



FOOD GROUPS

The role of the consumer-citizen in food systems



BUG ISSUE

New methods of surveilling parasite resistance



ACID TEST

An alternative approach for testing milk composition



INTERVIEW:
Karen Daly on the
importance of
soil health
p16

Soil health is our wealth

In this issue's Team Spotlight feature, we meet some of the minds driving the future of soil health research at Teagasc Johnstown Castle

Welcome

This issue of TResearch showcases some of Teagasc's work on soil health, water quality and sustainable development.

Research from Teagasc's Agricultural Catchments Programme highlights the potential of Pollution Impact Potential (PIP) maps as a decision-support tool for water quality management, while identifying key barriers to their wider adoption among farmers and advisors. You can read more about it on p14.

Soil health is an increasingly multidisciplinary field, moving from the purely agronomic to cover policy, biodiversity and industry upskilling. On p16 Karen Daly, Department Head and Principal Research Officer at Johnstown Castle, reflects on its growing influence.

On p20, former Teagasc colleague Lance O'Brien reports on the EU-funded 'Climate Smart Agriculture Research and Innovation for Dairy Value Chain Development', which he coordinated in Eritrea, Africa.

Soil research has a longstanding history at Teagasc, and today the organisation is at the forefront of the field. In our Team Spotlight on p24, we catch up with a few of the researchers from Johnstown Castle's Soils research programme.

Countries already have many tools to cut farm emissions, but success depends on doing things in the right order: measurement, on farm demonstration and then credible incentives, delivered through trusted advisory systems. You can read this 'external insight' article from former Teagasc Director Gerry Boyle and Satbir Singh Gosal, Punjab Agricultural University on p36.

Sustainable development in agriculture is important because it protects natural resources like soil and water, ensuring long-term food security, and helping farmers adapt to a changing climate. We invite you to explore the feature articles on these topics in this edition.

Catriona Boyle

Editor, TResearch magazine, Teagasc



Catriona Boyle

Eagarthóir, iris TResearch, Teagasc

San eagrán seo de TResearch, léirítear cuid d'obair Teagasc ar shláinte na hithreach, cáiliocht an uisce agus forbairt inbhuanaithe.

Leagtar béim sa taighde ó Chlár Dobharcheantair Talmhaíochta Teagasc ar an acmhainn a bhaineann le léarscáileanna Poitéinseal Tionchair Truailithe (PIP) mar uirlis tacaíochta cinnteoireachta maidir le cáiliocht an uisce a bhainistiú, agus saináithnítear ann na príomhchonstaicí atá ag cur bac ar fheirmeoirí agus ar chomhairleoirí glacadh leo ar bhealach níos forleithne. Is féidir leat tuilleadh a léamh faoi sin ar leathanach 14.

Is réimse é sláinte na hithreach atá ag éirí níos ildisciplíní i gcónaí, agus é ag athrú ó réimse agramamaíoch amháin go réimse beartais, bithéagsúlachta agus uasoiliúint tionscail. Ar leathanach 16, déanann Karen Daly, Ceann Roinne agus Príomhoifigeach Taighde ag Caisleán Bhaile Sheáin, machnamh ar an tionchar méadaitheach atá ag baint léi.

Ar leathanach 20, déanann iar-chomhghleacaí Teagasc Lance O'Brien cur síos ar an tionscadal 'Taighde agus Nuálaíocht na Talmhaíochta Cliste Aeráide le haghaidh Forbairt Slabhra Breislúacha Déiríochta', arna mhaoiniú ag an AE, a chomhordaigh sé in Eiriré na hAfraice.

Tá stair sheanbhunaithe ag baint le taighde ithreach ag Teagasc, agus sa lá atá inniu ann, tá an eagraíocht chun tosaigh sa réimse sin. Inár ngné-alt foirne ar leathanach 24, labhraímid le roinnt de na taighdeoirí ó chlár taighde Ithreacha Chaisleán Bhaile Sheáin.

Tá neart uirlisí ag tíortha cheana féin chun astaíochtaí feirme a ghearradh, ach braitheann an rath a bhíonn orthu ar rudaí a dhéanamh san ord ceart: tomhas, taispeántas ar an bhfeirm agus ansin dreasachtaí inchreidte, a sholáthraítear trí chórais chomhairleacha iontaoifa. Is féidir leat an t-alt seo faoi 'léargas seachtrach' ó Iar-Stiúrthóir Teagasc Gerry Boyle agus Satbir Singh Gosal, Ollscoil Talmhaíochta Phuinséab a léamh ar leathanach 36.

Tá forbairt inbhuanaithe tábhachtach sa talmhaíocht toisc go gcosnaíonn sí acmhainní nádúrtha amháil ithir agus uisce, rud a chinntíonn go mbíonn slándáil bhia ann san fhadtéarma, agus cabhraíonn sí le feirmeoirí oiriúnú don aeráid atá ag athrú. Fáiltímid romhat féachaint ar na gné-ailt ar na hábhair sin san eagrán seo.

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Main image shows (L-R) Karla Burke, Luis Lopez-Sangil and Fiona Brennan of Teagasc at a Soils event at the Irish Agricultural Museum at Johnstown Castle.

Gut feeling down under

Teagasc researcher André Brodkorb received the 2026 Harraway's 1867 Visiting Professorship Award by the University of Otago, New Zealand. This award recognises leading scientists who have made outstanding contributions to food science and nutrition.

As part of the professorship, André presented a lecture at the New Zealand Institute of Food Science and Technology Annual Conference in Auckland and visited the University of Otago in Dunedin, where he delivered a series of seminars and postgraduate courses on food science. He also delivered a public lecture, 'Morning breakdown: breakfast fuel and your gut', showcasing his internationally recognised research on food digestion, taking the example of how a typical breakfast of oat porridge interacts with the digestive system.

A Principal Research Officer with the Teagasc Food Research Programme in Moorepark, André is internationally recognised for his research on food science and nutrition. His work has significantly advanced understanding of how both food composition and food structure influences digestion and health. The award also strengthens ongoing international



Teagasc's André Brodkorb (front row, centre) with his award at the University of Otago, Dunedin, New Zealand

collaboration between Teagasc and the University of Otago in food and nutrition research.

"It is always rewarding to see your work and dedication to science recognised, especially from halfway around the world. The award also reflects the tremendous effort of our entire research group, past and present," André commented on receiving the award.

"Our work on *in vitro* digestion methods (Infogest methods) is well known around the globe, especially among the lab-based

postgraduates and postdocs. Our recent work on super-nutritious oat varieties, led by colleague Daniela Freitas, has also created a buzz not just in Ireland but abroad. Overall, it has been a very proud and somewhat humbling experience to be an ambassador of the vibrant and highly innovative food research sector in Moorepark, Teagasc and Ireland."



The VALPRO Path to success

The Horizon Europe-funded VALPRO Path project, coordinated by Teagasc's Ewen Mullins and project managed by Richard Lynch, aims to contribute to more resilient European food systems by increasing the production and utilisation of plant proteins for food and feed in the EU. As part of the project, Sheila Alves of the Crops Science Department at Teagasc Oak Park investigated intercropping of Irish peas and faba beans and the onward potential for food applications.

At Teagasc Ashtown, research led by Eimear Gallagher and Mehradj Fatema Mulla has shown that natural processing technologies, including soaking and germination of these intercropped grains reduced their anti-nutritional compounds (phytic acid, condensed tannins and

raffinose family oligosaccharides) while producing nutrient-rich flours.

These flours have been successfully incorporated into a range of baked products and snacks (including soda breads, crackers, cakes and waffles) through partial substitution of wheat flour.

"This enhances the nutritional composition of the final products without compromising dough techno-functional properties, product performance or shelf-life," explains Eimear. "Our research demonstrates that Irish-grown legume crops show potential as functional food ingredients, supporting the development of nutritious foods and providing new opportunities for more sustainable agriculture and food innovation."



A selection of baked goods produced using Irish legume flour at Teagasc Ashtown's food research labs

She Led the Way – honouring Aleen Cust

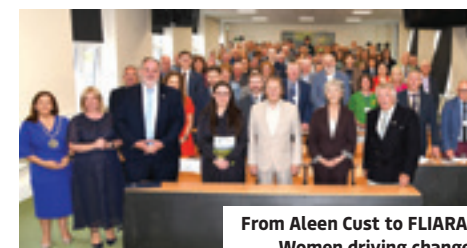
The President of Ireland, Catherine Connolly, formally opened the Aleen Cust Memorial Society conference at ATU Mountbellew, Galway, recently. Titled 'She Led the Way: Women at the Heart of Veterinary Heritage and Agricultural Progress', the event celebrated Aleen Cust, the first woman to qualify as a veterinary surgeon in Ireland and England, and highlighted women's roles in agriculture, heritage, innovation and equality.

The Horizon Europe FLIARA project (Female-led Innovation in Agriculture and Rural Areas), with Teagasc as a consortium partner, was featured as an example of innovation and network for policy change. This was followed by a presentation by Maura Farrell, University of Galway and FLIARA Project co-ordinator, and former Teagasc Walsh Scholar. Titled 'Women driving change in agriculture', this included insights and perspectives from the FLIARA project, including some of the forthcoming Irish policy recommendations arising from the research.

"Both presentations explored the remarkable journey of Irish women in agriculture,"

Anne Kinsella, Teagasc Economist and FLIARA researcher, said of the event.

"From the pioneering achievements of Aleen Cust through to contemporary experiences, including insights from FLIARA and on the constraints facing women in farming, this inspiring event was a wonderful celebration of the contributions of women to Irish agriculture, past and present."



From Aleen Cust to FLIARA: Women driving change

Floating great ideas at AQUAHACK



AQUAHACK freshwater tour participants, July 2026

Eighteen early-career researchers from Irish research-performing institutions, including Teagasc, recently took part in a two-day immersive experience to build entrepreneurial skills. Teagasc, Bord Iascaigh Mhara and Technological University of the Shannon ran this event, titled AQUAHACK, which highlighted opportunities within the integrated aquaculture site at the Mount Lucas biowetlands, Co. Offaly.

The participants investigated grand challenges to Ireland's emerging freshwater algae sector, through hands-on ideation, mentorship, and a structured challenge.

Hatch Blue, an innovation company with expertise in running innovation challenges for early stage aquatech companies, facilitated the event, which included a tour of the biowetlands facilities, training in customer discovery, IP commercialisation, and mentoring in pitching, and concluded with teams pitching to a judging panel.

"We are delighted with the success of this event," says Miriam Walsh, of Engage@Teagasc, Teagasc's Technology Transfer Office.

"Based on the enthusiasm, energy and outside the box thinking displayed, and the overwhelming positive feedback from the participants, we believe there is an appetite for such events, and these can have a significant impact in inspiring researchers to tackle grand challenges and respond to opportunities within the bioeconomy sector."

News in brief

Apple-solutely brilliant

Jane Ritchie, a Teagasc Walsh Scholar based at Oak Park was awarded the Best Oral Presentation at the recent Irish Plant Scientists' Association (IPSA) conference at the National Botanic Gardens in Dublin.

Jane received this recognition for her presentation on the progress of her PhD research investigating apple scab, one of the most important diseases affecting apple production. Her work is contributing valuable knowledge towards improving disease management and supporting the sustainability of the apple industry.



Award winner Jane Ritchie at Oak Park's orchards

Curie conversations

'Letters to Marie Skłodowska-Curie' is a reflective initiative led by the Marie Skłodowska-Curie Fellows within the Teagasc Food Research Programme, celebrating 30 years of the Horizon Europe-funded Marie Skłodowska-Curie Actions (MSCA). Researchers across the programme were invited to write personal letters to Marie Curie, reflecting on curiosity, resilience, mentorship, mobility, belonging and the realities of research.

Current and former MSCA Fellows respond through written reflections and short videos, drawing on Marie Curie's life, values and their own research journeys, celebrating the human stories behind science. Follow the initiative and explore the full collection on the Teagasc Food Research Programme LinkedIn page.





From the Five Freedoms to the Five Domains

Animal welfare science has moved beyond simply preventing suffering. A newer approach, the Five Domains model, is helping abattoirs better understand and improve the welfare of animals at slaughter.

For more than 50 years, the Five Freedoms have been the cornerstone of animal welfare, explains Kevin Brennan, a Principal Research Officer at Teagasc Ashtown's Food Research Centre.

"The Five Freedoms have influenced legislation, quality assurance schemes and everyday farming practices around the world. Their simple message, that animals should be free from hunger, discomfort, pain, fear and unnecessary restrictions on normal behaviour, remains as important today as ever."

However, animal welfare science has advanced considerably. Researchers now recognise that welfare is about more than avoiding suffering. It is also about understanding what an animal is likely experiencing and how different aspects of its environment affect its overall wellbeing, Kevin adds.

"This shift in thinking has led to the development of the Five Domains model, which is increasingly being used to assess welfare in livestock production, including in abattoirs."

The Five Freedoms

The Five Freedoms are an internationally accepted standard of care, affirming the rights of living beings to human treatment.

The Five Freedoms transformed how people thought about animal welfare because they provided a clear and

Animal welfare science is increasingly encompassing more than just the prevention of suffering. A newer model for assessing welfare seeks to move beyond physical dimensions.

practical framework, explains Kevin.

