Teagasc
Agriculture and Food Development Authority

TEAGASC

RESEARCH IMPACT HIGHLIGHTS IN 2021

Foreword

Teagasc's vision is to be a globally recognised leader in developing innovative, science-based solutions for the sustainable transformation of Ireland's land resources into products and services that benefit society. Each year, our research, advisory and educational activities contribute towards the achievement of our vision and make a real and tangible impact on farmers, policy and industry.

This publication contains 20 examples of our research impact from 2021. The examples highlight just a snapshot of the ground-breaking research and impact being delivered from our four research programmes: Animal and Grassland Research and Innovation; Crops, Environment and Land Use; Food; and Rural Economy and Development.

The research impacts showcase applied research conducted to address key issues in areas such as soils and the environment, animal production, forestry, crop production, pest management, food processing, consumer health, economics and social science. They also tackle key societal challenges, such as antimicrobial resistance, methane reduction strategies, nutrition, animal welfare and farmer health and safety.

"I am immensely proud of the continuous research outputs from Teagasc staff who diligently pushed forward over the last two years in spite of the unknown landscape that lay ahead."

Teagasc is extremely fortunate to have an outstanding core of scientists, supported by top-class technical, farm, advisory, specialist and administration staff whose work contributes to our collective research outputs. Additionally, I would like to acknowledge our collaborators in universities, institutes of technology and other external bodies – including the farming community and agri-food companies – who are directly involved in many of our research projects. I would also like to highlight our Walsh Scholars and post-doctoral fellows, whose contribution to our ongoing research activities is invaluable.

Our research is funded through a variety of sources, including core grant-in-aid allocated via the Department of Agriculture, Food and the Marine and competitive funding awarded nationally. Other important sources include competitive funding awarded from Science Foundation Ireland, Enterprise Ireland, the Environmental Protection Agency, the Irish Research Council, Horizon 2020 and Horizon Europe. Funding is also derived from farmer levy contributions and industry-funded research, as well as earnings from services offered and farming activities. Combined, these significant investments enable Teagasc to continue to support science-based advancements in the agri-food and bio-economy sectors that underpin profitability, competitiveness and sustainability.

Ensuring our research delivers real impact for our stakeholders is a key priority. To assess the impact of our research activities, we have developed a framework to guide the evaluation of our research. This framework (which can be found on page 15) provides a structure to describe how Teagasc's activities contribute to impact in the agri-food sector through three interconnected impact pathways: technology development and adoption; capacity development; and policy influencing. You will find the relevant impact pathways listed with each of our research impacts as you read through this publication.

Finally, I want to acknowledge the dedication of my colleagues in Teagasc who were involved with, or supported, the research activities contained within this publication. The impact of Covid-19 across every sector of society cannot be underestimated; however, I am immensely proud of the continuous research outputs from Teagasc staff who diligently pushed forward over the last two years in spite of the unknown landscape that lay ahead. I also want to commend the role of our extensive research teams across the organisation, whose work has also made a substantial impact but was not included in our 2021 publication.

Thanks to the combined effort of all Teagasc staff, I am confident that we can continue to safeguard our role as the leading organisation in the field of agricultural, environmental and agri-food research in Ireland.

Pat Dillon,
Director of Research,
Teagasc

Key figures 2021

300	500	7	€82m
Research projects	Scientific and technical staff	Research centres	Research expenditure

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All contributors listed are from Teagasc, unless otherwise specified.

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AGRIP

Dairy calf to beef best practice

Alan Dillon

The Teagasc Green Acres Dairy Calf to Beef Programme Phase 2 ran from 2019 to 2022 with 12 demonstration farms. The target of the programme was to promote best practice in dairy calf to beef rearing systems, with a target of achieving a net profit of €500 per hectare excluding all subsidies. A team of specialised advisors from Teagasc provided an intensive advisory service to the farmers, which focused on improving the health of calves through improvements in ventilation, implementing a calf vaccination programme and sourcing calves directly from farms to reduce stress on calves at purchase. There was a specific focus on grassland management and silage quality to reduce cost of production, as well as targeting an earlier age of slaughter. As a result of these measures, farm profitability improved from an average of €100 per hectare net profit (excluding subsidies) in 2019 to an average €650 per hectare net profit in 2021. This programme has now been expanded under the DairyBeef 500 campaign.

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Funding: MSD; Volac; Drummonds; Corteva; Munster Bovine; Liffey Mills.
Impact pathway: Capacity building.

+€550

Farm profitability increased by an average of €550 following the implementation of Teagasc's advisory measures.

