VISTAMILK EXPERTISE PORTFOLIO 2024

HOST INSTITUTION

Teagasc
Agriculture and Food Development Authority

PARTNER INSTITUTIONS

DCU · icbf Insight · Ollscoil na Gaillimhe University of Galway · Tyndall · UCD · UCC · Walton · SETU

FUNDED BY:

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Science Foundation Ireland SFI For what's next

VistaMilk

Foreword Message

Donagh Berry
Director of VistaMilk SFI Research Centre

The long-term viability of sustainable food production is conditional on both applied and fundamental innovative solutions deployed across a responsible foods system that is focussed on people's needs, solutions to imminent challenges, and taking advantage of opportunities across the soil to human spectrum – a *soil-to-society* approach.

The required transformational change in the food system will only be achieved through co-designed trans-disciplinary research developed in conjunction with stakeholders and end-users, encompassing the soil-to-gut in silico pathway. The portfolio of expertise and infrastructure collated in this document is the cornerstone to the delivery of the VistaMilk vision through a series of integrated themes and platform research programmes. A selection of case studies presented demonstrates the outputs to-date many of which have been converted to outcomes and impact. This transdisciplinary portfolio document can be used by industry and other stakeholders to initiate the process of engaging with VistaMilk in developing innovative solutions for the Agri-Food sector.

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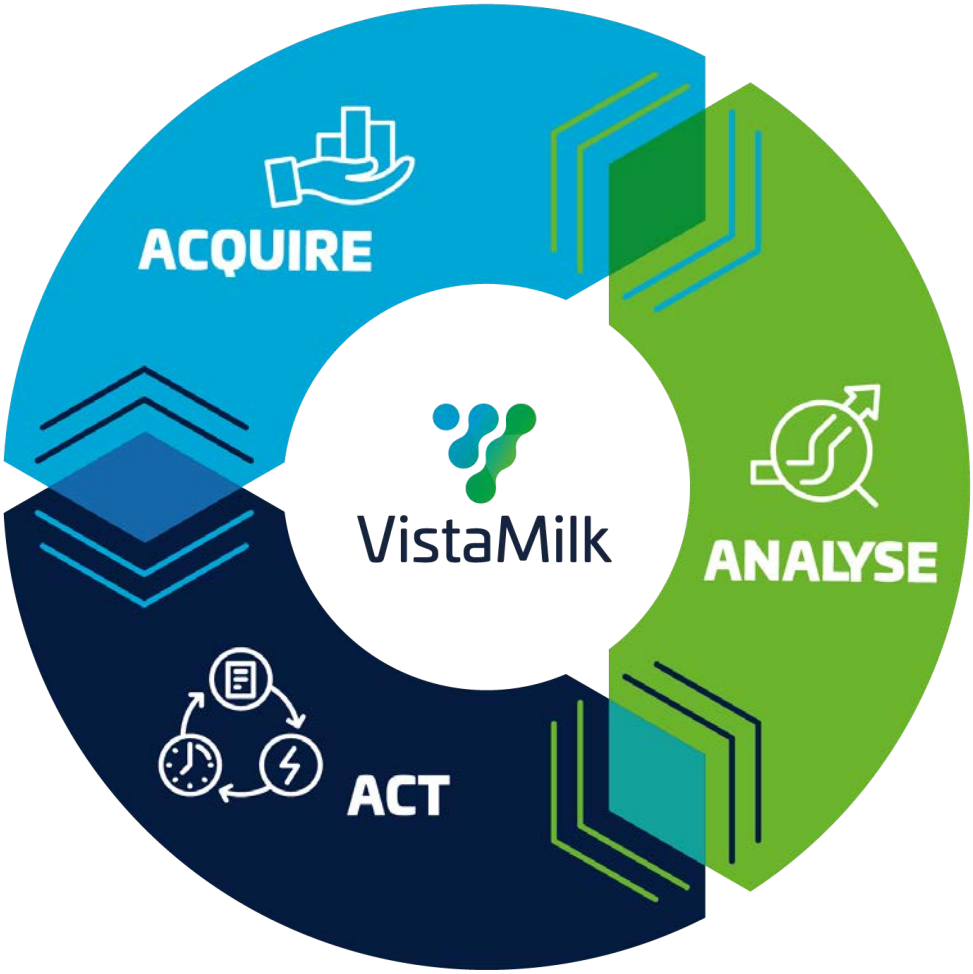
VistaMilk