"They remain an excellent guide for identifying poor welfare and have shaped training, regulation and welfare auditing for decades."

But there is one important limitation, he continues.

"Some situations, particularly transport and slaughter, are naturally stressful for animals. It is unrealistic to expect animals to be completely free from discomfort or fear during these events. Instead, the goal is to minimise these experiences and ensure animals are handled as calmly and humanely as possible."

The Five Freedoms also focus mainly on preventing negative experiences. They do not fully consider how different factors combine

to influence an animal's overall welfare or what the animal may actually be experiencing.

Together, these determine the fifth

domain, Mental State, which reflects the animal's likely experiences, such as comfort, fear, pain or calmness.

This approach recognises that good welfare depends not only on physical health but also on the animal's emotional experiences.

Applying the model

What does this mean in an abattoir setting? The Five Domains model has particular value during the final stages of an animal's life.

When animals arrive at an abattoir, assessors can evaluate the physical environment by looking at ventilation, lighting, flooring and stocking density. These factors influence how comfortable animals are and whether they experience unnecessary stress.

The Behavioural Interactions domain focuses on how animals are handled. Calm stockmanship, maintaining social groups where possible and reducing unnecessary noise all contribute to lower stress levels.

Health assessments include checking for injuries, lameness and, most importantly, ensuring stunning is effective so animals remain unconscious before slaughter.

"Looking at these areas together gives a much clearer understanding of likely animal welfare than relying on a simple checklist alone," Kevin says.

Supporting continuous improvement

"One of the biggest strengths of the Five Domains model is that it encourages continuous improvement," notes Kevin. "This is a core requirement of animal welfare regulations and quality assurance standards."

The four physical domains are:

- Nutrition,
- Physical Environment,
- Health,
- Behavioural Interactions.

The Five Freedoms consist of:

- Freedom from hunger and thirst**
- Freedom from discomfort**
- Freedom from pain, injury, or disease**
- Freedom to express normal behaviour**
- Freedom from fear and distress**



One of the biggest strengths of the Five Domains model is that it encourages continuous improvement – a core requirement of animal welfare regulations and quality assurance standards.



For example, poor flooring may increase the risk of slips and injuries while also making animals more fearful. Improving the surface can therefore improve welfare in several ways at once.

Similarly, investing in better stunning systems or improving staff training can reduce pain, distress and handling problems simultaneously.

The model also helps explain why good stockmanship matters. Staff can see how everyday decisions influence an animal's experience, encouraging a welfare culture that goes beyond regulatory compliance towards genuine welfare improvement.

Looking ahead

Assessing an animal's mental state is more challenging than measuring physical conditions because emotions cannot be



observed directly. Instead, assessors use scientific evidence together with animal behaviour and physical indicators to make informed judgements.

As welfare monitoring technologies continue to improve and scientific knowledge grows, the Five Domains model is becoming an increasingly practical tool for industry.

The Five Freedoms remain an important foundation for animal welfare.

However, the Five Domains provide a broader understanding by recognising

that welfare depends on both physical conditions and the animal's likely experiences, Kevin concludes.

"For abattoirs, this means better welfare assessment, more targeted improvements and greater confidence that animals are being treated as humanely as possible during the final stage of the food production chain." **T**

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A sustainable food system is about growing, distributing, and consuming food in a way that's good for the earth, fair to people, and sustainable for the long term. The EU ENFASYS project explored the role of the consumer-citizen in sustainable food systems.

The consumer-citizen connection

Standing in the supermarket aisle, a customer is deciding between two cartons of eggs. One is cheaper. The other is labelled free-range, locally produced and environmentally friendly, but costs more. They pick up the cheaper carton. They leave the supermarket and pass a stand seeking petitions for stronger environmental protections – they sign it. Same person, but they are acting in two different roles: as a consumer, and as a citizen.

"On the surface, these behaviours might seem contradictory – hypocritical even," notes Áine Regan, a Senior Research Officer at Teagasc's Department of Rural Economy & Development Programme.

"This is what researchers call 'the consumer-citizen gap'. We recognise it as reflecting the competing pressures people face every day and the complexity of untangling multiple food beliefs and behaviours."

Food agency describes an individual's personal agency around food choices; they can exert that agency to influence food systems through both private (consumer) and public (citizen) actions.

"Understanding food agency and dual citizen-consumer roles is becoming increasingly important as governments, businesses and researchers seek ways to build more sustainable food systems," Áine adds.

While consumers influence the market through what they buy, citizens shape

society through their voices, values and advocacy behaviours. Sometimes these roles reinforce one another. At other times, they pull in different directions. As part of the EU ENFASYS project, Teagasc led a survey of 9,600 citizens across 12 European countries, identifying diverse patterns of consumer-citizen beliefs and behaviours.

Identifying groups

Sustainable food choices are not one-dimensional. They include everything from choosing healthier diets and reducing environmental impacts to supporting fairer food systems and local economies.

"Our survey identified distinct groups of consumers across a spectrum of engagement with 12 sustainable food behaviours," explains Áine.

At one end were the "Sustainability Committed Consumers", representing 27.9% of people in the study who consistently embraced food choices that supported healthier diets, environmental protection, social wellbeing and economic sustainability. They were typically older, female and on higher incomes, but their differences went beyond demographics. They were also more likely to value fairness and shared responsibility, feel supported by those around them, and believe that their own purchasing decisions could contribute to a more sustainable food system.

At the other end of the spectrum were the "Low Involvement Consumers" (20.9% of participants), for whom sustainability played a smaller role in everyday food decisions. This group reported the lowest levels of motivation, social encouragement and confidence in making sustainable choices. They were more likely to be younger, male and on lower incomes. They also tended to hold more individualistic worldviews, suggesting that personal priorities and individual choice may have a stronger influence on how they approach food decisions.

Citizen engagement

Food choices tell only part of the story. People also shape sustainable food systems through their advocacy actions. Survey analysis revealed that voting for political parties with sustainable food policies was the most widely supported action, with 43% of participants saying they were likely to do so.

More direct forms of engagement were less common: 41% said they would consider signing or creating petitions, while fewer would join local groups promoting sustainable food (34%), donate to sustainable food campaigns (30%) or contact local representatives about sustainable food issues (28%).

"These findings suggest that many people are more comfortable expressing their views through elections and collective actions than through direct political engagement," says Áine. "Believing that individual actions could influence decision-making, along with

strong environmental and social values, were important drivers of advocacy behaviours."

Younger respondents – despite being less engaged in sustainable purchasing behaviours – showed greater willingness to take part in advocacy activities, particularly when these required less time or financial

commitment, such as voting or signing petitions.

The survey findings suggest that many people see value in these broader forms of engagement and a willingness to contribute to sustainability action beyond individual consumption choices. These actions recognise that many challenges

facing food systems cannot be solved by consumer choice alone. They require collective action and supportive public policy.

"This distinction, and the need to consider citizen views beyond individual consumption decisions, becomes even clearer when examining public attitudes towards agricultural policy goals," says Áine.

Sustainability dimensions

Survey results reveal that citizens place considerable importance on a wide range of agricultural policy goals, with improving water quality eliciting the strongest endorsement, followed by improving food safety standards, increased access to nutritious food and ensuring farmer incomes. Although reducing greenhouse gas emissions and promoting biodiversity attracted the lowest proportions, figures still indicate that a substantial majority value these environmental aims.

Taken together, this broad-based endorsement suggests that European agricultural policies addressing multiple sustainability dimensions – ecological, socio-economic, and nutritional – are likely to resonate positively with the public.

"Importantly, these findings remind us that consumers are not simply shoppers responding to market signals," Áine notes. "They are also members of communities who care about public goods such as clean water, healthy ecosystems, thriving rural communities and food security. Their

prioritisations for agricultural policy reflect these broader societal concerns."

Building sustainable food futures

Collectively, the survey findings on consumer food choices, citizen advocacy actions, and public prioritisations of policy goals underscore the complexity of food agency and individual behaviour change when building sustainable food systems in Europe. There is a need for integrated approaches that acknowledge diverse consumer motivations while expanding pathways for political engagement and public participation.

Transforming the food system goes beyond changing shopping behaviours, explains Áine.

"There is a need to recognise that we all play two important roles: as consumers, whose purchases influence the market, and as citizens, whose voices help shape the policies that govern our food system."

Sometimes these roles work hand in hand; other times they are pulled apart by the realities of price, convenience and access.

Helping people act on their values will require more than asking them to make better choices, Áine concludes.

"Sustainable options need to be affordable, accessible and trustworthy, while governments and businesses must create opportunities for people to have a genuine say in how food systems evolve. When people are supported both as consumers and as citizens, their everyday decisions and collective actions can reinforce one another."

Recognising these dual roles – as both consumers and citizens – is an important step towards creating a more sustainable food future in Europe. 

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Dan Dalton/istockphoto.com



Parasite surveillance

Despite the benefits of grass-based grazing systems, livestock run the risk of developing parasitic infections. As antiparasitic resistance grows, researchers at Teagasc Grange are investigating new methods of resistance surveillance.

The Irish agricultural sector represents a major source of income nationally. Ireland is well known for exporting some of the best meat and dairy products in the world. A key to this success is the use of a grass-based system, with animals grazing for the majority of the year. This offers a huge

benefit to farmers and livestock, reducing the cost of feed and improving the welfare of the animals. Despite these benefits, a major consequence of this system is the development of parasitic infections that animals can acquire while grazing. Common parasite types in Irish livestock include roundworms, flatworms and tapeworms. One of the most common types

to impact livestock is a group of roundworms affecting the gastrointestinal tract, known as gastrointestinal nematodes (GINs). Infection with these parasites occurs when grazing animals eat infective larvae, which, once inside the animal, travel to the intestinal tract where they mature and lay eggs. Animals then excrete these eggs back onto the pasture through their dung, where

Species identified	Number of eggs (pre-treatment)	Number of eggs (post-treatment)	% reduction
<i>Cooperia</i> spp.	100	0	100
<i>Ostertagia ostertagi</i>	226	24	89
<i>Trichostrongylus axei</i>	47	0	100
<i>Trichostrongylus vitrinus</i>	2	0	100

Table 1. A summary of the number of eggs per species on Farm A pre and post treatment, calculated using the FEC and nemabiome sequencing data.

Farm A: A suckler beef farm in Co. Roscommon. Animals were treated with a levamisole (yellow) drug in response to high FEC test result. Findings of the FECRT showed a 93% reduction in eggs overall following treatment. Through use of the nemabiome method, researchers saw that for three of the species the drug was 100% effective with no eggs shown after treatment. However, for one species (*Ostertagia ostertagi*) the egg count was reduced by only 89% following treatment meaning this species was resistant to levamisole on this farm.

Alfie Shaw

Species identified	Number of eggs (pre-treatment)	Number of eggs (post-treatment)	% reduction
<i>Chabertia ovina</i>	33	0	100
<i>Cooperia</i> spp.	145	0	100
<i>Oesophagostomum venulosum</i>	26	0	100
<i>Teladorsagia circumcincta</i>	187	44	76
<i>Trichostrongylus axei</i>	50	0	100
<i>Trichostrongylus colubriformis</i>	15	0	100
<i>Trichostrongylus vitrinus</i>	257	0	100

Table 2. A summary of the number of eggs per species on Farm B pre- and post-treatment, calculated using the FEC and nemabiome sequencing data.

Farm B: A sheep farm in Co. Roscommon. Animals were treated with ivermectin in response to a high FEC test result. Findings of the FECRT showed a 93% reduction in eggs overall following treatment. Prior to treatment a mix of nematode species were identified in the sample. Following treatment, the majority of these species were shown to be susceptible to the treatment, with a 100% reduction in eggs observed. However, for one species (*Teladorsagia circumcincta*) the egg count was reduced by only 76%, meaning this species is resistant to ivermectin on this farm.

under moist warm conditions (like the Irish summer climate), the eggs then hatch and the cycle continues once more.

This can pose substantial risks to livestock herds, explains Stephanie O'Donoghue, Postdoctoral Researcher at Teagasc Grange.

"These parasites can be hugely problematic if present in high numbers within the animal, causing clinical signs such as reduced feed intake, failure to thrive and in severe cases diarrhoea. For farmers, issues such as reduced animal performance – i.e. reduced weight gain or milk yield – and increases in veterinary and treatment costs can arise as a result of infections."

In the 1960s, the first safe, broad-spectrum antiparasitic drugs became available and since have been the common method used to treat these infections.

However, similar to antibiotics, the overuse and incorrect use of these agents means antiparasitic drug resistance (the ability of the parasite to survive doses of drugs that would usually kill it) is now a huge problem.

released by the host animal, making their way onto the pasture.

"When these worms are eaten by grazing livestock, and these livestock are subsequently treated with a drug the worms are resistant to, they once again survive and lay eggs which are released onto pasture and

As the number of resistant worms on pasture rises, it is increasingly difficult to control these infections as the population is no longer susceptible to the drugs.

develop into larvae," explains Stephanie. "As the number of resistant worms on pasture rises, it is increasingly difficult to control these infections as the population is no longer susceptible to the drugs."

