TResearch
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FAT CHANCE
The annual rhythms affecting milk fat percentages

SIDE DISH
Repurposing potato processing waste

TILL WE MEET AGAIN
How Irish growers adopt innovation

INTERVIEW: The increasing prevalence of continuous-cover forestry p26.

A new leaf for ash

Meeting the team behind *AshforFuture*, Ireland's project to fight ash dieback disease and protect the future of ash in Irish forests

Welcome

Research into forest resilience, sustainability and best management practices is focused on optimising this valuable resource and future-proofing Ireland's forests against climate challenges. So explains Tom Houlihan, Acting Head of the Teagasc Forestry Development Department, in this issue's Look Ahead column (p29). As climate change is set to impact forests and their growing conditions in different ways, Irish forests must adapt. Niall Farrelly explains how research in areas such as species and provenance choices, genetic diversity, and adaptive forest management can contribute to enhanced resilience (p6).

Research at Johnstown Castle is examining how afforestation and forestry management can play a crucial role in nature-based strategies for land-use and climate mitigation; on p17, Junliang Zou describes his work in forest carbon and its dynamics.

We then meet Dheeraj Rathore and his team on p18 who are working on the AshforFuture project. Ash dieback is one of the most serious threats to Irish native trees. As over 90% of ash trees are expected to be lost, urgent action is needed to identify and protect the small proportion of trees showing strong natural tolerance. This four-year, all-island research project combines genetics, forest pathology, silviculture, and public engagement to help support long-term ash recovery.

We catch up with Ian Short, who talks us through recent advances in closer-to-nature forestry and explains why agroforestry means much more than just land use incentives for growers. You can read all about it on p26.

Finally, one of our close forestry collaborators, John Kavanagh, Nursery Manager at None So Hardy Nurseries Ltd., describes how a long-standing partnership with Teagasc is helping to positively shape the future of Irish woodlands (p30). We hope this issue inspires you with the innovation, dedication, and optimism driving the future of forestry.

Catriona Boyle
Editor, *TResearch* magazine, Teagasc

Díríonn taighde ar athléimneacht foraoise, inbhuanaitheacht agus dea-chleachtais bhainistíochta ar an acmhainn luachmhar seo a bharrfheabhsú agus foraoisí na hÉireann a choinneáil slán i bhfad na haimsire in aghaidh dúshláin aeráide. Míníonn Tom Houlihan, Ceannaire Gníomhach den Rannóg Forbartha Foraoiseachta Teagasc, é seo i gcolún Breathnú Chun Cinn an eagráin seo (lth 29). Mar gheall go rachaidh athrú aeráide i bhfeidhm ar fhoraoisí agus a gcoinníollacha fáis ar bhealaí éagsúla, ní mór d'fhoraoisí na hÉireann dul in oiriúint. Míníonn Niall Farrelly an dóigh ar féidir le taighde i réimsí amhail roghanna speiceas agus foinse, éagsúlacht ghéiniteach agus bainistíocht foraoise oiriúnaitheach cur le hathléimneacht níos fearr (lth6).

Pléann taighde ag Caisleán Bhaile Sheáin an tionchar a d'fhéadfadh a bheith ag foraoisiú agus bainistíocht foraoiseachta ar straitéisí dúlra-bhunaithe maidir le húsáid talún agus maolú aeráide; ar lth17, cuireann Junliang Zou síos ar a chuid oibre maidir le carbón foraoise agus a dhinimic.

Ansin, buailimid le Dheeraj Rathore agus a fhoireann ar lth18 atá ag obair ar an tionscadal Fuinseog don Todhchaí. Is é críonadh siar fuinseoige ar cheann de na bagairtí is tromchúisí do chrainn dhúchasacha Éireannacha. Táthar ag súil go gcaillfear breis agus 90% d'fhuinseoga, agus mar sin de, is gá beart a dhéanamh chun an sciar bheag crann a bhfuil fulaingt nádúrtha láidir acu a chosaint. Cuimsítear géineolaíocht, paiteolaíocht foraoise, foraoiseolaíocht agus rannpháirtíocht phoiblí sa tionscadal taighde uile-oileáin ceithre bliana seo chun tacú le téarnamh fuinseoige fadtéarmach.

Buailimid le Ian Short arís, a phléann na forbairtí is déanaí linn maidir le foraoiseacht atá níos gaire don dúlra agus a mhíníonn go bhfuil i bhfad níos mó i gceist le hagrafhoraoiseacht ná spreagthaí úsáide talún do tháirgeoirí. Is féidir leat tuilleadh a léamh ar lth26.

Faoi dheireadh, cuireann duine dár ndlúthchomhoibrithe foraoiseachta, John Kavanagh, atá ina bhainisteoir plandlainne ag None So Hardy Nurseries Ltd., síos ar an dóigh a gcabhraíonn comhpháirtíocht fhadtéarmach le Teagasc le dul i bhfeidhm go dearfach ar thodhchaí choillearnach na hÉireann (lth30). Tá súil agam go spreagfaidh an t-eagrán speisialta seo thú leis an nuálaíocht, tiomantas agus dearfacht a spreagann todhchaí na foraoiseachta.

Catriona Boyle
Eagarthóir, *iris TResearch*, Teagasc

TResearch is an official science publication of Teagasc. It aims to disseminate the results of the organisation's research to a broad audience. The opinions expressed in the magazine are, however, those of the authors and cannot be construed as reflecting Teagasc's views. The Editor reserves the right to edit all copy submitted to the publication.

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Main image shows Teagasc's AshforFuture team at Oak Park (L-R): Stephen Byrne, Abishek Singh, Ricardo Pimenta, Dheeraj Rathore.

Contents

Throughout TResearch, *we include icons alongside articles where there is a clear link to the urgent actions in our Climate Action Strategy. These actions are: Reduce Nitrogen Emissions, Reduce Methane Emissions, Increase Carbon Capture, Enhance Biodiversity, Increase Diversification, Enhance Adaptation, Circular Food System, and Supporting Policy. Teagasc's four research programmes, frequently referred to by their acronyms, are: Animal and Grassland Research & Innovation (AGRIP); Crops, Environment and Land-Use (CELUP); Food (FOOD); and Rural Economy and Development (REDP).*

Teagasc potato researchers' Kenyan collaboration

Teagasc researchers Dan Milbourne and Denis Griffin recently visited collaborators in the team of Moses Nyongesa at the Potato Research Centre of the Kenyan Agriculture and Livestock Research Organisation (KALRO) in Tigoni, on the outskirts of Nairobi. Teagasc and KALRO are partners in the FOSC ERA-NET project 'Climate Resilient and Responsible Innovations in Potato' (CRRIsP), where they are collaborating on a breeding programme at KALRO specifically targeted at developing high value processing potato varieties, combining local adaptation from Kenyan varieties with quality and disease resistance from European varieties.

With KALRO breeder Susan Otieno, they performed selections on the second field generation of the CRRIsP breeding programme material, identifying over 160 promising variety candidates. These variety candidates were showcased at a stakeholder event attended by industry and government the next day, where participants gave excellent feedback on them.

As part of a potential next phase, staff from Teagasc, KALRO, IPM Potato Group Kenya Ltd, and the International Potato Centre were hosted by the Embassy of Ireland in Kenya to discuss potential start-up funding for a longer-term joint breeding programme, building on the CRRIsP initiative. Denis and Dan also visited the seed production facilities of IPM Potato Group Kenya in Timau with its Managing Director Eric Appeldooren, and saw during a visit to a grower how Teagasc-bred IPM Potato Group varieties, such as Java, are taking off as a high value prospect for Kenyan retail outlets and the hospitality sector.

Dan (front centre), Denis (back centre), and staff of the KALRO Potato Research Centre in Tigoni with the variety candidates from the CRRIsP project

Teagasc

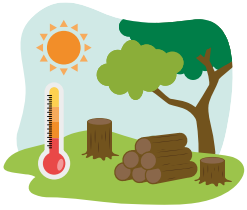
Enhancing Irish Forestry

The Teagasc Forestry Development Department has a diverse programme of research, covering many aspects of the life cycle of a forest, from seedling to sawdust. It covers a range of applied research themes, incorporating both conifer and broadleaf tree species.

Research capacity is significantly enhanced through a high level of synergistic collaboration with forestry research partners, both nationally and internationally.

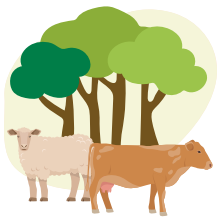
With significant climate-related and other challenges, Teagasc research places a strong focus on enhancing the resilience of Irish forestry, including in the following areas.

Tree improvement and breeding for enhanced resilience, including against pests and diseases



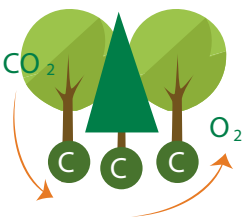
Adaptation, mitigation and protection strategies to increase forest resilience to climate change impacts

Best forest management approaches to promote productivity, sustainability and resilience



Research on new forest types such as agroforestry and continuous cover forestry

Assessing carbon dynamics and flows within varying forest types



Green light for VistaMilk Phase II

Phase II of the VistaMilk Research Ireland Centre was launched recently at Teagasc Moorepark, Fermoy, Co. Cork. This marks a significant step forward in the Centre's mission to enhance sustainability and innovation in Ireland's agri-food sector through pioneering research and technology.

Launching the second six-year phase of the Centre, Minister Heydon, TD, stated: "Ireland's agri-food sector, and particularly our world-renowned dairy industry, plays a vital role not just in rural communities, but also the national economy. It is critical that we continue to invest, through initiatives like VistaMilk, to ensure that we remain global leaders."

VistaMilk Phase II marks a significant boost to the local economy in North Cork, with the Centre set to recruit more than 130 personnel – most of whom will be based at Teagasc Moorepark. Phase II has set a similar target to Phase I: securing more than €20 million in competitive EU funding, critical for driving world-class research and innovation. Industry backing remains strong, with over 50 partners contributing €12 million during the initial phase and continuing their support into the second phase. This investment reflects a balanced mix of local enterprise and foreign direct investment from leading multinational companies.

Director of Teagasc, Frank O'Mara, welcomed the collaboration: "Research is the backbone of progress in agriculture. At Teagasc, we are proud to support VistaMilk's interdisciplinary approach to the dairy sector, addressing its challenges and influencing policy and best practice."

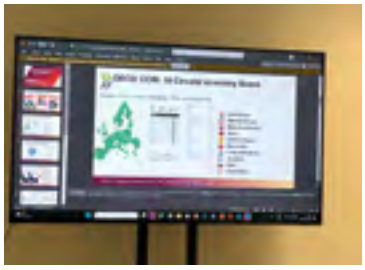
O'Gorman Photography

(L-R): Frank O'Mara, Director, Teagasc; Noel Grealish TD, Minister of State with special responsibility for research; Donagh Berry, Director, VistaMilk; Martin Heydon TD, Minister for Agriculture, Food and the Marine; and Siobhán Roche, Research Ireland

Circular economy in the western region

A new policy paper ,'The Circular Economy in the Western Region, Ireland', was launched at an event in Paris hosted by the European Commission's Circular Cities and Regions Initiative (CCRI) and the OECD. The paper outlines strategic recommendations to advance circular economy practices across Galway, Roscommon, and Mayo.