FOOD

A matter for digestion

Daniela Freitas, Laura G. Gomez-Mascaraque and André Brodkorb

Do you ever wonder what is happening to your food once you swallow it? How is a breakfast cereal transformed from a meal into something that is absorbed into the bloodstream? Scientists can simulate the digestion of food *in vitro* in the laboratory, but how accurate is the simulation? To find out, Teagasc scientists invited individuals with an existing ileostomy (surgical opening at the end of the small intestine) to participate in a food trial. Different Irish food staples, including breakfast cereal, were tested in combination with diet supplements provided by an industry partner. An extensive amount of data demonstrated close similarities between human and simulated food digestion, but also some significant differences which need to be addressed in the future. Teagasc scientists also provided direct evidence for probiotic survival and functionality of a probiotic formulation as early as a few hours after consumption. The results of this work will feed into an international drive to improve methods to better understand the digestion of existing and novel foods. Teagasc is also offering digestion studies as a service to food companies as part of its technical services to industry.

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Funding: Enterprise Ireland (Innovative Partnership Programme); Deerland Probiotics and Enzymes.
Impact pathway: Technology development and adoption; Capacity building.

CELUP

Boom to bust

Steven Kildea

In late summer of 2020, lesions of septoria tritici blotch (STB) appeared in great abundance in plots of winter wheat under evaluation for inclusion in the Irish cereal recommended list, across a number of varieties with the cultivar *Cougar* in their parentage. Until this point, these varieties had shown excellent levels of STB resistance, and were expected to be recommended for the 2021 planting season. To investigate what was happening, *zymoseptoria tritici* isolate collections were established and intensive controlled glasshouse studies initiated. Unfortunately, these confirmed the lesions were caused by strains of *Z. tritici* that were extremely virulent on the *Cougar* and its siblings under evaluation. Based on these findings, recommendations not to grow these varieties in high disease pressure environments – such as the south of the country – were issued. As these varieties also showed a poor performance in final field trial evaluations, they were removed from the 2021 Irish winter wheat recommended list. With 20% of the winter wheat seed for planting in autumn 2021 projected to be *Cougar* based, these recommendations were significant but extremely warranted given the potential implications for disease control.

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Funding: Teagasc.
Impact pathway: Technology development and adoption.

REDP

Changing behaviours: antibiotic use on farms

Alison Burrell (Animal Health Ireland) and Áine Regan

New veterinary medicines regulations are changing how antibiotics can be used on farms. Farmers and vets can be supported to change their animal health management behaviours by combining these top-down regulatory interventions with bottom-up interventions targeting individual knowledge, attitudes and social behaviours. To support this, the AMU project developed seven behaviour change interventions grounded in behavioural science. Empirical work with over 550 farmers and vets informed an effective and targeted intervention design. The interventions included:

- Reframing how we talk about antibiotics
- OneHealth – a cross-border awareness campaign
- Specialised communications training for veterinary and advisory professionals
- User-friendly on-farm prompts
- Peer-to-peer farmer social support and modelling
- Supporting farmers to monitor antibiotic use
- Vet champions for good antibiotic stewardship

Policy-makers and practitioners are provided with the building blocks to implement and evaluate these interventions. Impact is already being achieved through pilot projects trialling a specialised communications training programme for vets and farm advisors, delivered by psychologists from Animal Health Ireland and Teagasc.

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Funding: *safe*food.
Impact pathway: Capacity building.

Studio Romantic /stock.adobe.com

AGRIP

Breeding for earlier slaughter

Alan Twomey and Donagh Berry

A new tool to aid farmers in breeding animals that will reach slaughter at a younger age has been developed, to reduce the environmental footprint of beef farms. As part of GREENBREED, a Department of Agriculture, Food and the Marine stimulus project, genetic models have been developed to generate breeding predictions for age at slaughter. The breeding predictions were validated and will be deployed by the Irish Cattle Breeding Federation (ICBF) in Autumn 2022. This is the first tool available to Irish farmers that allows for the breeding and selection of animals that will reach slaughter at a younger age. There is the potential to reduce age at slaughter by more than one month on-farm through sire selection. Incorporating age at slaughter into Irish beef breeding objectives will improve profitability of beef herds, while also reducing their carbon footprint.

12,000

If adopted nationally, this breeding tool will help to reduce up to 12,000 tonnes of methane annually.

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Funding: Department of Agriculture, Food and the Marine.
Impact pathway: Technology development and adoption.

CELUP

Protected urea and soil microbiome

Aoife Duff

In Ireland, the agriculture sector accounts for 92% of nitrous oxide emissions and virtually all ammonia emissions. Protected urea (urea made with nitrogen stabilisers) reduces nitrous oxide emissions by 71% when compared to calcium ammonium nitrate- (CAN) based fertilisers, and reduces ammonia emissions by 79% when compared to standard urea, all while maintaining similar grass production. However, little is known about the impact of protected urea on soil biology, so Teagasc conducted a study to investigate it further. It demonstrated that there was no impact of protected urea on the structure and abundance of soil bacterial and fungal communities after five years of repeated application to an intensively managed grassland. The study further showed that the microbial communities involved in nitrogen cycling and nutrient transformation processes remained unchanged with the use of the urease inhibitor (a component found in protected urea that slows down the conversion of urea to ammonium). This work has provided reassurance for farmers in moving forward with the use of protected urea as a fertiliser at farm level, as it has no significant effect on the soil microbial community when compared to standard urea or CAN fertilisers.