In Ireland, resistance to many of the drug classes exists among worm populations, yet the full extent is not fully known. Faecal egg count reduction tests (FECRT) are the most commonly implemented method to monitor resistance, involving the counting of eggs in a dung sample from animals before and after treatment.

From this information, a reduction in egg count can be calculated; an FEC reduction of less than 95% is taken as a sign of resistance to anthelmintics (a group of antiparasitic drugs).

However, the ability to identify the species of worm based on the appearance of the eggs is a difficult task, with it being near impossible for many species. To overcome this difficulty, research has turned to the use of molecular-based approaches to

identify species through use of next-generation sequencing, commonly termed 'nemabiome' sequencing.

Specific treatments

"Although we know anthelmintic resistance is a problem on Irish farms, we don't know the full extent of the issue and what specific worm species are resistant to each drug class," Stephanie notes.

To help fill this knowledge gap, researchers across Teagasc Research Centres in Grange and Athenry have applied a molecular-based approach to identify worm species resistant to various anthelmintics across both cattle and sheep farming systems (snapshots of these results are provided as tables in this article).

As illustrated in these findings, nemabiome sequencing data holds major potential for resistance surveillance when integrated alongside more common methods like FECRT, allowing for the identification of resistance at the species level, concludes Stephanie.

"The application of this approach could provide more specific information required for the choice of drug at the individual farm level, allowing for the selection of a treatment option that is suited to the resistance situation on a particular farm."

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Going against the grain

New monitoring and laboratory evidence show that *Metopolophium dirhodum*, the Rose-Grain aphid, is common in Irish spring barley, where it reproduces rapidly and efficiently transmits Barley Yellow Dwarf Virus. This warrants its explicit inclusion in monitoring and Integrated Pest Management guidance.

Barley Yellow Dwarf Virus (BYDV) continues to threaten cereal yields when infection occurs early in crop development. Between 2022 and 2025, researchers at Teagasc Oak Park's Crop Research Department conducted integrated field monitoring and laboratory experiments to better understand potential threats from BYDV.

This research revealed that the Rose-grain aphid (*Metopolophium dirhodum*) is a regular, sometimes abundant visitor to Irish spring barley. Research Officer Louise McNamara explains more.

"The Rose-grain aphid has life-history traits that permit rapid local increases on barley crops. It also efficiently vectors the

MAV strain of BYDV, which is the strain most frequently in Ireland.

"These results indicate that *M. dirhodum* should be considered explicitly within national monitoring programmes and Integrated Pest Management (IPM) advice for spring-grown cereals."

Species-specific transmission

Current BYDV research and advice nationally and internationally have largely emphasised the English grain aphid (*Sitobion avenae*) and the Bird cherry-oat aphid (*Rhopalosiphum padi*) because of their roles in transmitting locally important virus strains and their seasonal behaviour.

However, epidemiological risk depends not only on aphid abundance but also on

species-specific transmission competency and seasonal timing.

Combined studies – a national aphid survey in collaboration with growers, laboratory life-history assays and multi-clone virus transmission trials – helped paint a clearer picture of the threat from the Rose-grain aphid.

"This combined research shows that *M. dirhodum* frequently arrives in spring barley during the crop stages most vulnerable to BYDV infection, where it reproduces rapidly under favourable conditions and is a highly competent vector of BYDV MAV," Louise explains.

"Because MAV is the dominant BYDV strain in Ireland, even modest *M. dirhodum* populations in spring could have important epidemiological relevance."

At a glance: Aphids and viruses

Aphids are small, sap-sucking insects. They can affect the yield of major cereal crops such as barley, wheats and oats, both directly and as disease vectors. Common species in the UK and Ireland include the Rose-grain aphid (*Metopolophium dirhodum*), English grain aphid (*Sitobion avenae*) and Bird cherry-oat aphid (*Rhopalosiphum padi*).

Barley Yellow Dwarf Virus (BYDV) is a viral disease affecting these crops, causing stunted growth and damage and discolouration of leaves. The virus has several strains, including BYDV-MAV, BYDV-PAV and BYDV-PAS, and is mainly transmitted by aphids feeding on infected plants.



A close-up of the Rose-grain aphid (*Metopolophium dirhodum*), an efficient vector of cereal crop viruses



Trap samples

From 2022 to 2025, growers and researchers deployed yellow pan traps in winter and spring barley crops across multiple fields and counties. Trap samples were collected and returned to the laboratory for species identification, and parallel in field visual plant checks were made at key growth stages to record aphid colonisation and abundance.

In controlled environment chambers, the researchers reared clonal lineages of *M. dirhodum* and recorded daily development, survival and reproduction to produce age-stage life tables.

Finally, transmission experiments run at University of Liverpool and Teagasc used multiple aphid clones and BYDV isolates to quantify vector competency for BYDV-MAV, BYDV-PAV and BYDV-PAS.

Field monitoring

The field monitoring showed presence of *M. dirhodum* in spring barley traps every year that spring trapping was undertaken. Across the programme, the total number of *M. dirhodum* captured in traps exceeded that of *S. avenae*. In-field tiller checks found

M. dirhodum most often during tillering and early stem extension during growth stage (GS) 21–31, part of the important window for BYDV damage (emergence up to GS31).

"Winter barley was less consistently colonised by *M. dirhodum* during the winter sampling windows, reflecting a



Integrating species data into decision support and risk models will enable more nuanced, evidence-based advice.



clear seasonal phenology with peak activity in spring and early summer," Louise notes. Laboratory life-history assays showed all three clones completed

four nymphal instars (development stages) in about 7.9–8.1 days and had long adult lifespans (27–34 days). Lifetime fecundity ranged from about 47.5 to 65.8 nymphs per female and intrinsic rates of increase (*r*) were approximately 0.27–0.29 per day, corresponding to population doubling times near 2.4–2.5 days under the controlled conditions used.

These traits combine to give *M. dirhodum* both a substantial individual transmission window (adults remain viruliferous for life once infected) and a capacity for rapid local population growth under favourable conditions on barley.

Transmission assays demonstrated that

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virus species was the dominant predictor of transmission success by *M. dirhodum*. Across the clones and isolates tested, BYDV MAV was transmitted at significantly higher rates than BYDV PAV and BYDV PAS.

In Ireland MAV is common, and *M. dirhodum* is an efficient MAV vector, Louise adds.

"The combined field timing, life history potential and MAV competency indicate that *M. dirhodum* can contribute meaningfully to BYDV epidemics in spring barley."

Targeted interventions

These findings hold several implications for monitoring and management, Louise explains.

For spring sown cereals, monitoring programmes and advisory messages should explicitly include *M. dirhodum*.

"Integrating species data into decision support and risk models will enable more nuanced, evidence-based advice that targets interventions when and where they are most needed," she concludes.

"Practically, growers should prioritise timely monitoring of spring barley in the vulnerable window and consider cultural measures – such as early sowing dates – to limit early colonisation." 

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Mapping the invisible threat

Research from Teagasc's Agricultural Catchments Programme highlights the potential of Pollution Impact Potential Maps as a decision-support tool for water quality management, while identifying key barriers to their wider adoption among farmers and advisors.

Protecting and improving water quality remains one of the greatest environmental challenges facing Irish agriculture. Considerable progress has been made in reducing nutrient losses through improved nutrient management, slurry application technologies and changes in farm practices. However, achieving further improvements requires a more targeted approach. Rather than applying mitigation measures uniformly across entire farms or catchments, attention is increasingly being given to identifying the relatively small areas that contribute disproportionately to nutrient and sediment losses.

These areas, commonly referred to as critical source areas, occur where a source of pollution coincides with a pathway capable of transporting it to a stream, river

or drain. During heavy rainfall events, runoff generated in these locations can rapidly transport phosphorus, nitrogen, sediment and other contaminants into nearby watercourses. Identifying these areas is therefore fundamental to improving water quality while maintaining productive farming systems.

Pollution Impact Potential (PIP) Maps provide an innovative decision-support tool that helps visualise these risks. Ábagh Harten, a Teagasc Walsh Scholar in Teagasc's Agricultural Catchment Programme (ACP), explains more.

"Developed using detailed information on soils, topography, land use, hydrology and drainage networks, PIP Maps identify where pollutants are most likely to be mobilised and transferred to water. Instead of treating every field as presenting the same level of environmental risk, they allow farmers and

advisors to focus attention on the locations where targeted management changes are likely to deliver the greatest benefit."

The approach reflects a key principle of Ireland's River Basin Management Plan and integrated catchment management: the right measure, in the right place, at the right time. By informing decisions on targeted measures, in contrast to 'one size fits all' regulations, PIP Maps have the potential to improve environmental outcomes while making more efficient use of both farm resources and advisory effort.

Bringing science to the farm

Although PIP Maps are based on sophisticated spatial analysis, their purpose is to support better farm management decisions, notes Ábagh.

“Participants consistently highlighted the importance of clear interpretation, practical demonstrations and opportunities to discuss maps within the context of their own farms.”

Research Officer Michele McCormack of Teagasc's Agricultural Catchments Programme takes readings at a catchment kiosk: understanding where pollutants reach waterways is an important tool for targeted mitigation measures

"A PIP Map should not be viewed as a prescription for action, nor does it replace the knowledge of farmers or advisors. Instead, it highlights areas that warrant closer attention."

A high-risk area identified on a map can prompt discussions about nutrient application, runoff pathways, livestock access, drainage, buffer placement or other mitigation measures that may reduce the likelihood of pollutants reaching water.

This makes PIP Maps particularly valuable during advisory visits. Rather than discussing water quality in general terms, farmers and advisors can examine specific locations within a field and consider practical measures tailored to local conditions.

Ábagh's research explores how farmers and Teagasc advisors perceive, understand and use PIP Maps. The project combined farmer and advisor surveys, focus groups and practical workshops to better understand how spatial decision-support tools can be integrated into advisory practice.

"The findings suggest that the availability of environmental data is no longer the challenge, but a greater focus is required on ensuring that complex spatial information



Images above show a flooding event in an ACP catchment alongside the corresponding Pollution Impact Potential (PIP) Map. The map accurately identifies the point where overland flow returned to the stream, illustrating how PIP Maps can locate critical source areas and support the targeted placement of mitigation measures

can be translated into practical, farm-level decisions," she explains.

"Participants consistently highlighted the importance of clear interpretation, practical demonstrations and opportunities to discuss maps within the context of their own farms."

From prediction to reality

Perhaps the strongest test of any predictive tool is whether it reflects what happens during real weather events. An example from a catchment in the ACP demonstrates this clearly. During a significant rainfall event, video footage captured overland flow moving across a field before returning directly to a stream. When the

corresponding PIP Map was examined, the highest-risk area identified by the model coincided precisely with the location where runoff entered the watercourse.

This real-world example demonstrates how PIP Maps can identify hydrologically connected pathways before pollution occurs, Ábagh notes. "Rather than reacting to water quality problems after they arise, farmers and advisors can use this information proactively to identify where mitigation measures are most likely to be effective."

Building confidence

Like many decision-support technologies, the effectiveness of PIP Maps depends not only on the quality of the underlying science, but also on the confidence of those using them. To support wider adoption, the project developed two practical knowledge-transfer resources. The first is a repeatable workshop that enables advisors to introduce PIP Maps within farmer discussion groups using local examples and interactive learning. The second is a training video designed to improve advisors' confidence in interpreting PIP Maps and integrating them into routine advisory discussions.

These resources recognise that successful adoption requires more than simply providing access to digital tools, Ábagh concludes.

"Farmers and advisors need opportunities to build familiarity with the maps, understand how they relate to local farming systems and appreciate how they can support everyday management decisions."

By linking environmental science with practical farm management, PIP Maps provide a means of identifying where interventions are likely to have the greatest environmental return, helping to ensure that future water quality improvements are both effective and evidence based. **T**

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Growth of the soil science

Soil health is an increasingly multidisciplinary field, moving from the purely agronomic to cover policy, biodiversity and industry upskilling. Karen Daly, Department Head and Research Officer at Johnstown Castle, reflects on its growing influence.

Photography: Browne's Photography



s Head of Teagasc's Department of Environment, Soils and Land Use (ESLU) at Johnstown Castle, Karen Daly has witnessed

first-hand the expansion of the soil science discipline. What was once a primarily agronomic concern now encompasses agricultural, environmental, technical and political concerns. While still an active Research Officer and PhD supervisor,

Karen's expertise has seen her attend a UN summit this year as an expert scientific advisor to the Irish government.

Could you tell us about how you got started in research?

I didn't come into this from an agricultural background, which may be a bit unusual. I studied Chemistry at Trinity College, followed by a Masters in Synthetic and Organic Chemistry. I always enjoyed the practical and experimental nature of chemistry at the workbench, delving into the equipment and instrumentation.

After graduating, I took a job with Dublin City Council as an Environmental Chemist, which taught me a lot about accuracy and precision, and industry compliance for topics like water quality regulation. A few years later I decided to return to research, applying for a PhD at Johnstown Castle through the Teagasc Walsh Scholars Programme, focusing on a blend of water quality and soil quality. I've stayed at Johnstown Castle since then, continuing to work primarily at this intersection of water and soil quality.