This launch follows a successful application securing the West's place as one of ten cities and regions selected across Europe to take part in this ambitious programme.



Teagasc

Teagasc was one of the consulted stakeholders to participate in the OECD fact-finding mission (joined by representatives from a number of government agencies, local development companies and organisations, including the Department of Agriculture, Food and the Marine, FORUM Connemara and ATU Sligo Innovation Centre), providing a great opportunity to contribute to the region-focused agenda and inform the report. Teagasc was represented by Mark Gibson, Brijesh Tiwari, and Anne Kinsella.

Anne says: "Collaboration across regions, communities and stakeholders can lead the way in better informing the conversation. Thanks to the Western Development Commission and Anne Graham for their initiative and in taking this key step forward with input from regional stakeholders, providing Teagasc the opportunity to engage in the process."

News in brief

Teagasc kicks off biodiversity farming project

New Decade TV

FarmBioNet, a newly launched project funded by Horizon Europe, aims to support farmers and foresters in providing habitats for biodiversity. A key element of the project is its 'Farming and Biodiversity National Networks', consisting of farmers, foresters, researchers, NGOs and policymakers. These networks will exchange knowledge on biodiversity-friendly farming practices and host workshops, farm walks and exchange visits. Ireland's kick-off meeting, led by Teagasc, attracted 46 attendees with a range of backgrounds. Project Coordinator Saorla Kavanagh (pictured) highlighted that ensuring a diverse representation of backgrounds is a priority. Meritxell Grau, Project Manager, highlighted the wealth of knowledge already available on biodiversity-friendly farming practices and the identification of knowledge gaps in the Irish context. Dairy farmer Rachel Creighton commented: "The potential of this project is exciting ... it gives farmers a voice in this change."

BSAS symposium boost for early-career scientists

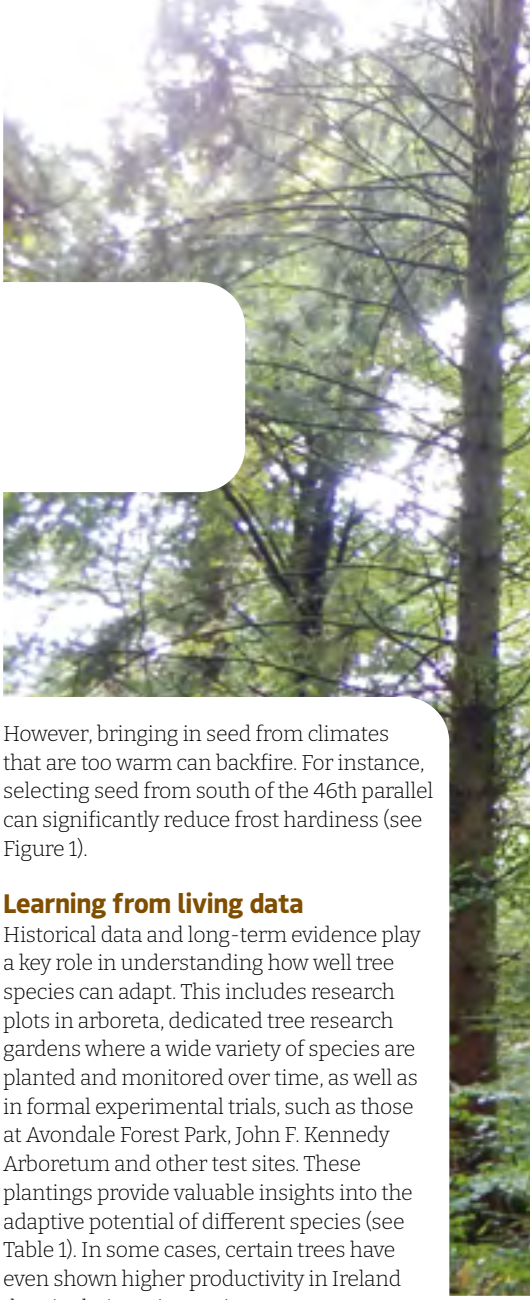
Minister Noel Grealish officially launched the British Society of Animal Science (BSAS) Early Career Symposium at the University of Galway in April. The symposium brought together emerging scientists, industry professionals, and academic experts to encourage collaboration, innovation, and growth among early-career animal scientists. Minister Grealish highlighted the symposium's role in fostering the next generation of talent. David Kenny, Head of Teagasc's Animal & Bioscience Department and current BSAS President, emphasised the importance of investing in young scientists. Peter McHugh, Interim President of University of Galway, said: "We're pleased to host this event with the British Society of Animal Science, supporting the next generation of talent and driving innovation in animal science."

BSAS

Enhance Adaptation

Leaf it to sci

As climate change reshapes growing conditions, Irish forests must adapt. New research explores how species choice, genetic diversity, and forest management can help build resilience from the roots up.



Climate change has the potential to pose specific challenges to Irish forests. Projected increases in seasonal temperature and rainfall will affect the growth and productivity of forests, resulting – in some cases – in reduced tree growth with the potential to affect species suitability.

Some tree species will be able to adapt and thrive, especially those already suited to warmer climates. Others may struggle and become less viable in the long term. One of the key steps in building climate resilience is assessing the performance of different planting materials and exploring new forest management practices that can help deal with the uncertainty climate change brings.

Adapting for the long haul

Because trees evolve over millennia, their ability to adapt in place over just a few decades is limited.

Niall Farrelly, Research Officer at Teagasc Athenry, explains: "Their short-term survival depends largely on phenotypic plasticity, their ability to adjust to environmental changes within a single lifetime. For example, the oak trees planted today may still be standing well into the 22nd century, by which time the Irish climate could be very different from what we know now."

In some cases, importing tree seed from warmer regions may be a viable adaptation strategy, but only with proper testing to assess performance. Certain species and provenances can thrive in Ireland if the climate of their origin matches ours.

Table 1: Examples of species where provenance experiments have been used to identify the best source material for planting.

Type	Species	Botanic name
Broadleaf	Peduncluate oak	*Quercus robur*
Broadleaf	Sessile oak	*Quercus petraea*
Broadleaf	Silver birch	*Betula pendula*
Broadleaf	beech	*Fagus sylvatica*
Conifer	Douglas fir	*Pseudotsuga menziesii*
Conifer	Lodgepole pine	*Pinus contorta*
Conifer	Norway spruce	*Picea abies*
Conifer	Scots pine	*Pinus sylvestris*
Conifer	Sitka spruce	*Picea sitchensis*
Conifer	Japanese red cedar	*Cryptomeria japonica*
Conifer	Monterey pine	*Pinus radiata*
Conifer	Western hemlock	*Tsuga heterophylla*
Conifer	Western red cedar	*Thuja plicata*
Conifer	Pacific silver fir	*Abies amabilis*
Conifer	Noble fir	*Abies procera*

However, bringing in seed from climates that are too warm can backfire. For instance, selecting seed from south of the 46th parallel can significantly reduce frost hardiness (see Figure 1).

Learning from living data

Historical data and long-term evidence play a key role in understanding how well tree species can adapt. This includes research plots in arboreta, dedicated tree research gardens where a wide variety of species are planted and monitored over time, as well as in formal experimental trials, such as those at Avondale Forest Park, John F. Kennedy Arboretum and other test sites. These plantings provide valuable insights into the adaptive potential of different species (see Table 1). In some cases, certain trees have even shown higher productivity in Ireland than in their native environments.

"Many native tree species are naturally well suited to Irish conditions," Niall explains. "However, some non-native species have also become naturalised, meaning they now grow successfully in the wild. One example is beech, which can produce high-quality timber, is visually appealing and is commonly used for ornamental planting, shelterbelts and hedging."

As Ireland's climate changes, we may need to look further afield for suitable species. Trees currently growing in warmer parts of Europe and the United States, such as walnut, hickory, red oak, and wingnut, could offer potential. Test plantings at sites like John F. Kennedy Arboretum give us valuable insights into how these species might perform under Irish conditions in the future.

More species, more strength

Trees with high genetic diversity are more likely to possess adaptive traits, such as tolerance to drought, pests, or diseases, that help them cope with changing conditions. Assessing this diversity can be a useful strategy for selecting species that are better equipped for the future.

Niall says: "Among Ireland's timber species,

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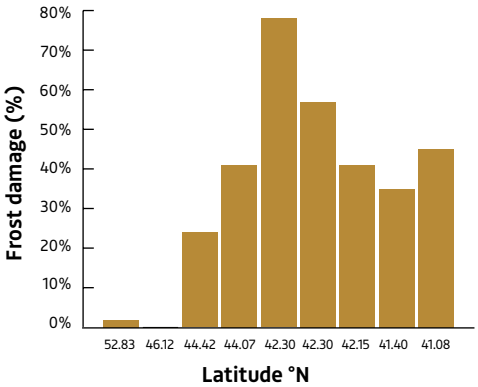
Continuous cover forestry systems are close to nature forests and allow newly regenerated seedlings to prosper under the cover of older trees to create the new forest of the future

Figure 1: A key component of adaption is frost tolerance related to latitude of seed origin (Latitude °N), choosing the varieties which are adapted to Irish climates is critical part of adaption.



increasing resilience is becoming more important than ever. That means selecting trees that can withstand new pests, changing rainfall patterns and drier soils."

Diversifying the range of tree species is one way to build this resilience. Species like Douglas fir, western red cedar, and coast redwood offer promising options to complement Sitka spruce, which currently dominates Irish forestry. These alternative species can help increase structural diversity and support continuous cover forestry systems, where forests are managed without large-scale clearfelling, a practice in which most or all trees in an area are uniformly cut down. Douglas fir, in particular, shows strong potential. It performs well on sheltered sites and is well suited to drier soils, making it a good choice for planting in the east of the country.

Designing forests for resilience

The term resilience is a measure of how a forest responds to perturbation and how quickly it can recover to its ideal state. Identifying vulnerabilities in Irish forests and increasing resilience will ensure the vitality and sustainability of our forest resource into the future. To offset the threats of biotic and abiotic threats, new diverse species options may need to be considered. This can help create resilient forests of the future.

Niall highlights: "Planting the 'best tree in the best place' is crucial to the creation and sustainability of the forests of the future."

The impact of diverse and adaptive forest management options is very important to avoid the large-scale impact of disturbance events on our forest resource. Devastating events such as windblow may require a redesign of our forests to minimise risks, these may include creating forests of uneven-aged structure, increasing wind firm edges, and limiting soils disturbance in reforestation. The use of natural regeneration using seed from the surrounding forests can afford the new generation of forests without the disturbing impact of a clearfell operation. T

FUNDING

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Getting into the rhythm of milk fat

The factors contributing to the annual reduction in milk fat percentage are likely to have consistent annual patterns, rather than variable patterns such as pasture nutritive value or weather conditions.

Valuable for butter, cheese and cream, the fat content of milk is also key to a farm's bottom line. Yet each spring and summer, Irish milk fat levels consistently decline. What's driving this seasonal dip? Researchers are exploring how diet, genetics and daylight interact in this complex annual rhythm.

