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BEEF 2016 - Profitable Technologies

Teagasc Technology Foresight 2035
Succession and inheritance
Dietary whey protein with a new facelift

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Technologies and innovations to increase the sustainability of the Irish beef industry

The beef sector is among the most important Irish indigenous industries. There are more than 100,000 farms contributing to beef production in Ireland. The Irish sector is mainly broken into suckler producers, fatteners and cattle finishers, with about 1.75 million head of cattle sent for slaughter in Irish meat processing plants and slaughterhouses annually. In 2015, cattle accounted for 39% of the gross output of the agriculture sector (excluding forage). Beef exports in 2015 amounted to 22% of total agri-food exports, worth €2.38 billion, representing a 51% increase in value compared to 2010.

Global forecasts indicate increased demand for protein, in particular protein from meat, and increased economic prosperity in many emerging markets presents opportunities for increased exports of high-quality, safe and sustainable Irish beef to international markets. The strong reputation of Irish grass-based beef production in traditional markets is an asset that can be further exploited and leveraged in the period to 2025 to achieve greater penetration of high-value markets, both in the EU and internationally.

The continued development of the Irish beef industry will depend on the development of new technologies and innovations because of the increased importance of globalisation and competitiveness. New technologies and innovations in the area of precision farming, animal genomics and grassland science will be of significant benefit. This special issue of *TResearch* focuses on how these technologies can help beef farmers to operate more sustainable farm businesses, overcome the challenge of market price volatility and provide adequate reward to their farm families. Additionally, these technologies will ensure that beef production systems will continue to meet the highest international standards of food safety and quality, be animal welfare friendly and environmentally sustainable.



Pat Dillon,
Head of Animal & Grassland
Research and Innovation
Programme, Teagasc

Teicneolaíochtaí agus nuálaíocht chun inbhuanaitheacht thionscal mairteola na hÉireann a mhéadú

Tá eanáil na mairteola ar cheann de na tionscail dhúchasacha is tábhachtaí in Éirinn. Tá os cionn céad míle feirm a chuireann le táirgeadh mairteola in Éirinn. Tá eanáil na hÉireann roinnte den chuid is mó ina dtáirgeoirí laonna, ramhraitheoirí agus ina gcríochnaitheoirí eallaí, agus cuirtear thart ar 1.75 milliún eallach lena marú i monarchana próiseála feola agus seamlais gach bliain. In 2015, ba ionann líon na n-eallaí agus 39% d'aschur comhlán eanáil na talmhaíochta (gan foráiste san áireamh). Ba ionann na heaspórtálacha mairteola in 2015 agus 22% d'iomlán na n-easpórtálacha agraibhia, arbh fiú €2.38 billiún iad, arb é sin méadú 51% ar an luach i gcomparáid le 2010.

Léirítear i dtuartha domhanda go bhfuil méadú tagtha ar an éileamh ar phróitéin, go háirithe ó fheoil, agus léirítear deiseanna leis an méadú ar an rathúnas eacnamaíoch ina lán margaí atá ag teacht chun cinn d'easpórtálacha méadaithe de mhairteoil Éireannach ar ardchaighdeán, shábháilte agus inbhuanaithe ar mhargaí idirnáisiúnta. Tá an cháil láidir a bhaineann le táirgeadh mairteola féarbhunaithe na hÉireann i margaí traidisiúnta ina hacmhainn ar féidir é a shaothrú agus a ghiarail tuilleadh sna margaí traidisiúnta sa tréimhse go dtí 2025 chun lena cur i bhfeidhm tuilleadh ar mhargaí ardluacha i margaí an AE agus idirnáisiúnta araon. Braithfidh forbairt leanúnach thionscal mairteola na hÉireann go mór ar fhorbairt teicneolaíochtaí agus nuálaíochtaí úra i ngeall ar an tábhacht mhéadaithe atá curtha ar dhomhandú agus ar iomaíochas. Beidh teicneolaíochtaí agus nuálaíochtaí úra sa réimse feirmeoireachta beaichte, géanómaíocht ainmhithe agus eolaíocht féaraigh ina mbuntáiste suntasach. Dirítear san eisiúint speisialta de *TResearch* ar an dóigh ar féidir leis na teicneolaíochtaí sin cuidiú le feirmeoirí mairteola gnóthaí feirmeoireachta níos inbhuanaithe a oibriú, an dúshlán a bhaineann le luaineacht margadhphraghsanna a sháru agus luach saothair dóthanach a chur ar fáil dá dteaghlach feirme. Lena chois sin, cinnteofar leis na teicneolaíochtaí sin go leanfaidh na córais táirgthe mairteola leis na caighdeáin idirnáisiúnta is airde a bhaint amach maidir le sábháilteacht agus cáilíocht bhia, nach ndéanfaidh siad dochar do leas ainmhithe agus go mbeidh siad inbhuanaithe ó thaobh an chomhshaoil de.

Pat Dillon,
Ceann an Chláir um Thaighde
agus Nuálaíochta Ainmhithe &
Féaraigh, Teagasc

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Karen Daly



Karen Daly has worked as a Research Officer at the Crops, Environment and Land Use (CELU) Research Programme at Teagasc, Johnstown Castle since 1999. As a Research Officer within ESU, Karen leads a programme of research in soil and catchment science. The aim of Karen's research is the improvement of nutrient-use efficiency and the protection of water quality. As such, her work draws on her training and expertise in soil chemistry and spatial modelling, and has provided the scientific evidence for delineating mineral and peat soils in Teagasc's nutrient advice for grassland and in current statutory instruments for the protection of water quality. Karen also worked on the benchmark catchment project 'Eutrophication from Agricultural Sources', which laid the foundation for the current Agricultural Catchments Programme at Teagasc and was project leader on three strands of phosphorus modelling research that differentiated wet and dry soils in terms of catchment scale phosphorus loss. Current catchment work includes Department of Agriculture, Food and the Marine-funded research on high status water bodies in Ireland to support sustainable farming in sensitive catchments and collaboration with staff in ACP on soil chemistry. Her interest in soil has extended to soil mapping and Karen led the scoping study for the recently completed Soil Information System for Ireland. Her current soil work has now expanded into soil sensing using emerging technologies and current projects include the application of spectroscopy to predict soil fertility and crop quality. Karen graduated with an Honours BA in Chemistry from Trinity College Dublin (TCD) in 1990. She followed this with an MSc in Synthetic Organic Chemistry from TCD and joined Dublin City Council as an Environmental Chemist for four years before joining Teagasc as a Walsh Fellow in 1996 to begin her PhD studies. Karen completed a PhD in Environmental Science at TCD and completed a FETAC Level 6 Certificate in Managing People in 2015.

Karen's research currently involves supervision of five PhD students and two post-doctorate fellows and involves collaboration across Teagasc with researchers at Oak Park, Ashtown and Athenry, and with universities including the National University of Ireland Galway, University College Dublin, Queen's University Belfast and University of Limerick.

Teagasc Technology Foresight 2035 launch



Pictured at the Teagasc Technology Foresight 2035 launch are (from left): Banning Garrett, Washington-based strategic thinker, writer and entrepreneur, and founding director of Atlantic Council's Strategic Foresight Initiative; Aidan O'Driscoll, Secretary General, Department of Agriculture, Food and the Marine; Janet Bainbridge, OBE, CEO, Agricultural Technology (Inward Investment and Trade), UK Trade & Investment; Frank O'Mara, Director of Research, Teagasc; Lance O'Brien, Foresight and Strategy Manager, Teagasc.

Padraig O'Kiely awarded Teagasc Gold Medal



Gold Medal winner Padraig O'Kiely being presented with his medal by Noel Cawley, Teagasc Chairman.

Padraig O'Kiely won the Teagasc Gold Medal, which is awarded annually to someone who has made an exceptional contribution to Teagasc and to the agriculture and food sectors. Padraig was honoured for dedicating a lifetime of work as a researcher at the Teagasc Animal and Grassland, Research and Innovation Centre in Grange, Co Meath. Teagasc Chairman, Noel Cawley presented the medal at a meeting of the Teagasc Authority in Oak Park, Carlow. He said: "Padraig is one of the leading worldwide figures in forage agronomy, conservation and utilisation. He has published almost 600 scientific papers, over 400 articles in technical and popular farming press and has given over 1,000 presentations to farming and industry conferences and events. He is an editor of five prestigious, international peer-reviewed journals. His work has stood the test of time and he is one of the outstanding scientists in the organisation."

CGIAR Consortium CEO delivers Teagasc lecture

The second lecture in the Teagasc Annual Distinguished Lecturer Series was presented in the RDS, Dublin, in March 2016 by Frank Rijsberman, CEO of the CGIAR Consortium, the world's largest, publicly-funded, international agriculture research organisation. With an annual budget of US\$1 billion, the CGIAR Consortium employs approximately 10,000 people in over 70 countries.

The guest lecturer said: "Our research organisations and funders want to see our research reach large numbers of poor families with nutritious food solutions; they want to see our research reach large numbers of farmers with smart sustainable agriculture solutions. We have 'boots on the ground' in over 70 countries around the world providing scientific solutions to address the challenges faced."



Pictured at annual Teagasc Annual Distinguished Lecturer Series 2016 were (from left): Frank Rijsberman, Presenter and CEO of the CGIAR Consortium; Frank O'Mara, Director of Research, Teagasc; Tom Arnold, Chairman and former CEO of Concern Worldwide; and Gerry Boyle, Teagasc, Director.

IDF conference

The latest developments in dairying internationally were recently discussed at the International Dairy Federation (IDF) conference in Dublin. The conference is sponsored by Ornu, Ireland's largest exporter of Irish dairy products.

Noel Cawley, Chairman of the IDF National Committee of Ireland and Chairman of the Teagasc authority welcomed 600 international dairy scientists, technologists, food formulators and process engineers, from academia and industry to the three-day event.

A session on 'Next generation dried infant milk formula processing' was presented by Mark Fenelon showcasing Teagasc Food Research Moorepark innovation in infant milk formula processing, and the adaptation of cow's milk to bring it even closer to that of human breast milk.

Paul Cotter, Teagasc Food Research programme, Moorepark, outlined how the latest molecular diagnostic tools such as nucleic acid-based approaches are being used to investigate microbial-related cheese quality defects.



Kevin Lane, CEO of Ornu, the conference sponsor, and Noel Cawley, Chairman, IDF National Committee, Ireland, and Teagasc Chairman, are pictured at the IDF Dairy Science and Technology Symposium 2016, which took place in Dublin in April.

Food lab of the year

Congratulations to Paul Cotter's Vision I laboratory at Teagasc Food Research Centre, Moorepark, which was awarded the Irish Food Laboratory of the Year title at the annual Lab of the Year awards in Dublin. This is the second time in recent years that the Vision I team have won such an award in recognition of their work in food microbiology, gut microbiology and health and natural antimicrobial/preservatives.



Fiona Crispie is pictured receiving the award on behalf of the laboratory from Phil Hemmingway, Programme Manager, Science Foundation Ireland.

Breeding animals with a quieter temperament

With farm deaths caused by cow attacks exceeding bull attacks in recent years, Teagasc geneticist Noírin McHugh said cow aggression around, or after, calving is a genetic trait that can also be reduced through breeding. She was speaking at a Teagasc seminar on Safety with Livestock, held in association with a visit to the centre of the Institution of Safety and Health (IOSH) Rural Industries Section. She outlined how genetic studies show that heritability of genetic factors controlling docility is in the 0.2-0.4 range, which allows considerable scope to breed for docility over a number of generations. Breeding from aggressive animals should be avoided and such animals should be culled from herds, she added.

Cattle-breeding programme in Eritrea

Dovea Genetics, Ireland's leading dairy and beef semen supplier, has teamed up with Teagasc and Irish NGO Vita to support a cattle improvement programme in Eritrea, East Africa, by sponsoring the supply of AI straws to the National AI Centre in Eritrea. Two thousand AI straws from bulls were sent to Eritrea last year and these are now being used as part of a crossbreeding programme with plans to send out more AI straws later in 2016.

The initiative follows a visit to Eritrea last year by a senior Irish delegation of agricultural specialists led by Vita and including Teagasc and Grote-SHA. The focus of the visit was to build on the partnership between these agencies and the Eritrean government.

"I am very optimistic about the Irish partnership with the Eritrean government – I feel that working together will have great impact on Eritrean farm families," said Professor Gerry Boyle, Director of Teagasc. "The Irish agriculture experience is rich in lessons learnt and successes won, and has evolved to meet so many challenges. Teagasc has considerable experience in cattle breeding and has worked closely with industry in developing economic breeding indices (EBI) for traits of importance in an Irish context. This knowledge and experience has direct relevance in Eritrea and can help the animal-breeding team in Eritrea as they develop breeding schemes appropriate to the Eritrean environment."

James O'Loughlin, Teagasc Moorepark, also understands the importance of an integrated approach to livestock production. "In the dairy pilot project in Eritrea, we are recommending a breeding programme based on cross breeding. The local breed (Barka) is crossed with Friesian or Jersey. The feed resource available is not able to support the nutrient requirement of animals bred for high milk output," said James. Another key component of the dairy project supported by Teagasc and Vita is in relation to capacity building of research and extension staff and farmers. James and his colleagues Pat Boyle and Seamus Crosse visit Eritrea regularly to work in partnership with research and extension staff on the key technologies associated with forage-based milk projection systems.

Teagasc technology adopted in Ornua facility in Saudi Arabia



Ornua, Ireland's largest exporter of Irish dairy products, has opened a new cheese manufacturing facility in Riyadh, Saudi Arabia. The €20 million state-of-the-art facility will use pioneering technology developed by Ornua and Teagasc to produce a range of bespoke fresh white cheeses for the increasingly sophisticated bakery sector, retail delis and foodservice customers in Saudi Arabia, the fifth largest dairy importer in the world. It will also provide a central hub to access the high growth dairy markets in the Middle East and North Africa (MENA) region. White cheeses are hugely popular in the MENA region. The technology allows milk ingredients to be recombined for fresh white cheese production.

Mark Fenelon, Head of the Teagasc Food Research programme, said: "We are delighted that this inclusive research and development approach by Ornua and Teagasc has proved effective. The technology underpinning this venture was developed at the Teagasc Food Research Centre, Moorepark, and was adapted and managed by Ornua as part of a highly integrated collaborative research programme to develop the current suite of local cheeses. It marks a new approach to cheese manufacturing involving the production of cheeses from reassembled milk without whey expulsion."

The Riyadh facility is the latest in a series of significant investments by Ornua, targeting new routes to market for Irish dairy products. Ornua CEO, Kevin Lane, said: "Our partnership with Teagasc is a great example of how innovative dairy technologies can create new ways of producing dairy products for global markets."

Drones trialled for BETTER farms

The Sensefly drone fitted with Airinov 4C crop reflectance sensor is being demonstrated/evaluated by Researcher Dermot Forristal and Crops Specialist Michael Hennessy as part of the Teagasc Crops BETTER farm programme.



Pictured with the fixed wing drone are (from left): Crops Researchers Richie Hackett and John Spink and Crops Specialist Michael Hennessy of Teagasc Crops, Environment and Land Use Research Programme, Oak Park, with Simon Rehill of Airinov and David Kelly of CAW.

Teagasc supports Smart Futures and SciFest

Teagasc partnered with Science Foundation Ireland's Smart Futures and SciFest to promote careers in science, technology, engineering and maths (STEM). SciFest is a series of one-day science fairs for second-level students hosted locally in schools and in third level colleges.

Teagasc Director of Research, Frank O'Mara, said: "I am delighted that five of our researchers were involved in promoting STEM careers to young students at SciFest. I am sure students will be excited and, maybe, a little surprised about the great opportunities for STEM-related careers in the agri-food industry, and how many of these opportunities involve interdisciplinary research. For example, in the area of smart or precision agriculture, we see the application of sensors, networking, data analytics and other digital technologies to issues related to sustainable food production. We recognise the importance of bringing new talent into the industry, and as one example, our Walsh Fellowship programme currently has 230 students. They are mostly engaged in research towards PhD degrees across a range of exciting topics and many will subsequently develop STEM-related careers."

Geographical Society of Ireland Book Award



A book co-edited by Teagasc Researcher David Meredith was one of three shortlisted for the Geographical Society of Ireland Book Award 2013-2015. *Spatial Justice and the Irish Crisis* took second place at a recent awards ceremony. Judge David Nally from the University of Cambridge said: "This edited collection examines the fallout of the Irish financial crisis 'on the ground', focusing on social indicators of 'stress', such as rising income and regional inequalities, evidence of ill-health and

environmental decay. This edited collection allows for this broad sweep, yet maintains its focus on the depth and breadth of the analysis, that the 'Irish crisis' is not such much an 'event' as a 'process' and an ongoing one at that. Importantly, the editors advance a geographical argument about spatial inequalities, which they contrast with the idea of 'spatial justice', a concept with tremendous analytical and political force."