I joined the ESLU as an early-stage Research Officer in 1999. I felt like a fish out of water for a while, as the age of my colleagues veered older, and I was the only female researcher on the permanent staff! I've seen the department undergo a lot of regeneration, and today we have 20 permanent research officers, including myself. Over time, I grew my own research team, focusing on soils, with soil health being the most prominent topic.

What is the relevance of this topic?

Soil health is the topic building the most momentum, and which we're most asked to look at. Generally, our departmental focus is: where can agriculture and the environment intersect, how can our research help build environmental actions into farms?

For the first time, there's now a cross-EU legislative framework and directive for protecting soil: the Soil Monitoring and Resilience law. All EU member states have to monitor soil health and report it to the EU Commission. It's at the forefront of understanding what soil health means, which research has been building towards over the past 10 to 15 years: the extent to which healthy soil furnishes further properties, e.g. habitat for biodiversity, carbon storage, water filtering, food production and climate resilience.

How has this field developed over time?

Johnstown Castle is the home of the soil survey. The first soil survey was run out of Wexford under An Foras Talúntais (the predecessor of Teagasc), with the original soil maps and characterisation starting there in the 1950s. That was done with a defined purpose: understanding how soil could help agriculture grow food.

Today, it's much more holistic. Bringing in the idea of soil health addresses all these other topics – carbon and water storage, nutrient cycling, biodiversity. What was once a linear purpose – fertility and drainage for soil as a growth medium – now poses so many more research questions. This allows a greater diversity of collaborations with other disciplines, making the subject area much more multidisciplinary.



What was once a linear purpose ... now poses so many more research questions.



What are the challenges surrounding this topic?

As the subject area has widened, so too have data gaps. Compared to topics like soil drainage, agronomy, soil chemistry and physics, we don't have as much national data on soil biodiversity. A research group at Johnstown Castle, alongside our university partners, are examining this. We'd like to know more about how soil biological functions affect plant growth, difference in seed covers, and above-ground/below-ground relationships. Partly, this is a capacity-building challenge, to meet a set of questions previously less considered.

Another challenge is increasing awareness among farmers and the public around the importance of soil health. The public are increasingly concerned with where their food comes from, so bringing

this issue to light would be a natural next step. We've had good engagement with citizen science projects such as the recent GroundTruth project, and at our Open Day in June focussing on healthy soils and clean water. I was also fortunate to write on the topic for RTÉ Brainstorm, which then made it into a leaving certificate biology paper. So, it's great to know word is spreading!

What research have you been doing in this field?

In my own research, I still use a lot of my chemistry background, and one of our big things as a department is innovation and developing new methods for soil analysis. Teagasc and Johnstown Castle are at the forefront of soil spectroscopy analysis in Ireland.

Spectroscopy is a form of infrared light measurement; you shine light at a material, this generates radiation which in turn creates a spectra of peaks and troughs. This is valuable chemical and physical information regarding soil composition, allowing you to make a prediction of 12 parameters such as concentrations of carbon, clay, sand, carbonates and pH values. When paired with machine learning and data analytics, spectroscopy gives you a powerful tool for soil health predictions.

What benefits does this research have?

One of the key benefits of spectroscopy is the extent to which it replaces wet chemistry. Before, you would have to send a sample through six to seven different labs to test all parameters, which would be a month's work for 100 samples. Spectroscopy lets you process 100 samples a day, which hugely reduces time, cost and chemical waste.

We're building a huge library of soil spectral models, currently over 10,000 samples. You still get an occasional 'wild card' not in the library, for which you still need wet chemistry. Over time, though, the library will become increasingly comprehensive and applicable for predictions. ►

The EU Soil Monitoring Law

Directive (EU) 2025/2360, the Directive on Soil Monitoring and Resilience, is commonly known as the EU Soil Monitoring Law. It establishes the EU's first common framework for monitoring and assessing soil health, addressing soil degradation and supporting healthier, more resilient soils by 2050.

Karen Daly, pictured outside the National Agricultural Sustainability Research and Innovation Centre: opened in 2025, the centre is home to the soil, crop, water and gas labs at Teagasc Johnstown Castle



Karen Daly (pictured left) speaks at the open day 'Farming for a better future: innovating for healthy soils and clean water' at Teagasc Johnstown Castle, June 2026

We also use mid-infrared (mIR) technology for particle size analysis, which was previously very laborious. Each sample fraction – sand, silt, clay – would have to be separated, and you'd be lucky to do 10 samples in a week. Transitioning to in-house mIR at Johnstown Castle substantially reduces sample waiting time, so researchers can act more quickly on making decisions for their trials.

What impact is this topic having?

Crucially, it's nice to see results of our early research now making impacts on policy measures and as advice to farmers on topics like reducing nutrient losses into water and agri-soil management. On the policy front, I serve as a national expert for the EU Soil Monitoring Law implementation group, providing scientific and technical advice to the government. As part of this, the Department for Climate, Energy & the Environment invited me to join their UNCCD-COP17 delegation as its soil science expert. It was an honour to be invited, with lots of exciting work to do in the run-up, folding science into policy, focused on the main topic of this year's summit: drought, desertification and land degradation.

It's like science diplomacy; it makes you alter perspective, thinking about wider policy implications and balancing the positions of the different member states to formulate a shared position for the EU. There's lots of interesting relationship-building, almost like a diplomatic mission. So, it's great to get that recognition of the value and international impact of our work in science.

What has the wider response been?

We've recently signed a memorandum of understanding with the Geological Survey of Ireland (GSI). We're granted access to its national database of physical soil samples, which we're scanning with our spectroscopy and mIR technology. Teagasc has traditionally focused on agricultural soils, while GSI's archive covers the whole country, giving us a wider picture of soil health, bringing in additional properties such as spatial distribution of particles, of chemicals like phosphorous and nitrogen, and of soil carbon.

As the topic of soil health grows in visibility, our stakeholders are asking us to develop materials on it. Hence a large part of our industry engagement being around upskilling. Teagasc Specialist Advisors have put together soil health training courses, as well as topics like emissions, farmland biodiversity, water quality and soil fertility. We've had good engagement so far when disseminating this work, thanks to the great work done by the specialists and Teagasc's Knowledge Transfer directorate. Beyond this, our expertise gives industry insight into topics like fertiliser development, emissions reduction, nitrogen leaching and seed technologies.

Up close and personal

What's your favourite animal?

Dogs: they're so fun to have around, give you so much joy and become such a part of your family.

If you hadn't ended up in research, what other job would you have wanted to give a go?

Sometimes in science you work alone a lot, but I enjoy working with other people. I will say I'm enjoying this diplomatic work – so maybe something like an attaché in a nice country!

What are you most proud of professionally?

With PhD students, you're guiding someone through years of not just professional but personal development, so I'm always very proud of them when they pass their viva. Seeing some of my writing on a biology paper for the leaving certificate was a highlight too!

What's next?

We need to continue addressing knowledge and data gaps at a wider, national scale. We have lots of good data so far, and this is increasing quickly thanks to the use of spectroscopy, and our engagement with GSI and industry. The ongoing task is to get soil health data aligned with related topics, such as biodiversity and water quality, to ensure it is correctly factored into decision-making at both policy level and farm level. **T**

UNCCD-COP17

COP17 is the 17th meeting of the countries signed up to the United Nations Convention to Combat Desertification (UNCCD), a global coalition for addressing desertification, land degradation and drought. Hosted in Ulaanbaatar, Mongolia, in August 2026, it brought together representatives from 197 parties to accelerate action under the theme "Restoring Land, Restoring Hope".

An “acid test” for grass-fed dairy

Irish dairy standards require cows' diets to be at least 95% grass-based, but current measurements rely on recorded farm practices. Researchers at Teagasc are examining an alternative for directly testing milk composition.

Ireland's reputation for premium grass-fed dairy is contingent on it having one of the world's most pasture-based systems. Together, Ireland's mild climate and long grazing season mean cows eat fresh grass for much of the year. The national Grass Fed Dairy Standard requires herds to be in the Sustainable Dairy Assurance Scheme and for cows' annual diets to average at least 95% grass and grass-based forage. However, the data for meeting this requirement relies on recorded farm practices rather than a direct compositional test of the milk.

Defining a biomarker

The fatty acid profile of bovine milk is impacted by several factors, but diet remains the biggest driver. Irish pasture is particularly rich in the omega-3 alpha-linolenic fatty acid (α LA), while other diets, such as concentrates and silages, contain less α LA, but also proportionally more linoleic acid (LA).

Kieran Kilcawley, a Principal Research Officer at Teagasc Moorepark's Food Research Centre, explains this distinction further.

“Although both LA and α LA are extensively altered in the rumen of the cow, the high dietary supply of α LA, combined with its greater transfer efficiency to milk fat relative to LA, produces elevated α LA concentrations in milk from Irish pasture-based systems.”

These differences create an opportunity to define a biomarker for grass-fed dairy based on the ratio of LA: α LA. A lower ratio indicates a greater reliance on fresh pasture, while a higher ratio reflects increasing use of non-pasture feeds.



“The appeal of the LA: α LA ratio lies in its simplicity: expressed as a ratio, it is largely independent of analytical method or reporting units, allowing direct comparison across laboratories and assays,” Kieran notes.

Seasonal effects

To test this, researchers at Moorepark analysed 1,554 bulk milk samples from silos supplied by seven industry partners across the Republic of Ireland. The samples were collected between 9 March 2021 and 9 April 2024 as part of the Dairy Processing Technology Centre's National Milk Seasonality Database (Research Focus Area 1) [see *TRResearch* Autumn/Winter 2026, p.35].

Over three years, the mean LA: α LA was 2.15, and the ratio remained below 2.5 throughout Ireland's main grazing period (mid-March to November). Outside that period, cows are predominantly housed on conserved forage and concentrates. This is also the same period when seasonal and lactation-related physiological changes occur due to Ireland's predominately spring calving system. During this period, the ratio rose, often exceeding 3.

“As both LA and α LA appear not to be substantially altered by butter making or cheese production, the ratio can potentially also be applied to these products,” adds Kieran.

Proposing a threshold

In a review of previously published research on milk, Cheddar cheese and salted butter derived from milk and produced during the main grazing period, all products had LA: α LA ratios below 2.5, further highlighting its potential as biomarker for grass-fed dairy products.

“We therefore propose an LA: α LA threshold of <2.5 to identify milk, cheese and butter produced on Irish pastures during the main grazing season,” concludes Kieran.

“This would not replace existing certification, but would complement it by providing a measurable, product-based indicator of grass feeding – particularly valuable for products manufactured during the grazing period. This threshold figure would also recognise that seasonality and system differences mean the threshold is context-specific and requires wider validation across different Irish dairy products.” **T**

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Climate-smart future dairy farming in Eritrea

Implemented from February 2020 to March 2026 with a total budget of approximately €4.2 million, the EU-funded project 'Climate Smart Agriculture Research and Innovation

Support for Dairy Value Chains in Eritrea' (CSARIDE) sought to improve food security, increase farmers' incomes and enhance the resilience of dairy production systems to the challenges posed by climate change.

Eritrea's dairy sector plays an important role in rural livelihoods, nutrition, and local economies. However, for many years it has faced major challenges, including low animal productivity, poor-quality feed, limited access to improved breeding and veterinary services, weak research and extension systems and fragmented market linkages. Climate change has added further pressure through increasing feed shortages, water scarcity and environmental degradation.

Using a research-for-development approach, the project brought together researchers, educators, government agencies, farmers, processors and development partners to strengthen the entire dairy value chain. The goal was to increase dairy productivity, improve milk quality and safety, support value-added processing and promote environmentally sustainable and climate-resilient farming systems in three regions of Eritrea.

At the heart of CSARIDE was the concept of Climate-Smart Agriculture, which seeks to increase productivity while improving resilience to climate change and reducing pressure on natural resources.

Generating knowledge

Comprehensive assessments of dairy and forage value chains identified major constraints and opportunities in the target regions. Market studies and financial analyses provided valuable insights into production costs, processing efficiency and market dynamics, helping stakeholders identify practical pathways for improving competitiveness.

The project also delivered significant research outputs through strengthening collaboration between Hamelmalo

Teagasc was the lead organisation in the European Union-funded CSARIDE project, a six-year initiative designed to strengthen Eritrea's dairy sector through research, innovation, capacity building and climate-smart agriculture. Here, Project Coordinator Lance O'Brien reflects on the lessons learned.



“By encouraging collaboration and knowledge exchange, the project helped bridge the gap between research and practice.”

Agricultural College (HAC) and the National Agricultural Research Institute (NARI). Researchers identified forage species suitable for local conditions and developed cereal-legume intercropping systems that can improve feed availability while making better use of land and water resources. Advances were also made in animal breeding and health management.

Demonstration farms established at HAC and NARI became important centres for testing technologies, training students

and sharing knowledge with farmers and extension personnel.

Strengthening skills

Building human and institutional capacity was a major focus of the project. Through postgraduate training, CSARIDE is expected to produce 15 MSc and seven PhD graduates, creating a new generation of researchers capable of addressing challenges in the dairy sector. By the end of the project, seven MSc students had already graduated.