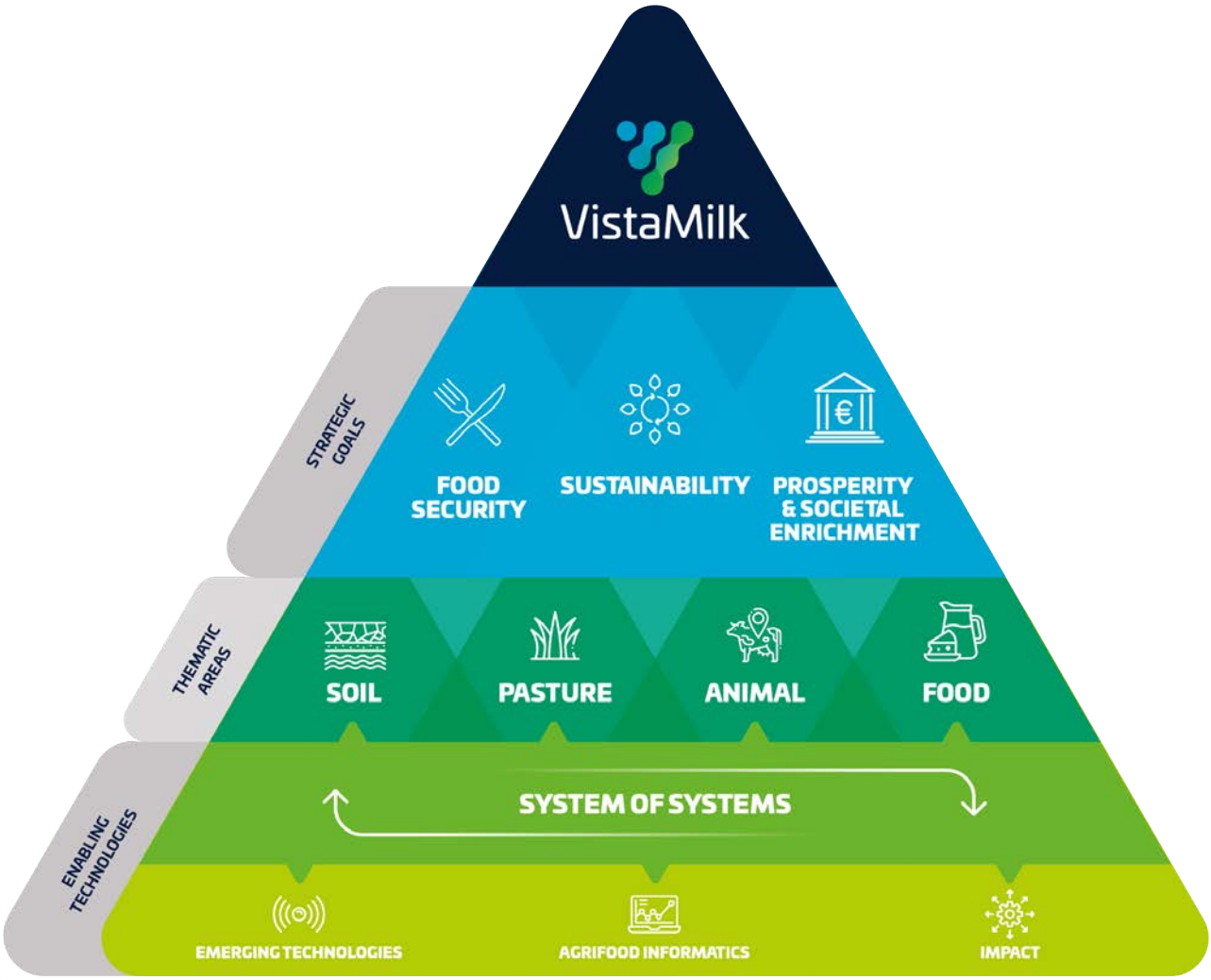
The VistaMilk Science Foundation Ireland Research Center aims to be a driving force for sustainable growth in the Irish dairy and Agri-Tech industry. Through innovative research in digital pasture-based dairying, VistaMilk strives to positively impact the environment, animal well-being, consumer health, and the economic status of key stakeholders. The center will create a connected digital system, covering the entire process from soil to gut, facilitate effective communication and interaction among different components—a system-of-systems. With a strategic position for national and global impact in agri-food, especially dairy production, VistaMilk aims to achieve three key goals: food security, sustainability, and prosperity with societal enrichment.

The VistaMilk research program follows the guiding principles of Acquire, Analyse, and Act, emphasising data capture, storage, analytics, and deploying solutions to end-users through public and farmer engagement channels. Stakeholder engagement and co-design are paramount to maximise participation.



