern Ireland is well aware of the sustainability issues it faces. These include water quality, soils, biodiversity, greenhouse gas emissions and the more recent ammonia challenge. These are on top of of the other issues, such as farm profitability, succession and land tenure.

The Agri-Food Strategy Board 'Going for Growth' plan outlines a vision for sustainable growth. This is around the industry meeting the three sustainability pillars – economic, social and environmental. The Sustainable Agricultural Land Management Strategy lays out a number of recommendations on how farming can deliver these targets in a sustainable way.

To do so it needs solid information from high quality local research. AgriSearch has helped ensure accurate figures and recommendations have been available for use in regulation and policy. One project showed that local, as opposed to UK-wide, nitrogen excretion figures were needed for the nitrogen loading calculation in the Nitrates Action Programme. The resulting Northern Ireland values allowed higher livestock stocking rates on farms, delivering cost savings for the industry.

Meeting environmental issues is a challenge that will continue to grow and it will do so in the context of continued pressure on farm incomes. Water quality will continue to challenge agriculture, particularly in relation to phosphate. However, the industry has shown it is willing to respond.

It has backed this with local science, such as the AgriSearch funded study on reducing phosphorus in cow diets. As the science around phosphorus in soils and water continues to move forward, government polices must take account of new evidence on best practice. The latest hurdle is the challenge of ammonia emissions. With 93 per cent of Northern Ireland emissions coming from agriculture there is an urgent need for local information on emissions and how to reduce them, particularly for the ruminant sector.

Researchers working with farmers, processors, policy makers and the environmental sector can ensure Northern Ireland is best equipped to deal with these big challenges. Success in doing so will drive the entire agri-food sector forward.

> **"Meeting the list of environmental issues is a challenge that will continue to grow."**

Niamh O'Connell
Queen's University Belfast

Why do we need animal behaviour and welfare research?

Animal welfare affects the efficiency of livestock production systems, and it is also an increasingly important marketing tool. While the cost of treating disease is visible, there are hidden costs linked to the behavioural and welfare effects of many common conditions.

Lameness is a recognised production disease in dairy cows. Pain associated with the condition contributes to reduced feed intake and stress, which in turn affect milk yield and fertility. Estimates are that lameness costs the average UK dairy farm up to £15,000 a year.

Researchers, in partnership with AgriSearch, have identified prevalence, risk factors and treatments for some key ruminant diseases. The speed with which diseases are recognised, diagnosed and treated remains critical. With conditions such as lameness, adverse effects on welfare and productivity may begin even before the animal becomes clinically lame.

Reflecting the drive towards precision farming, the goal now is to develop tools for the early detection of poor health status. Investigations currently focus on physiological measures of disease, but the behaviour of an animal can guide us towards how it is actually feeling. As with humans, sickness and pain in farm animals may initially affect activity levels, eating and drinking.

A better understanding of the impact of key health conditions on patterns of activity and feed intake would help with the development of automated warning tools. The welfare of ruminants is also influenced by issues other than health. The impact of pain and stress linked to poor handling and transport can be measured. These directly affect productivity and product quality.

Any inability to perform natural behaviour patterns causes stress in livestock. One of the most contentious issues when it comes to the welfare of farmed livestock is confinement. Many consumers view the concept of 'free-range' as central to ensuring high welfare. This creates an opportunity for researchers to highlight the unique welfare benefits of the more extensive production systems in Northern Ireland.

Where outdoor access is limited, the approaches used in other sectors, such as poultry, to design indoor environments on the basis of animal preferences could be a marketing plus. The added value of better welfare would be further enhanced if measurable gains to the nutritional value of the product could also be highlighted. While the beneficial effects of pasture access on the fatty acid profile of milk have been shown, future research should aim to link ruminant welfare to key aspects of micro-nutrient status and taste.

"Many consumers view 'free-range' as central to high animal welfare."

Conall Donnelly
NI Meat Exporters' Association

Producing what the consumer wants

"There is an expectation that industry behaves responsibly and ethically."

A common complaint from farmers is that today's youngsters don't know where their food comes from. They have a point when surveys show a third of young adults do not associate bacon with pigs. With growing urbanisation, the general public has never been further removed from food production. The reverse must then also be true. Farmers have become removed from those that eat their produce.

This disconnect is a problem. We have a large consumer-base with little empathy for farming practices. They are also exposed to strong anti-meat messages in the media. We have a responsible farming base, but one that too often disregards retail specifications and is cynical about change. Consumer needs constantly evolve and the industry needs to move with them.

Retailers engage with consumers. This is reflected in the specifications that define what we produce and how we produce it. We see a growing requirement for smaller, lighter cattle. This reflects a trend for smaller households. Coupled with rising prices, this has driven demand for smaller cuts in smaller packs. These requirements are easy for us to understand. They are practical and reflect tangible consumer choices based on price, quality and convenience. There is also a link between what the consumer wants and what society wants. Concerns such as animal welfare and environmental protection might not feature in the day-to-day shopping decisions of most consumers, but increasingly there is an expectation that industry behaves responsibly and ethically.

Our industry is under constant scrutiny from pressure groups, many with an anti-meat agenda. They drive consumer awareness and lobby large retailers and government. Social media influencers, celebrity bloggers and elements of the press are used by these groups to sway consumers away from meat. They do this by pushing their buttons on questions of health, animal welfare and the environment.

Most consumers do not, and will not, fully understand these issues. They however expect industry to do the right thing, whatever that is. To meet those expectations our industry needs to work together. It needs to demonstrate a responsible approach on these ethical issues. We cannot afford to be cynical. We need to accept and understand that consumers and society have strong views on these issues. That may mean changes are required. These will have to be addressed, if for no other reason, because it is what consumers want. For our response to be effective it must be backed by the best possible science to show that what we are doing is right for animals, the environment and the final product on the supermarket shelf.

David Dobbin
DairyUK

Volatility the new norm

Price volatility is nothing new as it is difficult to balance supply and demand in perishable food produce, not least because weather alone can account for big swings in production. Historically, the UK statutory marketing boards dampened volatility by managing markets. After their deregulation in the 1990's, EU market management measures took over.

With growing globalisation in agricultural trade and EU market management measures largely gone, price volatility has been increasing. In the UK some of this is down to exchange rate movements. Most agrifood commodities are priced in US dollars or euros and their value against sterling has been highly volatile.

This can be reduced by forward buying/selling foreign currency, but doing so means farmers have to take a position that may not always be favourable against the spot market. This highlights the dilemma in tackling volatility - hedging mechanisms involve a decision on whether to fix prices/currency to avoid downside risk but in doing so to miss out on a market upturn.