Milk fat contributes substantially to the economic value of milk, because it can be processed into a variety of food ingredients, such as butter, cheese, cream and whole milk powder. It's also considered the most variable component of milk, with many nutritional and non-nutritional factors thought to influence its production.

In Ireland, there is a consistent reduction in milk fat percentage from spring (i.e. February/March) to summer (i.e. May/June), with a reduction of 0.44% observed nationally during 2023 (CSO, 2024; Figure 1).

In such spring-calving pasture-based production systems, the herd's stage of lactation and the occurrence of peak milk yield are believed to contribute to this reduction. However, previous research has shown that the greatest reduction in milk fat percentage typically occurs in May for both spring- and autumn-calving dairy cows, suggesting that the time of year may have a greater influence on milk fat than the stage of lactation. Therefore, this seasonal decline in milk fat percentage may be associated with dietary factors – for example, pasture fibre concentration – or environmental influences, such as day length, during this high-risk period.

Dietary factors

Low fibre and high fatty acids in pasture during the high-risk period have been suggested as factors contributing to reduced milk fat.

Senior Research Officer Michael Dineen explains: "Fibre digestion provides a key source of acetate and butyrate for milk fat synthesis, with fibre also stimulating rumen buffering through saliva production. High unsaturated fatty acids, such as C18:2 and C18:3, are biohydrogenated within the rumen and, if rumen conditions are unfavorable, milk fat-inhibiting bioactive isomers can be produced."

Two recent observational experiments conducted on commercial Irish dairy farms did not find evidence linking these factors to reduced milk fat percentage. In both experiments, pasture fibre and fat were maintained at satisfactory concentrations across the high-risk period. It's possible that milk fat percentage is reduced when this pasture nutritive value interacts with concentrate supplementation. However, the impact of concentrate supplementation on milk fat in pasture-based systems remains inconsistent, with substantial effects likely requiring high levels of concentrate supplementation – more than five kilogrammes per day – or significant changes in concentrate formulation, such as high starch content.

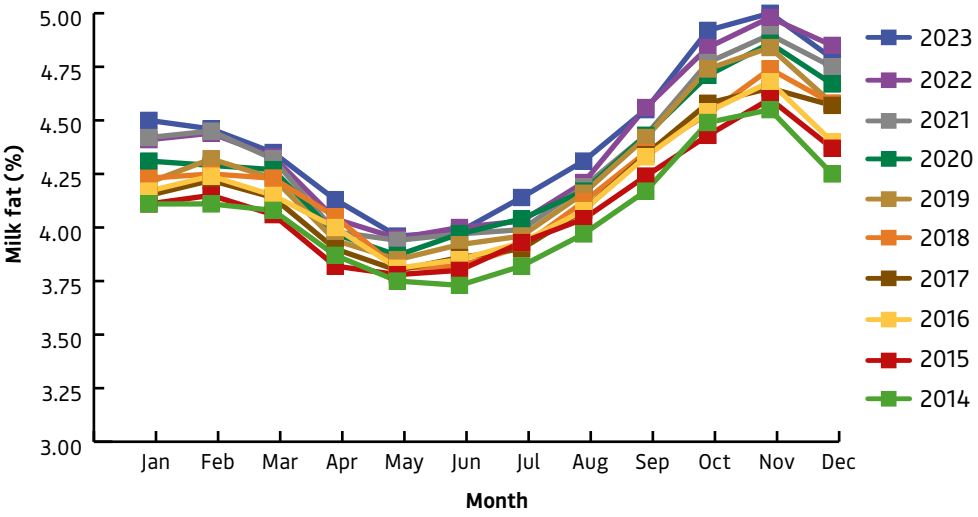
0.30%

A cow's biological cycle – circannual rhythms – could account for up to 0.30% of the fluctuation in milk fat percentage.

Teagasc

Teagasc Postdoctoral Researcher Christopher Heffernan gathers pasture samples for analysis

Figure 1. Fat percentage of milk supplied to Irish milk processors each month from 2014 to 2023 (CSO, 2024)



Environmental factors

Researchers from Penn State University have proposed that the variability in milk fat percentage across the year might be related to changes in photoperiod length and natural endogenous circannual rhythms – in other words, the cow's yearly internal biological cycles or processes.

These rhythms seem to operate independently of environmental factors, such as heat stress, or variations in forage quality. It's estimated that these annual rhythms could account for 0.15 to 0.30% of the fluctuation in milk fat percentage, with the magnitude of the effect possibly varying by latitude and hence change in photoperiod length.

"Interestingly," says Michael, "in dairy-producing countries in the southern hemisphere, a reciprocal circannual rhythm appears to occur. The exact mechanisms are unclear, but it's important that dairy farmers, nutritionists and researchers consider these annual rhythms when making management decisions."

Implications of animal genetics

Experiments have demonstrated the effect of animal genetics on the milk fat percentage of grazing dairy cows. Current estimates suggest that for every 0.1% increase in milk fat percentage predicted transmitting ability (PTA), there is an associated increase of 0.25-0.29% in milk fat.

Selecting animals for greater milk fat percentage PTA is a robust strategy to increase annual milk fat. However, it appears that the reduction in milk fat percentage during late spring to early summer might still occur in herds with high milk fat percentage PTA, albeit from a higher baseline.

The reduction in milk fat percentage from spring to summer represents a considerable financial loss for both milk producers and processors. There is limited evidence to suggest that pasture nutritive value is causing this reduction.

While a positive relationship between milk fat percentage PTA and milk fat highlights the important role of genetics, improvements in genetic merit does not seem to alleviate the reduction. A clear and consistent annual rhythm appears to be emerging, which dairy farmers, nutritionists and researchers should consider, as the factors driving this trend may be beyond the control of management. T

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As fresh produce consumption rises, so too do potential risks. New research in Irish horticulture explores where hidden contamination can occur, and how to stop it before it reaches your plate.

Hide and seek

Behind every piece of fresh produce is a complex supply chain – and potential risks that aren't always visible. As concern over foodborne illness grows, researchers are looking beyond the produce itself to what's happening in the environment where it's grown.

There are a number of reasons that may have contributed to the increase in disease outbreaks linked to consumption of fresh fruit and vegetables.

Firstly, an increasing emphasis on healthier diets, as well as dietary shifts toward the consumption of more plant-based products, have led to higher fruit and vegetable consumption. These are often consumed raw, or with minimal processing, which increases the risk of exposure to pathogens, if contamination has occurred.

Additionally, the scale and complexity of food production and distribution networks has expanded, facilitating the spread of contamination, if it occurs, across multiple regions.

Elena Anedda, Technologist in the Food Safety Department at Teagasc Ashtown says: "Improvements in detection and trace-back methods such as sequencing – which analyses the genetic makeu-p of pathogens – have greatly improved the ability to identify the source of foodborne disease outbreaks and also identify outbreaks that may have previously gone unnoticed."

How contamination happens

Listeria monocytogenes, Shiga-toxin producing *Escherichia coli* (STEC) and *Salmonella* spp. are foodborne pathogens that have all caused disease outbreaks linked to the consumption of horticultural products, with significant public health implications worldwide.

These pathogens are commonly found in environmental reservoirs like soil, manure, wastewater and wildlife, all of which can act as sources of crop contamination. Transmission can occur in various ways – through contaminated irrigation water, contact with soil, farm equipment, or during harvesting – making the entire production environment a potential risk.

"There is little information about their prevalence or the ecological niches in which they may reside in Irish horticultural production settings," Elena notes.

"Such information is critical to inform risk management strategies to minimise cross contamination and ensure product safety."

Working with Irish horticulture

As part of its objectives, the HortAssure project sought to map and identify potential contamination sources and at-risk areas for foodborne pathogens in commercial horticultural environments in Ireland. Production sites for three crops commonly grown in Ireland, each with differing risk profiles, namely carrot, strawberry and lettuce, were selected to evaluate microbial contamination risks.

Efired/shutterstock.com/

While fresh produce is increasingly a part of healthier diets, it's important to understand potential sources of contamination from unprocessed food sources

Environmental swab samples were taken from food-contact and non-food-contact surfaces, together with water and produce samples on a number of occasions. The pathogens of interest, *L. monocytogenes*, STEC, and *Salmonella* spp., were tested for using a combination of culture-based and molecular methods.

Hidden risks in the environment

None of the target pathogens were detected in the fresh produce samples tested and *Salmonella* was not detected in any sample type. *L. monocytogenes* was detected in 13 samples from different production facilities from a number of surface types, whilst Shiga-toxin genes were detected in eight water samples from different sites. Whole genome sequencing was performed on the pathogen isolates to further characterise the strains and assess their genetic relatedness. A variety of virulence genes were identified in these strains, underscoring their pathogenic potential for humans.

"This genomic analysis was able to provide a more in-depth understanding of how cross contamination may occur within specific facilities and processes, as well as identifying areas that may act as harbourage sites for foodborne pathogens," explains Elena. "Such environmental mapping of at-risk areas can inform the design of cleaning and sanitation schedules to best effect."

Additional analysis of the isolated strains demonstrated their ability to form biofilm, a protective layer that can provide enhanced resistance to cleaning and disinfection and contribute to persistence in production settings. These findings emphasise the critical need for stringent hygiene practices and environmental monitoring to mitigate the risk of product contamination.

> **Sequencing... greatly improves identification of outbreaks that may have previously gone unnoticed.**

A path to safer production

Different crop production systems present varying microbial food safety risks, underscoring the importance of comprehensive risk assessments to identify and mitigate potential hazards.

While *L. monocytogenes* was detected in a number of the environmental samples, it was not found on any produce samples, with its prevalence varying depending on the crop type. Whole genome sequencing provided valuable insights regarding the introduction and persistence of isolates in the production environment, thereby supporting the design of more targeted and effective cleaning and disinfection plans to minimise microbial risks.

The study also demonstrated that environmental monitoring programmes are vital components of effective risk management strategies, contributing to providing assurance of the safety of Irish horticultural produce. T

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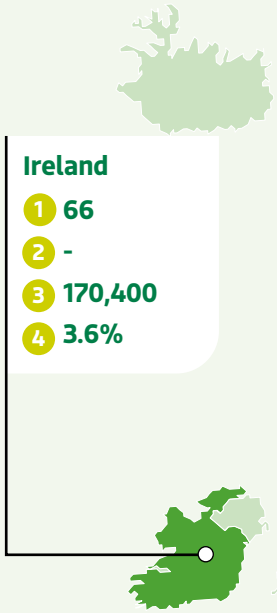
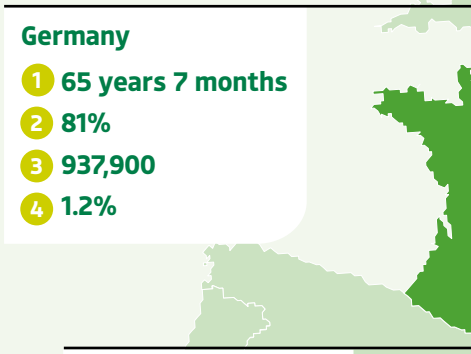
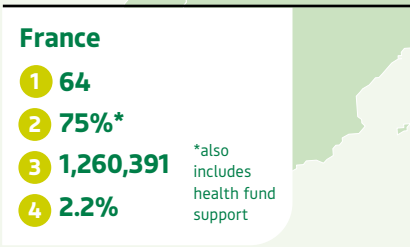
Securing farm futures

Low pension coverage and late retirement are stalling generational renewal. New research compares EU systems to explore solutions for supporting Irish farmers through the retirement transition.