This integrated approach in VistaMilk enables comprehensive scenario modeling for various factors like climate change, policy, farm advice, and research, addressing Ireland's unique challenges. VistaMilk focuses on four key thematic areas: *soil, pasture, animal, and food*, spanning the entire soil-to-gut chain. These areas leverage VistaMilk's expertise and collaborations with industry partners, supported by interconnected platforms incorporating biological, social, and information communication technologies.

The research undertaken in VistaMilk is expected to significantly benefit the economy, environment, and society, supported by a dedicated impact research platform and an education & public engagement strategy.



VistaMilk

CO-FUNDED BY

Science Foundation Ireland sfi For what's next

Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara

Phase 1 2018-2024 €20Million

9 Research Partner Organisations in Phase 1
Expanding to **14** in Phase 2

Host Institute

teagasc Agriculture and Food Development Authority

DCU Ollscoil Chathair Bhaile Átha Cliath Dublin City University

icbf

SETU Ollscoil Teicneolaíochta an Oirdheiscirt South East Technological University

Tyndall National Institute Institiúid Náisiúnta

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh

UCD DUBLIN

Ollscoil na Gaillimhe University of Galway

University of Limerick Ollscoil Luimnigh

Maynooth University National University of Ireland Maynooth

TUS Technological University of the Shannon: Midlands Midwest Ollscoil Teicneolaíochta na Sionainne: Lár Tíre Iarthar Láir

Institute for Information and Communication Systems Science

MTU Ollscoil Teicneolaíochta na Mumhan Munster Technological University

Trinity College Dublin Coláiste na Tríonóide, Baile Átha Cliath The University of Dublin

EXTERNAL FUNDING

€23.1M

VistaMilk researchers have acquired Non Exchequer Non Commercial funding

VistaMilk external project involvement

59 EU Participation

9 EU Co-ordination

33 VISTAMILK PROJECTS

8 Research Platforms
25 Industry Funded Research Projects

>50 Industry Partners in VistaMilk

>20 are Multinational Corporations
>30 are Small Medium Enterprises

€>3.5M
INDUSTRY TARGETTED PROJECTS

29 Irish Companies

24 International Companies

38 Agrifood Industry

13 Information & Communications Technology

2 Other e.g. charity foundations

VISTAMILK ACHIEVEMENTS

243 Researchers in VistaMilk

52 Postdocs
61 PhD Students
7 Master Students

38% International Researchers

37% Departed to Industry after VistaMilk

45% Continued in research after departing VistaMilk

Continuously hosting and implementing training courses

5 Internal Annual Conferences

5 Industry focused masterclasses

Equality, Diversity & Inclusion
Together We Can
Action Plan for VistaMilk supported by active EDI committee & Executive

A number of VistaMilk Researchers have received Awards & Achievements

4 No. best paper awards
SFI Young Researcher Award
4 No. Highly cited researchers from Clarivate and/or Web Science

>500
VistaMilk Publications
of which
98% were collaborative with other VistaMilk institutes

>45
countries collaborated with VistaMilk in Publications, of which, **29** are non-EU

>50% of VistaMilk publications in the top 10% of journals globally
>20% of VistaMilk publications in the top 10% cited globally

48 VistaMilk publications cited in **58** policy documents from **12** different countries

>100 Impact articles written

EDUCATION AND PUBLIC ENGAGEMENT

55,000+ primary, secondary and third level students, families and members of the public engaged in VistaMilk activities **each year** nationally

202,000
social media impressions

6,500
social media engagement

Phase 2
2024-2030

Co-funded by SFI & Department of Agriculture, Food & Marine
€20Million

INSTITUTES

The success of VistaMilk is conditional on the committed support for the respective institutes. Hosted by Teagasc, VistaMilk leverages the resources and expertise housed in 11 other institutes distributed across Ireland. Each institute brings it own unique skillsets and infrastructure to the VistaMilk ecosystem.

Teagasc as the VistaMilk host institute boasts one of the largest pasture-based dairy cow experimental units in the EU, with a total of 1,000 dairy cows on 500 hectares complemented with state of the art laboratory facilities and associated staff; this includes 6 GreenFeed machines for measuring methane in grazing cows as well as 28 eddy covariance towers to measure soil sequestration. Teagasc also strongly engages in participatory research undertaking research on collaborating commercial dairy farms. The research animals, land, buildings, equipment and other associated infrastructure are available to VistaMilk for executing its research programme all the way from soil through pasture, to animals and eventually to humans. Also available is an extensive array of database relating to animals, soil (https://www.teagasc.ie/environment/soil/nmp/) and pasture (https://pasturebase.teagasc.ie/V2/login.aspx).