For most products returns from long term fixed contracts have equated to the average spot price. Farmers need to balance their fear of missing out on high prices with the reassurance that they will avoid the very low price periods that often follow peaks. It is these extreme down cycles that can force farmers out of production by exhausting their cash reserves.

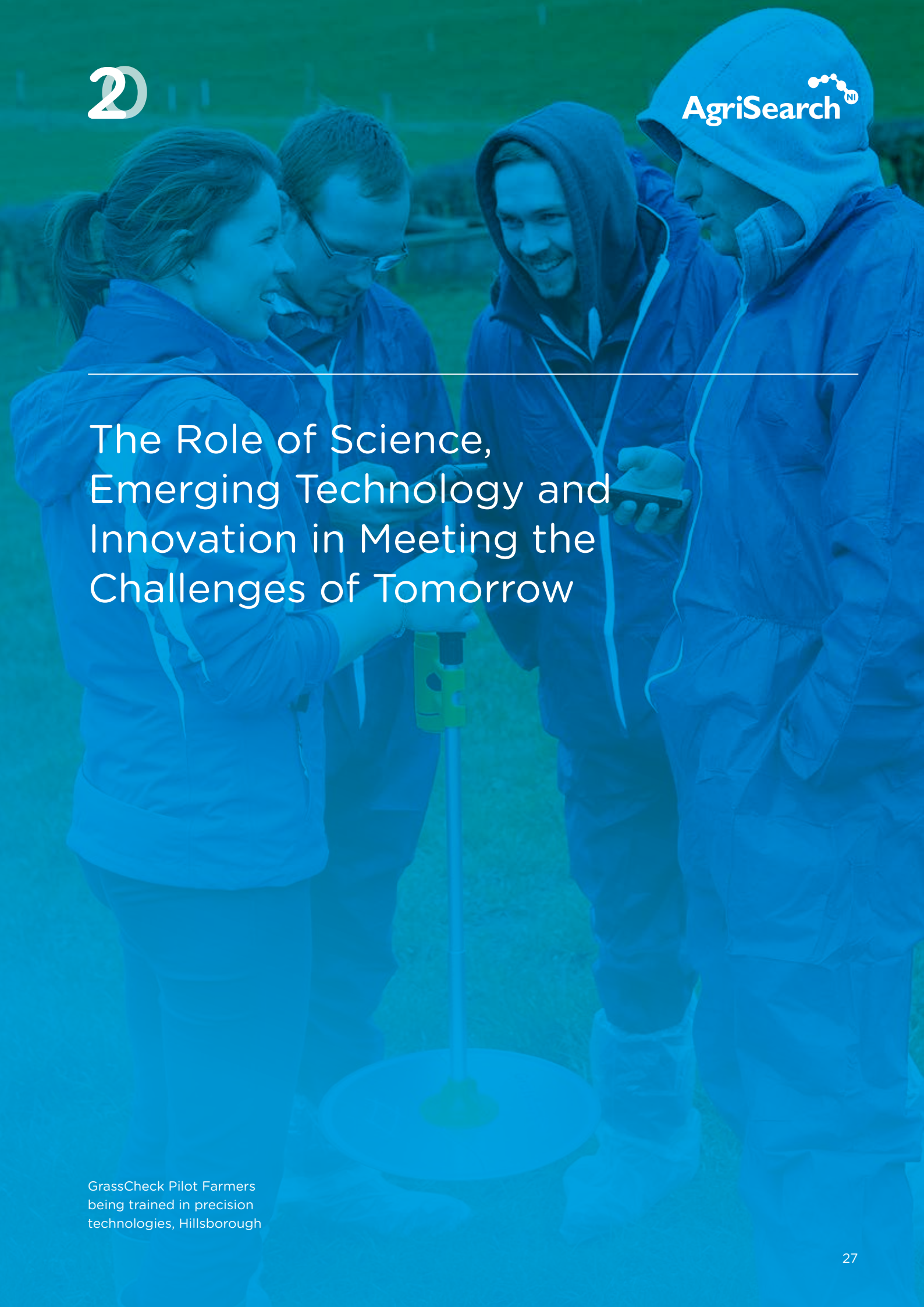
As a result farmers, and their banks, are increasingly interested in fixing a portion of their forward returns to avoid the downside risk of extreme price cycles. To reduce risk even further, farmers should be attempting to fix their margin over cost, rather than just their selling prices. This means fixing the price of their main input costs such as feed, fertiliser and energy at the same time as fixing their selling returns.

Volatility in agricultural produce is mainly down to supply fluctuations as demand is relatively stable. Supply, however, varies as a result of weather, seasonality, productivity improvements and farmers pursuing growth to reduce costs and improve returns. Farmers generally respond to price movements by increasing and decreasing their output as returns rise or fall. But delays in price movement information mean farmers can be increasing their output in response to perceived good returns when there is growing oversupply and falling spot prices.

"Farmers, and their banks, are increasingly interested in fixing a portion of their forward returns to avoid extreme price cycles."

This means that as well as fixing returns and costs through long term contracts and/or hedging, farmers need to better manage output in line with demand. To do so they need greater transparency on market activity and faster price transmission. Rather than trying to do this as individuals, cooperatives and groups can help in managing volatility. Government also has a key role to play in helping establish an effective futures market.

The Role of Science, Emerging Technology and Innovation in Meeting the Challenges of Tomorrow



GrassCheck Pilot Farmers being trained in precision technologies, Hillsborough

Steven Morrison
AFBI

Big data – the new power in livestock farming

"We use less than one per cent of all the data generated every day."

Data is generated by us every second of every day. This ranges from how we use our mobile phones, through what we buy in the supermarket to what we view on television and the internet. More data has been created in the past two years than in the entire history of the human race.

Just about every decision we make on the farm is data driven. It may be from past experiences, current performance or weather and market forecasts. What has changed in recent years is the quantity and diversity of the data.

More data is digitised and the speed at which decisions need to be made is greater. Bringing together and rapidly analysing these big data resources can provide knowledge and insight to improve decision making.

With the collaboration of the red meat processors in Northern Ireland, data from over 400,000 carcass records a year are collated and integrated in BovIS (Bovine Information System – online benchmarking system). This is backed with key information from APHIS. Simple to use, online tools allow producers to view, analyse and benchmark information. This includes animal growth rates and success or otherwise in achieving market specification. Results from ante and post mortem inspections and financial modelling will soon be included. This 'big data' revolution has been simplified into farmer friendly decision making support tools.