CSARIDE - in numbers



Project duration:
73 months
(6 years)



Budget:
€4.2M



Expected graduates:
15 MScs,
7 PhDs



Stakeholders participating in knowledge transfer:
900+



CSARIDE participants attending a farm walk

The project also strengthened extension services through farmer field schools, practical training programmes and the development of technical manuals and learning materials. These efforts improved the ability of extension staff to provide farmer-centred and demand-driven advisory services.

Institutional support extended to food safety and quality assurance systems. Staff of the national laboratories and regulatory institutions received training, and equipment was purchased and installed to strengthen milk testing, food safety monitoring and quality control. These investments are helping to improve consumer confidence and create conditions for higher-quality dairy products.

Innovating across the value chain

CSARIDE adopted a multi-stakeholder innovation approach that actively involved farmers, milk collection centres, processors, extension agents, artificial insemination technicians and local communities. By encouraging collaboration and knowledge exchange, the project helped bridge the gap between research and practice.

Processors and milk collection centres received technical assistance to improve milk handling, hygiene, packaging, shelf-life extension and product diversification.

More than 900 stakeholders participated in workshops, training events, exposure visits and learning activities. An international dairy conference held in 2024 further enhanced the visibility of project results and facilitated the

exchange of experiences among researchers, policymakers and industry representatives.

Benefits and impacts

The project generated encouraging results at farm level. Farmers increasingly adopted improved feeding, breeding, and animal health practices, leading to more efficient and productive dairy systems. Pilot sites demonstrated measurable improvements in milk yields, animal performance and milk quality.

Research findings supported the development of practical recommendations in three key areas: animal nutrition, animal health and breeding. These 'platform technologies' provide a foundation for improving productivity while reducing production costs.

The strengthened links between research institutions, extension services, and farmers also contributed to a more effective Agricultural Knowledge and Innovation System. Farmers gained better access to information and technical support, while researchers received valuable feedback from field experiences.

Climate-smart production practices are helping farmers improve resilience to climate variability while making more sustainable use of resources. Improved forage production and livestock management practices have the potential to reduce pressure on natural resources, lower greenhouse gas emissions and minimise environmental pollution.

The project also promoted gender-sensitive approaches, creating new opportunities for women in milk processing, retailing and small-scale dairy enterprises.

Looking ahead

Despite significant progress, important challenges remain. Unreliable electricity supplies continue to affect dairy processing and cold-chain management. High costs and limited availability of feed, veterinary supplies, equipment and packaging materials constrain wider adoption of improved practices. Seasonal fluctuations in milk demand also remain a challenge for producers and processors.

Scaling successful innovations presents another major task. More than 90% of Eritrea's milk production comes from smallholder farmers spread across diverse agroecological zones. Expanding climate-smart dairy practices will require continued investment in research, extension services, veterinary support, breeding programmes and infrastructure.

Challenges such as communal rangeland degradation, insecure land tenure and overgrazing require coordinated policy solutions that combine productivity improvements with natural resource restoration.

Strong foundations

By strengthening research and extension capacity, promoting climate-smart technologies, supporting value addition and improving food safety, the project established a strong foundation for a more productive, resilient and inclusive dairy sector in Eritrea.

The experience highlights the importance of investing in knowledge systems, partnerships and locally adapted solutions. Continued support for these approaches will be essential if the gains achieved through CSARIDE are to be sustained and expanded, helping Eritrea build a dairy sector that delivers economic, nutritional and environmental benefits for future generations. **T**

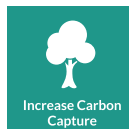
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Future grazing systems can play an important role in producing healthy foods more sustainably and profitably. A Teagasc-led, multi-year farm systems experiment is evaluating how sward diversity could improve dairy system performance.

Pasture, present, future

Improving dairy efficiency means meeting food demand while adapting to climate and ecosystem changes. In Ireland, pasture-based systems often rely on perennial ryegrass (PRG) monocultures for their nutritional value and resilience to grazing. However, PRG requires high levels of chemical nitrogen (N) fertiliser. Lower-input alternatives must also work economically for farmers.

Researchers have examined legumes and forbs (flowering plants) as ways to reduce chemical N use while maintaining productivity.

Multispecies swards (MSS) may increase pasture yield and feed quality while reducing gaseous and nutrient losses. However, longer-term evidence is needed, explains Brendan Horan, Research Officer at Teagasc Moorepark.

"Much of the evidence comes from short-term grazing evaluations or grazed or cut plot protocols," he says. "Neither accurately reflects longer-term performance under commercial grazing conditions."

Intensive evaluation

To tackle this knowledge gap, Multimilk, a three-year (2021–2023) systems-scale study, was conducted at Teagasc Moorepark.

Multimilk compared PRG white clover (PRGWC) and MSS swards receiving intermediate chemical N with PRG monocultures receiving higher levels.

For its base, the Multimilk project compared three 20-hectare farmlets:

- PRG, receiving 250kg N/ha/year
- PRGWC (comprising PRG and white clover),

- receiving 125kg N/ha/year
- MSS (comprising PRG, timothy, meadow fescue, white clover, red clover, hybrid clover, plantain, and chicory), receiving 125kg N/ha/year.

Each farmlet was stocked at 2.5 livestock units per hectare and managed under rotational grazing. Researchers measured pasture, animal and environmental performance:

- Pasture measures: herbage yield, botanical composition, nutritive value
- Animal measures: milk yield, composition, dry matter (DM) intake
- Environmental measures: enteric methane emissions, soil nitrate concentrations

Each system also underwent an economic appraisal using the Moorepark Dairy Systems Model (MDSM).

System results

"Across the three years, MSS delivered the best overall balance of production, environmental performance and profitability, despite using half as much chemical N as PRG," Brendan explains.

- All cows received around 600kg of concentrate per year. The three swards had similar chemical composition and no significant difference in crude protein.
- Despite receiving half the chemical N of PRG, MSS produced 13,227kg DM/ha, almost matching PRG at 13,317kg. PRGWC produced 12,502kg.
- Dry matter intake rose from 16.3kg DM/cow/

Further long-term research trials are required to reduce the variability in sward botanical contents.

day on PRG to 17.5kg on PRGWC and 18.7kg on MSS. As concentrate use was similar, the difference came from pasture intake.

- Milk production also rose, from 5,018kg/cow/year on PRG to 5,139kg on PRGWC and 5,297kg on MSS.
- Fat and protein composition was similar, so milk-solids results followed the same pattern.
- MSS had slightly lower organic matter digestibility than PRG and PRGWC.

Measuring methane

Using GreenFeed technology, enteric methane emissions were measured during year 3 of the study. PRG and PRGWC cows had similar methane yields (17.3g/kg DMI), while PRGWC produced more total

emissions because of increased DMI (294 and 310g/cow/day).

Total MSS emissions were similar to PRG (297g/cow/day), while methane yield (15.7g/kg DMI) and intensity (208g/kg MS) were lower than the other treatments. With higher milk production, MSS therefore had lower emissions per unit of total milk solids produced.

In addition, across the three-year period concentrations of total oxidisable N (nitrate plus nitrite; TON) were measured

	PRG	PRGWC	MSS
Herbage yield (kg DM/ha)	13,317	12,502	13,227
Concentrate (kg DM/cow/yr)	601	597	598
Pasture quality			
CP ¹ (g/kg DM)	205	206	212
OMD ² (g/kg DM)	801	799	788
Animal performance			
Dry matter intake (kg DM/cow/d)	16.3	17.5	18.7
Cumulative milk yield (kg/cow)	5,018	5,139	5,297
Cumulative milk solids (MS; kg/cow)	452	463	476
Environmental/ economic indicators			
Methane emissions (g/kg MS)	217	219	208
TON ³ concentration (mg/litre)	7.1	9.0	5.7
Net farm profit (€/ha)	2,366	2,385	2,533

Table 1. Sward, animal, environmental and economic performances of grazing systems comprised of a perennial ryegrass monoculture receiving 250kg N/ha (PRG), a perennial ryegrass-white clover receiving 125kg N/ha (PRGWC) or a multispecies sward receiving 125kg N/ha (MSS).

¹CP = Crude Protein
²OMD = Organic Matter Digestibility
³TON = Total Oxidisable Nitrogen

in soil solution using ceramic cups. These measurements, taken during the autumn-spring soil drainage period, indicate that the MSS swards have lower TON losses to soil solution (5.7mg/L TON) compared to both PRG and PRGWC systems (7.1 and 9.0mg/L, respectively).

Finally, the modelled economic results using MDSM show similar net farm profits for both PRG and PRGWC systems (€2,366/ha and €2,385/ha, respectively). Although PRGWC had lower costs linked to N fertiliser savings, lower overall pasture growth required additional silage purchases, which largely offset the fertiliser savings achieved.

In contrast, the MSS system outperformed both PRG and PRGWC systems in terms of net farm profit (+€167/ha and +€148/ha, respectively), primarily due to increased milk output and reduced N fertiliser costs.

Beyond production

To deliver additional benefits to farmers, consumers and society at large, future pasture-based systems must be redesigned beyond just milk production metrics, Brendan concludes.

"Such systems will need to rely less on imported feeds and chemical inputs, and more on high-quality grazed pastures, while consistently reducing impacts on environmental outcomes."

The Multimilk project demonstrates the potential for modest increases in sward species diversity in grazed pastures to maintain pasture production and quality, increase dairy system performance and profitability, while significantly reducing chemical N fertiliser use and associated nutrient losses to the environment.

"At the same time, further long-term research trials are required to reduce the variability in PRGWC and MSS sward botanical contents between paddocks, seasons and years," notes Brendan. "Such research will help identify management opportunities to increase the persistency of both swards under grazing within varying soil types and climatic conditions." **T**

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Soil research has a longstanding history at Teagasc, and today the organisation is at the forefront of the field. Here, we catch up with a few of the researchers from Johnstown Castle's Soils research programme.

Soil health is our wealth

As the field of soil research has expanded, an initial focus on soil fertility has grown to encompass a broad understanding of health.

Bringing in topics such as biodiversity, carbon sequestration and water quality, Teagasc's research aims to keep the farmer at its centre: how can science and advisory functions ensure soils remain resilient, productive and sustainable for the future?

To learn more, *TResearch* spoke to several researchers from the soils department: Research Officer Fiona Brennan, Soil Health Technologist Luis Lopez-Sangil, Soil and Plant Nutrition Specialist Veronica Nyhan, and Teagasc Walsh Scholar Karla Burke.

Can you explain the history of this team within Teagasc?

Fiona: Soils research dates from the 1940s at Johnstown Castle and became part of Teagasc when the organisation was formed. The initial focus was improving soils' capacity to produce food; it has since broadened to soil health and the full range of functions soils deliver, including water purification and storage, a habitat for biodiversity and carbon sequestration.

Luis: My role reflects that evolution: I was hired as a "Soil Quality" technologist, but the title quickly became "Soil Health". It signals Teagasc's wider focus not only on soil productivity, but on soil resilience and its role in supporting ecosystems and society.

What are your core priorities and objectives?

Veronica: Fundamentally, our job is to understand how soils work and help farmers get the best from them without damaging them. That means carrying out research and turning the science into practical advice. We develop tools, provide training, support advisers and work with policymakers so that the findings don't stay on a shelf but make a difference on farms.

Fiona: We generate knowledge on how soil characteristics and management determine agronomic, environmental and soil health outcomes. We also study how soils respond to various stresses and pressures, develop indicators and monitoring approaches to safeguard soil health and inform policy and advice.

How do you achieve objectives and share findings?

Fiona: The Soils research programme feeds directly into policy and advice on managing

Soil and Plant Nutrition Specialist Veronica Nyhan explaining soil health assessments at a Teagasc-led farm walk



Tom Ryan Casey



From left to right: Research Officer Fiona Brennan, Soil Health Technologist Luis Lopez-Sangil and Teagasc Walsh Scholar Karla Burke pictured at a Soils event at the Irish Agricultural Museum at Johnstown Castle

soils for nutrient efficiency, water quality, biodiversity, and greenhouse gas emissions.

Karla: Through Teagasc outreach, we share research with audiences ranging from scientists and advisors to farmers, teachers, students and the public. Seeing it move beyond the laboratory and into practical advice, while inspiring people to think differently about the living world beneath their feet, is especially rewarding.

Veronica: We use field trials, laboratory research and national soil data to answer practical soil-management questions. The research feeds into advisor training, farmer events, discussion groups, online tools and national recommendations, creating a clear pathway from research right through to on-farm practice and back again.

What are the key techniques and tools you use to achieve this work?

Veronica: Some powerful soil-health assessments are surprisingly simple. Digging a spade into the soil can tell you a huge amount about soil structure, roots,

earthworms and biological activity. We combine traditional testing with digital tools and national datasets to get more value from this information.

Fiona: Molecular and sequencing techniques let us examine soil microbial communities in detail. We also use microscopy, enzymatic assays and isotopic techniques to study organisms, soil function and nutrient flows, while spectroscopy measures chemical and physical properties.