Teagasc also has a variety of state-of-the-art food and processing facilities that are available to VistaMilk. These include laboratories with a biofunctional food engineering facility and an ultramodern 2,500 meter squared milk processing pilot-plant as well as housing the largest DNA sequencing facility in Ireland. Model gut studies can be performed using Teagasc's micro-Matrix mini-fermentation platforms.

University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

University College Cork is ranked in the top 1.1% of universities in the world. It is Ireland's leading institution for the delivery of research impact and the top Irish institution for highly cited researchers.

VistaMilk is represented in two themes within UCC's Framework. The School of Food and Nutritional Sciences focuses on human nutrition, food science, and the supply chain from farm to consumer. The school has extensive state-of-the-art facilities for both academic research and industry R&D projects relating to human nutrition and health, cereals and beverage technology, dairy science, food packaging, ingredients technology, consumer behaviour, food economics, supply chain management, international food policy and rural development.

The school of Biological, Earth and Environmental Sciences (BEES) comprises diverse specialities covering marine, terrestrial and fresh water environments. The five research themes within the school of BEES are: Biodiversity and Sustainability (ecology and evolutionary biology, biodiversity, vegetation science, animal behaviour and welfare, circular economy, marine science, and management & conservation); Climate and Resources (impacts of climate change, palaeoenvironmental studies, energy resources, and raw materials); Food Security (crops and model systems, biotechnology, fisheries, and aquaculture); Geosystems (Earth processes, palaeobiology, and geohazards); Environment and Health (water quality, soils, pathogens & pathology, and toxicology).

Tyndall National Institute
Institiúid Náisiúnta

Tyndall is a leading European research centre in integrated Information and Communications Technology materials, devices and systems. It is one of Ireland's five national labs, specialising in both electronics and photonics. Tyndall works with industry and academia to transform research into products in its core market areas of electronics, communications, energy, health, agri-tech and the environment. With a network of over 200 industry partners and customers worldwide, Tyndall is focused on delivering human and economic impact from excellence in research. Tyndall is home to a research community of over 600 people of 52 nationalities. Tyndall has a turnover of €45m annually. Tyndall has a research infrastructure values in excess of €250M. Tyndall has formed a Strategic Research Cluster on "Sustainable Agri-Foods & the Environment" (SAFE). SAFE brings together researchers from all corners of Tyndall and University College Cork, many of which are involved in the VistaMilk. Focused on real-life pain points, the objective is to provide the tools and technology to enable real-time decision-making to users in animal & plant health and soil, water, and air quality. Since its inception, SAFE has been granted patents and works with several multi-nationals and small to medium sized enterprises on specific industry projects.

South East Technological University (SETU) has campuses across the southeast in Carlow, Waterford, and Wexford, as well as a presence in Kilkenny and Wicklow. SETU brings together over 550 researchers, several research centres and four Technology Gateways, expanding the range and quality of research to meet the needs of the southeast region and beyond. Over the five years from 2016 to 2020 alone, researchers from SETU have successfully attracted over €95m in research funding from a variety of European and national funding agencies, state bodies and industrial partners.

Institute for Information and Communication Systems Science

Walton Institute has been operating since 1996 in the West Campus of South East Technological University (SETU). Walton undertakes cutting edge research blending fundamental science with real world commercial applications for today's society becoming a major driver of the emergence of an Information and Communications Technology industry in the South East of Ireland.

Employing over 80 research scientists and engineers, Walton Institute manages an active international network in excess of 700 partners from industry, academic and research institutes spread across 35 countries worldwide. Walton focuses on fundamental Information and Communications Technology domains such as:

- wired and wireless communication infrastructures
- artificial intelligence and autonomous systems
- pervasive sensing systems
- immersive technologies
- data analytics and machine learning
- Internet of Things
- quantum and satellite communication
- biological nano communication

Within these domains, Walton produces enabling technologies which can be applied to multiple industries such as health, agriculture, retail, tourism, finance, transport and entertainment through our basic, applied and commercial research programmes.

Ranked within the top 1% of higher education institutions world-wide in 2021/22, University College Dublin (UCD) researchers have secured €156 million in research grants from national and international funding agencies, companies and foundations.

The new UCD Science Centre is the epicentre of UCD's Science District offering state of the art teaching, research, outreach and innovation facilities, ensuring delivery of UCD's major research theme of Information and Communications Technology. The UCD Science Centre is home to the UCD School of Mathematics and Statistics (ranked in the top 1% in the world for both disciplines), in which UCD-registered students are co-located. These students have access to technical state-of-the-art facilities including computational power via servers housed within the School, and university supported high performance computing clusters. Additionally, students benefit from the services and infrastructures of UCD (cloud service, libraries, student accommodations etc). The School of Computer Science provides access to the Irish Centre for High End Computing (ICHEC), and also priority access to UCDs central Sonic High-Performance Computing.