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Funding: Teagasc.
Impact pathway: Technology development and adoption.

REDP

Communicating dairy cow welfare

Áine Regan

The welfare of dairy cows has captured societal attention, resulting in changed consumer behaviour. A Teagasc survey of almost 1,000 people found that while the Irish public have generally favourable views about animal welfare in the Irish dairy sector, they also feel uninformed about farming practices and welfare-friendly foods. Only 20% of survey participants felt there is currently enough information available about animal welfare-friendly food. Using this research as a base, and through a co-design process with relevant field experts, an animated whiteboard video was produced for the general public. The video uses engaging and public-friendly facts, language and imagery to communicate what good welfare practices look like on Irish dairy farms. Within six months of launching, the video received nearly 27,000 views on social media. The video empowers the citizen-consumer to become better informed about farm animal welfare and what that entails in terms of farming practices. It is an evidence-based resource that targets identified knowledge gaps and information vacuums, helping to reduce the growing consumer disconnect related to food production.

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Funding: Department of Agriculture, Food and the Marine.
Impact pathway: Capacity building.

FOOD

Beverages for better heart health

Dilip Rai and Ciaran Fitzgerald (RIP)

In Ireland, about 10,000 people die every year due to heart-related illnesses. To help improve cardiovascular health, researchers at Teagasc and University College Cork formulated enriched beverages using blackberry polyphenols (natural micronutrients). A double-blind diet intervention trial involving 82 participants for 18 weeks showed no significant change to blood pressure (BP) and other markers of heart diseases post-consumption of the beverage over a six-week period. However, in a sub-group there was a significant reduction in arterial stiffness in hypertensive participants, demonstrating greater reductions in BP in hypertensive adults. This was not observed in participants with normal BP. It also reflects individual variability of absorption and bioavailability of blackberry polyphenols, for which the next step would be customised dietary intervention. These findings are highly advantageous to the Irish food industry for the design of future polyphenol-based functional foods, and will inform policy makers establishing dietary recommendations for polyphenol intakes.

90,000

Approximately 90,000 people in Ireland live with heart disease.

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Funding: Department of Agriculture, Food and the Marine.
Impact pathway: Capacity building.

CELUP

Integrated pest management on mushroom farms

Helen Grogan

Cobweb disease on mushroom farms is a challenging disease to control. Its dry spores spread rapidly within growing rooms, causing brown spotting symptoms on mushrooms and new patches of disease, reducing the commercial value of the crop. In the worst-case scenario, growers lose about 15% of their harvest. In 2016, Teagasc-led research funded by the EU demonstrated that the fungicide metrafenone offered excellent control of cobweb disease, which facilitated its approval for use across Europe. However, growers reported in 2019 that the product appeared to be ineffective and metrafenone-resistant isolates were soon identified. Teagasc-funded infection trials in 2021 at the Ashtown Mushroom Research Facility demonstrated just how ineffective the product is now. The impact on growers is that they have no effective chemical product to control cobweb disease, which is encouraging them to adopt integrated pest management technologies instead (IPM). As a result of this research, Teagasc is advising farmers to focus on early detection and treatment with IPM to prevent a major outbreak.

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Funding: Teagasc.
Impact pathway: Technology development and adoption.

AGRIP

Lower emissions, same productivity

Paul Smith, Sinéad Waters, David Kenny, Stuart Kirwan, Stephen Conroy (ICBF) and Alan Kelly (UCD)

Methane, produced during the breakdown of feed in the forestomach (or rumen) of cattle and sheep, accounts for 60% of Irish agricultural greenhouse gas emissions. In 2021, the first large scale characterisation of methane emissions in Irish beef cattle was published and conclusively showed that, on average, some beef cattle can produce 30% less methane emissions for the same level of productivity. Emissions were calculated using a novel index termed residual methane emissions (RME). Cattle exhibiting a low RME phenotype provide the potential to simultaneously reduce the national herd's methane emissions while concurrently ensuring animal productivity is unaffected. Results from this study, which has been published in the *American Journal of Animal Science*, highlight the potential to select more environmentally sustainable animals, while at the same time not having a negative impact on their performance – and indeed profitability. Further work is ongoing to study the biology underpinning this trait, with the aim of potentially incorporating it into the national breeding indices for Irish beef cattle.