Karla: My research combines fieldwork with molecular and biochemical techniques. DNA-based methods identify microorganisms and genes involved in carbon, nitrogen and phosphorus cycling. Enzyme assays, alongside soil chemical and physical analyses, show how actively these microbial communities are functioning. Together, these methods move us beyond traditional fertility testing towards understanding soil as a living ecosystem and how management influences the biological processes supporting productive agriculture. ►

What specific projects are you currently working on?

Luis: One of the latest things we are developing is a soil type database to help researchers with soil experiments, and we're also exploring ways to extract more from the data we capture with drones.

Fiona: We assess how practices such as fertilisation, crop diversity and pH management affect soil functions and biological communities. We are also developing indicators and tools to assess soil health and responses to climatic stress.

Karla: The EuroGrass project investigates how agricultural grassland management intensity affects the soil microbiome's ability to cycle carbon, nitrogen and phosphorus. It combines European-scale field surveys with targeted experiments to identify microbial mechanisms that support sustainable grassland management and more environmentally resilient agricultural systems.

Veronica: Work across the team ranges from reducing emissions and developing recycled fertilisers to improving lime and phosphorus advice and creating practical soil-health indicators. My projects include the Soil Fertility Dashboard and SoilCycle, where farmers are helping shape practical



Veronica Nyhan demonstrates soil physical assessment methods at a Departmental Open Day

technologies to improve nutrient recycling and make better use of organic manures.

Can you explain the importance of your work in an agricultural context?

Fiona: We like to put it as: "Soil health is our wealth." Every blade of grass, drop of milk and ear of corn originates in the soil, making it one of a farm's most vital resources. Safeguarding it is central to more sustainable farming systems that can better withstand climatic and other stresses.

Veronica: Everything starts with the soil. Healthy soils produce better crops and grass, use nutrients efficiently, cope with difficult weather, protect water quality, enhance biodiversity and reduce gaseous emissions. With rising input costs and increasing environmental pressures, helping farmers manage soils sustainably has never been more important. No two soils are the same, however; every field tells a different story.

Karla: Soils are also living ecosystems. Understanding how different grassland management affects microbial communities and nutrient cycling can help farmers improve soil health, meet environmental targets and build resilience without compromising productivity.

What results have you seen?

Fiona: Our research informs soil practical decisions, including when and how to apply slurry and fertiliser, which crops or plant species to sow and how to manage machinery traffic. We have also seen greater uptake of on-farm soil assessment methods.

Luis: Our evidence and recommendations supported European discussions on monitoring soil health, which ultimately informed an EU soil directive. Advisers and outreach activities also show growing farmer interest in practical soil-health measures.

Veronica: Soil fertility has improved over recent years, particularly in soil pH and phosphorus levels. The GroundTruth project has also shown how engaged farmers and the wider public become when practical soil-health assessments are accessible.

Karla: We found that grassland management affects microbial carbon, nitrogen and phosphorus cycling, while



Fiona Brennan and Luis Lopez-Sangil in a soil demonstration pit at a departmental open day

activity follows a seasonal pattern and peaks during the main growing season. This evidence can support more sustainable grassland management.

How does Teagasc benefit from your work?

Veronica: One of the team's strengths is connecting research with practice while allowing on-farm experience to shape research. We work with researchers, advisors, industry and policymakers to turn new knowledge into practical advice, training and tools, helping Teagasc provide consistent, evidence-based guidance.

Luis: We also provide technical expertise and improved methods for analysing soil organic carbon, root biomass, texture, and the stability of carbon and nitrogen. These give Teagasc researchers a more accurate picture of soil health. As the saying goes: "You can't manage what you can't measure."

Karla: Through farmer events, schools and public engagement, we help more people understand soil as a living resource and why it must be protected for future generations.

Are there any upcoming trends that will affect your work?

Veronica: Digital technologies will increasingly support field-specific nutrient management. We expect greater use of soil-health indicators and real-time sensing, combining traditional science with new tools to give farmers better information for decision-making.

Fiona: Climate-related threats will become more prominent. The Soil Monitoring and Resilience Directive will also increase emphasis on assessing and monitoring the national soil resource, while we continue examining how to support farming systems and reduce nutrient losses to air and water.

Luis: Spectroscopy, AI, drones and citizen science are increasing the speed and scale of data collection compared with standard laboratory methods. Each approach has its strengths; the task is to combine them effectively.

Karla: The biological side of soil health will receive greater attention as molecular techniques become more accessible and affordable. Climate change will also increase interest in how soil biology responds to

What are you proudest of as a member of the team?

Fiona: The 'Farming for Soil Health' handbook distils the best available research into practical advice, while our education resources help teachers, advisors, farmers and the public understand soil and soil assessment.

Veronica: The Soil Fertility Dashboard, which makes decades of national data accessible, and the GroundTruth project, which encourages farmers and the public to see soils differently.

Karla: Helping people see soil differently. Sharing our science can be as influential as generating it, and I am proud to contribute to work which benefits farmers, the environment and society.

Luis: The people around me, and the satisfaction of continually contributing and learning alongside such great colleagues.



Soil health literature on display at an open day event

Getting to grips with mushroom quality



Through the SoftGrip project, Teagasc researchers explored how grower practices and crop flushes affect white mushroom colour, helping to establish a more consistent way to assess quality.

When it comes to white button mushrooms, the brighter the better. Consumers are attracted to bright, white, clean mushroom caps. Discolouration or bruising on caps will greatly reduce the value of the produce and ultimately the profit margin for the grower. For this reason, considerable effort is placed on optimising practices to produce high quality, unblemished mushrooms. The extent to which discolouration is a concern depends on the variety of mushroom. For example, in brown mushrooms, damaged skin is less visually obvious and therefore less of a consideration.

In contrast, the majority of white button mushrooms produced in Ireland are the strain Sylvan A15, which is valued for its naturally bright white colour. However, the

outer cap tissue of these mushrooms is extremely delicate and can be irreversibly damaged with only minor physical impact.

Minimising damage

Browning is an enzymatic process that occurs when damaged tissue exposes the enzyme polyphenol oxidase (PPO). This enzyme reacts with phenolic compounds and oxygen to form quinones that polymerise into melanins, the brown pigments responsible

for discolouration. This process begins almost immediately after a mushroom has been harvested, explains Donal Gernon, Mushroom Advisor at Teagasc's Horticultural Development Department.

"To minimise damage, experienced harvesters use careful handling techniques to reduce physical contact with mushroom caps," he explains. "Once mushrooms have been harvested, they are immediately transported to a cold-storage room to try and slow down PPO activity and preserve freshness before it is transported to the supermarket."

These challenges were examined through SoftGrip, a European research project focused on developing innovative technologies to support the automation

of mushroom harvesting. As part of the project, researchers also investigated factors affecting mushroom quality and marketability. As part of this wider research programme, researchers undertook a colour study, providing new insights into how mushroom appearance changes after harvest and how these changes can be measured objectively.

The latest research article from the SoftGrip project, 'Colour quality assessment of commercial white *Agaricus bisporus* mushrooms', has now been published in the *Irish Journal of Agricultural and Food Research*. This research looked at colour quality in commercial white mushrooms (*Agaricus bisporus*) across different growers and crop flushes. Authored by Donal, alongside Teagasc colleagues Helen Grogan and Andrea Uccello, the research aimed to determine the extent of the impact of growing practices on mushroom colour quality, and to develop a standard assessment method for this.

Harvesting flushes

Although browning is a completely natural and inevitable part of the mushroom life cycle, skilled growers can significantly slow this process down to ensure high-quality mushrooms reach supermarket shelves.

"Mushroom crops are typically harvested over 2-3 flushes. Later flushes will have different metabolic profiles due to reduced nutrient availability and water content in the substrate," Donal explains. "This is likely to have an impact on quality and browning, with first flush mushrooms generally considered superior in quality compared to second and third flushes."

The SoftGrip team collected harvested mushrooms from the first, second and third flushes across five commercial farms, as well as from crops grown in the experimental mushroom unit at Teagasc, Ashtown. Mushroom colour was measured using a CR-400 portable chromameter which records L*, a* and b* values. Donal explains further: "The L* value indicates how light or

Mushroom Technologist Brian McGuinness, pictured measuring mushroom colour in the Horticulture Development labs at Teagasc Ashtown

dark a mushroom is, with higher values representing a whiter appearance. The a* and b* values measure subtle shifts towards red/green and yellow/blue tones, allowing researchers to detect small colour changes that may not be obvious to the naked eye."

While the L* value alone is commonly used as an indicator of colour quality, these parameters can also be incorporated into various equations to calculate the whiteness index. The use of multiple approaches can lead to inconsistency and confusion, highlighting the need to standardise the method used to report mushroom quality going forward.

This research suggests that growing practices and techniques contribute significantly to determining mushroom quality.

Growing practices

The SoftGrip team used the measurements recorded to rank and compare mushroom quality among different growers in Ireland. A key finding was that individual growers had a strong and significant influence on the mushroom quality, notes Donal.

"While all mushrooms met acceptable commercial quality standards, some growers consistently produced higher-quality mushrooms than others. This suggests that growing practices and techniques contribute significantly to determining mushroom quality."

Adopting the practices used by higher-performing growers could help lower-performing growers to improve the value of their product. However, other factors, such as variability in substrate batch quality must also be considered. The data were also used to evaluate differences in mushroom colour and quality across flushes.

"Although moderate variation in colour quality was observed between flushes, some growers were able to maintain consistently high colour quality throughout," says Donal. "This indicates that reductions in colour quality over successive flushes may occur, but can be managed or mitigated through effective growing practices."

Standardising assessment

The final objective of the study was to standardise the measurement of mushroom quality. Data from the top 25% of mushrooms, based on the highest L* values, were used to calculate average L*, a* and b* values, representative of high-quality white button mushrooms.

These were proposed as standard reference values for calculating the whiteness index. To determine the most appropriate equation for assessing colour differences, two widely used approaches ΔE^*CWM and $\Delta E^*Ajlouni$ were compared. The results showed that mushroom colour characteristics L* and a* correlated more strongly with ΔE^*CWM than $\Delta E^*Ajlouni$. Therefore, the ΔE^*CWM equation was identified as the more accurate equation for representing of colour differences in white button mushrooms.

Overall, concludes Donal, these findings contribute to the standardisation of mushroom colour assessment, improving the accuracy and comparability of quality measurements across scientific and industry applications.

"It also highlighted the significant influence of grower practices on final product quality. By identifying achievable quality benchmarks and more reliable methods of measurement, the work supports more consistent evaluation and comparison across the industry." **T**

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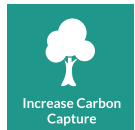


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Understanding consumer preferences for apples in Ireland

A nationwide survey of 900 people has revealed what consumers value most when buying apples in Ireland, providing valuable insights to guide future research and support the Irish apple industry.

As interest in expanding apple production in Ireland continues to grow, selecting the right varieties for new orchards has become increasingly important. Growers must consider factors such as yield, disease resistance and orchard performance, but long-term success also depends on producing apples that consumers want to buy and enjoy eating. Understanding consumer preferences can help ensure that new plantings are aligned with market demand and support the sustainable growth of the Irish apple industry.

To help address this, Teagasc, in collaboration with Atlantic Technological University, conducted a nationwide survey of almost 900 people living in Ireland to explore apple purchasing habits, consumption patterns and the characteristics consumers value most when choosing apples. The results offer meaningful evidence for growers,

retailers and researchers, helping guide future variety selection, orchard development and consumer-focused research.

An everyday choice

The survey confirmed that apples continue to play an important role in Irish diets, says Alberto Ramos Luz, Fruit Research Officer at Teagasc Oak Park.

“More than 90% of respondents reported eating fresh fruit every day or several times a week, and apples were among the fruits they consumed regularly.”

Around 94% of respondents said they usually purchased apples from supermarkets, while farm shops and farmers’ markets represented only a small proportion of purchases, with most consumers typically spending between €2 and €3 per shopping trip.

“These findings suggest that apples remain an affordable, everyday food rather than an occasional purchase, making consumer

preferences especially relevant to growers and retailers,” notes Alberto.

Quality or cost?

Consumers were asked to select the three factors that most influence their purchasing decisions. Two attributes clearly stood above the rest: freshness and taste.

More than 60% of respondents selected freshness among their top priorities, closely followed by taste. Colour, price and variety were also important, while brand ranked much lower than expected.

“This suggests that consumers are primarily looking for apples that deliver a good eating experience rather than simply the cheapest,” says Jean do Prado, Teagasc Walsh Scholar at Teagasc Oak Park.

“For growers, maintaining fruit quality from harvest through to the supermarket shelf may be just as important as selecting the right varieties for new orchards.”



“For growers, maintaining fruit quality from harvest through to the supermarket shelf may be just as important as selecting the right varieties for new orchards.”

Apple of your eye

Visual appearance plays an important role when consumers choose apples, but the survey revealed that some characteristics matter more than others.

Pink Lady was the most popular variety among respondents, while medium-sized apples were clearly preferred over very small or very large fruit. Most consumers favoured apples with a high proportion of red skin, but our survey also showed that not all shades of red are equally appealing. Bright, vibrant red colours received consistently higher preference scores than darker, deeper red tones.