Veterinary Medicine in UCD is one of only four Irish university subjects ranked in the top 50 QS world rankings. The School of Veterinary Medicine is renowned nationally and internationally for its research in veterinary public health, food safety, cattle health and welfare and is home to state of the art clinical and research facilities, the Lyons estate research farm and herd health hub, and the national centre for veterinary epidemiology and risk analysis. The school features the one of the highest densities of boarded European veterinary specialists in cattle anywhere in Europe, with expertise in individual clinical bovine medicine and surgery, precision diagnostics, herd level production and preventive medicine, and national disease control.

Ollscoil na Gaillimhe
University of Galway

University of Galway ranks among the top 2% of Universities in the world, and has been awarded over €100 million over the last seven years by the EU. The University's prestigious history spans almost two centuries and its global network connects them to partners around the world. The Data Science Institute is a dedicated research institute of University of Galway leading world-class research in data analytics, artificial intelligence and data engineering. Through the Data Science Institute, the University is at the centre of a wide network of national and international partners, from top academic institutions to multinationals and small to medium enterprises operating in the fields of data science and artificial intelligence.

The Galway research team has developed world leading expertise especially in the development and application of technologies from the semantic web, the internet of things, graph analytics and natural language processing. Over those areas, Galway's research has achieved significant results in machine learning and data mining. The University also hosts the Irish Centre for High-End Computing. The University of Galway offers competency focused on artificial intelligence as a broad field. Some of this competency can be recognised through the highly successful taught Masters programmes in Data Analytics and Artificial Intelligence, as well as the world-renowned postgraduate research programmes offered at the Data Science Institute.

The Irish Cattle Breeding Federation (ICBF) operates the national Irish cattle database housing 1.3 billion pieces of phenotypic (i.e., non-genomic) data with a further 118 billion pieces of DNA information from 2.5 million genotyped individuals. Data from all Irish dairy and beef farmers resides within the ICBF database and these data are used in the VistaMilk research programme. These data include individual animal level data pertaining to milk yield and composition (including infrared data), bulk tank yield and composition (and infrared), reproductive data, carcass information, linear type traits, calving performance, longevity, mortality, inter-location animal movements and health data. ICBF also acts as a point of deployment for developed technologies via its webservices used by Irish farmers and other key stakeholders.

Maynooth University
National University of Ireland Maynooth

Maynooth University is a distinguished institution with a long history of more than 200 years of academic research. Maynooth University has established itself as a leading research centre in the domains of climate, sustainability, and agriculture. The university is renowned for its innovative approaches and comprehensive research methodologies that significantly contribute to understanding and addressing crucial environmental challenges. Its interdisciplinary research teams, composed of experts in environmental science, geography, and agricultural science, are dedicated to exploring sustainable agricultural practices, climate change mitigation strategies, and the development of sustainable ecosystems.

The university's research in climate and data science is particularly noteworthy through the Hamilton research institute, with focus on artificial intelligence, foundational data science, climate modelling and the assessment of climate change impacts on various ecosystems. This research is instrumental in informing policy decisions and developing strategies for climate adaptation and mitigation. In the field of agriculture, the university prioritises sustainable farming techniques, studying the impacts of agricultural practices on biodiversity and ecosystem services.

The Intelligent Mechatronics (IMaR) Research Centre and at the AgriTech Centre of Excellence (ACE) is based at the MTU Kerry Campus. IMaR is an applied research centre delivering expertise in the areas of data analytics, intelligent systems, hardware (mechatronics, robotics, control systems), internet of things (Auto-ID, Sensors, Wireless Comms) and mechanical systems for increased productivity in the agriculture, manufacturing and process sectors. IMaR has in excess of 50 engineers, scientists and postgraduate students. ACE use digital immersive learning technologies such as e-learning and virtual reality platforms to deliver excellence in learning and development to enhance the capabilities of Ireland's AgriTech businesses/companies and expand their reach and global ambition. IMaR and ACE will be based in MTU's new 8,913 meters cubed in the Kerry North campus. This new facility consists of a split-level building of three stories, comprising of lecture theatres, classrooms, fully equipped agri-machinery, electronic and instrumentation workshops, halls and laboratory space, with an impressive array of agricultural machinery on-site. The ACE Suite is a purpose-built virtual and physical collaboration space. The ACE Suite hosts a huge array of the very latest augmented, virtual, and mixed reality platforms, enabling you to think differently whilst working in a unique technology-rich environment. These facilities will be used by the VistaMilk Centre for the investigation, development and trialling of sensing, automation, robotic and mechatronic and augmented/virtual reality systems and the deployment of agritech on agricultural machinery.