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Funding: FACCE ERA GAS RumenPredict project; Horizon 2020 MASTER project; Teagasc.
Impact pathway: Technology development and adoption.

FOOD

Drug residue detection in meat

Martin Danaher

Nitrofurans are a class of broad-spectrum antibiotics that were previously widely used as growth promoters and for treating infections in animals. They are now banned from use in food production in the EU however, and are listed under 'prohibited substances'. To protect both consumer safety and food trade, the monitoring of such chemical residues in food is of the utmost importance. The majority of methodologies for nitrofuran analysis have been focused on detecting four drugs (nitrofurantoin, furazolidone, furaltadone and nitrofurazone) and are time-consuming. In recent years, a fifth bound residue – DNSAH (marker residue for nifursol) – was added to EU testing, and in China, a further drug – nitrovin – was added to the priority list of veterinary drugs. Research conducted by Teagasc addressed the narrow scope of previous methods for analysing nitrofuran by including four additional drugs (nifursol, nitrofuroxazide, nifuraldezone and nitrovin). This newly developed and validated method can detect eight different nitrofuran drug residues in meat, and is accredited by the Irish National Accreditation Board (INAB). Furthermore, it is now being used in Ireland's national residue monitoring plan to assess and assure food safety.

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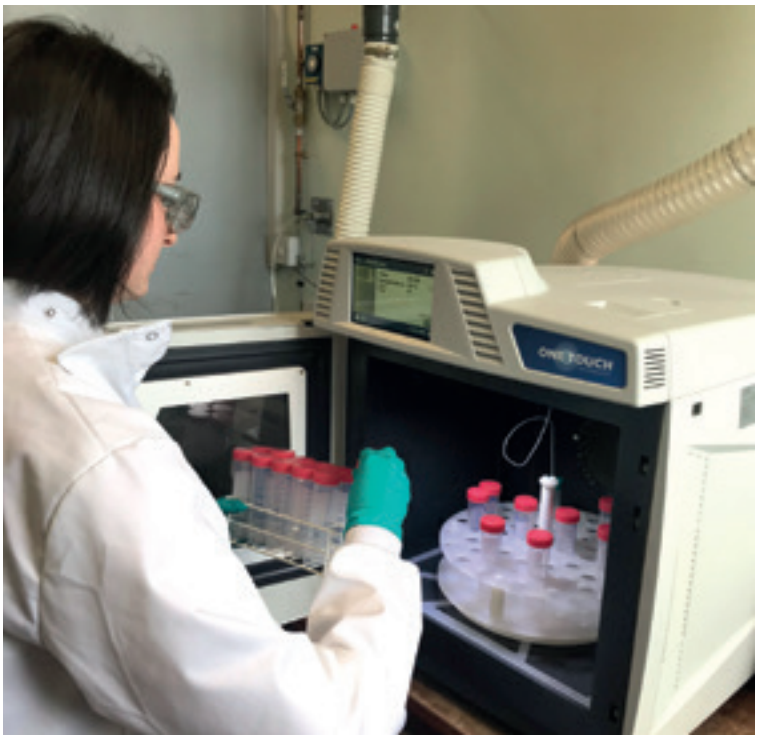
Impact pathway: Technology development and adoption; Capacity building.



REDP

Farm safety and farmer health seminar series

David Meredith, John McNamara and Mohammad Mohammadrezaei

Farm safety and farmer health are fundamental elements underpinning the social sustainability of farming. Improving safety and farmer health is challenging as it requires farmers to adopt new practices and behaviours. Supporting farmers to make these changes requires action by a range of organisations and institutions, including policy, regulators, advisors, farming organisations, farmers, farm household members and researchers. In 2021, Teagasc established and delivered a farm safety and farmer health Knowledge Exchange Seminar Series (KESS) to bring these groups together. The KESS – which continues to this day – encourages discussion, fosters improved understanding and seeks to realise opportunities for greater knowledge exchange and collaboration. To date, five seminars have been held, drawing on research based in Ireland and internationally. The KESS was launched by Martin Heydon, TD, the Minister of State with responsibility for Farm Safety. The seminars have attracted over 250 participants, including those with responsibility for social sustainability within EU agri-policy. The learnings from the KESS were critical in building the SafeHabitus consortium that successfully bid for €5,000,000 in Horizon Europe funding.

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Funding: Department of Agriculture, Food and the Marine BeSAFE project.
Impact pathway: Capacity building.