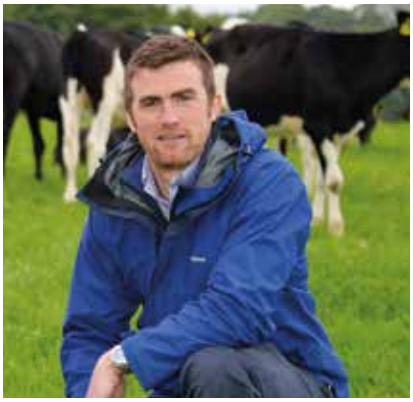
A Northern Ireland data hub could transform the breeding and management of livestock. Integration with land use strategies and new technologies, such as Lidar* and geo-tagged soil maps, could radically re-shape how we manage land to ensure sustainable food production and food security.

The continued growth of low cost scanning technologies will generate more and more data. Understanding what can be achieved by combining data from various sources and its use on everyday farms will challenge the livestock industry in the not too distant future.

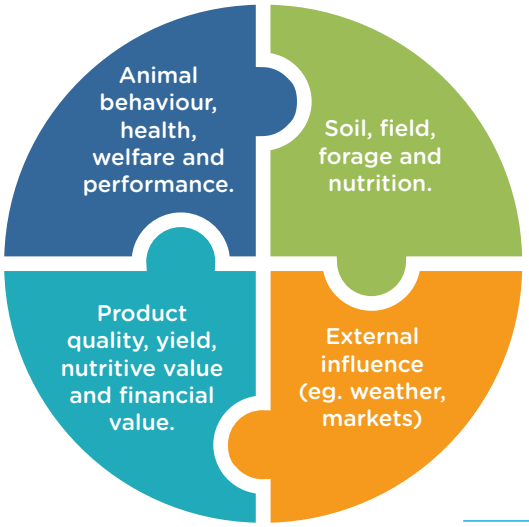
*Light Detection and Ranging – an aerial scan using laser technology to target water quality interventions and quantify carbon sequestration.

BovIS Benchmarking

	Weight (Kgs)	Fat	Grade	Age (Mnths)	Gain (Kgs/d)	In Spec (%)
Top 10% of Producers	384	3+	R+	21.3	0.60	58
All Producers	376	3=	R+	25.8	0.49	35



Connected Data



Data Analytics

- Deep insight and discovery
- Prediction and forecasting
- Optimisation through feedback

Impact

- Optimal land use
- Optimal genetics
- Optimal use of input resources
- Enhanced natural environment
- Improved product quality
- New product development
- Increased consumer confidence
- Enhanced marketability
- Increased profitability
- Increased employment

Across society we currently use less than one per cent of all the data generated every day. Imagine the future when we begin to harness the real power of the data available.

Could livestock diets and management be automatically tailored to the individual animal's DNA and gut microbiome, taking account of environmental considerations and the optimum market outlet?

Could farm, animal and market tailored veterinary medicine and health plans be based on optimum outcome forecasting?

Could land and resource use be optimised for sustainable intensification?

Could we better connect the consumer to primary production and deliver a transparent quality agenda?

Andrew Cromie
ICBF

Unleashing the genome – where genetics can take us

In the early 2000s dairy farmers, especially those with seasonal calving systems, were in a squeeze. They had highly productive Holstein Friesian cows, capable of producing 500 kg of milk solids per lactation, but infertility rates were at levels where these cows no longer fitted with production systems. The popular view was that these needed to change to match the cows. Others argued that if we had bred cows to be infertile, we had to be able to breed fertility back into them.

Step forward to 2017 and results from the Republic of Ireland. Initiatives such as profit indexes, national breeding programs and genomics have seen rates of genetic gain increase from zero in the early 2000s to almost €20 a year for dairy cows born in the last five years. This will be worth more than £550 million to the Irish dairy industry by 2022. That equates to eight pence a litre of extra profit. By then, Ireland will have a herd capable of producing 500 kg of milk solids per lactation in a seasonal production system, with an infertility rate of just eight per cent.

The role and impact of genetics and genomics will only increase as we move towards DNA based calf registration systems. These will facilitate a more accurate forecast of genomic evaluations of breeding stock from an early age. The cost/benefit will become clear as the cost of genotyping tumbles towards less than £10 per sample. Industry benefits will then be up to twenty times the cost of genotyping.

There will be an increasing focus on traits linked to environmental efficiency (greenhouse gas emissions), health, and animal welfare. These same traits are linked to profitability, as the animal of the future will need to be smaller, with more output per unit input and more resilient to infection. This will help address growing concerns about anti-microbial resistance in the food-supply chain. By breeding more resilient animals, we can help take control of this major threat to our very existence. The challenges will be around the accurate capture and consolidation of data into a central system, from which a genomics based breeding program can operate.

Even more radical technologies will emerge, including gene editing. The potential of having access to high genetic merit semen, where the genome was altered to deliver key traits, will be compelling. However, society's willingness to accept these technologies will be a topic of much debate. It is critical that we allow science to drive these discussions, in the same way it helped influence early discussions on improving the fertility of dairy cows.

"There will be an increasing focus on traits linked to environmental efficiency, health, and animal welfare."

Debbie McConnell
AFBI

Precision technology on the farm of the future

With advances in positioning systems, aerial technologies, and large scale data collection the potential for new technology to help better manage agriculture is vast. Technology development will bring the biggest step-change in farming in a generation. This will see fundamental changes in our understanding and management of soil, plants and animals. Embracing these will be key to improving technical efficiency and to building sustainable and competitive farm businesses.

Existing precision technologies are already bringing a number of benefits. Examples include the more efficient use of inputs such as labour through the use of robotics, feeding through identification and precision concentrate allocation and nutrients via variable rate fertiliser application.

These all help reduce input costs whilst maintaining output and that will automatically improve profitability. Technologies that aid individual cow management in large herds, and those that allow greater traceability will also help meet consumer demands for safe, high welfare, sustainably produced food.

"Key developments focus on better managing animals at pasture to maximise productivity from forage."

For Northern Ireland farmers, key developments in precision farming are those that focus on better managing animals at pasture to maximise productivity from forage. With a competitive advantage for highly productive grassland, Northern Ireland is perfectly placed to drive further efficiencies in livestock production systems through better use of forage.

AFBI's Precision Grassland Platform aims to advance our knowledge in managing the grazing environment. The platform is investigating a range of technologies to monitor variability in grassland productivity and utilisation, across both research environments and commercial farms.

Looking further to the future, much more can be done to optimise our management of cows at pasture. Core research is needed into concepts such as virtual fencing, individual nutrition at pasture, measuring individual dry matter intakes and real time data integration from the grazing environment.