“Interestingly, consumers showed little overall preference between striped and solid-red apples, suggesting that the intensity

and brightness of the colour may be more important than the pattern itself,” adds Jean.

These results can help growers and the wider industry identify the varieties and fruit characteristics most likely to appeal to Irish consumers.

The survey also revealed encouraging support for locally produced fruit. Just over half of respondents said they actively preferred apples grown in Ireland, while almost all of the remaining consumers had no strong preference. Very few specifically preferred imported apples.

“This represents an important opportunity for the Irish apple industry,” says Alberto.

“As local production expands, growers who can combine excellent eating quality with reliable fruit appearance may be well positioned to meet consumer expectations.”

From buying habits to eating experience

This survey represents the first stage of a wider consumer research project. Understanding how people choose apples is only part of the story. While visual appearance strongly influences the decision to pick up an apple, it does not necessarily determine how much consumers enjoy eating it, Alberto continues.

“The next phase of the project will therefore focus on what happens after the purchase: the eating experience. Consumers will be invited to taste a range of apple cultivars currently being evaluated in Teagasc research orchards and assess characteristics such as sweetness, acidity, crispness, juiciness, texture, flavour and overall liking.”

This will allow researchers to determine whether first impressions based on appearance are confirmed, or even changed, once consumers taste the fruit.

Consumer feedback will be combined with objective measurements of fruit quality, including firmness, sugar content, colour, size and external defects, as well as detailed sensory profiles generated by trained assessors.

Together, these complementary approaches provide a comprehensive understanding of the characteristics that influence consumer acceptance, concludes Alberto. By combining purchasing behaviour, sensory evaluation and fruit quality measurements, researchers will gain a more complete understanding of what consumers value – from the supermarket shelf to the first bite.

“These insights will help guide variety selection for new orchards, support the continued development of the Irish apple industry, and ensure that future plantings combine strong orchard performance with the eating quality consumers expect.”

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A row of different apple varieties: the survey suggested that colour intensity may be an indicator for consumer preferences



Anticipated legislation changes in the EU will likely require sows to be provided with greater freedom of movement during lactation. Teagasc is researching the practical implications to ensure optimal welfare gains for both sows and piglets.

Crate expectations

Sows are placed in farrowing pens shortly before farrowing, their birthing period. While intended to protect newborn piglets, farrowing pens can impair the welfare of both sow and piglets. With legislative changes pending, researchers at Teagasc Moorepark's Pig Research Facility are examining the welfare implications.

Farrowing pens are usually equipped with metal crates which confine the sow so that she can stand up and lie down, take a step forward and back, but not turn around. They help to prevent the sow from crushing her offspring, which is a major cause of death for suckling piglets. The crate slows and controls the sow's movements as she changes posture, allowing the litter time to move out of her way.

"While crated, sows cannot turn towards or move away from their piglets or choose where and how to lie down," explains Alan Foley, a Teagasc Walsh Scholar. "Thus, although crates reduce overall crushing risk, a crated sow cannot easily reposition herself in response to a trapped piglet."

Additionally, confinement prior to farrowing can cause stress, affecting both sow behaviour towards piglets, and milk let-down. Lastly, the bars of the crate can obstruct access to teats during nursing.

Alternative systems

In 2021, the EU Commission responded to the 'End the Cage Age' European Citizens' Initiative by committing to legislative changes prohibiting cages in the livestock industry. The EU strategy for Livestock was announced on 7 July 2026 and identified animal welfare as a central part of sustainable livestock production. For pigs, the aim is to announce revised rules by Q2 of 2027, explicitly covering the transition from crates to less restrictive farrowing systems.

"It is essential that alternative systems are thoroughly researched before widescale adoption," notes Alan. "The main knowledge gaps include effectively transitioning sows from fully crated to less-restrictive systems

'End the Cage Age'

End the Cage Age was a successful European Citizens' Initiative calling for an EU-wide end to cages for farmed animals, including farrowing crates for sows. Supported by almost 1.4 million people, it led the European Commission to set out plans to phase out and ultimately prohibit the systems covered by the initiative.

and safeguarding piglet welfare beyond survival alone."

Teagasc is currently focusing on investigating strategies to help both pigs and farmers achieve this.

At the end of 2025, Moorepark's Pig Research Facility installed 24 new farrowing pens. Each pen has a total area of 6.76m² and contains a crate that can be either kept closed (similar to traditional crates) or opened to allow the sow access to approximately 5m² of free space. Anti-crush rails along the pen walls provide piglets with a protected space as the sow lies down.

The crates are left open until the day before farrowing, then closed, and re-opened approximately 5 days post farrowing. This protects piglets when the risk of crushing is highest, while allowing the sow freedom of movement for most of lactation. This management system is normally referred to as 'temporary crating'.

Balancing act

Farrowing crates are designed to control sow movement but should be large enough that the sow is not at risk of abrasion and can stand comfortably. Mismatches between sow body size and crate dimensions can not only cause discomfort, but ultimately lesions and injuries.

The body dimensions of Irish sows were measured in 2005, and it was identified that their length, width, and weight had increased since the 1980s. Last year, Teagasc researchers replicated that study on four farms, including the Teagasc sow herd. Sows (all Large White × Landrace) from parity 1 to 5 were measured approximately 3 days before they were scheduled to farrow, which represents a time when they are at their largest.

They found changes in at least one dimension for all parities relative to those in 2005; sows of parity 1 and 2 were narrower, and parity 2 had less height. However, sows in parities 3, 4, and 5 were all longer than their 2005 counterparts, with parities 3 and 4 also deeper from the back to the base of the udder.

Thus, many crates in use today may not be sufficiently large to comfortably accommodate modern sows. Given that lower parity sows have reduced in size, it's possible that highly adjustable crates should be considered even for pens where the crate is open for most of the time, Alan adds.

Image capture from an automated piglet detection algorithm



"Getting the crate size right is a tough balancing act of restricting the sow enough to reduce crushing and giving her enough space to be able to comfortably farrow and nurse her litter."

A head start for farmers

It is also essential to assess the impact of farrowing pen design on piglets. The researchers are currently monitoring litters from both the new and conventional pens in Moorepark, looking at growth from birth to weaning, mortality, and strategies to improve welfare.

To date, researchers have found that piglets in the temporary-crating system have increased growth to weaning. However, mortality is higher, particularly due to crushing. To address this, researchers have identified two strategies: providing shredded paper at farrowing to support

thermoregulation and temporarily confining piglets in their nest box while the sow feeds to train them to rest in a safe space.

They are also investigating smart camera systems to identify at-risk piglets (slow growing, less responsive). They have now achieved automatic detecting and tracking of piglets from footage with reasonable accuracy.

Many Irish pig farmers are considering, or have already transitioned to, temporary crating. Insights from this work will give them a head start, so that each farmer does not have to work out the answers for themselves, concludes Alan.

"Establishing the features of a well-designed farrowing pen also supports manufacturers so that appropriate equipment is on the market when farmers need it. New technologies may also support that change, helping to ensure benefits for sows, piglets and farmers alike." **T**

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Hull of promise

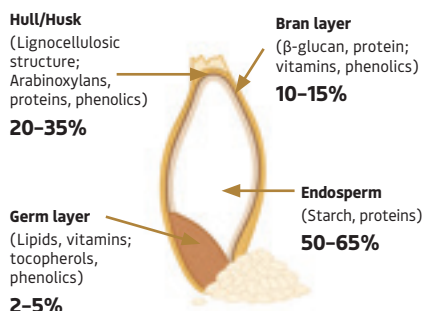
Oats are a staple of the Irish diet, but byproducts from their processing are often discarded or repurposed as livestock feed. Researchers at Teagasc Ashtown's Food Research Centre are examining better ways to make use of this waste, explains Teagasc Walsh Scholar Divya Aggarwal.

Oats have been a significant part of the Irish diet for generations, thanks to their nutritional profile and adaptation to Ireland's temperate climate. Regular consumption of cooked oats has historically provided an accessible source of complex carbohydrates and essential micronutrients, making them a reliable and nutritionally beneficial start to the day.

Beyond traditional use, a growing proportion of oat intake now occurs through plant-based oat beverages, produced by converting oat solids into a smooth milk-like liquid. The food industry is tapped into the ongoing popularity of oats, repurposing them as convenient, ready-to-eat snacks like flapjacks and protein bars, highlighting their growing versatility and strong consumer appeal across age groups.

As a result of oats being enthusiastically explored and assessed for product formulation purposes, substantial processing side streams are generated. These are often overlooked, discarded or diverted to livestock feed, notes Divya Aggarwal, a Teagasc Walsh Scholar based at the Food Research Centre at Teagasc Ashtown.

"For researchers at Teagasc, these streams represent a significant opportunity to develop a more sustainable system for processing oats, using scientific innovation and cutting-edge technologies."



Enhancing extraction

The first step in oat processing at any manufacturing site is dehulling. This removes the outer hulls or husks from the grain. Making up 20-35% of the grain's overall composition, they represent a major primary byproduct.

Research has already explored valorising oat hulls into biomaterials including cellulose, biosorbents and biofuel. The current emphasis, though, is increasing towards the extraction of proteins, dietary fibre, bioactives, phenolics, and flavouring compounds like vanillin from oat hulls.

At Teagasc, ultrasonic and microwave-assisted technologies have shown excellent findings in extracting arabinoxylans (a hemicellulose) from oat hulls, creating opportunities for their application as versatile ingredients in food formulations.

"Future research will involve investigating green enzymatic-assisted processes coupled with novel pretreatment techniques," says Divya. "The aim is to enhance the extraction yields of proteins and phenolics such as ferulic acid, a potent antioxidant with promising applications in functional foods and cosmetics."

A new chapter for oats

Researchers have so far had great success in valorising processing side streams into functional ingredients such as starch, protein, and dietary fibre (β -glucans).

"These successes have prompted the idea of developing a zero-waste biorefinery setup for oat production and processing, which will be a key focus moving forward," Divya notes.

Compared to other cereals, lipids constitute an important part of oats'

composition. Laboratory experiments at Teagasc demonstrated high recovery of oat oil (~4-5%) using green solvents with high antioxidant capacities and minimal cytotoxicity.

Subsequently, oat starch (~40-50%) and protein (~10-12%) were obtained using novel extraction technologies like ultrasound, resulting in enhanced purities of around 60-70%.

"Our upcoming work will focus on scaling up laboratory trials to higher Technology Readiness Levels," concludes Divya. "This is essential for optimising the processes and techniques we use, which will be critical for commercial adoption and contribution to the circular bioeconomy." **T**

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Creating a national milk compositional database

Building an updated database of Irish milk is an important step in understanding seasonal variability of milk composition and its effects on processing and manufacturing.



The composition of milk as supplied to the Irish dairy industry has changed dramatically over time and continues to do so. This is due to developments in genetics programmes and agricultural practices, alongside the occurrence of atypical weather patterns.

The last in-depth profiling of seasonal changes to milk's micro- and macro-nutrients was undertaken over a generation ago.

"Since then, milk's composition has changed dramatically," explains Diarmuid Sheehan, Principal Research Officer at the Food Research Centre, Teagasc Moorepark.

"Similarly, as national herds are predominantly spring calving, most of the milk pool undergoes complex and simultaneous seasonal changes in composition and chemistry. These seasonal changes cause associated challenges to milk processability and to the manufacture of dairy products of consistent composition and quality."

Under the Dairy Processing Technology Centre programme, researchers from Teagasc, University College Cork (UCC) and University College Dublin (UCD) collaborated to bring together data to build an updated database.

Extensive profiling

Between February 2021 and April 2024, over 51 weeks of each calendar year, bulk raw milk samples were sourced from silos at seven geographically dispersed industry sites. These samples were transported directly under cold chain to the Food Research Centre at Teagasc Moorepark.

The samples underwent first principles wet chemistry analyses and were extensively characterised to profile seasonal changes. The researchers profiled such changes in the following:

- 17 compositional and physicochemical indices
- 25 fatty acids
- 9 minerals in both milk and in the milk serum phase
- 11 nitrogen fractions
- 7 individual proteins.

The samples also underwent further profiling by Teagasc, UL and UCC researchers. Additional profiling focused on levels of the enzyme plasmin, peptide type and functional indicators of milk processability, including:

- Rennet coagulation properties (associated with cheese manufacture)
- Heat stability (associated with milk powder manufacture)
- Buffering capacity (associated with casein manufacture).

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Colleagues from UCD subjected this data to trend determination and predictive modelling, as well as generating spectral models. These spectra are suited to deployment within rapid analysis equipment located within commercial processing sites.

Assisting industry

"Ultimately, this work has delivered an in-depth, national database for milk composition," says Diarmuid. "A database of this kind can improve understanding of the current seasonal variability in Irish milk's composition, and hence its associated processability."

Generating a suite of predictive indicators and models will assist industry in implementing process efficiencies and optimisation. This will further serve as a platform for developing adaptive processes to mitigate seasonal challenges in the production of milk powder, butter and cheese. Industry partners are currently in negotiations to license access to this national milk database. **T**

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Trust transforms tomorrow

Achieving the methane reduction targets set out in several international commitments, such as the EU Effort Sharing Agreement and the COP26 Global Methane Pledge, will require nothing less than a transformation of existing agricultural systems.