The sustainability of agriculture in Europe is deeply intertwined with the financial wellbeing of its farmers, particularly concerning retirement provisions. As the farming population ages, ensuring adequate pension systems and the financial security of individual farmers becomes crucial in not only maintaining the vitality of rural communities, but in facilitating generational renewal and the broader dynamics of farm succession.

Research undertaken by Maynooth University and Teagasc examines the design of social security pension systems for farmers in five European countries, to identify gaps in Ireland's current system and suggest practical solutions. The research explored the current state of pension coverage among Irish farmers in comparison to EU counterparts, examining various national approaches to farm retirement schemes and drawing lessons to enhance pension provisions in the agricultural sector.

Pension provision for farmers

Anne Kinsella, Senior Research Economist in the Rural Economy and Development Programme at Teagasc, says: "Farmers face unique challenges regarding pension provision due to lower and variable incomes, the intergenerational nature of farm ownership and cultural attitudes towards retirement. In Ireland, a significant portion of farmers have limited pension coverage, with many not planning to retire formally."

This is worsened by the fact that some farmers may not qualify for the State Pension (Contributory or Non-Contributory), due to gaps in their Pay Related Social Insurance (PRSI) contributions. Such gaps can arise from late succession to farm ownership or low-income years where PRSI contributions were not made.

As a result, many farmers may need to continue working later in life or rely financially on family members. This can hinder farm succession and generational renewal. In 2023, approximately 45% of those working in the agriculture, forestry, and fishing sector had supplementary pension coverage, compared to 88% in the financial services sector (CSO 2024).

Private pension coverage

A key challenge facing the European agricultural sector is the low level of private pension coverage among farmers. A study funded by the Department of Agriculture, Food and the Marine revealed that only 50% of Irish farmers have private pension coverage. Disparities exist across farming systems: around 70% of dairy and tillage farmers have private pensions, compared to only 40% of sheep and cattle farmers.

Anne explains: "Barriers to uptake include affordability, procrastination, distrust in private providers, and reliance on savings or assets instead. Many farmers expect to rely on the state pension, family support, continued farming, or personal savings once they reach retirement age."

Lessons from Europe

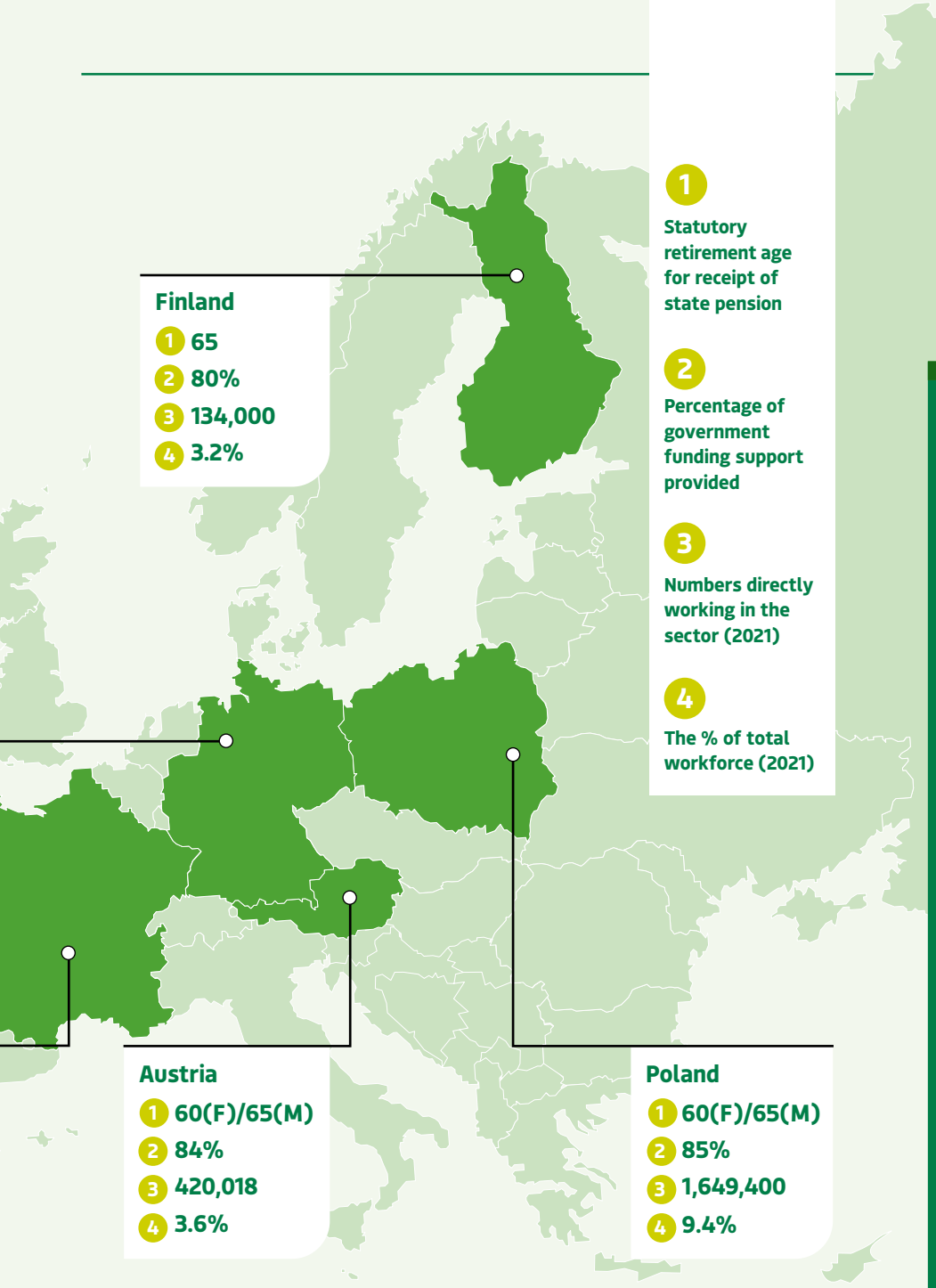
To assess Ireland's position relative to "best practice", researchers evaluated pension systems for farmers in five European countries: Austria, Finland, France, Germany, and Poland. These countries, all members of the European Network of Agricultural Social Protection Systems (ENASP), offer tailored social welfare schemes for farmers, serving as important benchmarks.

Michael Hayden, Assistant Professor of Accounting at Maynooth University, highlights that each country has its own approach to farmer-specific social insurance.

"In contrast, Ireland operates a single social security system with a general distinction between self-employed and employed workers. Farmers are classified as self-employed, but with some limitations in the definition for social insurance purposes."

ENASP countries recognise the unique needs of rural populations, including economic vulnerability, demographic challenges, and the central role of family farms. The research identifies which aspects of these systems could be adapted to help increase pension coverage and improve retirement adequacy for Irish farmers.

Using data from ENASP countries and international OECD comparisons, the analysis explored coverage levels, contribution models, and qualification criteria. The findings highlight how policy



reform could bring Ireland more in line with European norms.

A dedicated farm pension system?

EU countries take two broad approaches: either farmers are included in the general self-employed social insurance system, or they benefit from a dedicated preferential system. There are good reasons to adopt a separate model for farmers. Agriculture is a high-risk, low-profit sector, and higher pension contributions may not be viable without support, emphasies Bridget McNally, Associate Professor of Accounting at Maynooth University.

"Dedicated systems can also serve wider goals, like preventing rural depopulation, encouraging timely retirement and promoting regional equality."

In some cases, early retirement schemes are linked to succession incentives, which free up land for younger farmers.

Critics argue that mandatory pension insurance is unnecessary, given that farmers can continue working, lease or sell their land, or rely on family – but these assumptions don't reflect every farmer's situation. Not everyone can perform physical labour into old age, and relying on family support isn't always practical or fair.

Policy recommendations for Ireland

Drawing from the experiences of EU countries, several key lessons emerge for improving pension provisions, and facilitating generational renewal in agriculture:

- **Offer early retirement incentives: Finland's model shows how financial support can ease the path to retirement.**
- **Boost private pension uptake: Address affordability and trust barriers with financial planning support and education.**
- **Make PRSI contributions mandatory for farm workers: Ensure young farmers and family members build up entitlements from the start.**
- **Register spouses and partners for PRSI: Independent contribution records reduce reliance on means-tested supports.**
- **Provide transitional supports: Help current farmers without adequate coverage close the gap.**
- **Review the means test requirements for Non-Contributory old age State Pensions: farmers should be able to retain a small amount of land (<30 acres) without affecting entitlements.**

By adapting these strategies to Ireland's context, policymakers can help secure the financial future of family farms, support rural vitality and promote meaningful generational renewal.

FUNDING

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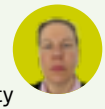


Milking the data

Leveraging data from technologies offers farmers a unique opportunity to enhance the productivity, sustainability and welfare of Irish pasture-based systems.

Cows that show signs of heat before the breeding season are significantly more likely to become pregnant, a finding that's helping farmers in seasonal-calving systems boost fertility and maintain a tight, profitable calving pattern.

In recent years, the industry has adopted new technologies to enhance the efficiency and management of pasture-based dairy production systems. Sensors – such as collars, ear tags, or boluses – that measure activity and rumination to detect oestrus (heat) and health events are becoming increasingly common on farms. These automated systems offer an alternative to traditional, labour-intensive methods of reproduction and health management.

In addition, genotyping and milk recording have grown in popularity. Approximately 20% of dairy cows in Ireland are monitored using behaviour-monitoring technologies, 39% are part of genomic testing programmes, and 68% are included in milk recording. This reflects a significant shift towards data-driven herd management.

The vast amount of data generated by these technologies presents a major opportunity – but it is essential that farmers and the industry use this data effectively to support informed decision-making. Teagasc researchers Emily Sitko and Stephen Butler, in collaboration with MSD Animal Health, are focused on using data to improve how breeding is managed on seasonal, pasture-based farms.

Turning technology into strategy

"More and more farmers are turning to data to improve breeding performance and make dairy farming more efficient and sustainable," explains Emily. "Several studies in confinement systems have shown that individual cow data can be used to classify cows into subgroups based on fertility potential."

Tailoring management practices to these subgroups has been shown to improve herd performance, profitability and overall outcomes compared with a one-size-fits-all approach.

For example, cows with higher fertility potential may benefit from artificial insemination (AI) at detected oestrus and are good candidates for sex-sorted semen. In contrast, cows with lower fertility potential may benefit from synchronisation and timed AI, and are better suited for receiving beef semen. However, this approach has not yet been evaluated in pasture-based systems.

To address this gap, Teagasc, in collaboration with MSD Animal Health, has launched a project to develop a precision reproductive management decision-support tool tailored to seasonal-calving, pasture-based farms. Since the first step in developing such a tool is identifying predictors of reproductive performance, the initial phase of the project has focused on exploring associations between cow-level factors and reproductive outcomes. Data were collected from over 8,500 lactations across 21 commercial herds in 2022 and 2023, including genomic information, calving and insemination records, milk production, and health and oestrus alerts from an automated activity monitoring system.