All new techniques however bring challenges. Data from precision applications must be easily interpreted to help make better informed decisions. Consequently, a major priority for AFBI's Precision Grassland Platform at Hillsborough is to develop efficient decision support systems which integrate data from the various technologies and provide easily understood action lists and high level data summaries which simplify decision making at farm level.

John Gilliland
Sustainable Land Management
Strategy Working Group

The land first – optimising our most valuable resource

The Going for Growth report asked for the development of a Land Management Strategy for Northern Ireland. This led to the creation of an expert group that looked at the challenges of doing so. The goal was a policy that would increase economic output and boost farm profitability, while at the same time also improving environmental performance. The group included farmers, since they will have to deliver most, but not all, of the changes needed to deliver a sustainable land-based agriculture sector.

A review of current structures and performance was helped by having access to quality research available locally. Much of this was farmer-funded through AgriSearch. Key evidence that guided our deliberations included;

- The significant gap between current grass utilisation (5 tonnes of dry matter per hectare per year) and potential yield (an average of 9.5 tonnes is achievable with many farms capable of producing in excess of 12 tonnes)
- The 48 per cent reduction in milk produced from forage between 2000 and 2015
- The lack of routine soil analysis on around 90 per cent of agricultural land and the consequent deficiency in soil pH
- The high proportion (30 per cent) of agricultural land without security of tenure beyond an 11 month conacre lease

Taking account of the evidence, the Expert Group agreed proposals for;

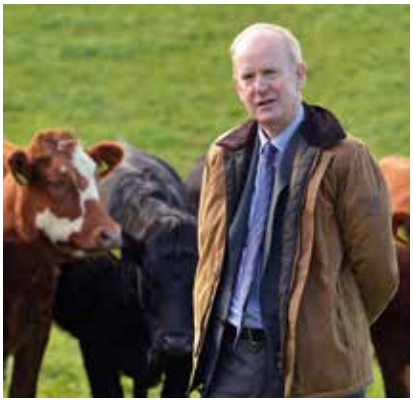
- **GPS soil sampling and analysis across Northern Ireland**
- **A full aerial scan using laser technology (LiDAR) to target water quality interventions and quantify carbon sequestration**
- **Water quality monitoring**
- **An online tool to provide access to soil analysis results and other key information**
- **Liming to optimise pH on agricultural land**
- **Better nutrient management on farms**
- **An "advocacy first" approach to environmental governance**
- **A fiscal incentive to encourage longer term leases of at least five years**

"An effective land management strategy will deliver clear and tangible benefits for farm profitability and the environment."

There are clear and tangible benefits for farm profitability and the environment if farmers and government can implement this integrated approach. Utilising an extra tonne of better quality grass will increase profitability by around £300 per hectare per year on dairy farms and up to £200 on beef farms. This approach would also have significant environmental benefits, with whole farm phosphorus balances reduced by at least 60 per cent.

The report also highlighted a number of knowledge gaps. These included whether new technologies such as soil potentiometers could support an approach where nutrient is applied based on soil conditions, not calendar date; the need for research into how slurries and manures can be transferred between farms while protecting biosecurity. As we look towards the next 20 years of AgriSearch, addressing practical issues that boost both the profitability and the reputationof our farming sector will remain a crucial part of its mission.

Sinclair Mayne
AFBI



Rediscovering the potential of grazed grass

Northern Ireland has a natural advantage when compared to many other livestock production areas – our ability to grow high yields of grass (up to 15 t DM/ha) at relatively low cost.

We must capitalise on this to the full if we are to remain competitive in dairy, beef and sheep production, particularly since subsidy support is likely to reduce post-Brexit.

On well managed dairy farms, utilised grass yields of over 12 t DM/ha have been recorded, but average levels of grass utilisation on Northern Ireland farms are well below potential. These are typically 7.5 t DM/ha on dairy farms and 4.1 t DM/ha on beef and sheep farms.

AFBI research has shown that improving grass utilisation by 1 t DM/ha, combined with improving grass quality by grazing at the correct stage, can boost the margin over feed costs by around £330/ha on dairy farms or £200/ha on beef farms.

This increased margin can be achieved with minimal capital investment. That means it translates directly into increased farm profitability – £13,200 for a 40 ha dairy farm and £8000 for a 40 ha beef or sheep farm.

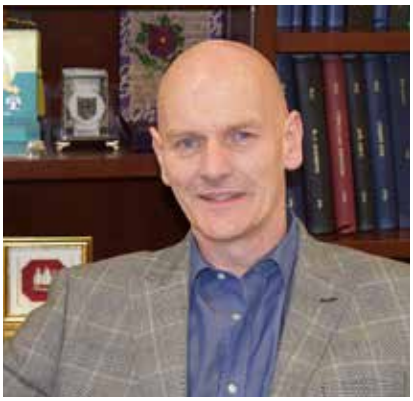
The majority of farms in Northern Ireland can grow and utilise more grass under grazing, irrespective of whether a low or a high input production system is used. Attention to detail and regular grass measurement is critical, but the financial return from increased grass utilisation represents one of the greatest opportunities to improve overall farm profitability.

> **"This translates directly into increased farm profitability, with minimal investment. "**

Achieving the full potential of grazed grass involves growing high yields and grazing at the correct stage, under a well-managed rotational grazing system. The key components of that system are:

- **Ensure correct soil nutrient status through regular soil analysis (once every three to four years)**
- **Optimise manure and fertiliser use based on soil analysis (focus particularly on nitrogen, potash and sulphur)**
- **Maintain a high perennial ryegrass content in grass swards (include clover particularly if using less than 100kg N/ha)**
- **Develop a well-managed rotational grazing system (daily paddocks for dairy cows, two to three day paddocks for beef cattle)**
- **Ensure early turnout in spring to maximise grass growth and quality (a range of techniques are available to enable grazing in wet conditions on heavy soils)**
- **Monitor grass growth and quality through the season. AgriSearch Grass Check provides weekly data on grass growth across NI. Use this in conjunction with regular sward measurement to develop an effective grass budget (grazing wedge) through the season.**
- **Avoid strong grass covers. Aim to graze leafy swards (around 3000 kg DM/ha) with a post grazing residual of 1600 kg DM/ha and remove any strong swards for silage.**
- **Close paddocks from early October onward with all paddocks closed by mid November.**

Chris Elliott
Queen's University, Belfast



The future of food

There has never been a more important time to reflect on how we produce food in Northern Ireland. We must accept that the future will be built on radical changes to what we have always done.