Seaweeds – Tomorrow's Sustainable Superfoods

Brijesh Tiwari from the Teagasc Food Research Centre, Ashtown, Dublin, recently gave a keynote address at the first Annual PROMAC Open Day, the theme of which was Seaweeds

– Tomorrow's Sustainable Superfoods. Brijesh spoke about novel processing technologies for seaweed for human application – giving an overview of which types of technologies are being used and developed for utilisation of seaweed.



Brexit concerns for Irish dairy and beef sector highlighted

In advance of the UK referendum on whether to remain in the EU, Teagasc economists prepared a report on the economic consequences of a 'Brexit'. They found that if UK voters decide to leave the EU in the referendum in June 23, it could have a significant impact on Irish agri-food exports.

Total Irish agri-food exports were worth close to €11 billion in 2014. The UK is the number-one export destination, with agri-food exports in 2014 worth over €4.5 billion. This makes the UK market more important to the Irish agri-food sector than for other sectors of the Irish economy. The report found that agri-food trade with the UK will not collapse if Brexit occurs, simply because the UK has a very large agri-food import requirement, due to its low level of agri-food self-sufficiency. However, if a vote in favour of Brexit occurs, an extended period of trade policy uncertainty will follow, as negotiations will need to take place to determine the future trading relationship between the UK and the EU member states, including Ireland. Author of the report, Kevin Hanrahan of Teagasc, noted that it would be in the interests of the Irish agri-food sector that trade with the UK would continue in an unimpeded fashion, through a mechanism such as a customs union.

Brexit could mean the re-introduction of trade barriers between Ireland and the UK, unless the EU can agree a suitable trade agreement with the UK as part of the UK's Brexit terms. In a worst-case scenario, Irish exports of dairy products, beef and other agri-food items could face import tariffs that would make it less likely that they would be imported onto the UK market. There is also the possibility that, following Brexit, the UK might eliminate all its import tariffs, allowing beef exports from South America and lamb and dairy exports from New Zealand to enter the UK market at much lower prices than prevail at present. This would depress prices on the UK market, which would be bad news for Irish beef exporters.

Teagasc Economist Trevor Donnellan noted that Brexit could mean a reduction in the value of Irish agri-food exports of anything from €150 million (1.5%) to €800 million (7.2%) per annum. The report concludes that if the UK votes to leave the EU, it will only be possible to make a detailed assessment of the consequences, when the terms of Brexit become clearer.

Farming and Country Life 1916



Teagasc recently hosted the largest 1916 centenary event outside of Dublin at its campus in Athenry. The historic Mellows Campus in Teagasc, Athenry, Co Galway hosted a series of exhibitions, re-enactments, lectures and demonstrations, and showcased a range of livestock breeds of the time. The event offered an invaluable insight into how communities lived and worked in rural Ireland in 1916, with something for all ages and interests; urban and rural, young and old.

Teagasc Technology Foresight 2035

The final report of the Teagasc Technology Foresight 2035 project was launched at an international conference in the Aviva Stadium, Dublin on March 8. As part of the project, over 200 experts and industry stakeholders were consulted to identify breakthrough technologies which will transform the Irish agri-food and bioeconomy sector by 2035.



Lance O'Brien,
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The agri-food and bioeconomy sector is a very significant part of the Irish economy in terms of jobs and exports. Its long-term competitiveness and sustainability are a priority concern for national policy. Agriculture, in particular, faces significant challenges in the coming decades, not only in Ireland, but in Europe and elsewhere around the world. It is in this context that the long-term future of Irish agriculture and food must be considered. The new industry-led strategy launched in 2015, entitled *Food Wise 2025*, sets out ambitious growth targets while acknowledging the need to deal with the many challenges.

The continuous development and application of new technologies will be crucial to the realisation of these ambitions and addressing the challenges. Not only are new technologies needed to increase the productivity and competitiveness of Irish agri-food enterprises, they must also enable all actors of agri-food and bioeconomy value chains to play their part in protecting the environment and mitigating and adapting to climate change.

Teagasc Technology Foresight 2035 project

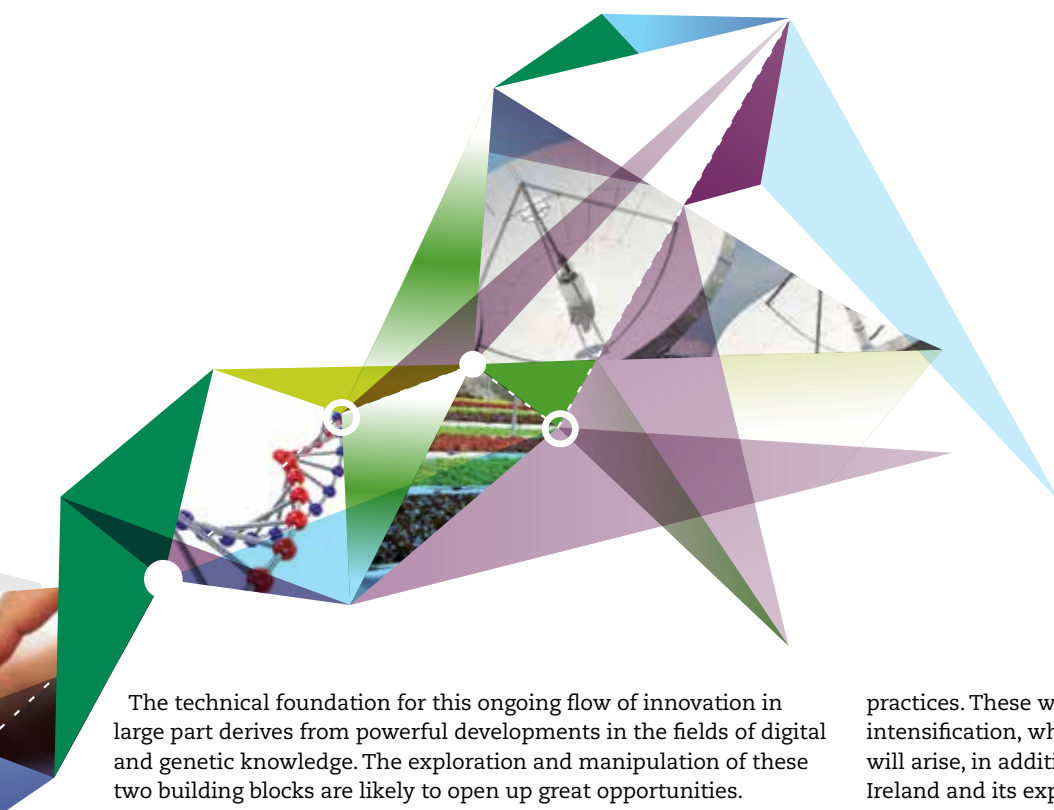
Teagasc Technology Foresight 2035 focuses on the identification of emerging technologies that will drive the competitiveness and sustainable growth of the Irish agri-food industry and bioeconomy sector over the next 20 years. Its goal is to identify new areas of technology in which Ireland needs to invest and to provide a comprehensive and well-researched source of evidence for policy decisions relating to Teagasc's future science and technology programmes.

With the aid of more than 200 experts who contributed to the foresight process, and in consultation with industry stakeholders, the following five technology themes have been identified as being the priorities for Irish research and innovation in the coming years:

- Plant and Animal Genomics and Related Technologies
- Human, Animal and Soil Microbiota
- Digital Technologies for Sensing, Analytics and Automation
- New Technologies for Food Processing
- Transformation in the Agri-Food and Bioeconomy Value Chains.

Emerging technologies

A key conclusion of the project is that the agri-food industry is on the verge of a revolution in the application of powerful new technologies. Increasingly rapid, recent advances in ICT and molecular biology, in particular, have the potential to transform the sector in the coming years. It is essential for the success of the Irish agri-food and related industries that Ireland is a central player in this revolution. Investment in new and existing technologies will play a decisive role in enabling the sector to sustainably intensify production and to grow output, exports and jobs, while respecting the environment.



The technical foundation for this ongoing flow of innovation in large part derives from powerful developments in the fields of digital and genetic knowledge. The exploration and manipulation of these two building blocks are likely to open up great opportunities.

Rapidly emerging new digital technologies, synthetic biology and nanotechnology, among others, will impact almost every sector of the global economy including the most important component of the Irish bioeconomy, our agri-food industry. New tools and techniques will help to better address the 'Grand Challenges' that confront mankind. In particular, new tools will enable the agricultural sector to better tackle the challenges of climate change and wider sustainability concerns while promising enhanced living standards and quality of life for sectoral players.

Use of technologies like satellite imaging, digital sensors, advances in plant and animal genomics and advanced data analytics could lead to farming practices that are more productive, more precise in their deployment and thus more sustainable. Some of these technologies are already changing the agri-food sector, while others, when scaled up, have the potential to truly revolutionise how our food is grown, processed, distributed and consumed.

Harnessing this transformation will not only enable ambitious increases in the export of world-class agricultural produce, but will also help drive the completion of a dynamic circular bioeconomy with potential to create new jobs and new opportunities. (A circular economy is an alternative to a traditional linear economy [make, use, dispose] in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life.)

Furthermore, by building on the capacity already existing in Ireland, it will drive exports of smart, knowledge-based, data-driven services developed by Irish service providers to markets in Europe and across the globe.

Implementing the vision

Teagasc is currently working with its partners and stakeholders to develop long-term research and knowledge transfer programmes which reflect the five priority areas of technology identified. The 'smart farming ecosystem' of the future will involve a complex range of players in the public and private sectors.

Partnering and collaboration are needed now more than ever to understand and integrate the diverse new sources of knowledge and data that will drive new services, systems and management

practices. These will enable growth based on sustainable intensification, while addressing the policy and regulatory issues that will arise, in addition to the concerns of consumers and citizens in Ireland and its export markets.

Teagasc is well-positioned to assume a national leadership role, establishing research and innovation platforms to act as vehicles to ensure the timely development of national roadmaps for each of these priority domains. Leadership in this case will involve a role of architect of the systems that will serve Teagasc clients and other stakeholders. As architect, it can ensure that services are designed to be affordable and easily adopted by the communities that will use them, while addressing the concerns of consumers and other potential barriers to adoption of these new agri-food and bioeconomy technologies.

As with all scientific and technological advances, end-user acceptance of new technologies cannot be assumed. Consumers have resisted such developments in the past for cognitive and emotive reasons, with enormous cost implications. The social sciences have an important role to play integrating science and technology push with demand pull (e.g., through supporting ongoing engagement with consumers and citizens as technologies progress through research commercialisation phases). Social science needs to be integrated into the design, development and implementation of new technologies to help find solutions to industry and societal needs. This will support informed consumer decision-making and help to ensure that technologies that offer significant benefits to society as well as the economy are not rejected out of hand.

It is of the utmost importance that all of the stakeholders in the Irish agri-food and bioeconomy sector begin to prepare now for the widespread deployment of transformative technologies in the sector. Such techniques are capable of enabling innovation and change at an exponential pace and of producing both benefits and risks. Surprising and abrupt changes will become more commonplace. Preparing for the disruptive and the surprising, and creating the future we want, will demand agility, resilience and an ability to anticipate alternative futures. Foresight is a critical tool in helping us deal with these challenges.

Reference

The 'Teagasc Technology Foresight 2035 – Technology Transforming Irish Agri-Food and Bioeconomy' final report is available at: <http://www.teagasc.ie/publications/2016/3897/Teagasc-Technology-Foresight-Report-2035.pdf>

BEEF 2016

– profitable technologies



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BEEF 2016, a major Teagasc Open Day, takes place on Tuesday, July 5, at Grange in Dunsany, Co Meath. Thousands of cattle farmers, from all over the country, are expected to attend this major national beef event, which is sponsored by FBD. This article outlines details of the event.

At this time of uncertainty in the beef sector, BEEF 2016 will focus on the application of technologies that will help Irish beef farmers to increase the profitability of their farming business. The main issues facing both suckler beef and dairy calf-to-beef producers will be addressed at BEEF 2016. Both the flagship Derrypatrick and Maternal Index herds will be on display. Technical updates will be provided on how to exploit superior genetics, improve performance from pasture and plan your herd's health.

Speaking at the launch, Pat Dillon, Head of the Teagasc Animal & Grassland, Research and Innovation Programme, said: "Global forecasts are for increased demand for protein, in particular protein from meat, and increased economic prosperity in many emerging markets present opportunities for increased exports of high-quality, safe and sustainable Irish beef to international markets. The strong reputation of Irish, grass-based beef production can ensure greater penetration of high-value markets both in the EU and in third countries."

Eddie O'Riordan, Beef Enterprise Leader, Teagasc Animal & Grassland, Research and Innovation Programme, Grange, said: "The emphasis of BEEF 2016 is on the profitable technologies that help farmers achieve more sustainable production. With its integrated programmes of research, advisory, training and education, and with the many industry stakeholders, Teagasc is well positioned to assist farmers with technological developments aimed at improving the economics of beef farming."

Technologies

The first five technical stands on the day will provide technical and financial updates on 'Suckler Beef', 'Exploiting Genetics', 'Dairy Calf-to-Beef', 'High Performance from Pasture', and 'Profitable Breeding and Herd Health'.

Then the event will progress into a series of interactive villages covering the 'BETTER Farm Beef Programme', 'Feed to Meat', 'Improving Animal Health', 'Business of Beef Systems', 'Breeding Village', 'Sustainable Farm Environment', 'Grassland Demonstration' and 'Health and Safety'.

One new feature this year will be looking at rotational grazing infrastructure requirements in terms of roadways, water and fencing, to both increase grass utilisation and labour efficiency. PastureBase Ireland has identified that creating one new paddock on a farm will give five extra grazings on the farm for the year. Therefore, a consequence of sub-dividing a farm into paddocks will result in increased number of grazings in conjunction with increased DM production.

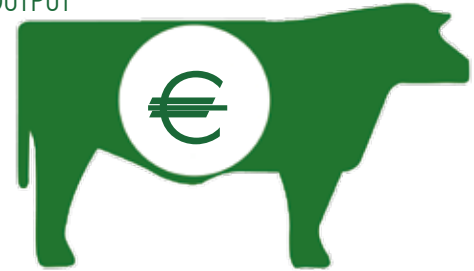
5TH LARGEST

NET EXPORTER OF BEEF IN THE WORLD



€2.1 BILLION

VALUE OF BEEF OUTPUT



50%

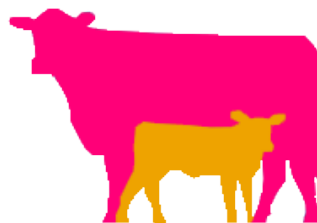
OF FARMS

HAVE OFF FARM EMPLOYMENT



1.1M

SUCKLER COWS



80%

OF MALES REARED AS STEERS



ACCOUNTS FOR 34%
OF GROSS AGRI-FOOD OUTPUT



MALE CALVES

FROM 1.2M DAIRY COWS
FOR BEEF PRODUCTION



Health and safety

The Health and Safety exhibition will have an enhanced focus covering all the main risk areas on farms, from livestock, machines, slurry gases, electricity etc., and will provide advice on how to manage the dangers effectively.

Industry partnership

Key industry experts from Bord Bia, the Irish Cattle Breeding Federation, Animal Health Ireland, the Department of Agriculture, Food and the Marine, the *Irish Farmers Journal* and University College Dublin will join with Teagasc at the various villages and on stands to present and discuss individual farmer queries. In addition, meat industry representatives, the main beef breed societies and AI breeding companies will be represented on the day.

Live demonstrations

Reseeded pastures outperform old swards in terms of grass production, so there will be demonstrations on the different establishment options for sowing grass and clover. A live exhibition will also take place on the ideal animal to meet market specifications for different market outlets.

Farmers' forum

At the end of the day, there will be a special forum on 'Young Farmers in Beef'. This will include a panel discussion with a number of young beef farmers on how they are planning to develop sustainable family beef farming business into the future.

Sustainable beef production



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Enhancing our understanding of the beef sector is vital to support sustainable economic development of drystock enterprises.

A key challenge confronting policy stakeholders and those concerned with the development of the beef sector is the highly variable nature of farm enterprises involved in cattle production. Drystock beef enterprises are characterised by substantial differences in scale, structure, degree of specialisation,

intensity and combination with non-farm economic activities. As a consequence, farm operators and farm households engage with and respond to policy or development initiatives in different ways. Rather than treating the beef sector as a homogeneous bloc of enterprises, it is necessary to identify distinctive sub groups within the population of farm enterprises engaged in cattle production. This allows the identification of the key characteristics associated with these groups, evaluation of sources of variation in costs associated with these farm enterprises and assessment of ways of increasing returns to each type of farm enterprise group through enhanced technical efficiency and adoption of new or novel technologies.