TUS
Technological University of the Shannon:
Midlands Midwest
Ollscoil Teicneolaíochta na Sionainne:
Lár Tíre Iarthar Láir

The Technological University of the Shannon was formed in 2021. Research, Development and Innovation at TUS supports, develops, and welcomes knowledge creators, innovators, and entrepreneurs, while supporting regional and national industry and other stakeholders. The vision of TUS is to deliver excellence in multidisciplinary research practice and encourage collaboration between researchers and strategic European and global partners in industry and academia. The aim is to advance the key research priorities relevant to the region, aligned with national and European research priorities, and the United Nations' Sustainable Development Goals. Technological University of the Shannon has a world leading research infrastructure which inspires and enables transformative research, development and innovation. We empower students by providing an outstanding higher education experience relevant and responsive to our stakeholders' needs. The hallmark of the educational philosophy is active learning through a fusion of theory and practice. Technological University of the Shannon is renowned for active leadership in education, enterprise, and engagement. Technological University of the Shannon supports a range of research institutes and centres (https://tus.ie/rdi/research/) relevant to the work of VistaMilk in the areas of artificial intelligence, robotics, and materials.

The Mathematics Applications Consortium for Science and Industry (MACSI) research centre (https://www.ul.ie/macsi) at the University of Limerick is Ireland's foremost applied and industrial mathematics/statistics group comprising of 22 academic staff, 46 postgraduates and 15 postdoctoral researchers. The primary research areas of expertise within MACSI are in the fields of mathematics, statistics, high performance computing and complex systems. MACSI researchers are focused on working on inter-disciplinary problems with public bodies and industry, with an emphasis on utilising mathematical and statistical models to solve challenging real-world problems. Over the past 10 years, MACSI has worked with over 30 companies (large multinational and indigenous small and medium sized enterprises), trained over 100 researchers (MSc, PhD and postdoctoral researchers), published over 400 papers and has raised > €80M in funding from exchequer, EU, and industry sources.

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Trinity College Dublin (www.tcd.ie) is recognised internationally as Ireland's leading university and is ranked in 81st position by the QS World University Rankings 2024. The School of Computer Science and Statistics has over 60 academic staff, over 400 researchers and postgraduate students and over 1000 undergraduate students. The School's research infrastructure provides researchers with state-of-the-art servers, an enterprise cloud and data centre virtualisation platform for use in research and teaching, a cloud storage service, dedicated hardware and software support staff as well as its own machine rooms and virtual server infrastructure for running evaluations.

INFRASTRUCTURE

In a multidisciplinary research center like VistaMilk dedicated to digitalising the dairy industry, robust infrastructure serves as the backbone of innovation and technology transfer. Modern laboratories, test-beds, pilot plants and animal facilities equipped with state-of-the-art technologies and instruments facilitate transformative fundamental and applied research in areas such as soil, animal, pasture and food science as well as data capture and analytics, artificial intelligence, and biotechnology. Collaborative spaces seamlessly integrate experts from diverse fields, fostering a dynamic exchange of ideas. Advanced communication systems at VistaMilk ensure seamless collaboration between researchers, industry stakeholders, primary producers and the general public. This comprehensive infrastructure not only accelerates groundbreaking discoveries but also propels the dairy industry into a sustainable, technologically-advanced future.

VistaMilk Infrastructure

SOIL RESOURCES

Researchers at VistaMilk are available to perform contract or collaborative research with undustry to measure soil health, model carbon flux and determine soil carbon sequestration rates for Irish agriculture.

Understanding soil nutrient availability and interactions with water quality and soil biological function is essential for sustainability. With the need to offset emissions from agriculture, there is a requirement to understand how soil reacts to changes in management to sequester carbon. VistaMilk and Teagasc has developed a research platform of carbon towers and soil science expertise to examine the impact of changes in management on carbon capture.

Facility

Expertise is available in soil science, ecosystem modelling, statistical modelling and spatial analysis. The facility has all necessary equipment for soil analysis offering of a range of classical and proximal sensing techniques
VistaMilk has the capability to model carbon flux and carbon storage, water quality, nutrient availability, and understand the implications for carbon farming and emissions offset. This can be achieved by providing information on land use, soil type and carbon flux.

Benefits

Teagasc can assist farmers and industry in practices that enhance carbon capture and protect soil health.