We pride ourselves, quite rightly, on high quality, safe and traceable products. While some of our food is sold around the world the biggest share of what we produce is sold within the UK. There the multiple retailers are king and supermarket price wars show no signs of easing. The pressure on the food chain to continually cut costs has never been more fierce.

The future of food must be the focal point for politicians, academics and most of all the industry. Farmers and food processors must adapt – not to stand still, but to grow in a harshly competitive market place.

I believe firmly that we should not be fixed on the idea that producing more for less is the only way forward. The implementation of new technologies and practices that reduce the industry's cost base are important. But there must be much more than this if we want a strategy that will work.

"We must build a unique brand built on the pillars of trust."

Over recent years we have successfully introduced the Food Fortress concept to give us the world's most secure ingredient and food supply chain. This should be seen as a foundation to build a global reputation for having the world's most trusted food. This is against a background of growing evidence that in many parts of the world consumers have lost trust in the food they eat. Food scandals, scares, confusing customers with misleading claims and most of all the loss of connection between how and where food is produced all contribute to this sad state of affairs.

We must build a unique brand for Northern Ireland food, built on the pillars of trust. While this may seem straight forward this is far from the case. To prove every aspect of our food has been produced to the highest standards of integrity is an enormous challenge, but it is one I believe we can meet.

We need a world leading traceability system from 'farm to fork' that is transparent to anyone, anywhere in the world. Central to this is that we need to control all ingredients we import. Our collective goal must be to produce food that is not only safe and authentic but is a real pleasure to eat while helping to support a healthy lifestyle.

At Queen's University, and in particular within our Institute for Global Food Security, we have world leading researchers eager and willing to help build our new brand of food. We welcome the challenges and huge opportunities ahead. We want to work alongside our farmers and processors to deliver the food of the future.

Justin McCarthy
Irish Farmers Journal

Creating a thirst for knowledge in the ruminant livestock sector

Someone advised me, when starting work with the Irish Farmers Journal, to try to write as though your audience are school children. This was not meant as an insult to the readers. Instead, it highlighted the importance of making sure technical advice is communicated in language that can be understood. This is central to research being successfully put into practice.

Most of us have read articles or attended meetings where the words blur into one another and the mind wanders. The chances then of the messages being understood are remote and the likelihood of the technology being adopted is non-existent.

Making the message understandable is vital. But it is just as important there is a thirst for knowledge within the audience. This begins with ensuring research is relevant, can be applied in practice on farms and most importantly will improve the finances of the farm business. Farmers must ensure the agenda is not set solely by scientists. The structure of AgriSearch, where farmers feed into the development of the research programmes, is a positive.

Even with good, relevant research there remains the challenge of communication. It is rare to find a researcher that can stand up in front of a group of farmers and present their findings in a way that farmers can understand well enough to take home and apply. This is not a reflection of their academic ability, but instead because the researcher is often so close to the subject matter – a classic case of not seeing the wood for the trees.

Assuming the communication is good, the problem often reflects some fear within the farm business. These are low margin family businesses. The risk of acting on advice that is perhaps not fully understood is a real barrier. The easier option is to stick with the herd, keep the head down and to wait and see what others do, but that is not a recipe for advancement. Much can be achieved simply by drawing from the existing bank of research knowledge that is available to all - but presented in a more practical way. Farmers who take up the advice can effectively become ambassadors for technical efficiency.

> **"There's a job to be done to make science simple."**

Change will only come if we can demonstrate in practical ways that technical efficiency does pay. One of the most successful has been through joint initiatives such as the Northern Ireland beef programme, in conjunction with the ABP Food Group and CAFRE. The farmers in this programme have become ambassadors for technical efficiency. Programmes like this underline that technical efficiency does pay, and that farmers will respond when they fully understand the message.

Photograph courtesy of Irish Farmers Journal

Dr Sharon Huws
Queens University Belfast

Biotech diagnostics – bringing molecular techniques inside the farm gate

Biotechnology involves technologies that beneficially alter a product. Many of the advances in biotechnology have occurred in the agricultural sector, resulting in beneficial changes in forage/food plants and livestock animals. Whilst biotechnology has enhanced agricultural practices since the early 20th century, the main biotechnological advances have occurred since the genomic era (early 1990s onwards). With World population growth set to double by 2050, biotechnological advances are key for ensuring future food security.

Plant based biotechnological advances

The development of genetically modified (GM) plants with enhanced growth/disease resistance/stress tolerance etc. in countries where the technology is legally adopted has enhanced the productivity of many agricultural crops, such as soya and corn. Within the EU the use of non-GM selective breeding technologies has also led to greatly enhanced forage crops, for example high sugar grasses developed by Aberystwyth University that enhance ruminant production. New technologies, especially CRISPR-cas9 are currently revolutionising our ability to precisely modify food crops, and livestock animals, resulting in enhanced characteristics in countries employing GM technology. In the EU, CRISPR-cas9 still allows researchers within the agricultural sector to test gene associations with certain beneficial traits and develop non-GM methodologies. Indeed, enhanced understanding of potential genes underlying beneficial plant characteristics will lead to improved selective breeding alongside better breeding goals which emerge from understanding interactions with soil and the animal.

Animal based biotechnological advances

The ability to genotype livestock animals in the last 20 years has allowed the development of technologies to associate genes with beneficial characteristics such as high fertility, easy calving, high milk yield/growth. This has led to the development of Estimated Breeding Values (EBVs) for sire characteristics, allowing farmers to make informed decisions for better breeding resulting in farm livestock improvements. Whilst utilising the best genomics is important, it is also critical to manage diseases effectively. Treatment of plant and animal diseases is an increasing challenge due to the increased incidence of antimicrobial resistance (AMR). Therefore, the development of novel strategies to circumvent the increase in AMR is critical e.g development of novel antimicrobials, including vaccines. One recent example of a biotechnological advancement in this area is the pig circovirus vaccine (PCV2) developed in Queens University Belfast and the Agri-food and Biosciences Institute in Northern Ireland. Porcine circovirus causes postweaning multisystemic wasting syndrome, manifesting in poor growth rate, ill thrift, and/or wasting, and eventually death across the World. Therefore, the availability

of the vaccine has significantly enhanced pig production globally. Treatment of parasites, such as liver fluke has also become increasingly challenging due to the increase in AMR. As such vaccines are currently under development against liver fluke, alongside other livestock parasites.

"New technologies are currently revolutionising our ability to precisely modify food crops, and livestock animals, resulting in enhanced characteristics."