Glossary

Milk recording – Regular measurement of how much milk each cow produces, along with its composition and quality, to help improve herd management and breeding decisions.

Oestrus/"heat" – the time when a cow is fertile and ready to be bred.

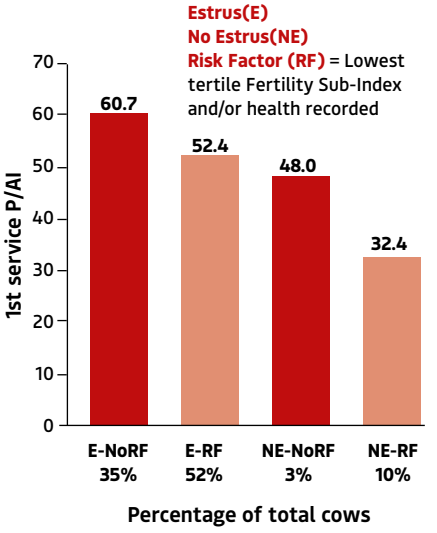
Genotyping/Genomic testing – Incorporating animal DNA information to predict traits like fertility, milk yield, and health.

Seasonal calving – a system where cows are bred to give birth during a specific time of year, often to match peak grass growth with peak herd demand for feed.

Sexed semen – semen that has been sorted to increase the chances of producing either a male or a female calf.

MSD Animal Health

Figure 1: First service P/AI for cows categorised based on multiple sources of information (i.e. oestrus alert before mating start date, Fertility Sub-Index, health alert in early lactation).



Cow fertility predictors

Several key factors were strongly associated with reproductive performance. Cows with at least one oestrus alert before the start of the breeding season had higher pregnancy per AI (P/AI) and conceived sooner (51% and 23 days) compared with cows that had no oestrus alert (37% and 33 days).

As the Fertility Sub-Index increased, so did the likelihood of pregnancy to first AI. Cows in the highest tertile for Fertility Sub-Index (over €117) had the best results (54% P/AI and 26 days to pregnancy), compared with those in the middle (€89 to €117; 48% and 28 days) and lowest tertiles (under €89; 34% and 32 days).

Health status also played a role. Cows with two or more post-calving health alerts had lower P/AI rates and took longer to conceive (43% and 29 days) compared with cows that had no health alerts (48% and 27 days).

Lactation number mattered too. First-lactation cows had better outcomes (48% and 26 days) than cows in their fourth or later lactations (43% and 30 days), with second- and third-lactation cows falling in between.

Emily says: "It's clear that combining multiple predictors helped identify subgroups of cows with more pronounced differences in reproductive performance than when using a single factor alone."

For example, combining oestrus alert data with Fertility Sub-Index and health alerts created subgroups with significantly different first-service pregnancy rates. These findings highlight the potential of using precision technology data to support more targeted, effective reproductive management.

The future of breeding

With a clearer understanding of the cow-level factors most useful for creating fertility-based subgroups, the next phase of the project will focus on designing management strategies to optimise the performance of each group – and ultimately, the whole herd.

Specifically, researchers will explore how to best allocate sexed and beef semen based on fertility potential, identify cows that could benefit from hormonal treatments and maximise reproductive performance through more precise AI timing.

"These strategies aim to support a compact calving pattern and produce a high-merit calf crop – all of which contribute to greater sustainability," adds Emily.

The final phase of the project will include on-farm trials to assess how the decision support tool affects reproductive performance and profitability, compared with traditional breeding approaches. These findings emphasise the value of integrating precision technology data into reproductive management. Key predictors identified include oestrus expression before the mating start date, Fertility Sub-Index, health alerts, and parity. Ongoing research will evaluate the impact of the decision support tool on the performance and profitability of Irish pasture-based dairy farms. T

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Increase Carbon Capture

Put your best root forward

Research at Johnstown Castle is examining how forestry management can play a crucial role in nature-based strategies for land-use and climate mitigation.

Appropriate afforestation and sustainable forest management can have positive effects on carbon sequestration, greenhouse gas (GHG) emissions and broader environmental topics such as water quality and biodiversity.

Junliang Zou is a forest carbon Research Officer, in the Forestry Department and Teagasc Climate Centre, based at Johnstown Castle. His research focuses on ecosystem carbon cycling, soil GHG inventories and the impact of climate change on the mechanisms governing carbon sequestration in forest ecosystems.

This research plays an important role in shaping Ireland's climate-smart forestry policies and ensuring that afforestation strategies align with both national and international climate targets.

Management cycles

As a Research Officer for Teagasc, one of Junliang's main focus areas is how forest management practices can influence carbon and nitrogen cycles, using a mixed approach integrating field measurements, ecosystem modelling and data synthesis. "These projects aim to contribute directly to refining national GHG inventories, to develop sustainable land-use strategies, and to help ensure that we can provide robust scientific evidence to inform forest policies," he explains.

Junliang is currently involved in several key projects, focussing variously on carbon sequestration, the wider implications of peatland forestry on climate, biodiversity and water quality, and on enhancing forest genetic diversity.

Long-term monitoring

The first of these is ForCaSt, a research project quantifying the effects of forest thinning on carbon sequestration, soil health and biodiversity, for which Junliang is research coordinator. This project integrates field inventory measurements to compare carbon stocks in thinned and unthinned forests. It analyses soil respiration and litter decomposition to track carbon flux post-thinning and uses ecosystem modelling to project long-term carbon sequestration outcomes. "By incorporating long-term monitoring data, ForCaSt aims to identify optimal thinning regimes that maximise carbon storage while maintaining ecosystem functionality," Junliang notes.

"The findings will inform sustainable thinning strategies that balance timber production and climate mitigation."

Accounting for change

The PeatFor project focuses on carbon and nitrogen fluxes in forested peatlands. This project, led by the University of Limerick, examines how peat type, drainage level and tree species influence carbon and nitrogen dynamics. It seeks to refine predictive models for carbon stock changes to enhance National Inventory Reporting, and evaluates the sustainability of strategies for drainage, rewetting and afforestation.

PeatFor combines field measurements, remote sensing and modelling to assess forest-climate interactions, providing insights to inform future land-use policies.

"Given Ireland's significant cover on peat soils, this project has crucial implications for national carbon accounting and the development of climate adaption strategies for forests on organic soils," notes Junliang.

Of further value for this research area is Adap4Tree, a project focused on enhancing the genetic diversity of forests for climate adaption. As a project partner, Junliang's role here is in monitoring tree growth and assessing climate resilience through progeny trials for birch and alder, as well as conducting multisite trials to identify stress-resilient genotypes, and evaluating genetic conservation strategies for beech, to support future breeding programmes. These efforts strengthen Ireland's tree improvement initiatives amid increasing climate challenges.

Junliang is also involved in STRATUM, a national soil strategy and monitoring programme for Ireland, where he focuses on forest soils. This project conducts reviews and stakeholder consultations to develop a framework for a national soil strategy, and to implement a monitoring network for agricultural and forest soils. STRATUM will deliver a final report and policy brief to the Department of Agriculture, Food and the Marine to help guide future research, address knowledge gaps and inform sustainable soil management options.

Looking forward

Collaboration with international research institutions and government agencies, as well as educating the next generation of researchers and promoting public awareness through knowledge transfer, is key for ensuring that this research advances both scientific understanding and practical applications of forestry management.

A key focus for future research is improving the accuracy of carbon flux estimates from different forest ecosystems. With growing interest in nature-based solutions for climate change mitigation, there's ample scope for exploring how forestry can be optimised to provide multiple ecosystem services – such as carbon storage, biodiversity conservations and water regulation.

"The ongoing research aims to refine carbon sequestration models across various forest types and management practices," Junliang concludes. "By integrating long-term monitoring data with advanced modelling approaches, this work will continue to support evidence-based policies for climate mitigation and sustainable forestry." T

Junliang Zou: career highlights

PhD, University College Dublin: effects of climate change on soil GHG emissions.
Postdoctoral researcher, Tsinghua University: nitrogen constraints in ecosystem carbon sequestration.
Researcher, Beijing Academy of Agriculture and Forestry Sciences: ecosystem carbon quantification and GHG flux dynamics.
Researcher, 'Grain for Green' programme: a major ecological restoration intiative in China.
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Teagasc

Branching out for ash

Ash dieback is one of the most serious threats to Irish native trees. As over 90% of ash trees are expected to be lost, urgent action is needed to identify and protect the small number of trees showing natural tolerance. *AshforFuture* is a four-year, all-island research project that combines genetics, forest pathology, silviculture, and public engagement to support long-term ash recovery.

Photography: Finbarr O'Rourke

Here, we meet the team behind *AshforFuture*: Dheeraj Rathore, Tree Improvement Research Officer and the project's coordinator; Stephen Byrne, Research Officer in Genomics; Ricardo Pimenta, Postdoctoral Researcher in Genomics; and Abhishek Singh, Teagasc Walsh Scholar in Pathology. Together with a skilled technical team across Teagasc forestry, they are working to understand ash dieback disease, identify resilient trees, and guide the future of ash in Ireland's forests.

How did the *AshforFuture* team come together?

Dheeraj: Teagasc has worked on ash improvement since the early 2000s, originally focusing on tree form and wood quality – traits linked to productivity. However, when ash dieback was identified in Ireland in 2012, our focus shifted to protecting and restoring this important native tree species. *AshforFuture* launched in 2024 and builds on that foundation, bringing together a multidisciplinary team of researchers and partners from across the island of Ireland to develop long-term solutions to conserve ash.

A unique part of our approach is the citizen science campaign, which is helping us find healthy ash trees that are surviving even in areas where most nearby trees are severely affected by the disease. These survivor trees are central to our efforts to conserve ash for the future.

Ricardo: This is a truly all-island project. Through *AshforFuture*, Teagasc is working

The *AshForFuture* team in the micro-clima hub at Oak Park (L-R): Stephen Byrne, Dheeraj Rathore, Ricardo Pimenta, Abhishek Singh

> **One challenge is that tree research works on much longer timescales than most funding cycles allow. Building lasting impact will depend on continued support and strong collaboration across sectors.**

with the Agri-Food and Biosciences Institute in Northern Ireland. The project is jointly funded by the Department of Agriculture, Food and the Marine in the Republic of Ireland and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland. We're also working closely with University College Dublin, None So Hardy Nurseries, Coillte, local authorities, and a range of NGOs.

What are the core goals of the *AshforFuture* project?

Dheeraj: A major focus is developing a robust communication plan to engage with the public, forestry specialists, policymakers, and other stakeholders. The goal is to effectively disseminate crucial research and updates, while also involving the public in identifying trees that remain unaffected by ash dieback and might possess high levels of natural tolerance.

Stephen: A core priority is developing genetic tools to support durable ash dieback tolerance. This includes identifying and using molecular markers linked to disease resistance, allowing us to screen and propagate ash trees that can survive *Hymenoscyphus fraxineus* infection, the causal agent of ash dieback disease.

Abhishek: We are also studying the ash dieback pathogen itself, *Hymenoscyphus fraxineus*, to understand how it has established, spread, and evolved since its arrival in Ireland. By examining different strains of the pathogen, and how they interact with potentially tolerant ash trees, we aim to develop strategies to protect and future-proof ash trees against the disease.