Fortunately, the transformation needed in terms of component solutions has largely been established by research. However, the ultimate success of this transformation hinges less on the range of available component solutions than on their sequencing – i.e. the order in which they are implemented.

Thus, a successful transformation programme will need packages of interventions that embrace capability, trust and incentives, implemented in the correct order.

Transition determines global stakes

The transition of agriculture to a low-carbon system fails less from a lack of solutions than from getting the order of implementation wrong. Ireland has been learning this lesson on nitrogen. The Netherlands is still working through it, and New Zealand has learned it on emissions pricing.

The technologies to cut agricultural emissions exist. Protected urea reduces nitrous oxide and ammonia emissions compared with conventional fertiliser. Precision nitrogen application, cover cropping and managed grazing reduce emissions in livestock and arable systems. Alternate wetting and drying in rice cuts methane emissions by 24–38% while saving 15% of water. Short-duration varieties, direct seeded rice and laser land levelling add further gains.

The question is why deployment has been uneven, slow and, in some cases, politically contested.

In the right order

Practice change requires three things: measurement, demonstration on real farms and incentives/disincentives. The latter only work once evidence, trusted advice and on-farm experience are in place. The correct sequencing of actions does not mature quickly. Even when the phases overlap, they

Across the globe, countries already possess many of the technologies needed to cut farm emissions affecting climate change, but success depends less on available solutions than on getting the sequence right: measurement, on-farm demonstration and credible incentives delivered through trusted advisory systems.

Words by

Gerry Boyle, former Director, Teagasc, Ireland and
Satbir Singh Gosal, Vice Chancellor, Punjab Agricultural University (PAU), India



are measured in years, not in seasons, and in lower-readiness settings, often over a decade or more.

Ireland's experience with protected urea illustrates the principle of getting the phases of implementation in the correct sequence. Uptake was uneven for several years. Sustained advisory campaigns, on-farm demonstration through the Teagasc-led, stakeholder-driven Signpost farm programme, and trusted technical guidance helped to accelerate adoption. Where capability and trust matured alongside the policy signal, the instrument did its work.

When trust breaks, transition fails

The experience of The Netherlands illustrates what happens when the key adoption steps get out of kilter. Dutch nitrogen policy set reduction targets so severe that many farmers believed their operation could not survive them and the entire implementation process resulted in a collapse of trust rather than in a managed transition. The policy has been reopened, redesigned, and contested for several years running. A transition demanding sacrifices on this scale required trust and political acceptability that were not in place.

In New Zealand, government and the major farm organisations spent several years co-designing an agricultural emissions pricing scheme. The government departed from the partnership's final recommendations in the design phase and the trust built through consultation broke

down. The change of government in late 2023 led to agriculture being removed from the emissions trading scheme altogether. Ultimately, the political and farmer buy-in built during consultation did not survive through to implementation.

There is a common thread in the three examples. The order in which the trilogy of implementation elements (measurement, demonstration and incentives/disincentives) are introduced, and the trust and transition arrangements that accompany them, determine whether the outcome results in a durable change or a disruptive backlash. Trust lost in political confrontation lengthens the timeline further and is harder to rebuild than the capability that was missing in the first place.

Advisory systems build trust

Measurement requires both hardware and software (the people to use the equipment properly). Incentives/disincentives work best when farmers understand the information concerning the transition, meet the verification requirements, and believe the political commitment behind it will hold. If these requirements are not in place, there is the potential for resistance to set the process back years.

Advisory systems house the disciplines the transition requires. Where they have built deep farmer engagement over decades, they also carry the credibility that makes farmers willing to test, discuss and adapt difficult changes on their own farms. Ireland's ongoing protected urea transition has relied on this credibility.

India's rice – global stakes

Globally, India's rice sector is critical to determining whether the Global Methane Pledge target of 30% reduction by 2030 will be achieved. Rice generates 17% of India's agricultural greenhouse gas emissions, and solutions to reduce them are already available, including Punjab Agricultural University's short-duration varieties and Direct Seeded Rice (*tar wattar*). Key pillars are in place: strong agricultural universities, active extension systems and farmer communities with a history of adopting demanding technologies when they are properly supported.

In many other countries, the science to implement the transition is in place. The real question is whether countries will begin at the end of the curve or begin where durable transitions always begin: with the skills, the institutions and the trust that lets everything else work. **T**



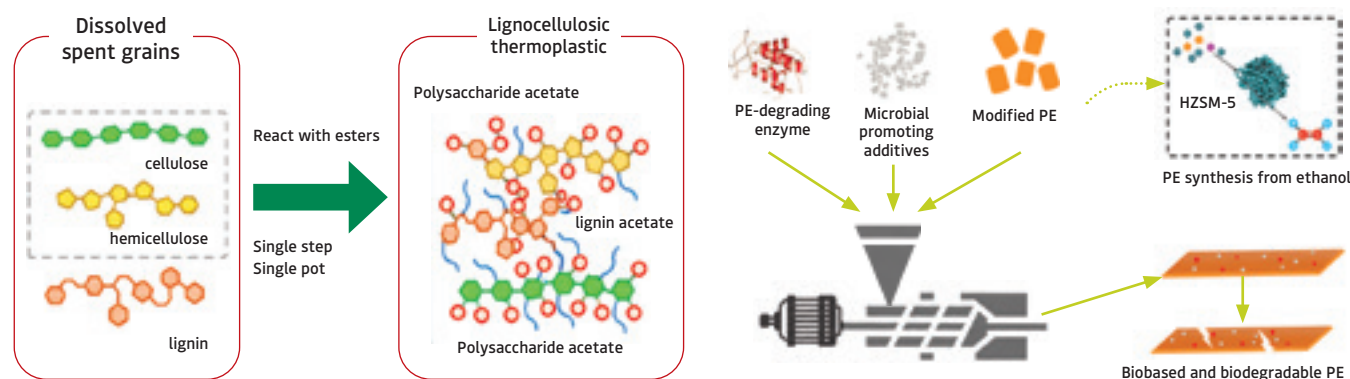
The transition of agriculture to a low-carbon system fails less from a lack of solutions than from getting the order of implementation wrong. **Q**



Satbir Singh Gosal and colleagues undertake a field inspection of short-duration rice trials at Punjab Agricultural University, Ludhiana

Nothing to (cellu)lose

Renewable packaging materials are becoming increasingly important for the food sector. Research from Teagasc Ashtown's Food Research Centre is making a strong case for cellulose and nanocellulose as next-generation options.



Bio2PEs project

Reducing dependence on fossil-based plastics has become a priority for the food and packaging sectors, driven by environmental concerns and EU policy targets. As industries seek renewable, high-performance alternatives, cellulose and nanocellulose have emerged as leading candidates.

Derived from plant biomass, these materials offer biodegradability, excellent mechanical properties and strong alignment with Europe's transition towards a circular bioeconomy. Their relevance is further underscored by EU-funded initiatives such as the Bio2PEs project, which aims to develop next-generation bio-based polyethylene and polyesters from biomass waste.

Advancing renewables

Cellulose is the Earth's most abundant biopolymer and can be sourced from forestry residues, agricultural byproducts and food processing waste, all widely available in Ireland. Processing it into nanoscale structures yields nanocellulose, materials with exceptional strength and barrier performance.

Nanocellulose combines excellent oxygen-barrier properties, high tensile strength and natural biodegradability, making it a viable replacement for petroleum-based plastics in food packaging. Nanocellulose films can rival commercial oxygen barrier polymers, while remaining compostable and free from microplastic formation.

Applications in packaging

Nanocellulose is being explored for films, coatings, laminates and reinforced biocomposites.

Its transparency, grease resistance and compatibility with biodegradable polymers such as polylactic acid, polyhydroxyalkanoates and starch enable the development of stronger, lighter and more sustainable packaging materials.

Dense, layered nanocellulose "nanopapers" offer tuneable mechanical and barrier properties. Antimicrobial additives and hydrophobic coatings could also support active and smart packaging.

Innovation framework

The Bio2PEs project provides a strategic framework for cellulose-based materials. Its objectives include:

1. Producing biodegradable polymers from biomass waste.
2. Developing eco-friendly packaging prototypes for food, textiles and agriculture.
3. Assessing full-lifecycle social, ethical and environmental impacts.
4. Testing biodegradability across soil, freshwater and marine environments.
5. Enhancing circularity through self-repairing coatings.
6. Improving recyclability using fluorescence markers.
7. Supporting consumer adoption through interactive labelling.
8. Using AI to optimise material performance and biodegradation.
9. Advancing the EU Circular Economy Action Plan.

Nanocellulose supports these goals through its renewable origin, compatibility with compostable systems and potential for circular, smart packaging.

Ireland's agricultural and forestry sectors generate significant cellulose-rich residues suitable for nanocellulose production.

Opportunity for Irish bioeconomy

Regional biorefineries could create new value chains, reduce waste and support rural development, while Teagasc's expertise can help drive European research efforts and industrial adoption.

Challenges include moisture sensitivity, energy-intensive production processes and standardised food-contact safety testing. Research is advancing on humidity-stable films, greener extraction methods and scalable production technologies. Cellulose and nanocellulose combine renewability, performance and environmental compatibility. As Europe moves towards a circular bioeconomy, initiatives like Bio2PEs highlight their strategic potential. Ireland's biomass resources and research expertise position it well to lead this transition. **T**

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Events: my take-home message

Teagasc's researchers attend many events throughout the year, sharing the findings from their research with national and international audiences. Here, we capture the take-home messages – key pieces of information that our researchers want people to remember – from recent events. In this issue we focus on sustainable agriculture and innovation in mushroom production.



Conference attendees from Teagasc Climate Centre, University College Dublin, Agrifood and Biosciences Institute, and Trinity College Dublin

Climate for collaboration

Event: Agriculture and Land Use in Ireland: Pathways to a Sustainable Future

Date: May 26 and 27

The Agriculture and Land-Use in Ireland conference was hosted by the Teagasc Climate Centre in collaboration with the Agri-Food and Biosciences Institute and universities across the island of Ireland. The conference brought together researchers from across the fields of agriculture and environmental research to share their latest findings.

Conference chair Karl Richards, Teagasc Climate Centre, explains how the conference came about.

"One of the objectives of the centre is to provide a focal point in Ireland for the co-ordination and dissemination of agricultural climate change research. We felt that Ireland was missing an all-island conference to bring researchers together to share their findings. The response was overwhelming, with over 250 abstracts received and 350 attendees."

A key message from the conference, held in Portlaoise, County Laois, was the interdependency across various fields of research: from greenhouse gas mitigation strategies to the study of behavioural change, and rural economics to the adaptation of our farming systems to future climate scenarios.

Muireann Egan, Operations Manager, Teagasc Climate Centre adds: "Across the plenary and parallel sessions, there was a clear need to consider a systems approach for resilient, sustainable agriculture and land-use across the island of Ireland."

The climate centre was well-represented on the agenda, including presentations from Ben Lahart, Gary Lanigan and Elodie Ruelle, who lead the Methane, Carbon and Adaptation pillars, respectively.

Michael Scully Photography

Automatic advances in mushroom management

Event: Teagasc Mushroom Innovation Day: Automation Advances and the Future for Irish Growers

Date: May 6

Teagasc's Horticulture Development Department invited mushroom growers, researchers and technology suppliers to explore how automation, sustainable practices and peat-free systems could shape the sector's future at this innovative event.

Michael Gaffney, Acting Head of Department, opened the event, commenting on the sector's economic background. "Input costs have risen 78% since 2020 and labour accounts for 45.6% of production costs, underscoring the need for automation to maintain competitiveness".

The programme began with presentations and a panel from leading international harvesting technology suppliers, showcasing advanced systems and demonstrating how automation can improve labour productivity and long term competitiveness for Irish growers.

Attendees toured Teagasc's Mushroom Research Facility to view demonstrations from the Department of Agriculture, Food and the Marine-funded 'Beyond Peat' project and trials of biocontrols and biostimulants for disease management, highlighting research aligned with industry priorities.

A talk by Lael Walsh examined how sustainability, innovation and business strategy can support brand building and value addition. An industry panel of leading growers discussed practical challenges (rising costs, labour shortages and market pressures) and outlined pathways for adaptation and growth.

"Despite pressures, Irish growers have a strong record of adaptation," emphasised Mushroom Advisor Donal Gernon. "That investment in automation and peat free systems will be key to protecting and expanding the sector's UK presence."



Shroom for improvement: growers, researchers and technology suppliers get together to explore the sector's future

Teagasc

Don't miss Teagasc's upcoming events! Join us at one of our Science Week events around the country (November 8 to 15). Visit our website for more information on this and all our upcoming events: www.teagasc.ie



From field to bread

Set in a flourishing pea field at Teagasc Ashtown, this image shows the full journey of peas: from grains, to flour, to bread. Rich in protein and fibre, peas offer a nutritious and sustainable path from farm to fork.

Photo & description: Mariana Macas and Barbara Biduski

Teagasc Project: HighPBreads

Funding Body: Teagasc Core Funding (1383)