Table 1. Average financial performance per hectare of the eight cattle farm classes

	Dairy Enterprises (with beef) Average (€)	Finishers (with tillage) Average (€)	Finishers (Mid-earning) Average (€)	Diversified On-Farm Enterprises Average (€)	Off-Farm Diversifiers Average (€)	Extensive Suckler Enterprises Average (€)	Cattle Farming Enthusiasts Average (€)	Low Earners Selling Stores Average (€)
Gross output	1,791	1,654	1,025	1,012	979	647	958	754
Direct costs	1,089	961	599	634	544	409	568	508
Gross margin	703	693	426	378	434	238	390	246
Fixed costs	608	635	480	459	494	402	556	446
Net margin	95	58	-54	-81	-60	-165	-166	-200

Overview of beef production in Ireland

Cattle production remains the dominant form of farming in Ireland. The Census of Agriculture 2010 classified 55% of farms as 'specialist beef producers' and established that over 100,000 farm enterprises, 70% of the total number of farms, were involved in some aspect of beef production. These figures belie the fact that the returns from beef production to most farmers are low, if not negative, (National Farm Survey, 2014). Given that few specialist beef producers generate a positive return from the market, it is unsurprising to find that most are dependent on Common Agricultural policy (CAP)-related payments to off-set production losses.

Agricultural policy related to the European and Irish beef sector is increasingly based on EU external trade policy and decoupled income support payments under the CAP. In the two most recent reforms (2003, 2013) of the CAP, member states have had limited freedom to 'recouple' some of their direct payment budgets to agricultural production. Ireland, to date, has chosen not to avail of these options. As a consequence, farm enterprises involved in cattle production have become increasingly exposed to the vagaries of the international market in recent years. In this context, the capacity of cattle producers in Ireland to compete with key international producers has become increasingly important. Comparing the relative productivity and profitability of beef producers in Ireland with those of selected international competitors, research undertaken as part of the project found that the cash costs paid by Irish beef farmers are low when compared with other important EU countries. This apparent competitiveness disappears, however, when total economic costs are included in the assessment. This situation is compounded by the fact that Irish cash costs (as opposed to economic costs), which are low by EU standards, are substantially higher than our main competitors worldwide. This is particularly true for suckler farms and highlights the challenges associated with the further opening up of the EU beef market to international producers. In turn, this highlights the critical importance of technical efficiency among cattle producers in Ireland. An examination of beef farms in Ireland carried out as part of this study indicates that technical efficiency in the beef sector has been consistently poor. This finding applies to the sector as a whole. Our study was conducted using National Farm Survey data identifying sources of efficiency on different types of beef farms.

Types of farms

A typology was created using a latent class model. The model identifies clusters within multivariate data that group together individuals who share similar characteristics. The model drew on data from the National Farm Survey (2012) and included all farms with any cattle (N = 821). The analysis identified eight distinct groups

of farm enterprise engaged in cattle production: Dairy Enterprises (with beef) (23%), Finishers (mid-earning and elderly) (16%), Finishers (with tillage) (15%), Diversified On-Farm Enterprises (15%), Extensive Suckler Enterprises (12%), Off-Farm Diversifiers (8%), Low Earning Selling Stores (7%), Cattle Farming Enthusiasts (4%).

Efficiency

Using this typology we compared the financial performance of the eight different classes (Table 1). The average gross output varies considerably between the classes, e.g., output from 'Dairy Enterprise (with beef)' is more than double that of 'Extensive Suckler' enterprises. The variance in performance can be largely attributed to differences in stocking rate. This, in turn, is likely to be influenced by conditions on the farm such as soil quality and the characteristics of the farmer themselves. Perhaps the most worrying aspect of the comparison of the financial performance across the classes is the fact that only two of the eight typologies identified were, on average, making a positive market-based net margin.

Conclusion

The results of the research present a more nuanced view of Ireland's cattle production sector. Some types of farm enterprise are capable of generating a return to the marketplace, particularly those combining this activity with dairy or tillage production. These enterprises represent the opposite ends of the supply chain; dairy enterprises are typically producing calves or weanlings, while tillage enterprises are finishing cattle for slaughter. Enterprises engaged in rearing cattle are, on average, making a loss and, hence, are highly dependent on CAP payments. Looking to the future it seems unlikely that the orientation of EU agricultural policy will revert to coupled direct income support measures or policy measures designed to support producer prices other than those associated with tariff protection. In this context, it will be necessary to develop initiatives that enhance the efficiency of all producers.

Acknowledgements

This article reflects the contributions of several authors in addition to those listed above including Maria Martinez Cillero, Thia Hennessy, Anne Kinsella, Daniel O'Callaghan and Fiona Thorne. This research is part of the Profitable Dry Stock Enterprise Development: Pathways to Growth project, which was funded by the Department of Agriculture, Food and Marine through the Research Stimulus fund. The project team would like to acknowledge the input of industry stakeholders and farm operators who have contributed to the research. For more on the National Farm Survey see: <http://www.teagasc.ie/nfs/>

BETTER beef farms: higher productivity, greater profit

A comparison of the physical and financial performance of BETTER and National Farm Survey suckler beef farms highlights greater profitability through increasing output.

increasing the lower threshold for output, contributed to this increase). Similarly, suckler cow numbers and livestock units decreased by 5% and 7%, respectively, on BF compared to an approximate 35% increase in both variables in the NFS. Accordingly, stocking rate increased by 16% and 5% on BF and NFS, respectively.



In order to improve the productivity and profitability of beef farming in Ireland, the Teagasc/Irish Farmers Journal BETTER (Business, Environment and Technology through Teaching, Extension and Research) beef farm (BF) programme was established in 2009. The programme has consisted of two three-year phases with the first beginning in January 2009 and the second in July 2012 (Table 1). In this article, we examine the annual trends in output, costs and profitability for the BF participants for the years 2008 to 2014. To provide some context, we also present the average profitability of suckler farms in Ireland as represented by the National Farm Survey (NFS) annual reports (cattle-rearing category). All input and output costs were corrected for annual price changes based on the Central Statistics Office price index and all subsidies were excluded.

Cost analysis

Total variable costs (TVC) increased on both BF and NFS (Figure 1), with an average increase in costs of 32% on BF compared to 17% on NFS farms from 2008-2014. Total fixed costs (TFC) decreased by 5% on BF compared to an 8% increase on NFS farms. Extreme weather conditions in 2012-2013 increased feed costs, but the cost increase was greater on BF farms compared with NFS farms. This is represented by a 53% increase in TVC/ha on BF from 2011 to 2012 compared to a 20% increase on NFS farms.

From 2012 to 2013, TVC continued to increase on NFS farms but declined on BF. This reflects improved planning of forage requirements on BF, where fodder purchases were made in 2012, thus bearing much of the cost of the prolonged winter of 2012/13 in advance. In contrast, much of the costs of fodder shortages on NFS farms were made in 2013 when the shortage became acute.

Output and margin analysis

Gross output value on BF was consistently more than double that achieved on NFS farms (44% vs. 20% for BF and NFS, respectively). Gross margin increased by 58% on BF compared to a 23% increase for NFS farms. Gross margin decreased by 62% for BF in 2012 as a result of large increases in TVC and the introduction of new Phase 2 farms. In contrast, the NFS farms maintained gross margin levels, albeit at a much lower level; however, NFS farms showed a decline in gross margin in 2013. Net margin increased from €49/ha to €384/ha on the BF over the seven-year period, while NFS farms remained loss-making in all years.

Table 1. Number of BETTER beef farms per year from 2008-2014.

Year	2008	2009	2010	2011	2012	2013	2014
Number of farms	15	16	16	14	37	32	29

Farm structure

Farm size, suckler cow numbers, number of livestock units (LU) and stocking rate were greater on BF than NFS (Table 2). However, the effect of participation in the BF programme is exemplified by the yearly change within each of these variables. Farm size decreased by 19% from 2008-2014 on BF, reflecting the introduction of predominantly smaller Phase 2 farms in 2012. In comparison, there was a 30% increase reported in the NFS (note: a change in the sampling criteria in 2012,

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Table 2. Comparison of farm size, number of suckler cows, number of livestock units and stocking rate of the BETTER farms (BF) and farms in the Teagasc National Farm Survey (NFS) from 2008-2014.

	Farm size (ha)		Suckler cow no.		Livestock units (LU)		Stocking rate (LU/ha)	
	BF	NFS	BF	NFS	BF	NFS	BF	NFS
2008	64	30	68	20	119	30	1.85	1.00
2009	64	30	70	20	124	30	1.95	1.01
2010	63	32	70	21	128	30	2.01	0.95
2011	59	31	72	21	120	29	2.03	0.95
2012	52	35	59	25	101	36	1.97	1.04
2013	51	38	63	26	107	39	2.08	1.03
2014	52	39	64	27	110	40	2.15	1.04

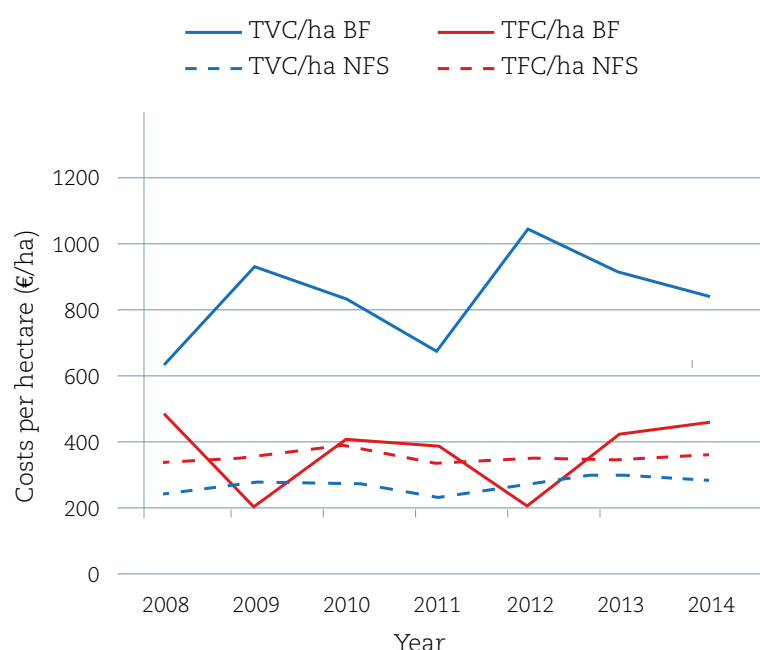


Figure 1. Total variable costs (TVC) and total fixed costs (TFC), on a per hectare basis, on BETTER farms (BF) and National Farm Survey (NFS) farms from 2008-2014.

Conclusion

While yearly variation was largely concurrent on BF and NFS farms, the higher level of production intensity achieved on BF resulted in higher overall profitability.

This was a result of greater gross output attained from higher stocking rates and hence, higher live weight output per ha. Cost efficiencies were also better on BF than NFS farms reflecting the increased focus on weight gain from grazed grass and improved reproductive performance on BF. While the adverse weather experienced during 2012 and 2013 had a lesser effect on NFS variable costs, the much lower levels of output resulted in these farms continuing to be loss making. An interesting feature of the data is that the BF increased output and profitability with

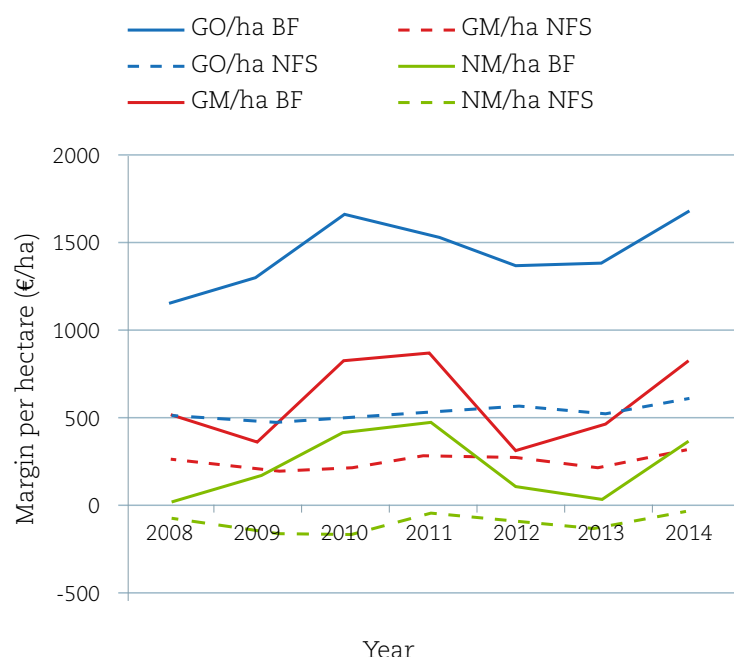


Figure 2. Gross output (GO), gross margin (GM) and net margin (NM) on a per hectare basis, on BETTER farms (BF) and National Farm Survey (NFS) farms from 2008-2014.

minimal changes in fixed costs. Fixed cost increases were greater on NFS farms, but with much smaller increases in gross output. The data indicates that there is large potential for farm profitability to increase through increasing productivity on beef farms in Ireland.

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Producing suckler-origin male cattle from grass-based systems

Researchers at Grange have recently been comparing suckler-bred steers and bulls and the effects of supplement feed on weight gain and carcass attributes.

Irish ruminant livestock production is largely pasture-based where, collectively, grazed and conserved pasture account for almost 90% of the lifetime feed consumption. Suckler herd progeny account for approximately 45% of the national steer kill and late-maturing breeds and their crosses predominate. Nationally, mean steer slaughter age is approximately 28 months – towards the end of the third season at pasture. While steer production continues to predominate nationally, more recently about 25% of the male progeny are finished as bulls; these are typically slaughtered at less than 20 months of age.

Steers and bulls compared

Upon reaching puberty, bulls are inherently more efficient than steers, due to naturally-occurring male steroid hormones. A review of studies carried out at Teagasc Animal & Grassland Research and Innovation Centre, Grange, comparing bulls and steers of dairy-beef origin, reared under similar management on the same diet and slaughtered at the same age showed that, on average, live-weight gain was 8.4% higher, carcass weight was 9.5% heavier and lean meat yield

was 20% greater for bulls than steers. In practice, bulls and steers are generally reared in different production systems involving different levels of feeding, different lifetime ratios of grazing to indoor feeding and different ages and weights at slaughter. This means that the effects of 'gender' are confounded with production-system factors.

In a more recent study at Grange, weaned, spring-born, late-maturing breed suckler bulls and steers (about eight months old, 360kg at start) were compared in two contrasting (forage- or concentrate-based) production systems. Apart from live weight at the end of the first winter, where bulls were only marginally heavier than steers; and, fatness at slaughter, where steers were fatter, bulls had significantly greater growth rate, carcass weight and conformation score. At pasture, daily live-weight gain of bulls was approximately 0.2kg greater than steers with a similar advantage found when finishing indoors.

Effect of weanling winter growth rates on subsequent performance

Exploiting compensatory growth is a key goal when feeding weanling/store cattle in winter; the optimum indoor winter growth rate for steers destined to return to pasture for a second grazing season is about 0.5-0.7kg live weight/day. However, the optimal live-weight gain during the first winter for high-growth potential young suckler bulls to exploit subsequent



compensatory growth at pasture is not clear. Recent research at Grange has addressed this issue.

Spring-born, late-maturing, weaned suckled bulls, were placed on: (1) *ad libitum* grass silage (DMD 731g/kg) supplemented with either 2kg, 4kg or 6kg concentrate/day for 123 days, then turned out to pasture for about 100 days, again re-housed and adapted to an *ad libitum* concentrate diet. Animals were slaughtered when the group reached a mean live weight to achieve the target carcass weight of 380kg. At the end of the first winter, compared with feeding 2kg of concentrates/day, animals supplemented with 4kg or 6kg concentrates/day were 26kg and 65kg heavier, respectively. At pasture, average daily gain was greatest for animals that received 2kg concentrates/day during the winter, and lowest for animals that received the 6kg concentrates/day. By re-housing, there was no difference in live weight between the 2kg and 4kg concentrates winter supplemented groups; however, the 6kg concentrates group was 32kg heavier. At slaughter, live weights were not significantly different between the three different first winter feeding treatments. There were no significant differences in slaughter weight, carcass weight, kill-out proportion or carcass fat score.

Another study, with suckler-bred bull weanlings, was undertaken where 3kg or 6kg concentrates/day were offered as a supplement to grass silage over a 127-day indoor winter period. Animals returned to pasture after the indoor winter and were re-housed after 98 days for finishing on *ad libitum* concentrates. At the end of the winter phase, animals receiving 6kg concentrates/day were 50kg heavier than those receiving 3kg concentrate/day. However, after 98 days at pasture the live weight difference had disappeared. Nevertheless, at slaughter bulls fed 6kg concentrates/day during their first winter had a 20kg heavier carcass.