Microbiome research

The microbiome constitutes the genetic components contributing to the surrounding microbiological activity. Recent research suggests that having an optimal soil microbiome can lead to enhanced forage yield and even to the enhanced ability to withstand disease. Likewise, the microbiome found within the rumen is linked to efficiency of ruminant production and the quality/healthiness of milk and meat produced. Whilst microbiome research has advanced due to developments in sequencing technologies, the field is in it's infancy. Nonetheless, defining the optimum soil or rumen microbiome has huge potential for further improving upon advances made through breeding, thus meriting further study.

Conclusions

Future food security is reliant on future biotechnological advances. These advances will likely involve improved breeding, further development of antimicrobials including vaccines, and understanding the role that microbiomes play in the agricultural sector.

Conclusion: Call to action

"We must take change by the hand or, rest assuredly, change will take us by the throat."

This quote from Sir Winston Churchill has never been so relevant to the agri-food sector. As has been highlighted by the authors of this publication we face numerous challenges and live in rapidly changing and 'interesting' times.

Modern science and innovation can address many of these challenges. Big data, genomics and precision technologies can all improve our production efficiency and lower agriculture's environmental foot print. These gains boost animal health and welfare and so reduce the use of antibiotics.

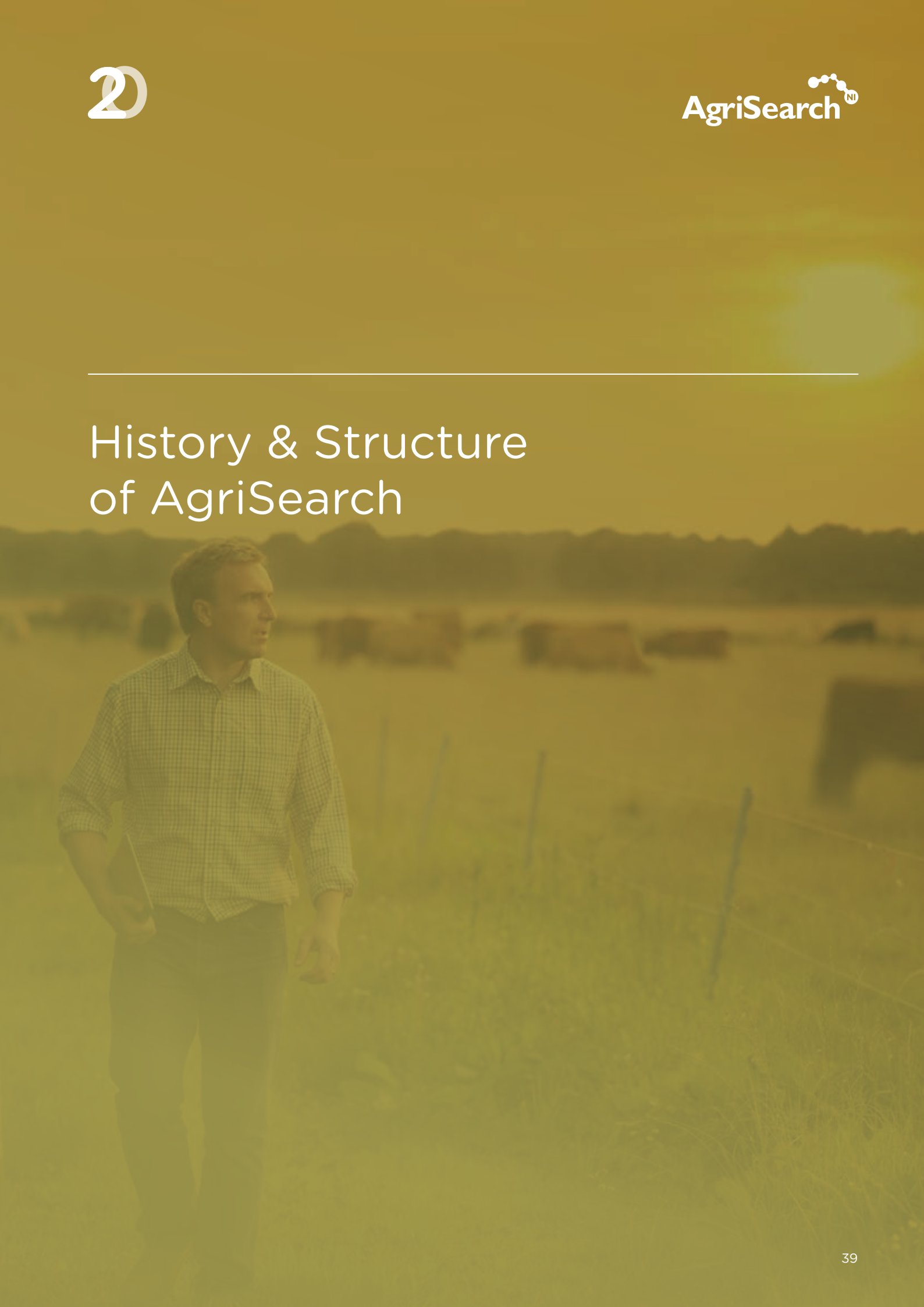
Maximising the use of grass will maximise the profitability of our ruminant livestock systems. However, our changing climate presents challenges. AgriSearch is alive to these issues and its flagship 'GrassCheck' programme and other research initiatives are designed to meet these challenges.

Other issues are more difficult but working in partnership with other industry organisations AgriSearch can help deliver the necessary research and innovation to tackle these key challenges. AgriSearch has always supported the 'multi-actor' approach. The Agri-Food Quest Competence Centre has driven greater co-operation across the supply chain and is worthy of further support.

Knowledge exchange and farmer take-up are vital and AgriSearch is focussed on improving this process. It is safe to say that in the future more resources will be allocated to communication and knowledge exchange. AgriSearch is an organisation with limited resources but by engaging with a wide spectrum of industry and government partners we can maximise the reach and impact of research information.

AgriSearch is a small organisation with big ambitions for our industry. Only by working with our research partners, our enthusiastic team of farmer co-researchers, the agri-food industry, veterinarians and government can we hope to achieve our aim. That is, as it has been from the start 20 years ago – *To make the Northern Ireland ruminant livestock sector more competitive, profitable and sustainable.*

History & Structure of AgriSearch



History – formative stages at the end of the 20th Century

The mid-1990s policy that 'near market' research should be paid for by industry rather than by government led to the closure of several agricultural research facilities in Great Britain seen as overly-academic in their output. A proposition was put to the Ulster Farmers' Union that if farmers contributed part of the funding, public money would continue to be made available.