AGRIP

Taking the chlorine out of cleaning on dairy farms

David Gleeson, Bernadette O Brien, Tom Beresford and Lorna Twomey

When detergents containing chlorine are used for cleaning milking equipment, they can leave residues such as trichloromethane (TCM) and chlorates in milk and dairy products. These residues are potentially harmful to human health if present in significant levels in dairy products. Cleaning protocols for milking equipment were developed at Teagasc Moorepark to address the issue of chlorine-related residues in bulk tank milk. The chlorine-free protocols incorporate new detergents developed in conjunction with chemical manufacturers, with a focus on water temperature and an increase in the use of acid-based products. The protocols were initially evaluated on Teagasc research farms and then on commercial dairy farms. Teagasc communicated the details of these protocols to farmers using a dedicated web link and a series of webinars undertaken in conjunction with milk quality advisors and the Teagasc advisory services. Since January 2021, it has been recommended practice that all dairy farmers adopt chlorine-free protocols for milking equipment cleaning.

7%

Using chlorine-free protocols resulted in a 7% reduction in detected chlorate residues in bulk tank milk.

17%

Using chlorine-free protocols resulted in a 17% reduction in detected trichloromethane residues in bulk tank milk.

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Funding: Department of Agriculture, Food and the Marine; Teagasc.
Impact pathway: Technology development and adoption.

FOOD

Food safety and productivity on broiler farms

Declan Bolton

Food safety assurance on farms is reliant on effective biosecurity practices, which often require investment in improved infrastructure. As rising input costs erode profit margins, many broiler farmers cannot afford to modernise broiler houses in line with food safety best practices. With these conflicting issues in mind, Teagasc has developed a novel biosecurity system for broiler houses that protects birds against avian disease and the carriage of human pathogens such as *Campylobacter*, while increasing productivity by up to 20%. Commercial trials found that, at a stocking density of 20 birds per m^2, the broilers in the 'biosecurity cubes' had better health, welfare and growth rate, resulting in faster growth and shorter production cycles. Investment costs in enhanced biosecurity were covered within six to twelve months, thereafter yielding increased profits while assuring food safety and improving bird welfare. Overall, there has been a huge increase in broiler farmer awareness of the importance of biosecurity and *Campylobacter* control. Moreover, linking enhanced biosecurity to increased profit has provided a new motivator for food safety control and enhanced broiler welfare.

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Funding: Department of Agriculture, Food and the Marine; Teagasc.
Impact pathway: Technology development and adoption.

CELUP

Calculating carbon storage

Tom Houlihan

Teagasc has developed the Forest Carbon Tool – an online calculation tool that provides a user-friendly way to estimate carbon removals through various forest creation scenarios and other climate change mitigation pathways. The tool provides indicative values for mean annual CO_2 sequestration and mean cumulative sequestration, the latter being an estimate of the (once off) maximum potential sequestration (CAP value), derived over two forest cycles. Future tool updates and enhancements are planned as appropriate data becomes available. The tool supports a number of important objectives: it is increasing awareness and knowledge of forest carbon sequestration potential, and it demonstrates the changing trends in sequestration over the forest cycle for varying forest types. Application of the tool helps inform and support decision making for forest owners, foresters and stakeholders across many sectors in terms of carbon sequestration potential for forest establishment and selected management options. It has generated significant interest since its launch in 2021, in addition to many direct advisory engagements on its usage and applications. It has been widely disseminated in the media and has featured in a Teagasc Signpost Webinar and presentation to partners of FOREXT, the European forestry extension network.

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Funding: Department of Agriculture, Food and the Marine; Teagasc.
Impact pathway: Technology development and adoption.

REDP

Introducing WeedWatch: a mobile field app

Réamonn Fealy, David Schilder, Jimmy Staples and John Mahon

Using Geographic Information Systems (GIS) technology, a cloud-based mobile mapping and survey app has been developed to assist the fieldwork component of the Enable Conservation Tillage (ECT) project. The ECT project focuses on conservation tillage practices across Europe, and has been investigating and offering sustainable, cultural and chemical control solutions and support tools to impact the prevalence of grass weeds on farms. The app – named WeedWatch – was built using highly customisable Survey123 technology from Esri Inc. It runs on surveyors' phones, allowing concurrent users to efficiently and accurately collect paperless, location-based crop information throughout the season on project farms. It has also enabled highly accurate repeat visits to sample locations over two field seasons. The app, which is customisable for other applications, offers in-field recording of crop and weed status, removing paper and the need for transcription of field notes from the survey workflow. This has led to significant efficiency and time savings for field workers.

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Funding: European Innovation Partnership (EIP) funded by the Department of Agriculture, Food and the Marine.
Impact pathway: Capacity building.