Ricardo: A key priority is exploring how different forest management approaches can help ash trees thrive despite the dieback disease. By testing mixed species planting instead of monocultures, the project aims to enhance resilience and biodiversity. It's all part of a wider effort to protect Ireland's ash trees for the future.

How does your work contribute to those goals?

Dheeraj: Engaging the public is a crucial element of our strategy. Through the AshComm work-package, led by Brian Clifford, (Forest Sector Development-DAFM), we run a citizen science campaign aimed at identifying and reporting healthy ash trees nationwide. We also strive to bridge the gap between research and the general public and policymakers. This includes media engagement, workshops and events to ensure the dialogue extends beyond the research community.

Abhishek: We're studying different strains of *Hymenoscyphus fraxineus*, collected from across Ireland under AshPath work-package, led by Richard O'Hanlon (Plant ▶

The *AshForFuture* team at the Ash gene bank at Oak Park: Linking tree phenotype with genomics is an important step in combatting ash dieback disease

Science Division-DAFM). By comparing their aggressiveness and genetic variation, we gain a better understanding of how the disease spreads and evolves. This helps us predict and manage its impact more effectively.

Ricardo: Our silviculture work focuses on how forest management can support ash re-establishment. We're setting up field trials comparing monocultures with mixed species planting to see which strategies reduce disease impact. Through our experimental work and field trials, we aim to generate reliable, evidence-based results that can be published in peer-reviewed journals and shared at conferences.

What are the main techniques and tools your team uses?

Ricardo: To assess tolerance to ash dieback, we are using high-throughput sequencing to analyse whole genome data from our ash tree collection. This helps us to identify genetic markers linked to tolerance and study how different trees respond to ash dieback. The data are processed using Teagasc's high-performance computing infrastructure and will be used to link variation in the DNA among trees in the collection with differences in tolerance to ash dieback. Alongside this, we are establishing field trials under the AshSilva work package, led by Ian Short (Teagasc), to explore how forest management, including mixed species planting, can support resilience. We also contribute to AshComm by helping share updates through outreach activities and events.

Abhishek: In the pathology work, we collect *Hymenoscyphus fraxineus* samples from infected ash trees across Ireland and Europe. We use molecular sequencing to examine variation between isolates and carry out artificial stem inoculations in the lab under controlled environmental conditions to assess how aggressive each strain is. This combination of lab and field data helps us understand how the pathogen behaves under Irish conditions and how tolerant trees respond.

Why is this project important for Ireland's environment and forestry sector?

Dheeraj: *AshforFuture* is a practical step towards protecting one of Ireland's most valuable native tree species. Ash trees are deeply rooted in our landscape – culturally, economically and ecologically. They provide habitat for nearly 1,000 species, play a role in traditional farming systems and are the key source of timber for making hurleys. However, ash dieback has affected most trees; without action, the species is at risk.

This initiative allows us to take coordinated measures while healthy ash trees remain, collaborating with the public to find solutions. While we don't claim to solve everything in four years, we are laying the foundations for long-term recovery. This benefits biodiversity, supports rural livelihoods and informs future forestry policy.

Ricardo: Ash is a keystone species in Irish woodlands. Losing it would affect the entire ecosystem, from birds and pollinators to the fungi and insects that depend on it. By protecting tolerant trees and promoting resilience through forest management, we're helping conserve both biodiversity and native woodland structure.

What progress has your team seen so far?

Dheeraj: Our work builds on years of ash breeding research at Teagasc. This year, we established a new field trial at Kinsealy with over 1,500 ash trees. Through our citizen science campaign and personal contacts, over 200 Irish ash genotypes showing signs of tolerance were reported. We've now grafted more than 3,000 trees from this material to generate the next population for field testing. Public engagement is also increasing, with more people aware of the

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

Stephen: I am proud to be part of a team that strives to find solutions to difficult challenges, and I am optimistic that the *AshforFuture* project will help secure a future for ash in Ireland.

Ricardo: It's been rewarding to connect science with public action; sampling over 200 healthy ash trees this year with help from people across 23 counties was a real highlight.

Abhishek: I'm proud to contribute to understanding this destructive pathogen. Studying its behaviour across Ireland and building lab assays has been a challenging and valuable learning experience.

Dheeraj: Leading this project, I'm proud of building a collaborative, all-island team that's working across science, policy and society. Seeing public engagement grow around ash conservation has been one of the biggest rewards.

disease and actively contributing to the search for survivor trees.

Ricardo: We've started analysing whole genome sequence data from a selection of tolerant ash trees identified in earlier research. This is helping us uncover potential genetic markers linked to disease tolerance, which will guide our future breeding efforts. The design phase of our field trials is also underway, with trials focused on comparing monocultures and mixed-species plantings to test durable resilience under field condition.

Abhishek: On the phytopathology side, we've collected over 40 *Hymenoscyphus fraxineus* isolates from infected ash trees across Ireland. We are preparing them for controlled inoculation experiments. These trials will help us assess their aggressiveness under standardised lab conditions. We're also sequencing the isolates to understand genetic variation and how different strains interact with potentially tolerant ash trees.

What role does your team play within Teagasc?

Dheeraj: *AshforFuture* strengthens Teagasc's role in native tree improvement and conservation by combining applied research with practical tools for forestry. It connects long-running breeding work with new capacities in genomics, pathology and silviculture – creating a stronger base for future research programmes. The project also deepens collaboration across the island and builds public trust through citizen involvement. It's not just about responding to a disease, it's about helping shape how Teagasc supports resilient, biodiverse forestry into the future.

What changes or challenges do you see ahead?

Stephen: One major shift is the growing potential of genomic selection. As sequencing becomes more affordable and accessible, we can more efficiently identify trees with tolerance to ash dieback. But resistance is complex, and we'll need to keep refining our tools and approaches as new pathogen strains emerge.

Dheeraj: The big challenge is translating our research into action on the ground. We've identified promising genotypes and set up new field trials, but long-term success depends on collaboration with forest managers, policymakers and communities. As the disease continues to spread, adapting our methods and staying aligned with on-the-ground needs will be critical for long-term conservation.

Ricardo: We're beginning to integrate environmental data such as soil and micro-climate, along with seasonal changes into our genomic analyses. This will help us understand not just which trees are tolerant, but where and why they thrive. It's a more holistic approach to ash conservation.

Abhishek: We're watching for changes in the pathogen itself. *Hymenoscyphus fraxineus* could become more aggressive or adapt to new conditions. Tracking its genetic variation and understanding interactions with microbes inside the tree may offer new insights into resistance.

What does the future of your work look like?

Stephen: Advances in genomic selection are moving fast, and we're well placed to apply those tools. As sequencing becomes more accessible, we can increase the accuracy and speed of identifying tolerant ash trees. We'll need to stay flexible, though; ash dieback is a moving target, and our methods will have to evolve with it.

Dheeraj: The next few years will be about turning early progress into long-term solutions. We've identified promising trees and set up trials, but now comes the real test – monitoring their performance, refining our selection methods and supporting replanting on a wider scale. One challenge is that tree research works on much longer timescales than most funding cycles allow. Building lasting impact will depend on continued support and strong collaboration across sectors. T

Meet the tech team

The *AshforFuture* project is supported by a skilled technical team with expertise across genetics, propagation, field trials and nursery management.

Tomás Byrne
Tree Improvement Technologist, Forestry Development Department, Ashtown:
"I apply phenotypic and genetic data to help select and cross ash trees with improved traits, including dieback tolerance. I also manage our forestry laboratory and nursery facilities to support research across the programme."

Donna Gregan
Laboratory Assistant, Forestry Development Department, Ashtown:
"I assist with mass propagation of ash and other native species, harvesting seed from selected trees, and maintaining healthy nursery stock for ongoing research trials."

Derek Gibson
Forestry Research Technician, Forestry Development Department, Oak Park:
"I work on the vegetative propagation of tolerant ash through grafting and air layering. I also help establish and maintain field trials, monitoring tree health and growth performance."

Rory Newell
Forestry Research Technician and Horticulturist, Forestry Development Department, Athenry:
"I provide technical support across forestry projects, with a focus on propagation and plant care. I'm particularly interested in native tree conservation and support work on ash field trials."

Circular Food System

Reduce Methane Emissions

Chipping away at food waste

Potato processing side streams contain valuable nutrients like proteins and starch, which can be efficiently extracted using green technologies. Scaling up these processes enables a zero-waste biorefinery model, turning waste into economic and environmental benefits.

Each year, Ireland's thriving potato industry generates thousands of tonnes of waste – from misshapen tubers to nutrient-rich wastewater. But new research from Teagasc is turning this challenge into an opportunity. Using innovative, eco-friendly extraction techniques, scientists are recovering high-value proteins and starch from potato processing side streams. These ingredients don't just reduce waste: they offer functional benefits for the food industry, with potential health-promoting properties and economic value.

Reducing food waste is a major priority under the Sustainable Development Goals (SDGs) and the European Green Deal, which aim to cut food waste by 2030. The key to achieving this is shifting from a linear economy, where resources are used and discarded, to a circular economy, where waste is repurposed into valuable products.

From waste to high-value ingredients

Ireland has the highest per capita consumption of potatoes in Europe – around 80 to 90kg per person per year. With national production reaching approximately 300,000 tonnes annually, it's no surprise that potato processing side streams are a major source of food waste.

These side streams include whole potatoes discarded due to shape, size or colour imperfections, as well as leftover scraps from cutting and peeling. Additionally, wastewater used for washing and starch extraction represents another major challenge, with three to five cubic metres of water used per tonne of potatoes. This wastewater is

Andrew Downes

Both discarded whole potatoes and leftover scraps can be valuable sources of recovered proteins and starch

Lab-scale tests have achieved extraction yields of up to 60%; the next step may be to work at factory-scale, says Teagasc Researcher Giulia Romano

essentially a mix of water, starch, peels and pulp.

"The high chemical oxygen demand and biochemical oxygen demand of this wastewater make it a pollution risk if not managed correctly," explains Giulia Romano, Postdoctoral Researcher at Teagasc Food Research Centre. "But what if we could turn this problem into an opportunity?"

Potatoes and their wastewater contain around 2% valuable proteins with exceptional nutritional and functional properties. Unlike many other plant-based proteins, these are allergen-free and highly soluble, making them highly attractive for food applications. Some even exhibit bioactive properties, such as anti-inflammatory and anti-tumour effects. Additionally, starch recovery is another promising avenue. With an average starch content of 18% in whole potatoes and 9% in wastewater, reclaiming this valuable resource can significantly reduce food waste while generating economic benefits for processing companies.

"By efficiently extracting both proteins and starch, we achieve a dual benefit," Giulia states. "Less waste for the environment, more value for the industry."

Clean extraction and scaling up

At Teagasc, researchers are developing eco-friendly extraction techniques to maximise nutrient recovery from potato side streams. These include traditional methods like grinding and sedimentation for starch recovery, as well as advanced green technologies such as ultrasound-assisted extraction and enzymatic hydrolysis, which break down cell walls to release proteins. Additionally, isoelectric precipitation is used to recover proteins from the solutions, producing high-purity protein isolates.