To avail of this, it was necessary to have a local organisation to commission research. It would allocate funds raised from a levy on each litre of milk and on all cattle and sheep sold to processors.

The directors of the new organisation came from the farm organisations and one appointee from the Department of Agriculture, with an independent chair adding commercial business experience.

"A key asset of AgriSearch is facilitating on-farm research."

They set the following guiding principles:

- every penny collected would be spent on research and development and knowledge transfer
- producers to have full control of the spending of the levies
- funds collected for a particular sector to be spent on that sector
- costs of R&D commitments should not exceed money already collected
- R&D must have a practical benefit for primary producers
- Avoid duplication of existing R&D work
- Get maximum leverage from complementary funding sources

Early in the new millennium, the Agricultural Research and Development Council achieved charitable status and adopted the trading name 'AgriSearch'. Its trustees continued the guiding principles.

With levies unchanged during its first ten years, AgriSearch had brought in £4.2 million by March 2007 and committed £3.7 million across 60 projects. That was around a third of the cost of these projects. The introduction in 2009 of the DARD Evidence and Innovation (E&I) strategy brought clarity on the direction of agricultural research. In time, there was a renewed focus on 'food security'.

New Challenges And Opportunities

The launch of the Research Challenge Fund (RCF) in 2010 offered 50 per cent co-funding from government for projects subject to a competitive bidding process. AgriSearch had to rise to the challenge of being a 'lead partner', working with research providers. This brought substantial administrative demands. The RCF also required 'knowledge transfer' events where the results of research could be disseminated to farmers. This tied in with a core objective of AgriSearch.

Across all funding streams there is now a requirement for active industry involvement. Collaborative projects are becoming more common and this trend will grow. A key asset of AgriSearch is the industry engagement it can bring, particularly facilitating on-farm research.

The transformed operating environment for research, development and innovation has been seized upon by AgriSearch. It has moved from being solely a co-funder to a more active participant in a wide range of innovative projects. This involves farmers as co-researchers and participants in knowledge exchange, bringing research closer to on the ground farming. Farmers now have a voice and role in research projects that give them the tools and information they need to compete in an ever-changing world.

Co-authors

James Campbell
David Dobbin
William Yarr



Structure of AgriSearch

Governance

AgriSearch is managed by a Board of Trustees, made up of representatives nominated by the Ulster Farmers Union (3), Northern Ireland Meat Exporters Association (1), Dairy UK (1) as well as three independent farmers and five independent trustees selected for their range of skills and experience. The posts of Chair, Vice-Chair and Senior Vice-Chair are independent trustees serving on a two-year rotation.

AgriSearch has beef, dairy and sheep advisory committees. These are made up primarily of farmers. Each also has a representative appointed by the processing sector (DairyUK / NIMEA) and an independent scientific expert. The Livestock and Meat Commission also nominates representatives to sit on the Beef and Sheep Advisory Committees. CAFRE (College of Agriculture Food and Rural Enterprise) also has a non-voting nominee on each committee. Each advisory committee appoints its own Chair and Vice-Chair once every three years.

Any research proposal must benefit farmers by:

- **Reducing costs**
- **Improving performance**
- **Driving innovation**
- **Improving welfare**
- **Improving the environment**

The role of the advisory committees is to:

- **Identify areas/topics requiring further research**
- **Review proposals from research organisations**
- **Recommend proposals for funding**
- **Review progress by researchers**
- **Monitor and advise on knowledge transfer**

Research Projects Funded by AgriSearch
Dairy Farming

- Improving Milk Composition In The Dairy Herd
- Development Of Improved Methods For Rationing Dairy Cattle
- Developing Improved Heifer Rearing Systems
- A Comparison of Four Contrasting Milk Production Systems For Winter Calving High Genetic Merit Cows
- Survivability Of Dairy Cattle And The Factors Which Influence This On The Farm
- Dairy Herd Fertility – Examination Of Effects Of Increasing Genetic Merit And Other Herd Factors On Reproductive Performance
- On Farm Monitoring Of Grass Growth, Grass Quality and Herbage Intakes Of Dairy Cows In Northern Ireland - Grass Check 1
- The Effectiveness Of A Range Of Time-Temperature Pasteurisation Combinations
- To Assess The Potential Of The Norwegian (NRF) Breed As A Means Of Improving The Fertility And Health Status Of The Northern Ireland Dairy Herd (NRF Comparison)
- An Examination Of The Potential Contribution Of Cross Breeding To Improve The Profitability Of Dairying In Northern Ireland
- Expanding Output Efficiently In Environmentally Friendly Systems
- Achieving High Milk Production At Pasture (Postgraduate Studentship)
- Optimum Northern Ireland Milk Production Systems, with Milk Prices Between 16 and 21ppl
- Developing Supplementation Strategies For Dairy Cows
- Footbath design and use
- Alternative Forages for Dairy Cattle
- Low Input Forages for Dairy Cow production Systems
- Grass Check II
- Strategies for Reducing Lameness in Northern Ireland Dairy Herds
- Investigate if MAP can survive the spray drying process
- Development of Methodology to enable prediction of actual Manure N output from Dairy Cows in NVZ's in Northern Ireland
- Measurement of grass growth and utilisation and herd performance to enable the development and implementation of decision support systems to optimise performance in different regions in Northern Ireland
- Asessing Global Research for Dairy Farmers
- Relationships between nutrition and immune function in dairy cows, and their impact on cow health and fertility, with particular reference to uterine health.
- GrassCheck V – Grass growth monitoring and the provison of information to improve grassland utilisation efficiency
- The role of higher protein forages and home grown protein sources with Northern Ireland dairy systems
- Economics, dynamics, and diagnosis of bovine herpesvirus 1 (BoHV-1) infection in dairy herds in Northern Ireland
- An examination of late lactation management strategies to impove the body condition score of thin cows, and the effects of these strategies on cow performance during the subsequent lactation
- Evaulation (pilot study) of a new technological approach to improving the detection of sub-clinical mastitis in cows and an adjunct to SCC
- Evaluation of prediction accuracy of milk mid-infrared spectroscopy technique for feeding efficiency and methane emmissions from dairy cows using AFBI calorimeter data
- The role of higher protein forages and home grown protein grains within Northern Ireland dairy systems
- Providing strategic direction to the NI dairy sector through the interrogation of the CAFRE benchmarking database
- The role of confinement, partial confinement and zero grazing systems within the NI dairy sector and the identification of strategies to optimise these systems
- Efficient, innovative and sustainable heifer rearing systems: imprivng efficiencies through the utilisation of precision technologies and an enhancd understanding of the nutrient requirement of dairy youngstock
- GrassCheck VI – Grass growth and quality monitoring
- EuroDairy: a pan-European network for dairy farming
- Impact of rearing regime on the performance, behaviour, health and welfare of dairy origin calves
- Enhancing precision within winter feeding systems for dairy cows
- Plasmafluidic Paper-Based Analytical Device: A rapid point-of-sampling diagnostic and management support platform of infectious and antimicrobial resistant pathogens.
- Recovery and recycling of phosphorus from waste.
- GrassCheck VII – Grass growth and quality monitoring
- Novel renewable sorbents for removal and recovery of nitrogen from waste.
- Animal and processing factors associated with the therapeutic and performance enhancing properties of bovine colostrum for human consumption.
- Understanding barriers to improving grass utilisation and milk from forage