Concentrate supplementation at pasture: spring/summer

A study was undertaken to examine the effects of concentrate supplementation level at pasture in spring/summer on performance of suckler-bred weanling bulls. They were offered either zero, 2.7kg or 5.3kg concentrates/head daily for 100 days. At the end of the grazing period, bulls were housed and finished on an *ad libitum*, barley-based concentrate diet and slaughtered at an average age of approximately 19 months. After 100 days at pasture, the zero concentrate supplemented animals were 17kg and 36kg lighter than those getting 2.7kg and 5.3kg concentrate/day, respectively. During the finishing phase, highest growth rates occurred in the animals that were unsupplemented at pasture, i.e., compensatory growth. At slaughter, the low and high pasture supplementation levels were 7kg and 24kg live weight heavier than the unsupplemented group. Overall, the study concluded that supplementation at pasture increased animal live weight, but, the scale of the differences were such that the economics of concentrate supplementation were marginal. A second study using similar animal types came to a similar conclusion.

Conclusions

Animal winter growth will clearly respond to additional supplementary feeding but such gains are invariably diminished during the subsequent grazing season as compensatory growth takes place. Supplementing yearlings at pasture in spring will generally improve performance. The additional live weight gained, however, is often insufficient to meet the input cost of the concentrates. The animal production response to summer concentrate supplementation is influenced by both pasture supply and quality. In times of pasture scarcity or where pasture quality is poor an economical response is likely. However, when well-managed autumn pastures are supplemented with concentrates, the production response is often only breakeven in economic terms. So, while kill-out proportion, fat and conformation scores may be increased, the cost of the supplemented concentrates is not always covered by the additional animal gain.

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Does nutritional management affect beef quality?



This article focuses on the influence of the nutrition of cattle on aspects of beef quality.



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Purchasers of beef at all points in the production chain (e.g., processors, retailers, restaurateurs, individual shoppers, etc.) can be considered as beef consumers. More than 85% of Irish beef is exported, to a myriad of markets and consumers. Each consumer may have a different definition of beef quality. The challenge for beef farmers is to know the preferences of their target consumer and to most cost-effectively satisfy these preferences. Within the broad definition of beef quality, the appearance, shelf-life and eating quality can be affected by management of the animal on-farm, its carcass during the early post-slaughter period and its meat during maturation and cooking. This article summarises data on the influence of the nutrition of cattle on these aspects of beef quality. It is important to note that the effects of nutrition or ration composition on beef quality may be direct, i.e.,

all other possible influences have not changed, or they may be indirect, i.e., carcass weight/age/fatness may change as a result of a change in nutrition and these may also influence beef quality.

Colour of beef

Appearance and/or colour strongly influence the decision to purchase beef, either as a carcass or as an individual cut of meat. Some EU markets require carcasses that have white fat and bright red or pink meat colour, while individual purchasers will generally choose bright red rather than darker beef. The diet of beef cattle can change fat colour. The yellowing effect on fat of different feeds can be ranked in decreasing order as follows: grazed grass, grass silage/concentrates, concentrates/straw, maize silage/wheat silage (Figure 1). The colour of fat from cattle fed a barley grain-based ration was similar to that of cattle fed maize grain or fodder beet-based rations. In our studies we see little effect of concentrate-based rations, concentrate type or



Figure 1. Carcasses from cattle slaughtered from pasture (right) can be more yellow than those from cattle slaughtered after concentrate feeding (left).



Figure 2. Colour of beef after seven days retail display in a high oxygen environment. Left, grass-fed beef; centre, beef with an elevated concentration of omega-6 PUFA; right, beef with an elevated concentration of omega-3 PUFA.

grazed grass *per se* on muscle colour. There are however, reports of darker beef being produced from grazed cattle compared to 'feedlot' cattle in the United States but these studies are usually confounded by differences in animal age. Animal age appears to have a greater effect on muscle colour than diet, with younger cattle having muscle that is lighter and less red in colour. Minimising pre-slaughter stress is important, particularly for bulls, to ensure that muscle does not become dark due to the higher than normal pH (lower acidity) that develops in the muscle of stressed animals.

The shelf-life or colour stability of beef can be affected by cattle nutrition. In general, grass-fed beef has a longer shelf-life than concentrate-fed beef, mainly due the greater amount of anti-oxidants present. Increasing the susceptibility of the fat in beef to oxidation can decrease the colour stability.

Nutritional quality of beef

Beef is generally recognised as a good source of protein, minerals and anti-oxidants, but there is also a perception that beef is rich in 'unhealthy' saturated fatty acids. However, lean beef with less than 4% fat can be considered a low-fat food. The emphasis on decreasing the consumption of saturated fatty acids is being increasingly questioned, but medical authorities currently advise a decrease in their consumption and an increase in the consumption of monounsaturated and polyunsaturated fatty acids (PUFA). Within the PUFA, increasing the intake of omega-3 fatty acids is particularly encouraged. Conjugated linoleic acid (CLA) is a fatty acid that may protect against cancer and other diseases. Cattle nutrition is the major factor influencing meat fatty acid composition. An increase in energy consumption can increase the fat concentration in beef (intramuscular fat or marbling), and this in turn can influence the fatty acid composition independent of the nature of the ration. Feeding grass and/or concentrates containing linseed or fish oil results in beneficial changes to the omega-3 PUFA and CLA concentrations in beef. These benefits can be enhanced further by preventing dietary PUFA from being digested (hydrogenation)

in the rumen through feeding 'protected' forms of supplement. When rumen-protected PUFA were fed to cattle, the concentration of beneficial omega-3 PUFA in muscle was such that it complied with the European Food Safety Authority definition of a source of omega-3 PUFA. However, this beef had a shorter shelf-life, indicating that additional dietary anti-oxidants were required in the supplement fed to the cattle (Figure 2). There is considerable interest in the possible health benefits of grass-fed beef. While the levels of omega-3 PUFA are below the definition of a 'source', grass-fed beef can contribute to overall omega-3 consumption. The challenge for the food industry is to develop strategies to market grass-fed beef as a meat that is more in line with human health requirements than alternative sources.

Sensory quality of beef

Tenderness is considered to be a major determinant of the enjoyment that comes from eating beef. Overall acceptability is an assessment of satisfaction, which also incorporates flavour and juiciness. Post-slaughter management of the carcass, such as rate of cooling, electrical stimulation and, in particular,

ageing/hanging can have a big influence on tenderness and overall acceptability. The treatment of the meat from carcass to plate can confound the effects of the nutrition of the animal on the farm. When compared directly, the composition of the diet does not greatly influence beef tenderness or overall acceptability. An increase in energy consumption will increase growth rate. If slaughtered at the same carcass weight/fatness, there is little effect on sensory quality. If slaughtered at the same age, carcasses from cattle fed the higher energy ration will likely be fatter. Since intramuscular fat has a small positive influence on tenderness, an apparent positive effect may be seen. There is some evidence that the production system *per se* may influence the eating quality of suckler bull beef. For example, inclusion of a grazing period before finishing on a high concentrate ration decreased the tenderness rating by trained assessors but the scale of the decrease was unlikely to be detected by consumers. This topic is currently under investigation, within a project led by Teagasc and supported through the Department of Agriculture, Food and the Marine Competitive Research Programmes.

Impact for the consumer

The expectations of the consumer at each point in the supply chain must be satisfied. This requires information on the requirements and/or preferences of each consumer group. Nutritional management of cattle can influence aspects of beef quality, depending on the perspective of particular consumers, but care must be taken when examining the direct effects of nutrition across different production systems since other potential influences on beef quality may also be changing.

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Male dairy calf-to-beef systems

This article outlines the blueprints for Holstein-Friesian male dairy calf systems and makes the case for their economic stability.

Growth in the national dairy cow population will result in a proportional increase in the number of dairy calves available for beef production. Currently, 61% of calves born are bred from dairy sires, 27% from early maturing sires (Angus and Hereford) and the remainder from continental sires and other breeds (Figure 1). The proportion of calves born to dairy sires has increased in recent years due to dairy expansion. As a result, there has been an increase in the number of male dairy calves available for beef production.

The blueprints and economic sustainability of, Holstein-Friesian male dairy calf systems are outlined below. Attention to detail with regard to calf rearing, animal health and pasture management is essential to ensure that optimum animal performance is achieved.

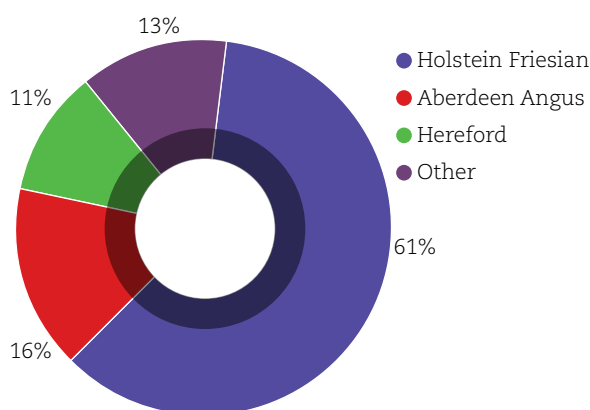


Figure 1. Sire breed profile of calves generated from the dairy herd (Animal Identification and Movement, 2015).

Blueprints for dairy calf-to-beef production systems

For all the blueprints described below it is assumed that calf performance is optimised during the first season at pasture. The target average daily gain (ADG) of a calf during its first season at grass is 0.80kg/day, with a target live weight at housing of 230kg. Previously, the majority of male dairy cattle were finished as steers during the second winter. In this system, Holstein-Friesian steers are offered good quality grass silage with 5-6kg of concentrates daily and slaughtered at 24 months of age with a target carcass weight of 320kg. More recently, alternative production systems and finishing strategies are being explored by producers. Although some beef producers have shifted from steer to bull beef production, particularly for Holstein-Friesian animals, it is essential that the market requirements are understood from the outset. Age at slaughter, carcass weight, conformation and fat scores are critical issues for beef production. A wide range of bull, steer and heifer production systems have been evaluated at Teagasc Johnstown Castle and Grange in recent years (see blueprints below).

15-month bull system

Calves are housed in late October/early November, remain indoors, and are finished on concentrates *ad libitum* with a limited proportion of roughage or excellent quality silage. Bulls are slaughtered in May/June. Concentrate input during the finishing period is approximately 1.8t. The target carcass weight in this system is 270kg with conformation scores of O=O+ and fat scores 2=2+. Meeting these targets at less than 16 months of age is necessary to satisfy UK market specifications. The target carcass weight for this system was difficult to achieve, and the system is highly vulnerable to increases in concentrate input costs. In addition, calves in this production system should be approximately 250kg at housing in November to successfully meet the market specifications.

19-month bull system

Bulls are turned out to pasture for the second grazing season for 100 days in early March, housed in June and finished on concentrates *ad libitum* over a 100-day period with a concentrate input of 1.2t during the finishing period. Target carcass weight for this system is 320kg. Given that these animals are greater than 16 months of age at slaughter, the market outlet for these carcasses is more limited. Therefore, very close communication with meat processors is essential for this production system.

21-month steer system

For spring-born calves (Holstein-Friesian and early maturing dairy crossbred calves), winter finishing can be avoided by slaughtering cattle at a lighter carcass weight at the end of the second grazing season. Steers are finished at the end of the second grazing season having been supplemented with concentrates for the final 60 days. Concentrate input during the finishing period for this system is 350kg. Calves must have good lifetime performance and have an early birth date for this system (January/February born). Target carcass weight is 280kg. For Holstein-Friesian steers, conformation scores are predominantly P+ and O-, with fat scores of 2=.

28-month steer system

Animals are at pasture for the second grazing season. They are then housed on a grass silage-only diet for the second winter. During this period animal performance is typically 0.50kg/day. Steers are then turned out to pasture in late February/early March and slaughtered in June. Holstein-Friesian steers are slaughtered at 28 months of age and achieve a carcass weight of 350kg. Conformation scores are predominantly O= with a fat score of 2+.

Economic sustainability

Figure 2 shows the net margin of the production systems described above on a 20ha (50ac) farm model. Price assumptions were: male Holstein-Friesian calf purchase price €100, an R3 steer beef price €4 per kg and a finishing concentrate price of €255. Actual beef price payable depends on carcass grading, seasonality (beef price being highest in May and lowest in September) and eligibility for quality assurance bonus. The impact of a 30c/kg discount on the 19-month bull production system was also investigated. Results clearly indicated that huge variation in profit exists across production systems. The 15-month Holstein-Friesian bull system has a very modest land requirement (although it is important to bear in mind the organic nitrogen and slurry contribution of these cattle with regard to the stocking rate and slurry capacity limitations of the Nitrates Directive). This system was the least profitable on a per head and per hectare basis.

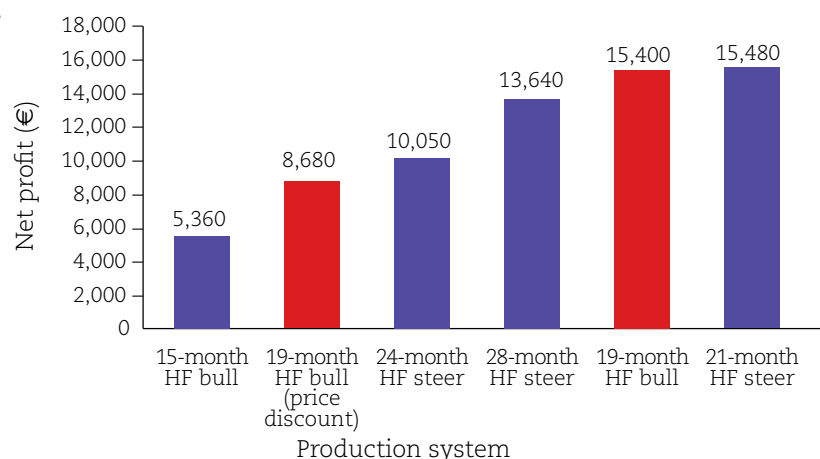


Figure 2. Net profit of a range of dairy calf-to-beef production systems on a 20ha farm. HF = Holstein Friesian.

Although the traditional 24-month steer production system is profitable, grass-based production systems (21- and 28-month Holstein-Friesian steer production systems) were the most profitable systems. While the 19-month Holstein-Friesian bull is one of the more profitable systems, the impact of a discount in beef price has the potential to render it one of the least profitable systems. Therefore, close communication with meat processors is required.

Results from the research at Johnstown Castle have shown that systems where a high proportion of weight gain was achieved from grazed pasture were the most profitable. The success of these systems is highly dependent on good grassland management to optimise animal performance from pasture.

Conclusion

Various production systems can be employed on Holstein-Friesian calf-to-beef enterprises. The success of the system is based on achieving a high proportion of total life time gain from grazed grass. Aside from the selling price of beef, the profitability of these beef systems is vulnerable to increases in calf purchase price and concentrate input costs.

Acknowledgements

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Derrypatrick Herd recent findings



The Derrypatrick research demonstration herd was set up to evaluate alternative suckler calf-to-beef production systems. This article reports on its recent findings.

production systems. The current study involves a comparison of late-maturing (Charolais and Limousin) and early-maturing (Angus) terminal sires and a comparison of steer, heifer and bull finishing systems. The current study began in spring 2013; the existing Derrypatrick herd were bred to either early- or late-maturing sires. All replacements coming into the herd were high Replacement Index. Because of the change in market requirements, all bulls (both late- and early-maturing) were slaughtered at less than 16-months of age without a second spring grazing period. The planned slaughter age of the steers from the early- and late-maturing sires was 22 and 24 months, respectively. The corresponding planned slaughter age for the heifers was 18 and 20 months, respectively.

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The Derrypatrick Herd at Grange is a 100-cow research demonstration herd on 65ha of intensively managed grassland. The primary objective of this herd is to evaluate alternative suckler calf-to-beef

Table 1. Animal performance at slaughter.

Animal genotype	Maturity	Age (days)	Weight (kg)	Conformation score	Fat score	Carcass (kg)	Kill out (%)	Euro/kg
Steer	Early	585	649	7.69	9.46	361	55.6	4.15
Steer	Late	663	668	8.45	8.09	383	57.4	4.05
Heifer	Early	570	574	7.82	10.64	311	54.2	4.19
Heifer	Late	627	596	8.60	8.48	339	57.0	4.24
Bull	Early	465	664	9.38	8.85	380	57.2	4.35
Bull	Late	469	664	10.30	7.20	395	59.5	4.41

Animal performance at slaughter

The performance of the steers, heifers and bulls at slaughter for both the early- and late-maturing genotypes is summarised in Table 1. The late-maturing steers and heifers had greater carcass weight (+22kg and +28kg, respectively) and required longer to finish (+78 days and +57 days, respectively) compared to their early-maturing counterparts. The age at slaughter and live weight were similar for the early- and late-maturing bulls, but the carcass weight of the late-maturing bulls was 15kg greater due to the higher kill out percentage (59.5% vs. 57.2%). The conformation score was greater for the late-maturing animals, whereas the fat score was greater for the early-maturing animals.