"The right combination of these techniques allows us to optimise extraction yields," says Giulia. "For instance, enzymes can break down starch into sugars, which can then be used for fermentation to produce bioactive compounds, enzymes or even organic fertilisers."

A critical step in making these innovations viable for industry is scaling up from laboratory experiments to real-world applications. Initial tests involved extracting proteins and starch from just one litre of side streams using ultrasound probes. The results were impressive, with protein and starch recovery rates reaching 90% and 80%, respectively.

The next challenge will be moving to industrial-scale trials. "We've tested these processes with volumes of up to 300 litres using industrial equipment," Giulia explains. "Even at this scale, we've achieved extraction yields of up to 60%, proving that these methods can work in real factory settings."

The future: a zero-waste model

Transitioning to large-scale implementation is crucial for making food waste valorisation a reality. Laboratory research lays the groundwork for optimising processes, while industrial trials confirm their practicality and economic potential. But the goal is a zero-waste biorefinery approach.

"In the future, every part of these side streams should be repurposed, not just to benefit the companies themselves but also to protect our planet," Giulia emphasises. "This is the next big step for the food industry."

By rethinking food waste as a resource, Ireland's potato industry, and the food sector as a whole, can lead the way towards a more sustainable, circular economy. T

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Increase Carbon Capture

Enhance Adaptation

Think before you till

A new study reveals the conditions under which Irish tillage growers adopt innovations.

Most Irish tillage farmers won't adopt a new practice unless they see proof that it works – on local soil, under Irish conditions, and backed by growers they trust. That's one of the key takeaways from a recent study involving 154 Irish tillage farmers, covering over 29,000 hectares – around 9% of Ireland's total cropping area. The research set out to answer four practical questions:

1. What kind of evidence do growers need before changing their crop establishment system or adopting a new innovation?
2. Where do they prefer to get this information?
3. How do they want to access it?
4. Do these preferences vary depending on the system they currently use?

Jack Jameson, Postdoctoral Fellow at Teagasc's Crop Science Department, says: "The findings offer a roadmap for researchers, advisors and policymakers aiming to boost innovation uptake and promote more sustainable farming in Ireland's tillage sector."

What proof do farmers want?

It was found that many growers demand robust, locally validated evidence before considering the adoption of an innovation.

The study found that a significant number of farmers insist on seeing clear, region-specific results from local trials, along with evidence that the innovation they are considering is being widely adopted locally by their peers. For these growers, the assurance that a new innovation works reliably under Ireland's unique climatic and soil conditions is essential before they commit to change. These were the views held by the majority of plough-based (90%) but less-so with non-plough growers (39%).

In contrast, many more non-plough growers (61%) compared to plough-based

Oleg Marchak/istockphoto.com

Research highlights that peer-to-peer exchange is a highly valuable knowledge source for Irish growers, especially plough-based growers

growers (10%) displayed a higher tolerance for risk and are generally more willing to experiment with novel practices, even when local data is less abundant. This behaviour, typical of early adopters, may not be compatible with the scale and economic circumstances of many farm businesses.

Jack explains: "Adopting unproven innovations that require significant capital expenditure risks placing these businesses under excessive financial pressure, if the innovation is not optimised for Irish conditions."

Trusted voices matter

The research highlights that trusted, local information sources are highly valued among Irish growers, especially plough-based growers. Many growers expressed a strong preference for advice provided by well-established local advisory services, particularly those offered by Teagasc. In addition to formal advisory services, growers also place considerable trust in their peers, placing stock in learning from other growers that have first-hand experience with new innovations.

"This peer-to-peer exchange is especially valuable," highlights Jack. "It offers practical insights that are directly relevant to the challenges growers face locally."

However, the study also revealed a notable trend: many growers, particularly those using non-inversion systems (40%), often turn to non-Irish sources for information. While non-Irish sources can certainly offer some valuable insights, this reliance on data generated under conditions that differ markedly from Ireland's signals the presence of significant Irish knowledge gaps.

The danger for growers is that information relating to an innovation gained from non-Irish sources may not fully reflect the specific challenges posed in Irish growing conditions and the adoption of innovations in this case might carry excessive hidden risks. This reinforces the urgent need for more Irish research on crop establishment systems particularly.

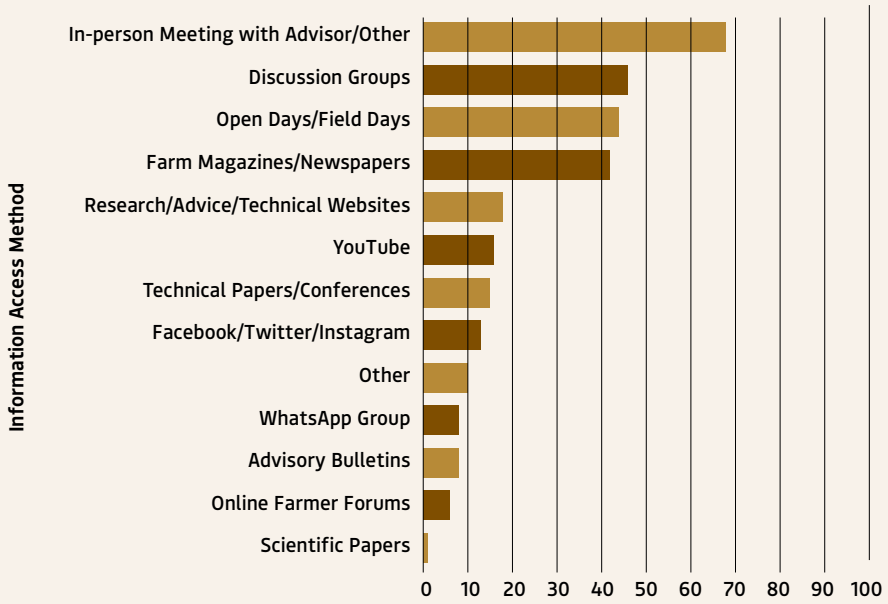
Face-to-face still leads

When it comes to accessing information, Irish growers overwhelmingly favour traditional, face-to-face methods (Figure 1). In-person meetings, field days, and discussion groups were consistently rated as the most trusted channels for knowledge exchange. These interactive formats allow farmers to observe demonstrations first-hand, ask detailed questions, and engage directly with researchers, advisors, and fellow growers who share their learnings and experiences. Print media also figures prominently, reflecting the strong technical content of some publications.

"It was surprising that there was not a higher preference for digital information access methods, which rated poorly, especially given that the survey was conducted well into the COVID-19 pandemic when digital channels were heavily used and relied upon for agricultural dissemination activities," says Jack.

These results suggest that while digital methods were widely used at this time, growers still prefer traditional, in-person information access methods.

Figure 1. Information access methods, used for major decisions (all growers), as determined by ranking in growers' top three choices.



Turning insight into impact

Bringing together three key insights provides a clear roadmap for improving the uptake of research and advisory efforts in Ireland's tillage sector:

1. The type of evidence farmers need before adopting new practices.
2. Where they prefer to get this information.
3. How they want to access it.

This study shows that most tillage farmers need clear, locally relevant proof before they make changes. Just as importantly, the information must come through trusted and accessible channels. By aligning research and extension efforts with these preferences, we can boost the impact of new knowledge and support the adoption of innovations that are both economically sound and environmentally sustainable. T

FUNDING

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Enhance Adaptation

Diversification

Seeing the forest for trees

Forestry Senior Research Officer Ian Short talks us through recent advances in closer-to-nature forestry, and why agroforestry means more than just land grants for growers.

Photography: Finbarr O'Rourke

Ian Short grew up in Norfolk and always enjoyed being outdoors. When he was finishing school, he would go hiking, thinking about what he wanted to do, and what jobs get you outdoors. While on an interview at Bangor University in Wales for a forestry degree, one of the lecturers tipped him off about the agroforestry degree. It sounded like the ideal fit and ultimately brought him to where he is today.

Towards the end of his bachelor's, Ian got a research assistant job at the Waterford Institute of Technology, where he also completed his master's by research. This was followed by a Teagasc Walsh Scholarship to do his PhD in Agroforestry with Queen's University, Belfast. At Teagasc, he initially interviewed for a important role in broadleaf silviculture but maintained his strong interest in agroforestry. The latter has turned out to be a topic of increased wider interest in the last five years.

What are the topics you work on? Why are they relevant?

Broadleaf silviculture is how you manage the growth of broadleaf trees – oak, beech, birch, etc., those that typically lose leaves in autumn. Silviculture is essentially the science and art of growing trees. I say "art" as there's a bit of instinct or gut feeling to it. Given the long timelines involved in mapping tree growth, results can take decades to become apparent.

Ian appreciates seeing agroforestry and Continuous Cover Forestry enjoy a "renaissance" as increasingly valid approaches in recent years

Tree growth is a slow process, requiring a patient approach to achieve results

If you look at forestry from 150 years ago... the knowledge is there, but we need to align it to our more contemporary scientific approach.

A simple definition of agroforestry is "growing trees on farms". More specifically, on farms with an interaction between agricultural enterprise and trees. So, your primary objective may not necessarily be timber production, but rather things like reducing lamb death, reducing water runoff, diversifying income. Agroforestry focuses on the grower's perspective: what can planting trees do for the rest of your farm?

I work on a few projects. They share similarities in how long-term their timescale is, which sometimes differs from more immediate work elsewhere in Teagasc. For instance, I have sites where I've been working on the same thing for 15 years. This is rare, and a bit of a challenge because of the usual five-year scope of research funding. Agroforestry has only picked up in the past few years, but the projects there are long-term. It's a topic that ultimately can intersect with every part of Teagasc; agroforestry systems can fit into almost any enterprise.

What projects/research are you working on within these topics?

One project is work in Continuous Cover Forestry (CCF). The predominant management for forests is clear-cut or clearfell systems: trees grow, they reach a particular height, you fell them all and restart. Clearfelling has a public perception issue and possible environmental concerns.

By contrast, CCF is a management technique in which there are always some standing trees on-site. It's a 'closer to nature' type of forestry; it tries to copy and use naturally occurring processes in forests, you end up with multispecies and multiculture forests, and the public tend to prefer the look and feel of CCF.

The normal management of forests involves planting, establishing growth, and then thinning – taking out inferior trees to give more space to the remaining trees to grow. We have two Sitka spruce stands – stands are almost like a paddock in forestry, an area of forest that's quite homogenous, uniform in species composition and managed as a single unit.

We use these stands to investigate different approaches to thinning. The standard practice is low thinning, we're comparing it against crown thinning and graduated density thinning.

Low thinning means removing lower-diameter trees; crown thinning means selectively removing trees that are competing in the canopy with selected superior trees; while graduated density thinning involves removing trees in a way that creates a more open and varied forest structure.

The long-term aim is to see how these approaches will facilitate the stands' graduation to CCF and how they can introduce more variability into stands. Low thinning aims for uniformity, whereas crown and graduated is clumpier and variable, which is what we ideally look for in CCF.

The sites have now had four thinning cycles. We'll continue monitoring the techniques and their effects – for example, the natural regeneration of seedlings, the economics of these management techniques, the volumes of timber coming out. It's a very long-term process. Perhaps I'll see the endgame by my retirement! So far, we're seeing that graduated and crown have some improved regeneration and similar volumes harvested but with early sawlog harvesting. ▶

Agroforestry focuses on the grower's perspective: what can planting trees do for the rest of your farm?