Of Interest to

- Farmers
- Agri-food industry
- Policy makers

For further information contact:
Karen.daly@teagasc.ie

PASTURE RESOURCES

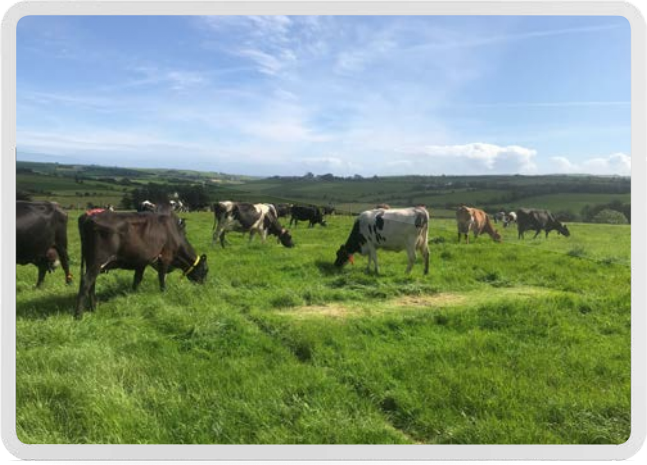
VistaMilk Infrastructure

VistaMilk has access to a range of facilities and equipment for pasture monitoring and evaluation.

Ireland has a pasture-based dairy industry reliant on the supply of high quality pasture in sufficient quantities to feed dairy cows throughout lactation. Tools to assist farmers and advisors in grassland management are of key importance. Equipment and facilities to enable grassland phenotyping are required to evaluate new technologies as well as management and sward type impact on pasture production.

Facility

VistaMilk has a range of field and laboratory equipment for grassland measurement and phenotyping. Herbage chemical composition can be analysed through wet chemistry or near-infrared spectroscopy. Herbage mass, sward composition, and herbage chemical composition can be measured in grazed and cut grassland. VistaMilk also has access to grassland plots at a number of locations, facilitating grassland phenotyping under a range of soil types and climatic conditions.



Benefits

- Ability to phenotype grassland swards
- Measurement of herbage chemical composition
- Ability to assess a range of management and sward type effects on herbage production, botanical composition and herbage quality

Of Interest to

- Seed companies interested in developing appropriate seed mixtures
- Seed companies to evaluate production and persistence of pasture species under grazing

For further information contact:
Michael.Odonovan@teagasc.ie
Deirdre.hennessy@ucc.ie

VistaMilk Infrastructure

HARVEST MOUNTED NEAR-INFRARED SPECTROMETER

VistaMilk uses a harvester mounted near-infrared spectrometer to collect data in real-time.

Laboratory based near-infrared spectrometers are already used to analyse forage samples and the resulting spectrum used to predict forage quality parameters. The cost associated with sample preparation limits its application as a high-throughput phenotyping tool. VistaMilk's harvest-mounted spectrometer enables a spectrum to be collected in a high-throughput manner without any additional cost.

Facility

VistaMilk owns a near infrared spectrometer mounted on a forage harvester at Teagasc. VistaMilk also has access to thousands of forage plots that undergo simulated grazing at up to 10 time-points annually and has amassed a large library of scan data with matching wet-chemistry information.

Benefits

- Supports collection of spectrum without the need for labour intensive sample preparation
- High-throughput system allows the evaluation of forage quality parameters throughout the entire growing season
- VistaMilk has vast chemometric and statistical expertise to develop new predictive equations

Of Interest to

- Plant breeding companies developing new forage cultivars
- Value for Cultivation and Use testing systems
- Seed companies constructing and evaluating forage mixtures

For further information contact:
dan.milbourne@teagasc.ie

GREENFEED SYSTEM

VistaMilk runs several GreenFeed instruments for measuring individual cow methane emissions both outdoors and indoors.

Methane is a potent greenhouse gas. Tools to reduce the quantity of methane emitted per animal is invaluable at reducing the environmental footprint of Irish agriculture. Equipment to measure methane emissions on a sufficiently sized sample population of individual cows is needed to evaluate alternative mitigation strategies.

Facility

One approach to deliver high-throughout measurements of methane emissions on individual animals is through the use of GreenFeeds. VistaMilk owns several of these machines enabling a throughout of >100 dairy cows at the same time. VistaMilk also has access to several hundred cows of different genetic merit grazing pastures of different composition. VistaMilk facilities enable the feeding of different diets to animals and importantly can also measure any potential repercussions for animal performance or impact on downstream processing, food safety or food nutritional qualities.

Benefits

- Calculate emission factors for the national inventory
- Evaluate the impact of different diets on methane emissions
- Quantify the contribution of genetic variability to obseved variability

Of Interest to

- Animal feed companies to evaluate different feed additives
- Breeding companies to understand the extent of genetic differences
- Pasture breeding companies to quantify the impact of different pasture composition

For further information contact:
ben.lahart@teagasc.ie

VistaMilk Infrastructure

DNA SEQUENCING

VistaMilk provides high throughput DNA sequencing services to study microbiomes of relevance to human, animal and planetary health.