The average birth weight was 4kg greater for the late-maturing male calves (48 vs. 44kg) and 3kg greater for the late-maturing female calves (44 vs. 41kg) compared with their early-maturing counterparts. Growth rates during the different stages of the production life cycle are illustrated in Figure 1.

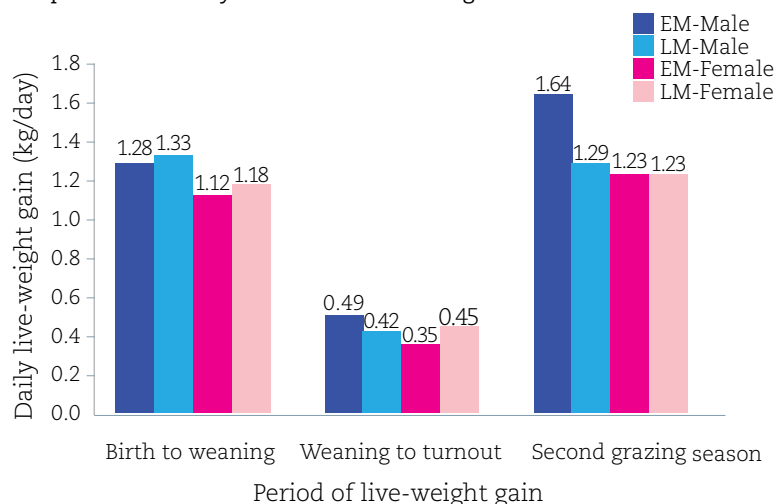


Figure 1. Average daily live-weight gain of early-maturing (EM) and late-maturing (LM) genotype male and female beef cattle during the key stages of the production lifecycle. Male = bull until weaning, and steer thereafter.

Implication of genotype for feeding system

The lifetime concentrate consumption of the early- and late-maturing steers, heifers and bulls from the Derrypatrick herd is summarised in Table 2. The amount of concentrate supplement per animal was 529kg and 360kg less for the early-maturing steers and heifers, respectively, compared to the late-maturing genotypes. The amount of concentrate supplement intake was 156kg higher for the early-maturing bulls when compared to the late-maturing bulls. At the end of the second grazing season, 92% of the steers and 100% of the heifers in the early-maturing genotypes were slaughtered before housing. Only 36% and 48% of the corresponding late-maturing

genotype animals were slaughtered before housing. The results indicate that both suckler production system (i.e., steers, heifers or bulls) and animal genotype (i.e., early- or late-maturing) have a significant effect on the composition of the diet in terms of the proportion of grazed grass, silage and concentrate feed.

Table 2. Concentrate supplementation level and slaughter date.

Animal genotype	Maturity	Concentrate fed (kg)	Slaughtered off pasture before 2 nd winter (%)
Steer	Early	293	92%
Steer	Late	822	36%
Heifer	Early	195	100%
Heifer	Late	555	48%
Bull	Early	2,015	n/a
Bull	Late	1,859	n/a

Suckler farms have a broad geographical distribution in Ireland, and make an important contribution to economic activity in diverse regions throughout the country. The profitability at farm level, however, is generally low. On average, family farm income is less than the average of total direct payments. Ireland has a competitive advantage in growing grass, and consequently grass-based beef systems are the most profitable. The preliminary results from this study highlight a number of key findings. First, very high animal performance was obtained in all three suckler beef finishing systems. Second, very high animal performance was obtained from both the steer and heifer feeding systems with low levels of concentrate supplementation (especially with the early-maturing genotype). Third, early-maturing genotypes could significantly reduce on-farm fixed costs as they don't require housing for a second winter.

Conclusion

The results reported are from the first year of a three-year study, and the results for the following two years are required before definitive conclusions can be drawn. A detailed financial appraisal will be completed, including sensitivity analysis of beef prices, concentrate costs and farm pasture utilisation. The available results from the first year of the study do, however, demonstrate that a much greater animal performance can be achieved from a grass-based feeding system than what is currently being achieved nationally.

Acknowledgments

The Derrypatrick demonstration herd is funded by the Teagasc Core Fund.

The Irish beef breeding programme

Genetic indexes are an important tool for beef farmers to make more informed breeding decisions on the selection of the ideal animal to increase farm performance.



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The ultimate objective of any breeding programme is to increase profitability year-on-year in a sustainable manner. The benefit of breeding is cumulative and permanent. This could also be a disadvantage, however, if poor breeding decisions are made, as these may have devastating repercussions for many generations thereafter. A profitable Irish beef industry requires an easy calving, low-cost cow that produces a good quality progeny carcass every year, with calving coinciding with the initiation of grass growth. This article describes the various components of the beef national breeding programme that underpin a profitable beef industry and focuses on new developments in beef breeding.

Breeding objective

The national beef breeding objectives are designed to increase herd profit through a combination of greater revenue (i.e., carcass price) but also through a reduction in the cost of production traits (i.e., fertility and survival). The Irish Cattle Breeding Federation (ICBF) Beef Euro-star genetic indexes were introduced in 2007. Similar to the dairy and

sheep indexes, the Euro-star indexes have undergone several modifications since their introduction to better reflect changes in beef production systems. Currently, two overall indexes are available on each beef animal: a replacement index, which focuses on the performance of the cow and her progeny; and a terminal index, which focuses on the performance of the bull's progeny that are destined for slaughter. The generation of an animal's individual index includes information on both the animal's own performance and ancestry information. Each trait included in the index is weighted by the relative economic importance of the trait for farm profitability.

New traits

The ability to breed for a given trait is dictated by the availability of data, either for the trait itself (e.g., carcass lean meat yield) or a genetically correlated trait (e.g., ultrasound muscle depth as a predictor of carcass lean meat yield). Ideally, the data should be measurable early in life, preferably in both genders, and available at a low cost. In recent years, research has shifted towards the use of farmer-scored traits in the genetic evaluations. Current research has shown that traits such as weanling docility, cow docility and cow milkability score are accurately recorded, are under genetic control and sufficient data is available to achieve high reliability. Schemes such as the Beef Data and Genomics Programme will provide routine access to novel traits such as calf quality, calf vitality, bull functionality and

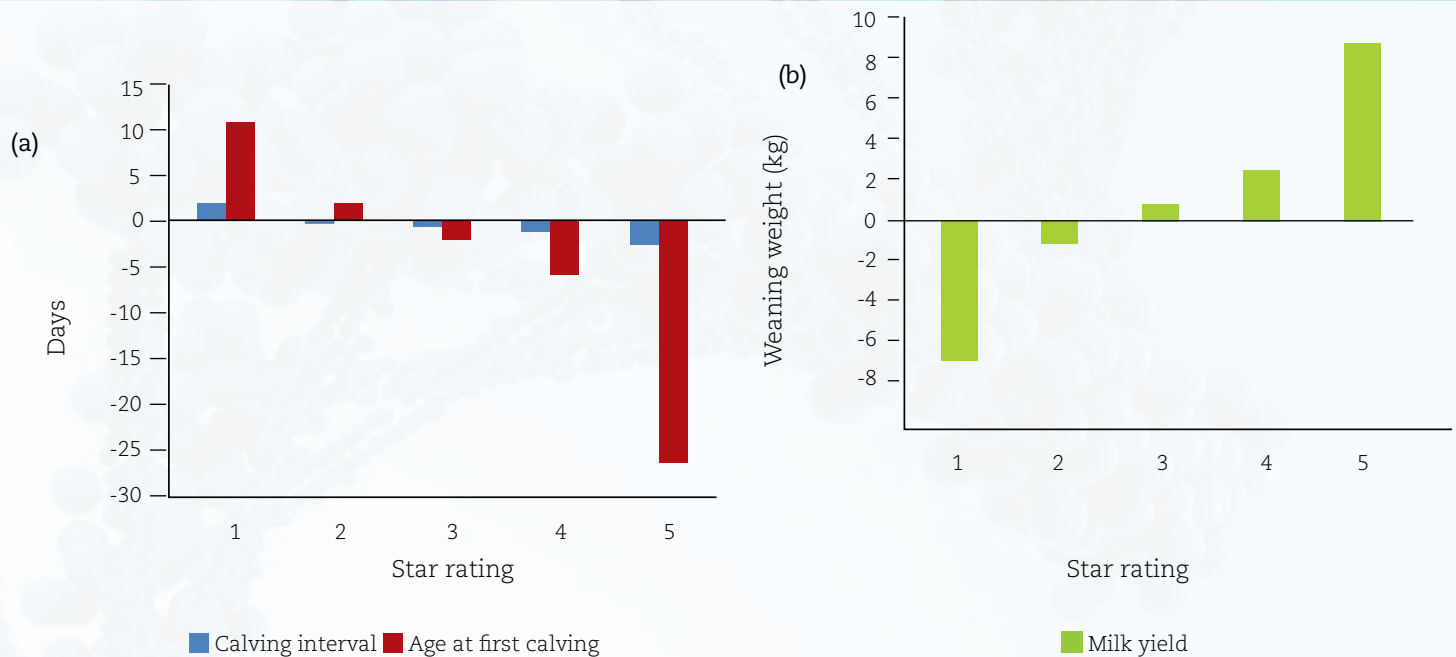


Figure 1. Mean on-farm performance of cows differing in Replacement Index star ratings for the respective traits of calving interval and age at first calving (measured in days) (a); and weaning weight (measured in kg) (b).

health traits. It is envisaged that once research is completed these traits will be incorporated into the breeding objectives. Research on breeding for superior meat quality is also underway.

Genetic and genomic evaluations

The success of any breeding programme is predicated on the ability to accurately identify the genetically elite (and poorest) animals. Current genetic evaluations are based on the accumulation of an animal's performance and information on closely-related animals. Access to large quantities of data on individual animals is one of the main barriers to accurate genetic evaluations in Ireland. Therefore, consideration needs to be given to alternative approaches such as genomic selection. Genomic selection is the process of mapping the DNA profile of an animal and relating this DNA profile to an animal's performance. This technology provides a more accurate prediction of how the animal will perform before any records are available on the animal. Genomic selection has been operational for the Irish dairy industry since 2009, and through schemes such as the Beef Data and Genomics Programme, research on the introduction of genomic selection for the beef breeding objectives is close to completion. Current research shows that the introduction of genomic selection will increase the accuracy of selection by 18 (calf mortality) to 30 percentage units (feed intake), thereby reducing fluctuations in animal proofs overtime. It is anticipated that genomic selection will be launched for the Irish beef industry in autumn 2016.

Index validation

There is unequivocal evidence across multiple species, both nationally and internationally, that genetic evaluations for individual traits manifest themselves as differences in performance 'in the field'. To increase farmer confidence in the beef-breeding objectives, however, Teagasc has recently undertaken extensive analysis to evaluate the accuracy of genetic evaluations for individual traits and the overall indexes using data from the national database.

The national database provides detailed individual animal data across a wide range of management and production systems. This kind of data facilitates quantification of how genetic differences among animals results in actual performance and profitability differences. Results from such analyses have clearly shown that beef cows with higher star ratings for fertility had superior reproductive performance (earlier first calving, shorter calving intervals; Figure 1a). Cows with a five-star ranking for daughter milk yield produced weanlings that were on average 15kg heavier than one-star cows (Figure 1b). Similar trends were observed for other maternal traits: relative to a cow with five stars for the respective maternal trait, one star cows were 40% more likely to experience some level of calving difficulty, 7.4% more likely to have a dead calf and 3.2% less likely to survive to a subsequent calving. Analysis of terminal traits has shown that progeny from sires with high star ratings for terminal traits were 38.7kg heavier at slaughter, had superior conformation, had less fat and were slaughtered six days younger compared to their low star contemporaries.

Conclusions

The national beef breeding programme will continue to focus on improving profitability for Irish beef farmers. Genetic indexes are an important tool for beef farmers to make more informed breeding decisions on the selection of the ideal animal to increase farm performance. Future research will focus on the continual improvement of the national breeding programme to ensure that production and profitability gains are maximised for the beef industry.

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Concentrate feeding for beef cattle



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Small improvements in feed cost efficiency have a relatively large influence on farm profitability.

Feed provision accounts for over 75% of direct costs of beef production. Relative to concentrates or conserved forage diets, grazed grass is generally the cheapest feed source on grass-based farming systems. Due to the considerably lower comparative cost of grazed grass as a feedstuff, beef production systems should aim to increase animal output from grazed grass. Nevertheless, the main feed costs on beef farms relate to indoor (winter) feeding periods, especially feeding of finishing cattle. For example, within grass-based, suckler calf-to-beef steer systems on research farms, grazed grass, grass silage and concentrate account for 66%, 27% and 7% of the annual feed budget, respectively. When this feed budget is expressed in terms of cost (land charge included), the outcome is very different: grazed grass, silage and concentrate account for 44%, 39% and 17% of the total annual feed costs, respectively. This means that even small improvements in feed (cost) efficiency at these times has a relatively large influence on farm profitability. Economic sustainability of beef production systems therefore depends on optimising the contribution of grazed grass to the lifetime intake of feed, and on providing silage and concentrate as efficiently and at as low a cost as feasible.

Concentrate type

The deficiencies in nutrient supply from forages are usually overcome by supplementing with

concentrates. Feeding concentrates is a key component of beef production systems, especially during the indoor winter period and the finishing period. Energy is the most important nutrient required by growing finishing cattle. In addition to cereals, a wide variety of feed ingredients is available and used extensively in beef rations. Winter feed costs could be reduced through utilisation of alternative, (more cost effective) feed ingredients.

Supplementing grass silage for growing cattle

The optimum winter growth rate for weanling cattle destined to return to pasture for a second grazing season is about 0.5-0.7kg live-weight daily. These animals will subsequently avail of compensatory growth on low-cost grazed grass. This target growth rate can be achieved by feeding good-quality grass silage (e.g., 700g/kg dry matter digestibility) to appetite plus 1-2kg concentrates per head daily, depending on the nutritive value of the silage.

Two recent experiments at Teagasc Grange examined the effects of replacing rolled barley (i.e., starch-based feed) with soya hulls (Experiment 1) or citrus pulp (Experiment 2); (i.e., digestible, fibre-based feeds) in a concentrate supplement on intake and performance of young, growing, suckler-bred, male weanling cattle offered grass silage to appetite. In Experiment 1, they were offered 1.7kg dry matter (DM), once daily, of one of two concentrate supplements:

1. Barley/soyabean-based (862g rolled barley, 60g soya bean meal, 50g molasses, 28g vitamin and minerals/kg);
2. Soya hulls-based (933g soya hulls; 50g molasses; 17g minerals and vitamins/kg).



In Experiment 2, they were offered 1.6kg DM, once daily, of one of two concentrate supplements:

1. Barley/soya-bean-based (same formulation as above);
2. Citrus pulp-based (855g citrus pulp, 80g soya-bean meal, 53g molasses, 12g vitamins and minerals/kg).

Concentrates were prepared as coarse mixtures and formulated to have similar concentrations of protein (PDIE) on a DM basis. Concentrate supplement type did not significantly affect daily grass-silage intake, live-weight gain, final live weight, ultrasonically-assessed body composition or measurements of skeletal size. In conclusion, at the levels of supplementation used in these experiments, soya hulls and citrus pulp can replace barley in concentrate supplements for growing cattle currently fed grass silage, without negatively affecting performance. Implications are that beef farmers have the opportunity to source alternative (cost-effective) feed ingredients as supplements to grass silage.

Concentrate feeds for growing-finishing cattle

Processed maize grain is usually included in cattle rations to increase performance and, mainly due to anecdotal evidence, to increase the rate of fat deposition and, thus, achieve earlier 'finish'. The effect of replacing half the barley in a barley-based concentrate ration with maize meal (plus sufficient soya-bean meal to ensure adequate dietary protein) on the performance of young dairy bulls and suckler bulls offered concentrates *ad libitum* over 170 and 86 days, respectively, was evaluated at Grange. In the dairy bull study, intake was higher for the maize meal-based ration but there was no difference in carcass weight between the two rations. Conversely, in the suckler bull study, intake was similar between the two rations but carcass weight was higher for the maize meal-based ration. Maize meal inclusion in the diet did not enhance carcass fat deposition in either study. Additionally, flaked, toasted maize was evaluated in the suckler bull study; animal intake, growth and carcass traits did not differ from the barley-based control ration.