AGRIP

Antimicrobial resistance in the Irish pig sector

Edgar Garcia Manzanilla

Antimicrobial resistance (AMR) is one of the 10 biggest health threats in the world according to the World Health Organisation. Thus, it is urgent to promote prudent antimicrobial use (AMU) in humans and animals to reduce AMR and keep antibiotics effective against common bacterial diseases like pneumonia or sepsis. Following EU legislation, the Department of Agriculture, Food and the Marine (DAFM) is implementing iNAP – the National Action Plan to reduce AMU – and Teagasc is playing a key role through several initiatives. The first step to reducing AMU is to establish a database monitoring current use. Teagasc collected the first database on AMU in Ireland for the pig sector in 2018 as part of project AMURAP (Antimicrobial Use and Resistance in Animal Production). DAFM used this database as a reference to build the National AMU Database for pigs, implemented in 2019. All farmers have to provide AMU data to this database as part of new 2021 requirements for Bord Bia's Pig Quality Assurance Scheme for pig farms and the AHI Pig HealthCheck programme. This database is essential for DAFM, veterinarians and farmers to understand AMU in pig farms, implement the necessary actions and monitor the reduction in its use.

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Funding: Department of Agriculture, Food and the Marine.
Impact pathway: Technology development and adoption; Capacity building; Policy influencing.

CELUP

Assessment of multi-species swards

John Finn

Multi-species swards with six species in them – containing grasses, clovers and herbs – perform better than monocultures, including perennial ryegrass. Mixtures can deliver higher yields with less nitrogen (N) fertiliser. This advantage is underpinned by a clover content that is no less than 20% and can deliver the same or higher yields with just 150 kg/ha of nitrogen fertiliser, compared to perennial ryegrass with 300 kg/ha nitrogen fertiliser. Multi-species mixtures have a lower nitrous oxide emissions intensity, are more resilient in the face of climatic disturbances such as drought, and are effective in suppressing weeds (in the absence of post-emergence herbicide). Research at Teagasc has found that, with good wilting, they deliver high quality silage. Over the last 20 years, the majority of research has been conducted by harvesting experimental plots. Teagasc sites at Johnstown Castle, Moorepark and Grange are now investigating the performance of multi-species swards under grazed systems. Collectively, this research has been used to inform the development of a new Department of Agriculture, Food and the Marine Multi-Species Sward Scheme that aims to incentivise the establishment of approximately 12,000 hectares of multi-species swards nationally – in addition to the many farmers already implementing these swards.

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Funding: Teagasc; EU Framework Programme.
Impact pathway: Technology development and adoption.

FOOD

Reducing methane emissions

Catherine Stanton

The livestock sector is responsible for 14.5% of global anthropogenic greenhouse gas (GHG) emissions. Dairy cattle account for around 20% of these emissions, which are a direct result of rumen microbial fermentation. Innovative solutions to reduce methane emissions from livestock are necessary to support the development of sustainable food production systems while moderating GHG emissions. Lactic acid bacteria (LAB) offer a safe and practical way to influence the rumen microbial community for methane mitigation, creating a more sustainable, emission-efficient food production system. The METHLAB project has been investigating whether LAB can be used to reduce enteric methane emissions. A series of animal feeding trials were completed in which researchers demonstrated that LAB administered via inoculated silage led to reduced methane emissions in dairy cows, while animal productivity and health were not affected. The results indicate that the use of LAB fed directly to animals or mixed in silage, or both, hold great potential as a strategy to reduce ruminant GHG emissions. Further research is required to determine which precise LAB, or combination of LAB, is most effective in enhancing animal productivity and reducing ruminant methane emissions.

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Funding: FACCE ERA-GAS is the ERA-NET co-fund for Monitoring and Mitigation of Greenhouse Gases from Agri-and Silvi-culture.
Impact pathway: Technology development and adoption.

allenpaul1000/stock.adobe.com

REDP

Market opportunities for Irish beef and sheep

Maeve Henchion

Approximately half of cattle and sheep carcasses are not meat. This proportion – termed the 'fifth quarter' by industry – includes edible and inedible components, and is a potentially valuable feedstock from which high value constituents can be extracted. Significant research has already been undertaken internationally to identify such constituents and the technologies and processes that enable their extraction. As part of the Meat Technology Ireland programme, key findings from this research have been synthesised and organised into a format that can be used to benefit the Irish meat industry. Using a systematic literature review, a database identifying such opportunities – including centres of excellence and key contacts globally – has been developed. This is now being used by Irish industry and others within the innovation system to drive strategic new market opportunities that simultaneously address sustainability challenges in the industry, in keeping with the sustainable, circular bioeconomy. It also provides direction for the future development of the sector. An Invention Disclosure Form (IDF) has been produced, resulting in the database being freely available to MTI-participating companies, with a peer reviewed publication outlining the related value chains accepted for publication.

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Funding: Enterprise Ireland; Irish meat companies.
Impact pathway: Technology development and adoption; Capacity building.

Measuring the impact of Teagasc research

Compiled by Máire Caffrey and Kevin Heanue

Teagasc uses two main approaches to identify the impact of its research: science excellence and societal impact. Science excellence focuses on peer reviewed publications and their indicators of quality, while societal impact focuses on understanding the pathways through which such science is put into use and the changes it helps to bring about in society. Throughout this publication, we have identified the impact pathways for each of the featured research impacts.