What are the benefits of this research?

There are so many benefits that can be accrued from agroforestry. There's a policy – and grant – in Ireland to get more trees in the ground, and farmers are the landowners best placed to do this. The narrative currently is around encouraging farmers to plant trees to sequester carbon, support pollinators and biodiversity and improve water quality.

These societal benefits are great, but I think a way to drive this is by also highlighting the benefits to the planter. Trees provide shade and reduce heat stress for livestock, they can reduce lamb mortality by sheltering paddocks, they improve biodiversity in farm systems for grazing ruminants – and animals will know which plants to go to if they're missing micronutrients in their diet, for example. And because trees intercept rainfall, improve soil infiltration and reduce erosion, this also improves water runoff levels to the farmyard.

What impacts does this work have?

Agroforestry can potentially be linked to all enterprises within Teagasc; it has potential positive impacts on carbon, soil, water, livestock, tillage, biodiversity, disease, pollination. As it's still a relatively little-examined field, however, it will take a while to clarify all the benefits and for whom.

In terms of knowledge transfer, I provide technical support to the Irish Agroforestry Forum, established in 2020 to be a gateway to agroforestry knowledge and to facilitate projects demonstrating agroforestry's value and applications. The forum combines research and support, and there are over 200 paid-up members now including farmers, landowners, foresters and other key stakeholders. I think having this knowledge transfer alongside research is beneficial in keeping your research grounded, relevant, and applicable to those real-world applications for stakeholders and industry.

What are the challenges?

For CCF, the benefits are a harder sell. While observations so far suggest that there may be environmental benefits to it and it may have better public perception, the industry may assume that it's less productive and more complex to manage compared to clearfelling. For researchers, then, it's about providing the right data and evidence to promote the benefits of CCF to industry.

For both CCF and agroforestry, funding research is a challenge. The longest funding windows tend to be five years, and funding bodies want results and outputs, which can be a challenge to produce in a field that operates on much longer timescales.

What does the future hold?

Looking at how CCF in Ireland will affect carbon sequestration compared to other management types. There are few mature CCF sites currently as the concept is relatively new. Interest in the approach is growing, however; DAFM has introduced support schemes for both forest establishment and management that follow CCF principles.

In a way, agroforestry and alternative silviculture are "rediscovered" topics, along with ideas like multi-species swards or organic farming, for example. If you look at forestry and agriculture books from 100, 150 years ago, these ideas are all in there. It's just that farmers and landowners have been incentivised in a different direction for the past century. The knowledge is there, but we need to find the confidence to apply it and to align it with our more robust, contemporary scientific approach. T

Up close and personal

What's your favourite animal?
Wolves; they're team players, they work together well and can have a positive impact on their ecosystem. For birds, I like the Longtail Tit for similar reasons; they roost together to protect their flock.

If you hadn't ended up in research, what other job would you have wanted to try?
As a kid I fancied being a long-distance lorry driver, but most likely I'd be a nature reserve warden otherwise.

What are you most proud of professionally?
Helping agroforestry develop as a field of research, mentoring students and working alongside such a good team in our department – especially the farm staff and technicians who make our research possible.

Strengthening forests for climate challenges

Tom Houlihan, Acting Head of the Teagasc Forestry Development Department, outlines how research in forest resilience, carbon, and management practices is helping future-proof Ireland's forests against climate challenges.

Building more resilient forests is central to Teagasc's work in forestry. Through targeted research, advisory services and training, the Forestry Development Department is supporting climate adaptation, sustainable management, and long-term forest health across Ireland.

The focus of our research is tree breeding, tree improvement, and sustainable forest management, to support a stronger and more sustainable forest sector. We are working to build resilience against both biotic stresses (such as tree diseases) and abiotic stresses (like climate change). More recently, we have expanded our research into carbon sequestration, the process by which trees absorb and store carbon dioxide from the atmosphere. This is to better measure the impact of afforestation (planting new forests on land that was not previously forested), and to model how forest management affects greenhouse gas (GHG) emissions. We also study the social and economic factors that influence how and why landowners choose forestry as a land-use option.

Our research takes place at Teagasc centres in Ashtown, Athenry and Oak Park, as well as through long-term trials across the country. This in-house research supports our advisory and training work and helps us share knowledge nationwide. Alongside our core staff, postdoctoral researchers and Teagasc Walsh Scholars play a vital role in delivering our research programmes.

Securing future forests

Looking to the future, there are challenges to address and opportunities to grasp in building a resilient future forestry sector. These include the significant role forestry plays in the environmental, economic, and social needs of forest owners, rural communities, and society. There is also a requirement to provide evidence to support and inform many of the policy decisions and practices that are arising at national and EU level.

There is a continued need to strengthen research capacity and focus efforts on supporting the sustainable growth and resilience of Ireland's forest resources. There is an increasing need to mitigate the negative effects of climate change, which may be served by adapting species and sustainable forest management practices to increase resilience.

Weathering the storm

The recent severe storms have demonstrated the potential impact of extreme climatic events. Key research areas therefore include breeding resilient and climate-adapted conifer and broadleaf planting stock to enhance future forest resilience. There is a need to build further knowledge on appropriate forest establishment and management options including, for example, agroforestry, which combines trees with crops or livestock, and Continuous Cover Forestry, which avoids clearfelling by maintaining a permanent forest canopy. Appropriate future research will help protect our forests and reduce threats from pests and diseases. There is also potential to study the impacts of forestry and its contribution to environmental goods and services, and the role of adaptive forest management in relation to various soil types.

Clear communication unites stakeholders

Continued two-way engagement and information flows across a wide range of stakeholders will be essential to inform future research approaches, while facilitating advancements in generating science-based innovation and knowledge. In carrying out research, we place a very high value on the many existing collaborations with forestry stakeholders, research organisations, and co-workers, both nationally and internationally. These partnerships help develop synergies and give us access to greater research capacity. They also assist us in meeting our objective of supporting the development of forests and forest management approaches that maximise the potential of the sector from an economic, environmental, and social perspective. T

Sylvia Becerra Gonzalez/istockphoto.com

Andrew Downes

Restoring ash, diversifying native species and strengthening forestry resilience – a long-standing partnership between Teagasc and None So Hardy Nurseries is helping shape the future of Irish woodlands.

Words by:
John Kavanagh, Nursery Manager, None So Hardy Nurseries, Ltd.

For over three decades, None So Hardy Nurseries Ltd, based in Shillelagh, Co. Wicklow, has been dedicated to producing high-quality planting stock. As Ireland's primary supplier of forestry planting stock, our commitment extends beyond supplying trees. We actively collaborate with research partners to address emerging challenges and contribute to the advancement of the Irish forestry sector.

Long-term commitment

Our long-standing partnership with Teagasc is central to national efforts to combat ash dieback (causal agent *Hymenoscyphus fraxineus*), a significant threat to native ash populations. Each year, we assist in the clonal propagation (the process of producing genetically identical plants from a parent tree) of potentially tolerant ash genotypes by providing technical expertise in seed germination and producing robust rootstocks for grafting (joining plant parts to grow as one tree). These rootstocks are cultivated from seeds collected from potentially tolerant trees and nurtured over two to three years under nursery conditions before being used for grafting by Teagasc researchers. As part of the *AshforFuture* project, we've expanded this collaboration to include field trials.

In 2024, we established three trial plots of one-year-old selected ash genotypes at our Donishal site, and an additional trial in Oak Park under existing ash stands. These trials aim to evaluate the long-term durable tolerance of these genotypes in natural environments, informing future seed production strategies and contributing to the restoration of this culturally and ecologically significant species.

A model for commercial impact

This type of research-to-field partnership has already shown results with another native species: downy birch (*Betula pubescens*).

In collaboration with Teagasc, we helped move improved birch material, selected for timber quality and form, towards commercial deployment. This work has led to the material being added to the recommended species list for afforestation grants, with licensed supply now underway. It provides a clear model for how ash could follow a similar commercialisation pathway.

In parallel, None So Hardy has worked with Teagasc to establish an improved sycamore seed orchard, a specially managed area where trees are grown to produce improved seed for planting. As the establishment and management of an ash seed orchard will be very similar to the sycamore seed orchard, None So Hardy's experience will be invaluable.

As tolerant ash genotypes are further validated through the *AshforFuture* project, we aim to support the development of an ash seed orchard capable of producing reliable, improved planting stock. With sustained collaboration and commitment, we believe the future of ash can build on the success already achieved with downy birch and sycamore.

Diversifying for resilience

We believe the future of forestry in Ireland lies in greater species diversity. We continue to support work on other native hardwoods such as silver birch and alder, and advocate for wider use of Scots pine, Ireland's only commercially viable native conifer. Expanding native options requires strategic planning and close alignment between nursery operations and forestry policy.

A shared vision

The success of long-term forestry initiatives relies on strong collaboration between research and practice. At None So Hardy, we are proud to be a trusted partner to Teagasc for research-led tree improvement in Ireland. Our enduring collaboration with Teagasc reflects a shared commitment to resilience, biodiversity, and the provision of improved planting material. Together, we're working to secure the future of ash and strengthen the foundation for a more diverse, sustainable Irish forestry sector.

Accelerated dry-aging of beef

Value proposition:

Our novel technology enhances and accelerates the development of the distinctive flavour and aroma of dry-aged beef, significantly reducing the aging time required to achieve these desirable characteristics.

Opportunity:

Through accelerated oxidation of lipids and flavour precursors, our technology enables the faster accumulation of aroma and flavour compounds associated with dry-aged beef, resulting in a shorter aging period. This allows beef processors to reduce costs associated with the lengthy aging process, while still producing high-quality beef with the same aromatic and flavour profile consumers expect.

Advantages:

The main cost of dry-aging beef is the time required for flavour development. Our technology shortens this time by 25%, reducing processing costs and potentially decreasing trimming losses. This makes it ideal for beef processors and retailers seeking efficiencies while maintaining quality of this premium product.

Opportunity to collaborate:

Of relevance to beef and meat producers. We welcome business engagement to discuss potential collaborations for further technology development, market validation and commercialisation purposes.

Technology Readiness Level 3: Experimental Proof of Concept completed

Research funding

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Teagasc leads

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Life from decay – a microcosm of biodiversity in a forest

This vibrant image highlights the intricate beauty of decaying wood, where moss thrives and life cycles continue within the forest ecosystem. It exemplifies the biodiversity and ecosystem services provided by decomposing matter, serving as both habitat and food for countless organisms. The decay process seen here is essential to nutrient cycling and forest health, demonstrating the critical role fungi, moss and wood play in sustaining these ecosystems.

In line with Teagasc's vision for research and innovation, this image underscores the importance of recognising fungi's role in ecosystem management and conservation efforts for a more sustainable future. This picture was taken in Oak Park Forest, where ash trials are underway to identify genotypes tolerant to ash dieback disease, aiming to restore ash populations in Ireland.

Photo and description by:
Dheeraj Rathore

Teagasc project:
AshforFuture – Breeding Ash for Dieback Disease Tolerance

Funding:
Department of Agriculture, Food and the Marine