Dried distillers grains, a cereal by-product of the distillation process, are the residual product following the sequential milling, fermentation, and removal of water from cereal grains. Intake and performance of beef cattle offered a barley-based ration with increasing levels of inclusion of maize or wheat-dried distillers grains as a supplement to grass silage ('growing phase') and, subsequently, to appetite ('finishing phase') were evaluated. The concentrates assessed were: a barley-soya 'control' ration (862g/kg rolled barley, 60g/kg soya-bean meal, 50g/kg molasses and 28g/kg minerals/vitamins), and barley-soya based rations where the barley (plus all soya-bean meal) was replaced with 200, 400, 600 and 800g fresh weight maize-dried distillers or wheat-dried distillers grains/kg. Steers were individually offered 3kg DM of the respective concentrates as a supplement to moderate digestibility grass silage offered to appetite over a 70-day growing phase and, following a 26-day dietary adaptation period, were offered the same concentrates *ad libitum*, plus 3kg fresh-weight grass silage during an 86-day finishing phase. Results showed that maize-dried distillers grains had a superior feeding value (based on dietary feed conversion ratio) to wheat-dried distillers grains at both concentrate feeding levels. Both maize and wheat-dried distillers grains had a superior feeding value compared to the barley-soya-based control ration when offered as a supplement; however, this superiority was not evident when the concentrate was offered to appetite. Under the conditions of this study, results indicated that the optimal inclusion level of dried distillers grains in the concentrate was about 800g/kg when the concentrate ration was offered as a supplement to grass silage and about 200g/kg when the ration was offered *ad libitum*. In summary, the feeding value of dried distillers grains was a function of their inclusion level in the concentrate and whether the concentrate was offered as a supplement to grass silage or offered to appetite with restricted grass silage. These latter findings imply that the relative economic value of by-product feed ingredients is contingent on concentrate-feeding practices.

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Applying grassland technologies to beef farms

Drystock farms that utilise the key grassland management technologies achieve grass production levels that are similar to high producing dairy farms.

The strong reputation of Irish grass-fed beef production in traditional and new markets is an asset that can be further exploited. The potential to achieve high levels of lifetime carcass gain from grazed grass provides Irish farmers with a valuable competitive advantage over most of their European counterparts. On average, the cost of producing a kilo of live-weight gain from grazed grass is 80-85% less compared with an intensive concentrate-based system. Every extra tonne of grass utilised on a drystock farm is worth an additional €100/ha. Therefore, grass utilisation is a key profit and sustainability indicator on beef farms.

PastureBase Ireland (PBI) (Hanrahan et al., 2015) has been in operation since January 2013. PastureBase Ireland is a web-based grassland management tool incorporating a dual function of grassland decision supports (spring rotation planner, grass wedge and grass budgeting for both spring and autumn) and collecting and storing a vast quantity of grassland data from dairy, beef and sheep farms in a central national database. At present the vast majority of farms recording measurements on PBI are dairy farms, with drystock farms accounting for 10-15% of the client base. The data accumulated to date indicate that PBI participating farms have achieved improvements in grass dry matter (DM) production and grazing management.

Knowledge of farm cover, grass demand and grass growth are essential for grazing management decisions. A major weakness on many farms is low grass utilisation. Farms that are dependent on imported feed are very exposed in the current volatile price environment.



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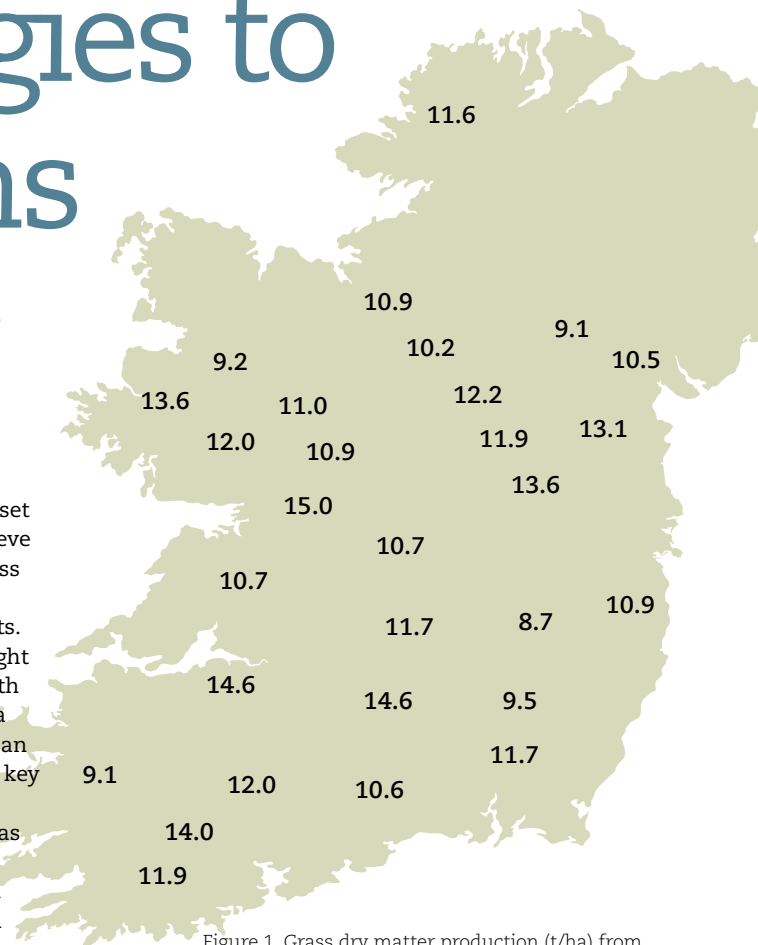


Figure 1. Grass dry matter production (t/ha) from PastureBase Ireland drystock farms in 2015.

Grassland performance on farms

Figure 1 illustrates the annual DM production achieved on drystock farms across Ireland in 2015. These farms have >25 weekly farm walks completed on PBI. The average grass DM production on drystock farms was 10.5, 11.8 and 12.3 t/ha in 2013, 2014 and 2015, respectively. Drystock farms with the poorest grass production only produced 8-9t DM/ha, while the best drystock farms exceeded >14t DM/ha of grass grown. In addition, the highest producing farms achieved >8 grazings on the grazing platform. Drystock farms that utilise the key grassland management technologies achieve grass production levels that are similar to high producing dairy farms.

Table 1. Total dry matter production (t DM/ha) from drystock farms from PastureBase Ireland grass recordings in 2014 and 2015.

	Mean	Minimum	Maximum	Range
2014				
Total DM production (t DM/ha)	11.8	8.7	15.1	6.0
Grazing DM production (t DM/ha)	10.3	8.1	15.1	7.0
Silage DM production (t DM/ha)	1.5	0.2	3.0	2.8
Number of grazings per paddock	5.0	4.0	6.9	2.9
2015				
Total DM production (t DM/ha)	12.3	9.1	14.6	5.5
Grazing DM production (t DM/ha)	9.8	7.2	12.7	5.5
Silage DM production (t DM/ha)	2.4	0	4.6	4.6
Number of grazings per paddock	5.4	3.9	8.1	4.2

The grass DM production performance is directly related to the grazing management applied. Drystock farm data in PBI indicates that farms in the midlands and northwest produce higher quantities of grass DM than those in the south. Data analyses were undertaken to examine the factors responsible for the variation in farm grass DM production. It was apparent that achieving more grazings from each paddock on the farm during the grazing season was the key driver of increasing total grass DM production. On a high proportion of drystock farms the number of paddocks is not adequate, leading to large paddock sizes with longer residency periods. As a consequence, livestock are grazing these paddocks for too long (residency time is up to two weeks), reducing the productivity of these paddocks. Where regrowths are unprotected, continual regrazing occurs, target residuals are not achieved and nitrogen application is delayed. Inadequate grazing infrastructure is a major problem on some farms. Figure 2 shows the relationship between the number of paddocks per farm and the total number of grazings achieved per farm. PBI data indicate that creating one new paddock on a farm will give five extra grazings from the farm for the year. Hence, sub-dividing a farm into paddocks of appropriate size will increase the number of grazings, which in turn will increase total grass DM production.

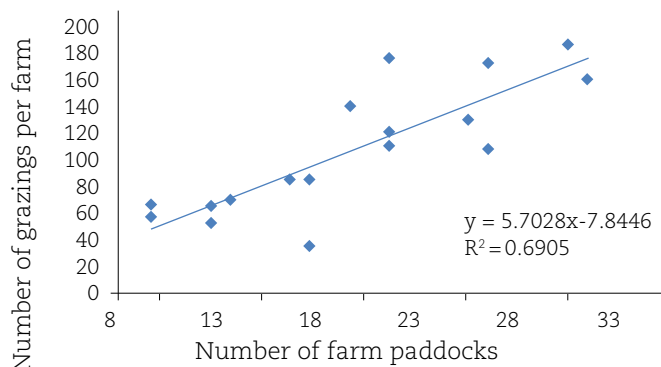


Figure 2. The number of paddocks per farm and its association with the total number of grazings per farm.

Figure 3 illustrates the relationship between the number of grazings achieved per paddock and the associated DM production. Every extra grazing achieved per paddock will increase annual DM production by 1,385kg DM/ha. It is critical that drystock farms sub-divide existing paddocks into more appropriate grazing areas. Paddock residency should be no longer than three to four days during the mid-season.

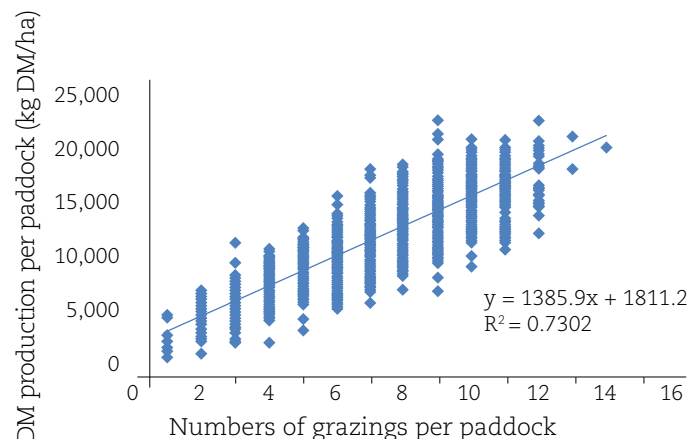


Figure 3. The number of grazings achieved per paddock and annual grazing dry matter production.

Summary

PBI will allow the beef industry to move forward with better understanding of the grassland performance of drystock farms. Ireland has an incredible potential to increase annual grass DM production and utilisation by placing a stronger focus on grazing management. Drystock farmers need to target achieving more grazings on their farms. This can only happen by creating a suitable grazing infrastructure on the farm and by applying key grazing management technologies such as the spring rotation planner, the grass wedge and autumn grass budgeting. There are approximately 200 drystock farms using PBI, but there are over 100,000 drystock farms in Ireland, of which >4,000 are full-time farmers. Most beef farmers can significantly improve productivity and profitability by applying key grassland technologies.

Acknowledgements

Pasturebase Ireland gratefully acknowledges the financial support of FBD Trust.

For more on PastureBase Ireland see: <https://pasturebase.teagasc.ie/>

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Recent research in suckler beef cow fertility

Quantifying the overall effect of reproductive wastage at a herd level, as well as the impact of various management interventions, is critical to improving overall herd profitability.

Reproductive efficiency will be one of the key factors in achieving the productive and economic targets set out for the beef industry under the Food Wise 2025 report. Notwithstanding this, however, the current reproductive performance of the national beef cow herd is suboptimal with only eight in every 10 beef cows producing a calf on a yearly basis, less than 20% of heifers calving at the target age of 24 months and about 20% of calves born to beef cows bred using artificial insemination (Irish Cattle Breeding Federation data, 2015). While there are many potential reasons for the poor reproductive efficiency of beef cow herds (Diskin and Kenny, 2014), the relative importance and potential impact of the various contributory factors have not been quantified.

'BEEFCOW' research programme

In order to address some of the key issues contributing to reproductive inefficiency, a large-Department of Agriculture Food and the Marine funded, all-Ireland, beef cow fertility research programme was instigated, which is led by Teagasc, Grange, and involves partners at University College Dublin, ICBF, Agri-Food and Biosciences Institute in Northern Ireland and the *Irish Farmers Journal*. The main objectives of the project are as follows:

- Conduct an all-Ireland epidemiological study of the key factors affecting reproductive efficiency of beef cow herds, with particular emphasis on the prevalence and impact of pathogen and trace element status;
- Evaluate a number of oestrous synchronisation protocols to facilitate timed artificial insemination (TAI) and, thus, enable greater AI usage;
- Examine the effect of breed, genetic merit and nutritional management on the onset of puberty and pregnancy rate of beef heifers; and
- Undertake economic modelling analysis to evaluate and quantify the effect of various reproductive management decisions on overall herd profitability. Some of the component studies involved in this project are discussed below.



Impact of pathogens and trace elements on reproductive performance

Numerous bacterial, viral and protozoal pathogens can result in clinical disease leading to both direct and indirect effects on productive and reproductive efficiency (Van Leeuwen *et al.*, 2010). Additionally, trace elements (copper, iodine and selenium) are essential to support normal growth, reproduction and lactation in cattle. Deficiencies in certain minerals have been anecdotally implicated as a cause of poor reproductive performance in cattle, particularly in beef cow herds in Ireland. However, there is a lack of scientific evidence to substantiate this.

In order to comprehensively establish, for the first time, the status of Irish suckler cow herds for a range of key pathogens and trace elements, a large on-farm study was undertaken incorporating almost 6,000 cows from 169 spring-calving, suckler cow herds across the island of Ireland (32 counties).

Cows were blood sampled during the summers of 2014 and 2015, to measure sero-prevalence (antibodies) of pathogens (leptospirosis, Bovine Viral Diarrhoea [BVDV], Infectious Bovine Rhinotracheitis [IBR] and neosporosis) and blood concentrations of trace elements (copper, iodine and selenium). A comprehensive survey was also carried out to determine the vaccination policy undertaken in each individual herd.

Preliminary findings from the study indicate a sero-prevalence of 71%, 78%, 44% and 5% for leptospirosis, BVDV, IBR and neosporosis, respectively, in non-vaccinating herds. Additionally, data to-date for trace elements suggests that many cows are deficient in selenium and iodine. The association between the pathogen and trace element status and cow fertility is currently being examined.

Use of AI in suckler herds

Less than 25% of calves born in beef herds, on average, are bred through AI. Such low usage of this technology does not bode well for genetic improvement and, most likely, reflects the difficulty and labour requirements for heat detection, assembly of cow(s) for insemination, as well as land fragmentation in beef herds. Despite this, it is well acknowledged that AI allows access to genetically proven sires for key terminal and maternal traits, including ease of calving. One of the primary objectives of the current Beef Data Genomics Programme is to improve the genetic merit of the

national beef herd, particularly for maternal traits. Greater use of AI will be necessary to produce higher genetic merit (4 and 5 star) female replacements.

Synchronised breeding regimens or synchronisation protocols have been commercially available for more than 25 years. There is, however, a need for practical, labour-efficient and effective protocols for pasture-based herds, which facilitate treated cows to be bred without recourse to heat detection.

A series of large scale, on-farm, oestrous synchronisation studies were conducted in 2014 and 2015, involving 74 beef cow herds with 2,205 cows all over the island of Ireland. Cows that were calved at least 35 days were enrolled in the studies. Three different synchronisation protocols, all based on insertion of a progesterone releasing intravaginal device (PRID) for seven days, were compared. All cows were subjected to a single TAI at 72 hours after PRID (CEVA Animal Health; *in situ* for seven days) removal. Herd owners were free to use the semen of their choice (non-sexed), thus, resulting in a large number of bulls being used across the studies. Despite this, pregnancy rates ranged from 50-70%, with an overall average of 55% achieved to a single timed insemination. Many herds on the study achieved an 80% pregnancy rate for submitted cows, within the first three weeks of the breeding season (TAI plus any subsequent repeat breedings), thus, condensing the herd calving pattern and reducing calving interval.

Bio-economic modelling

Quantifying the overall effect of reproductive wastage at a herd level, as well as the impact of various management interventions, is critical to improving overall herd profitability. Thus, a key component of the BEEFCOW project is to develop a bio-economic systems model of suckler cow herd reproductive performance to facilitate the technical and economic evaluation of alternative reproductive performance indicators. The work will also underpin the future derivation of economic values for key reproductive traits within the context of the Irish beef cattle genetic evaluation programme.

Acknowledgements

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Passive immunity and health of Irish dairy and suckler calves



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This article reports on the results of a large-scale observational study on passive immunity and calf health under field conditions in Ireland.

Transfer of passive immunity

Calves are immunologically naïve at birth because the bovine placenta prevents *in utero* transfer of immunoglobulins (Ig) from dam to calf. Consequently, calves are dependent on passive immunity for immunological protection against disease challenges in early life.

Passive immunity is achieved through ingestion and absorption of Ig from colostrum immediately post-calving. Colostrum is the first milk produced by the cow. Passive immunity is facilitated by the calf's small intestine, which has the ability to absorb macromolecules during the first 24 hours after birth. Failure of passive transfer (FPT) of immunity occurs when the calf does not absorb sufficient Ig in this time period. Calves with FPT are at increased risk of morbidity and mortality, begin exhibiting clinical signs of disease at younger ages, and experience a greater number of sick days and reduced growth performance when compared to calves with adequate passive immunity.