Peer-reviewed publications

Measuring the impact of our research is a key activity for Teagasc. One method we use is to track and monitor the number of articles in scientific journals authored by Teagasc researchers. Another strategy involves tracking how many times these articles are cited by other journal articles.

There are a number of resources available providing these citation counts and other metrics. We use online subscription-based indexing service Scopus and its accompanying research evaluation tool SciVal. The performance of our articles (considered to be those that have at least one author affiliated to Teagasc) is compared annually to that of other relevant research-performing organisations, for publications in a rolling six-year period.

Publication and citation patterns vary considerably across subject areas. Therefore, when using publication counts or citation-based metrics, comparisons within subject categories are the most meaningful. To place our performance in a national context, we can compare Teagasc's performance with that of Irish universities, within three relevant subject categories: one broad category of Agricultural & Biological Sciences, and two narrower categories of Food Science and Agronomy & Crop Science.

Citation counts are merely a snapshot in time, as citations are constantly accumulating. When comparing Teagasc with Irish universities between 2016 to 2021:

- within Agricultural & Biological Sciences (Figure 1) – Teagasc published the second highest number of articles, and had the second highest overall citation count
- within Food Science (Figure 2) and Agronomy & Crop Science (Figure 3) – Teagasc had the highest overall number of articles and citations.

Furthermore, the strong international and national reputation of Teagasc research is demonstrated by the fact that, during this same period, 53% of Teagasc articles (indexed by SciVal) listed international collaborators, with a further 40% listing national collaborators.

Of course, all bibliometric analysis must be placed in context and the impact of our research must be evaluated in a variety of other ways in order to give the full picture.

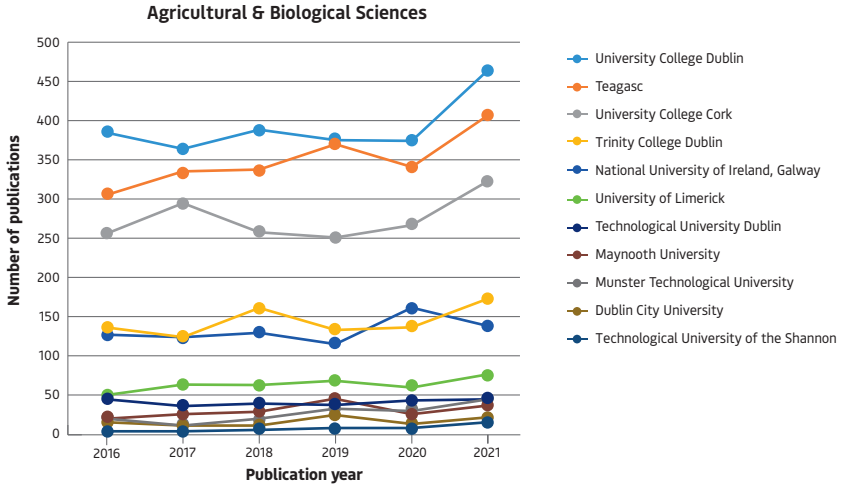

Figure 1: Number of papers by Teagasc and Irish universities that are indexed in Scopus category Agricultural & Biological Sciences (2016-2021).*

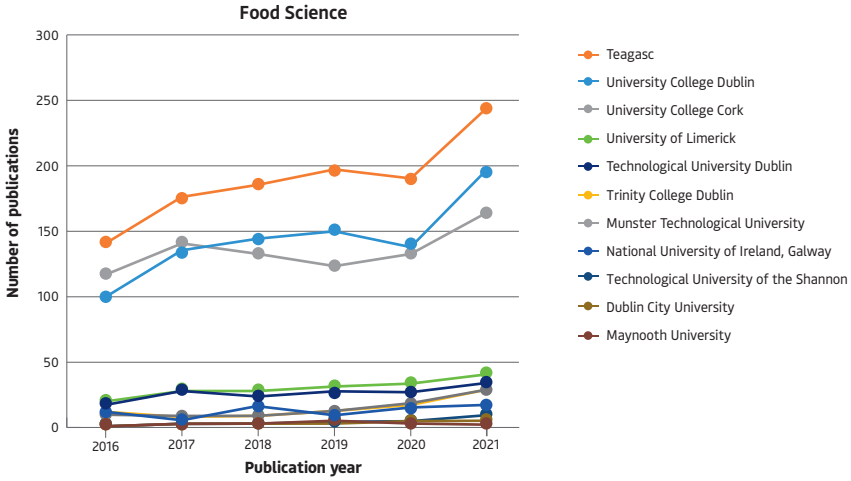

Figure 2: Number of papers by Teagasc and Irish universities that are indexed in Scopus category Food Science (2016-2021).*