Research Projects Funded by AgriSearch
Beef Farming

Factors affecting the dirtiness of finished beef cattle
Effect of Housing System on Behaviour Welfare and Performance
Effects of Genotype of Beef Cows and Terminal Sires on Quality of Progeny and Suitability for Different Market Outlets
Effect of Slaughter weight on Efficiency of Lean Meat Production from Holstein Bull Calves and on the Quality of Processed Meat from Their Carcasses and its Suitability for Markets
Increasing the Lifetime Growth Rates of Beef Cattle
Maximising Beef Output From the Suckler Herd Through Production of Heavy Suckler Bulls.
Low input forages for beef production
Contribution of meat from grass fed ruminants to the total human diteary intake of long chain n-3 polyunsaturated fatty acids.
Developing sustainable systems of beef production from the suckler herd - Funding Reallocated to BS-55-11
Development of genetics/ management recording system for the Northern Ireland beef industry.
Evaluation of efficiency of beef systems based on cattle sourced from the dairy herd
Environmental implications of livestock grazing on a range of differing LFA environments
An evalution of mid and late pregnancy feeding strategies for managing conditon scorfe of spring calving suckler cows and their subsequent reproductive performance and progeny performance.
Pilot Study on the use of syncronisation on sucker farms
An evaluation of the ability to improve output of the Northern Ireland suckler herd through novel breeding methods coupled with high genetic merit sires
An evaluation of grouping and housing systems for Northern Ireland beef cattle
Mart Data Project (BovIS enhancement)
On-farm research to direct low carbon beef production in the Northern Ireland beef industry.
Reviewing Beef Nutritional Standards
Development of systems to improve dairy origin beef young stock health and performance
Beef from Grass: An evaluation of beef grazing systems and trace element supplementation within suckler beef production.

Research Projects Funded by AgriSearch
Sheep Farming

Effects of Genetics of Cross-Bred Lowland Ewes and Terminal Sires on Lamb Output and Carcass Quality
Developing Low Cost "Natural Care" Systems of Sheep Production
Low-Cost Easy Care Lambing Systems II
Improved Ewes for the Hill Sheep Sector Through Cross Breeding
Low-Cost Easy Care Lambing Systems III
Improved Worm Control Strategies for Sheep in the Hill and Lowland Sectors
Improved Ewes for the Hill Sheep Sector Through Cross Breeding II
Improved Worm Control Strategies for Sheep in the Hill and Lowland Sectors II
Developing Management Systems for Easy Care Sheep Production
Long Term Economic Consequences of Maintaining Crossbred Ewes in the Hill Sector
Environmental Consequences of Maintaining Ewes in the Hill Sector
Selecting for Easy Care Traits in Lowland Sheep Flocks
Developing breeding and management strategies to reduce lameness in the NI sheep industry
Research to evaluate the factors influencing the rates of adoption of sheep research in the NI sheep industry
Development of sheep breeding strategies for sustainable sheep systems
Developments in breeding strategies to further improve the production efficiency of hill and lowland sheep systems.
Investigation Of The Relationship Between Genotype, Trace Element Status And Gastrointestinal Parasite Infections In Lambs, And The Development Of Nutritional And Management Strategies To Increase Lamb Output From Grazed Grass. FINAL
Genetics of one-carbon metabolism in sheep in relation to productivity, fertility and health
Provision of a ewe-recording service to the Northern Ireland Sheep Industry (Hillsborough Recording Scheme)
Development of a field guide to lameness diagnosis and treatment in sheep
Feed into Lamb (FIL): an investigation of the metabolisable energy requirements of sheep
Review and pilot study to assess the robustness of an EID recording system
Development of OvIS (Ovine Information System)

Research Projects Funded by AgriSearch
Sheep Farming

On-Farm Sheep Breeding Research
RamCompare
Detecting JRSV in a Thin Ewe Diagnostic Package
Optimising ewe efficiency through better recording
Provision of a ewe recording service to the NI sheep industry using mobile applications
Impact of sheep grazing systems and genotypes on grass utilisation, performance and health on lowland and upland pasture.

Research Projects Funded by AgriSearch
Combined Projects

Calf Growth Rates (Management and Nutrition of Calves during the Neonatal Period)
Reducing Organic Nitrogen Output From Dairy Cows And Beef Cattle In Nitrate Vulnerable Zones (NVZ Study)
Economic Evaluation of Holstein Bull Beef Production
Maximising returns from Beef Progeny sourced in the Dairy Herd
Using Information to Reduce Costs (Covering Dairy, Beef and Sheep Sectors)
FGS McClure Watters - Appraisal of Research
Avoidance of Botulism in Cattle
A review on the effect of legumes on ewe and cow fertility
Study to determine the prevalance on Northern Ireland suckler adn dairy herds with evidence of current or recent infection with BVD virus.
Identifiying the limiting factors in beef and sheep systems and undertaking reesearch to underpin improved biological efficiency and financial performance to support, productivity, sustainability & competitiveness
Development of beef and sheep systems for improvbed sustainability biodiversity and delivery of ecosystem services within hill areas of Northern Ireland
Improving the control of liverfluke infection in cattle in the UK
Relationship to characterise the development of immunocompetence from brith to weaning in artificially reares dairy and suckled beef calves, differing in neonatal passive immunity.
Rumen fluke
Establishment of nitrogen fertiliser recommendations for grassland and arable land within Northern Irelandm including a critique of RB209 8th Edition recommendations
Impact of compaction on soil quality and nutrient availability for sustainable and competitive production in grassland and arable farming systems in Northern Ireland
AFSB / AbacusBio Report - Outline Business Case for a NI Livestock Industries Data Hub
Support for AHWNI BVD Eradication Scheme
Development of a Business Case for a NI Livestock Industries Data Hub

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