Assessing passive immunity in calves

Multiple tests are available to detect FPT in calves and to monitor the effectiveness of on-farm colostrum management programmes. Radial immunodiffusion (RID) and enzyme-linked immunosorbent assay (ELISA) are testing procedures that directly measure serum Ig concentration. Calves with serum immunoglobulin G (IgG) concentration of less than 10mg/mL are classified as having FPT. Indirect test methods can also be applied to estimate serum Ig. One commonly used indirect test is the zinc sulphate turbidity (ZST) test.

Passive immune status of Irish calves

The All-Island Animal Disease Surveillance Programme (Department of Agriculture, Food and the Marine (DAFM) in the Republic of Ireland and Agri-Food and Biosciences Institute in Northern Ireland) reports that between 40% and 66% of calf serum samples submitted annually to veterinary laboratories have FPT (defined in this case as <20 ZST units). However, these samples are generally voluntary submissions from clinically ill calves or animals in herds with ongoing calf health problems. Hence, the FPT estimates are unlikely to be reflective of the overall national herd status.

A large-scale observational study, funded by DAFM, was implemented to formally evaluate the passive immune status and health of Irish dairy and suckler calves. In Year 1 of this study, a total of 84 dairy and 111 suckler farms throughout Ireland were visited during the autumn 2014 and spring 2015 calving seasons. Farmers were recruited to participate in this study through Teagasc advisors, discussion group meetings, open day events and word of mouth.

Table 1. Mean sampling age, ZST results and incidence of disease for calves blood sampled during the autumn 2014 and spring 2015 calving seasons.

	Dairy calves (n=1,040)	Suckler calves (n=923)
Sampling age (days)	9.6 ± 5.3	11.0 ± 5.6
ZST results		
Low	14%	21%
Medium	50%	51%
High	36%	28%
Incidence of disease from birth to three months of age*		
Overall disease risk	17%	25%
Diarrhoea risk	12%	7%
Respiratory disease risk	1%	7%
Navel/joint infection risk	1%	5%

*Disease data available for 683 dairy calves and 577 suckler calves.

Blood samples were collected by jugular venipuncture from 1,040 dairy and 923 suckler calves between one and 21 days of age, and serum was analysed using the ZST test. ZST results varied substantially for both dairy and suckler calves (Figure 1). These ZST results were categorized as: Low = '<10', Medium = '10-20' and High = '>20' units (Table 1). Dairy calves were less likely to have ZST results in the lower categories than suckler calves. This is an unexpected result because dairy cows generally have lower colostral Ig concentration than suckler cows.

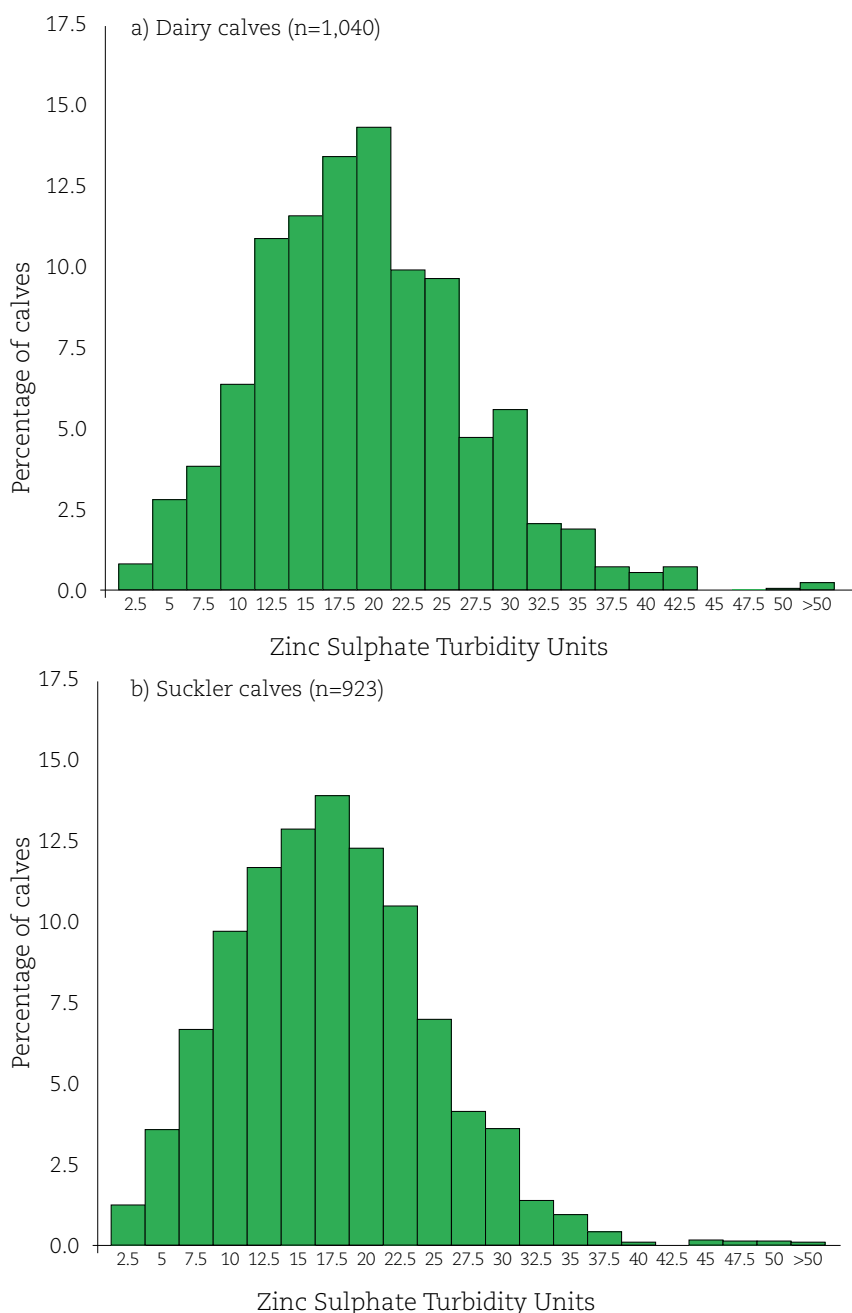


Figure 1. Distribution of ZST units for dairy (a) and suckler calves (b) blood sampled during the autumn 2014 and spring 2015 calving seasons.

A cut-point value of less than 20 ZST units, which includes the Low and Medium categories, is commonly used to describe FPT. With this interpretation, approximately 64% of dairy calves and 72% of suckler calves had FPT, which suggests that the aforementioned disease surveillance estimates have underestimated the prevalence of FPT in Irish calves. However, new reports from the Limerick Regional Veterinary Laboratory (DAFM) have proposed that a lower ZST cut-point value for FPT needs to be adopted. Hence, if only the Low category results are interpreted as indicative of FPT then approximately 14% of dairy calves and 21% of suckler calves had inadequate passive immunity. A formal cut-point evaluation is ongoing to determine more appropriate FPT cut-off values for ZST, as well as other indirect testing methods.

Calfhood disease in Irish calves

Farmers were requested to complete detailed health records for each calf blood sampled during Year 1 of the study. Standardised case definitions for disease were provided. A disease event was defined as a calf being treated for at least one case of disease between birth and three months of age. Health records were obtained for 683 calves from 54 dairy farms and 577 calves from 73 suckler farms. In total, 17% of dairy calves and 25% of suckler calves were treated for at least one disease event in the first three months of life (Table 1).

The overall risk of at least one disease event in dairy versus suckler calves was not significantly different. The risk of dairy calves experiencing a disease event did not differ by ZST status. However, suckler calves with Low ZST were significantly more likely to be treated for disease than suckler calves in the Medium or High ZST categories.

Conclusions

This is the first large-scale observational study on passive immunity and calf health to be conducted under field conditions in Ireland. These results demonstrate that many Irish calves are at risk of FPT and calfhood disease. Research is ongoing to identify the risk factors for FPT and calf disease, as well as to better understand the relationships between passive immunity, calf health and survival.

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CELU

GenSPI: Genomic selection for potato improvement



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Can we make better selection decisions and develop improved 'crisping' varieties that will meet the needs of the potato processing industry and growers? A new EU Marie-Sklodowska-Curie Fellowship project, GenSPI, at Teagasc, Oak Park has been addressing this question.

Breeding new varieties of potato

Traditional potato breeding involves making many pair-wise crosses between different varieties and breeding lines and evaluating the offspring for agronomic value. Evaluation takes place over 12 years; and each year underperforming seedlings are eliminated. The evaluation of seedlings intensifies year-on-year, until only the top 60 seedlings (from approximately 100,000) are evaluated in large multi-location trials. This process is not perfect, as decisions to eliminate seedlings have to be made early in the breeding cycle, when our capacity to evaluate agronomic and processing value is low.

Improving selection decisions earlier in the breeding cycle

Imagine a simple blood test that we could apply to all newborn foals in Ireland, and from this, we could predict how successful they are likely to be as racehorses over a range of distances and tracks. Using this information, we could identify the foals

with the greatest potential, and invest effort to ensure they realise this potential. In plants, such tests could lead to better crop varieties for humankind. Genomic Selection is one such 'test' where we aim to use information contained in a seedling's DNA to predict its agronomic and processing performance. This involves some initial efforts to establish links between information in the DNA and agronomic/processing performance. Establishing this link involves: creating a panel of seedlings and recording accurate measurements on them (phenotypes); and sequencing a portion of the DNA of each seedling. We then build a model that relates the differences in the DNA sequence between seedlings to the differences in phenotypes between seedlings. Next, we apply the model to make selections on new material. In this case we would take seedlings at an early stage in the breeding cycle, sequence a portion of their DNA, and use our model to predict the performance of the seedling for a particular trait. This allows us to generate Genomic Estimated Breeding Values (GEBVs) for each seedling and make better selections at a stage in the programme when extensive phenotyping is not practical. The key improvement this offers is the ability to make more precise selections much earlier in the decadal breeding cycle.

Breeding better varieties for processing

Perhaps, surprisingly, in Ireland we import approximately €10 million worth of processing potatoes to serve the chipping and crisping sectors each year. One of the goals of the potato breeding

programme at Teagasc is to develop varieties with light fry colours that are suitable for the processing industry, and which are broadly adapted to growing in Ireland and other northern European countries. Poor fry colours result from naturally high reducing-sugar levels in some varieties, accumulation of sugars due to natural senescence and low-temperature sweetening during cold storage, all leading to very dark fry colours and potential acrylamide build-up. At present, storage is mostly carried out at 8°C to avoid low-temperature sweetening; however, storing tubers at these higher temperatures requires the use of sprout suppressants and, in time, these are likely to be phased out by the EU due to health concerns. A key attribute of a good processing variety is the ability to be stored for extended periods under low temperature (4-6°C) without deterioration in fry colour. The routine collection of phenotypes for this trait is difficult because it requires storing tubers from every seedling under different storage criteria in cold stores for many months, followed by frying or sugar analysis. In the early years of the breeding cycle, seedling numbers are large (thousands to tens of thousands), and decisions on what seedlings to keep in the programme need to be made quickly to allow planting for the following year's evaluation. The ability to use information in the DNA to predict resistance to low-temperature sweetening would enable us to identify seedlings with the greatest potential for processing. To develop the genomic selection models for this process in potato we created a panel of seedlings to develop the genomic selection models, and these were harvested in 2015 and stored at either 4°C, or 8°C with the use of sprout suppressants. These were removed from storage at different time points and processed to evaluate fry colour (Figure 1). At the same time we have sequenced a portion of the genome from every seedling in the panel to develop models that can be used for selection. Already, this additional phenotyping effort has enabled us to identify seedlings that can be used as parents in breeding cycles starting in 2016. We will target offspring from these crosses in our initial deployment of genomic selection in the Teagasc potato breeding programme in the coming years.

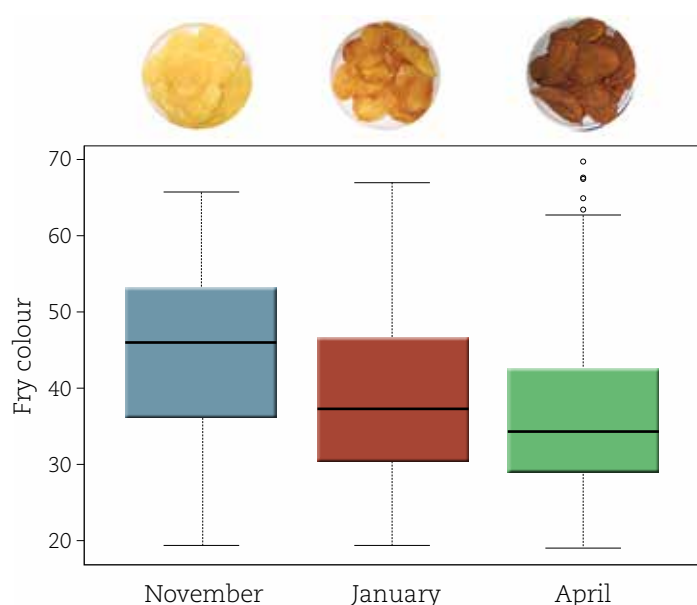


Figure 1. Distribution of fry colour in the training population during storage at 4°C. Fry colour is measured as HunterLab L values, with higher L values indicating more desirable fry colours. As storage progresses, the median fry colour of the population declines.



Using selection indices to develop better processing varieties

Resistance to low-temperature sweetening is just one crucial characteristic of a processing variety. However, there are a range of other traits that are either processor requirements or grower requirements.

These include dry matter content, tuber shape, flesh colour, yield, and resistance to potato cyst nematodes, blackleg, spraing, blight, potato virus Y, and bruising. Some are crucial for variety success and others are desirable. We are developing a weighted selection index for the breeding of new processing varieties that will aid seedling selection. The goal is to develop genomic selection models for all traits in the selection index, enabling us to generate genomic estimated breeding values for 'crispers' and bring more varieties to commercialisation that meet the requirements of both the processing industry and growers.

Acknowledgments

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Bovine serum albumin: dietary whey protein with a new facelift

Bovine serum albumin is a plasma protein that has been part of our diet for millennia because of its association with milk, and yet we know little about its biological effects. Here, we provide an overview of recently published data showing for the first time that bovine serum albumin (BSA) has anti-obesity effects. These findings provide the basis to screen for the bioactivity, which we anticipate will be more efficacious than the intact protein.

The prevalence of obesity has increased significantly, affecting more than 600 million adults over the age of 18 (World Health Organisation estimates). Since development of obesity is a risk factor for comorbidities such as diabetes and cancer, the management of which costs the global economy €1.8 trillion annually, there is an urgent need to develop interventions to impede weight gain in humans and/or cure existing obesity. In this regard, there is a focus on developing functional food ingredients, where health benefits are supported by robust scientific evidence.

It has been known for some time that dairy intake is inversely associated with obesity. This suggested that milk contains anti-obesity bioactivity. Notably, we have shown that milk derived whey protein isolate (WPI), which includes alpha-lactalbumin, BSA and lactoferrin (Lf), has anti-obesity effects (McAllan *et al.*, 2014). This published work, summarised in articles in winter issues of this journal in 2013 and 2014, led us to search for the bioactivity in WPI.

BSA has anti-obesity effects

BSA has been used traditionally in cell culture experiments because of its ability to bind small molecules and fatty acids. Beyond this work, little emphasis has been placed on assessing the biological effects of BSA despite the fact that the protein has been a part of our diet (in milk) for millennia. As such, we were interested in finding if BSA has anti-obesity effects similar to WPI. We were further motivated to

test BSA because this protein constitutes only 5% of the whey proteins, where the abundance may reflect an evolutionary mechanism to reduce potency arising during ancestral times of food shortage. We therefore hypothesised that enrichment of BSA in the diet will significantly reduce weight gain and fat mass.

By undertaking animal feeding trials, we confirmed our hypothesis (McManus *et al.*, 2015b). Notably, in the adipose tissue, where the fat is stored, BSA increased expression of genes linked to fat catabolism, which appear to underlie how this dietary whey protein reduced body weight (Figure 1a). BSA also reduced circulating levels of the stress-related hormone corticosterone. This change occurred independent of the effects on the adipose tissue, suggesting distinct mechanisms of action (Figure 1a). Since corticosterone is produced by the activity of the brain associated stress axis (hypothalamus-pituitary-adrenal) following exposure to stress, a common cause of obesity, the reduction of this hormone was consistent with the anti-obesity potential of BSA. Importantly, BSA was more effective than WPI in terms of reduction in weight gain and adipose tissue mass. This work supported our hypothesis that WPI has bioactivity (BSA being one example), which, when isolated and enriched in the diet, would be more efficacious than WPI.