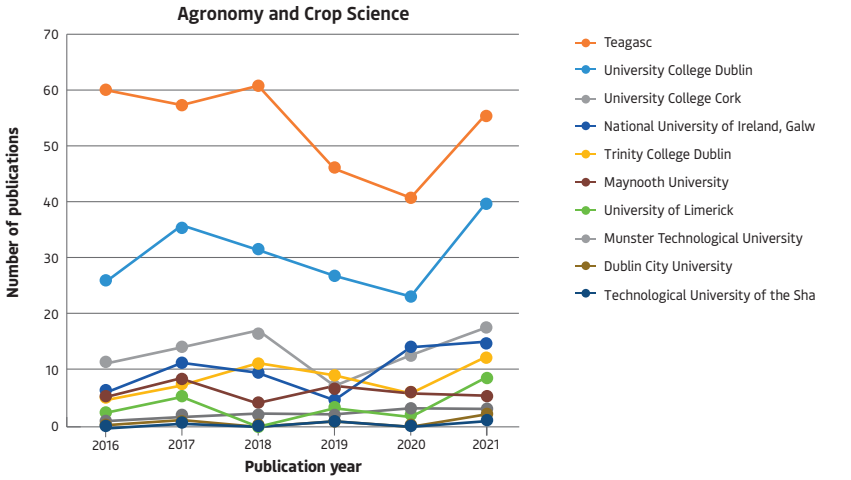

Figure 3: Number of papers by Teagasc and Irish universities that are indexed in Scopus category Agronomy & Crop Science (2016-2021).*

* These metrics are from SciVal as per its April 2022 update.

Understanding research impact pathways

Another approach to measuring the impact of research is to focus on identifying the changes in society that the research contributed to, and trying to understand how the research helped make those changes come about. In our latest statement of strategy *Teagasc Together*, we adopted a framework (Figure 4) to inform our approach to evaluating the societal impact of our research – and other activities – in this way.

The framework provides a structure to describe how Teagasc activities contribute to impact in the agri-food sector through three interconnected impact pathways. Research may contribute to one or more of the pathways, which are:

1. Technology development and adoption.
2. Capacity building.
3. Policy influencing.

Information about how research has contributed to societal change is gathered primarily by using a case study approach. These cases not only focus on the research, but also the sectoral stakeholders, partners, other research-performing organisations and end users involved, and how their actions, interactions, activities and events help to create societal impact from the use of the research.

The three pathways are interlinked with self-reinforcing feedback loops around the capacity development pathway, which builds the capacity of the agri-food sector to innovate and transform.

1. Technology development and adoption

This pathway is the most familiar to many researchers. It is a reasonable simplification of reality when researchers are developing technology in already-established outcome trajectories; for example, breeding to maintain plant resistance to pests and diseases. Of course, it may also be new technological or institutional innovations that are developed by researchers.

“Teagasc uses two main approaches to identify the impact of its research: science excellence and societal impact.”

2. Capacity building

In this pathway, the process of carrying out research builds the capacity of actors in the agri-food system to innovate. The pathway emphasises the need to enhance the capacities and interactions of actors that play a role in developing and putting into use the new knowledge, practices and services that contribute to achieving common developmental objectives, or resolving shared problems.

The actors involved include farmers and their organisations, other private sector organisations, public sector agencies, NGOs and civil society, as well as research, education and extension bodies. Participatory and collaborative research brings different stakeholders together to identify common challenges, building structural and cognitive social capital in the process.

Capacity development empowers actors involved in agricultural innovation systems – including farmers. An effective way of building this capacity is as part of collaborative research processes that engage a range of actors around a shared set of objectives, according to their interests and comparative advantages.

3. Policy influencing

In our final pathway, researchers generate insight and evidence with the specific intent of influencing policy; for example, in respect to strategies for agriculture to mitigate and adapt to the effects of climate change. Policy change then helps build an enabling environment for beneficial agri-food innovations.

Figure 4. Framework for evaluating Teagasc's impact pathways on the agri-food sector.

Spring storm clouds

"Spring 2021 was one of the coldest in many years, resulting in a relatively low pest and disease pressure for winter and spring crops in Ireland. This photo was taken in a winter barley field at Teagasc Kildalton, where we had to interrupt our fieldwork shortly after these precursors of another weather front came up, bringing rain and storm once again. However, they also brought these beautiful, almost Romanesque clouds to us."

Photo and description by: Maximilian Schughart, a Teagasc Walsh Scholarships Programme recipient whose research is focused on understanding barley yellow dwarf virus epidemiology and aphid resistance mechanisms.

Maximilian's photo was named the overall winner of Teagasc's 2021 Vision of Research and Innovation image competition.