Understanding the bioactivity and mechanisms

If evolution had an impact on the abundance of BSA within whey, then one can predict that Lf, which is 1% of the whey proteins, should be equally or more effective in reducing body weight and fat mass. Contrary to our prediction, our investigation revealed that Lf does not reduce body weight and fat mass in the same experimental design as that used for BSA (McManus *et al.*, 2015a). However, Lf reduced the plasma corticosterone hormone through effects on the stress axis (Figure 1b). This work suggested that BSA and Lf have both common and distinct bioactivities related to reduction in weight gain and fat mass (BSA: mechanism 1) and stress axis (BSA and Lf: mechanism 2) (Figure 1 a & b), and that a comparison of the protein derived components (amino acids and peptides) following digestion may assist in characterisation of the bioactivity unique to BSA.



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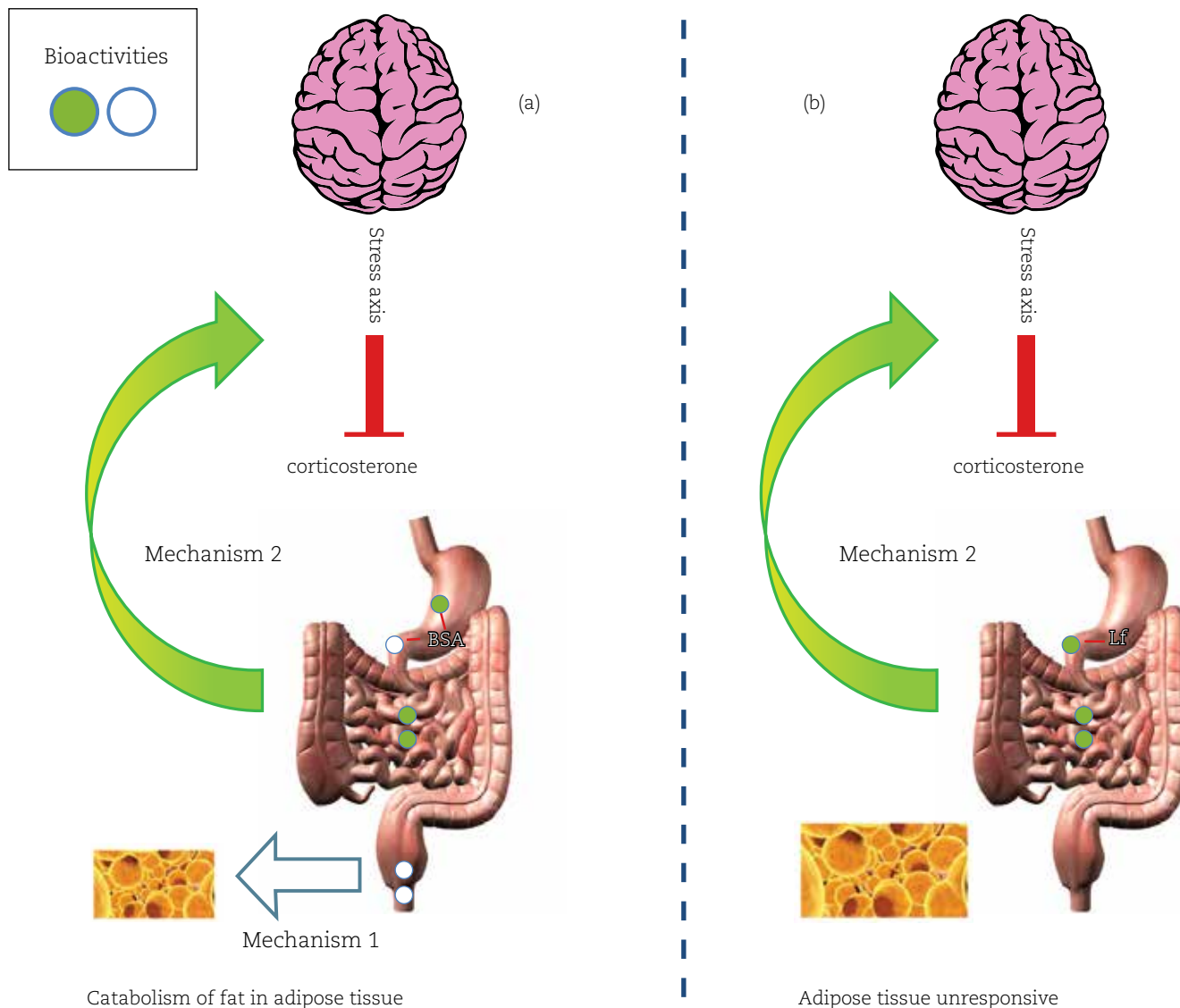


Figure: The mechanisms and related bioactivity of bovine serum albumin (BSA) and lactoferrin (Lf) impacting on adipose tissue fat catabolism and the stress axis. Effects shown are relative to casein as the control protein.

Relevance to policy makers and industry

Whey is a by-product of cheese manufacture, and thus, there is a considerable economic benefit to utilising the associated proteins as a health-promoting food ingredient. While attention has been focused on WPI in weight management and improved body composition (fat to lean mass ratio), our data show for the first time that its constituent protein BSA has more potent anti-obesity effects. The data provide the basis to screen for the bioactivity in BSA with a view to creating health-promoting food products. Since BSA can also be isolated as a by-product of the meat industry, and given its effects on stress, there is also a potential application of BSA and related activity in the management of stress during animal (e.g., pig) development.

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RED

Intergenerational family farm transfer



– the human side

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This article looks at the human factors that influence the intergenerational transfer of the Irish family farm.

Intergenerational family-farm transfer is a complex and highly topical issue. It is increasingly seen as crucial to the survival, continuity and future prosperity of the agricultural sector, traditional family farm model and broader sustainability of rural communities. While financial incentives to stimulate and entice the process are important and, indeed, well meaning, there are many more facets to the farm transfer decision-making process, which in large part have been neglected. Recent research into achieving greater land mobility in Ireland touched on this, alluding to the fact that 'apart from the economic driver of payments retaining elderly farmers on land, there are also

psychological drivers involved' and 'addressing the issue of low levels of mobility must also take cognisance of these psychological barriers' (National Rural Network, 2013). This research came 40 years after Commins (1973) first stressed that retirement policy, with economic objectives, should not ignore possible social consequences or wider issues of human welfare. However, to date, such recommendations have largely been ignored, resulting in the formulation and implementation of largely unsuccessful farm transfer-policy strategies, which have little or no regard for elderly farmers' emotions. For example, the eligibility requirements for farmers entering the most recent Early Retirement Scheme for farmers (ERS 3) (June, 2007), included that: 'Persons intending to retire under the Scheme shall cease agricultural activity forever'. Essentially, farmers were being asked to revise their self-perceptions upon retirement. It is in probing these issues further that this research is based.

Data collection methodology

In order to secure an in-depth understanding of the complex and competing emotions that influence the process of transferring the family farm business, from the perspective of the senior generation, questionnaires were initially distributed to a randomly-selected sample of farmers in attendance at a series of 'Transferring the Family Farm' clinics delivered by Teagasc in September and October 2014. As these clinics took place at 11 locations throughout Ireland, the sample provided is nationally representative of the Irish farming population across a range of diverse regions, farm sizes and operations. In order to validate, deepen and build on the quantitative data gathered at the clinics, interviews were then conducted with a 10% sample of questionnaire respondents who gave their consent to be interviewed.

Results

Research findings provide an appreciation of the complex nature of family farm succession and retirement. For many farmers, identity and self-esteem are strongly attributed to their occupation and, as a result, sacrificing one's professional and personal identity upon transferring managerial control of the farm and retiring is a concept that they find difficult to accept. For example, 72-year-old dairy farmer Jack from the south east has no intention of retiring from farming: "Have I considered retiring? Never ... I couldn't, I just couldn't! I'd be always saying I'll take it easy, but I couldn't, I have that drive to keep going ... sure I am up every morning at half six and I could be going until 10 or 11 o'clock at night, so I couldn't even imagine it. I make out it wouldn't be good, because I think it's

important to be active, I enjoy it. I like to farm. But if I had to retire, it would not be for a few more years; I'm only 72, so definitely not for a few more years."

Farmers also resist transferring the farm on the basis of an anticipated loss of the recognition and social status that has accompanied their position as an active and productive farmer in society. Subsequently, the senior generation resist succession and retirement planning as a means of sustaining their position as head of the family farm. There is also a cultural expectation within the farming community that 'farmers don't retire'. Those who do retire are generally perceived by interviewees to have a defeatist attitude or else seen to have no option but to do so due to ill health.

Conclusion

In an era of unprecedented transition in global agriculture, this research acknowledges that the phenomenon of an ageing farming population calls for and justifies the development of various farm transfer incentives that will enable enthusiastic young farmers gain access to productive assets and subsequently improve the

competitiveness of the agricultural sector. However, as it is the older generation who ultimately decide whether the process occurs or not, even the most sophisticated of farm transfer plans are of little avail if policy makers and practitioners are not adequately cognisant and understanding of how painful it is for the older generation of farmers to 'let go'. Ideally, any new initiative put in place to support and encourage family farm transfer, or any policy, must be accompanied by a comprehensive set of interventions to deal with the personal and social loss an older farmer may experience upon transferring the family farm. In order to do this, future policies and programmes relating to family farm transfer must develop effective strategies addressing the emotional wellbeing of elderly farmers. For example, on its own, and with the numerous perceived negative connotations associated with it identified, perhaps the term 'Early Retirement Scheme' is no longer appropriate for policy to use in a farming context. Perhaps the term 'Farm Progression Scheme' would be more effective as it portrays a sense of purposefulness rather than one of cessation to an elderly farmer.

In addition, instead of reporting that farm management decisions are in the hands of a generation who may be more resistant to structural change and growth, policy makers and key stakeholders need to embrace, publicly promote and recognise the older generation's invaluable store of knowledge, skills and years of experience working on the farm that the younger generation have not yet accumulated. This may help to diminish the stigma and defeatist stereotype associated with transferring the family farm and, subsequently, promote a more positive and wilful attitude towards the process over time. The development of such strategies concerning the human dynamics of family-farm transfer has the potential to greatly ease the stresses of the process. Anyone who considers such recommendations to be too idealistic should remember that we all inevitably have to face the prospect of letting go of our professional tasks and ties in our old age. No one can avoid ageing and as this research has identified, most elderly farmers opt to maintain the facade of normal day-to-day activity and behaviour instead of retiring. As such, the full report on this study published in the *Journal of Rural Studies* (Conway et al., 2016), in attempting to understand the world as farmers perceive it, can be drawn upon to inform future policy directions and, as a consequence, prevent older farmers from being isolated and excluded from society almost by accident rather than intention.

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- Commings, P. (1973) *Retirement in Agriculture: A Pilot Survey of Farmers' Reactions to EEC Pension Scheme's*. Dublin: Macra na Feirme.
- National Rural Network (2013) *NRN Case Study, Achieving Greater Land Mobility in Ireland*.

Events

JULY

July 3-8

Convention Centre Dublin

World Buiatrics Congress

The 29th World Buiatrics Congress (WBC 2016) is the premier cattle health and production conference in the field. With between 2,500-3,000 attendees from academia, research, general practice and government services branches of the veterinary profession, as well as leading animal scientists, it is held over five days, bringing together world experts in cattle health and production systems with all the latest updates in diagnostics, animal health systems, animal welfare initiatives, food safety, zoonosis, mastitis control, parasitism, reproductive technologies and a wide range of infectious disease control programmes. The scientific committee is made up of staff from Teagasc, UCD and the Department of Agriculture, Food and the Marine.

Contact: wbc2016@mci-group.com

www.wbc2016.com

July 5

Teagasc, Animal & Grassland Research and Innovation Centre, Grange

Teagasc National Beef Open Day

The theme of Teagasc's National Beef Open Day is 'Beef 2016: Profitable Technologies'. Set against a backdrop of Ireland being the fifth largest beef exporter in the world and the largest exporter of beef in Europe, the value and importance of the sector to both the national and local economies cannot be underestimated. Attending this event is a necessity for all beef farmers and stakeholders in the Irish beef industry. This event is sponsored by FBD.

E-mail: edward.oriordan@teagasc.ie

<http://www.teagasc.ie/events>

July 19-22

UCD, Dublin

FoodMicro 2016

The theme of this international four-day conference is "One health meets food microbiology", which aims to bring together academic contributors, public health specialists, veterinarians, food regulators (both national and international) and stakeholders in the food industry to discuss matters of mutual interest around the conference theme. The conference is forward looking with topics of interest to those in the modern food industry as a novel means of improving their food safety controls and exploring developments using microbes as beneficial health-giving organisms. The local organising committee is made up UCD, Teagasc and FSAI.

E-mail: FoodMicro2016@mci-group.com

<http://www.foodmicro2016.com/>

AUGUST

August 21-25

RDS, Dublin

IUFoST 2016 World Congress of Food Science and Technology

The International Union of Food Science and Technology (IUFoST) is the global scientific organisation for food science and technology supporting programmes and projects to increase the safety and security of the world's food supply. Throughout more than 65 member countries, it represents over 300,000 food scientists and technologists worldwide. Its 2016 conference is themed 'Greening the Global Food Supply Chain through Innovation in Food Science and Technology'. 'Teagasc International Gateways' will take place this year as part of IUFoST (August 22-25), where Teagasc research staff will promote selected capabilities for international engagement/collaboration.

Contact: info@iufost2016.com

<http://www.iufost2016.com/>

August 29-September 2

Waterfront Conference and Exhibition Centre, Belfast, Northern Ireland

European Federation for Animal Science (EAAP) 2016 – 67th Annual Meeting of the European Federation of Animal Science

The theme of this event is Sustainable Food Production: Livestock's Key Role. This is Europe's largest animal science conference and will feature 1,000 presentations and 1,200 delegates. Teagasc is involved in the scientific and organisation committee of the 2016 EAAP scientific conference and is also sponsoring the conference. A joint keynote paper will be presented by Jean-François Soussana, Institut national de la recherche agronomique (INRA), France and Pat Dillon, Teagasc, entitled: 'The role of pastures as an essential resource to cope with future food demand and environmental impact'.

E-mail: info@eaap2016.org

www.eaap2016.org/

SEPTEMBER

September 7

Keadeen Hotel, Newbridge, Co Kildare

Teagasc National Tillage Forum

The forum will focus on agronomic decisions for the autumn, economic returns and investment strategies for the sector. Farmers and advisors will hear the latest winter cereal result from the DAFM variety testing and an update of the latest research in agronomic practices for the coming autumn. The discussion forum will be preceded by a presentation by Teagasc Rural Economy researcher Fiona Thorne outlining research on tillage farmers income from the past number of years, with income projections for the medium term and a look at investment strategies with an eye to the availability of TAMS grants for tillage farmers.

E-mail: Michael.Hennessy@teagasc.ie

OCTOBER

October 19-21

University College Dublin

10th International Life Cycle Assessment of Food Cycles 2016

The conference is structured into four broad themes. The first will look at specific environmental processes and services as addressed by life cycle assessment (LCA) including soil, biodiversity, ecosystem services, water and land use. Theme two will look specifically at animal agriculture with contributions on dairy, beef, pigs and poultry, post-farm processing and whole chain studies. Theme three will look at interaction with humans and human systems including contributions on crop systems, waste, processing, diet, nutrition, behaviour, and health and food innovation. Theme four will address various aspects of how life cycle assessment (LCA) is used, with contributions ranging from data, methods and tools, through socioeconomic methods, to PEF, labelling and policy.

E-mail: sinead.lawlor@conferencepartners.ie

<http://lcafood2016.org/programme/>

NOVEMBER

November 13-20

Teagasc locations nationwide

Science Week – Festival of Farming and Food – SFI 'Science Rising' at Teagasc

Each year during Science Week, Teagasc research centres open their doors to second and third-level students to find out about the research carried out and to explore careers in agriculture and food research.

This year, as part of the Science Foundation Ireland Science Week festivals programme, visitors from Teagasc Trinity Access Programme, Carlow IT Lifelong Learning Centre and members of the general public will be invited to events at Teagasc centres.

The annual Teagasc Walsh Fellowships seminar takes place at the RDS, Dublin, on Thursday, November 11.

E-mail: catriona.boyle@teagasc.ie

<http://www.science.ie/>

November 23

Teagasc, Food Research Centre, Ashtown

Novel Processing Technologies Gateways

Food industry representatives will have an opportunity to see the latest developments in terms of novel food processing at the 11th Food Innovation Gateways event, which will showcase significant expertise, technical services and emerging technology opportunities relevant to stakeholders and will provide a unique opportunity to meet and interact with the key researchers.

E-mail: gateways@teagasc.ie

For a list of Teagasc's food industry training schedule (food safety, food law, animal welfare, quality assurance, microbiology, cheese making, calculating meat content, laboratory auditing) please see: <http://www.teagasc.ie/food/research/training/schedule.asp>

For presentations from previous Teagasc events see: <http://www.teagasc.ie/publications/>