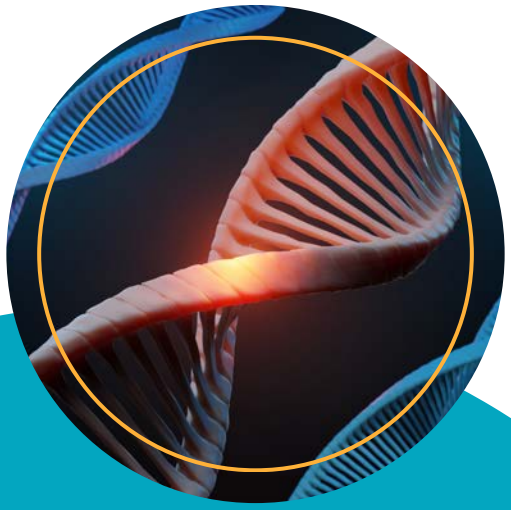
DNA or RNA sequencing can be used to determine what populations of microbes live in a given environment. This has been studied extensively for the human gut, particularly in response to dietary or other interventions but can also be applied to assess the impact of different interventions/treatments/diets on the microbiome of fermented foods, processing and production sites, animals or soil.

Facility

The facility contains a selection of DNA sequencers, including an Ion Proton and PGMTM, an Oxford Nanopore MinIon and GridIon, and an Illumina MiSeq, NextSeq 2000 and NovaSeq 6000. Also contains considerable peripheral infrastructure to support preparation and quality control of samples for sequencing. More recently, the facility acquired an Echo Biomek, an acoustic liquid handler integrated with a robotic pipetting system which allows both miniaturisation and automation of the preparation of samples.

Benefits

Ability to assess the impact of different interventions and diets on different microbiomes and, in turn, human, animal and environmental health.



Of Interest to

- Animal feed companies to evaluate the impact of different feed additives on the rumen microbiome
- Food companies developing products to enhance the human gut microbiome
- Producers of modulators of soil microbiomes

For further information contact:
paul.cotter@teagasc.ie

MIR-INFRARED SPECTROMETER

VistaMilk Infrastructure

Teagasc subjects routinely taken cow milk samples to mid-infrared spectrometry.

The milk mid-infrared spectrometer generates an infrared spectrum of routinely taken milk samples from dairy cows in Teagasc research farms. The spectrum can be then used to predict fine components of milk as well as individual cow traits like methane emission, energy balance, and nitrogen efficiency. Spectrometers are already used in many milk laboratories globally.

Facility

The available mid-infrared spectrometer can be used to generate spectral data which can be aligned with milk quality parameters and animal level performance metrics. The instrument has been used for several decades to analyse the milk samples of >1,000 cows of different genetic merit twice weekly all exposed to different management treatments. VistaMilk has vast expertise in the analyses of such multi-dimensional spectral data and has published many scientific papers linking these spectra to a range of milk and cow-level parameters.

Benefits

- Ability to predict expensive measures from routinely available milk spectra
- Help in developing prediction models using advanced statistical methods
- Opportunity to test the potential impact of milk spectral data to predict new components
- Understanding the impact of different management strategies (e.g., multi-species swards) on granular measures of milk quality and difficult-to-measure cow performance traits

Of Interest to

- Milk processors to enhance their milk characteristics
- Breeding companies to generate phenotypes
- Farmers to generate more information from routine milk recording

For further information contact:
donagh.berry@teagasc.ie

VistaMilk Infrastructure

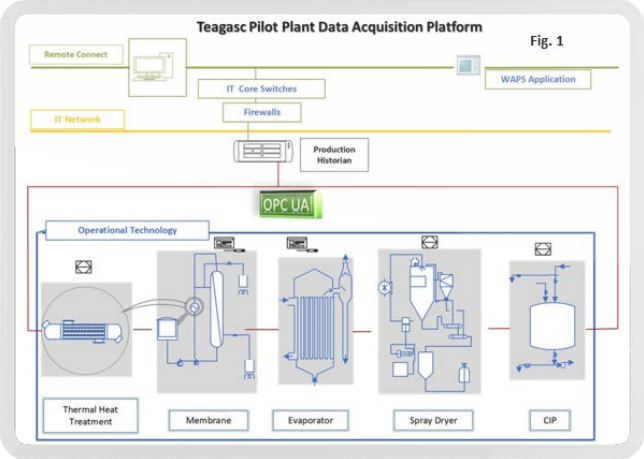
PILOT PLANT DATA ACQUISITION PLATFORM

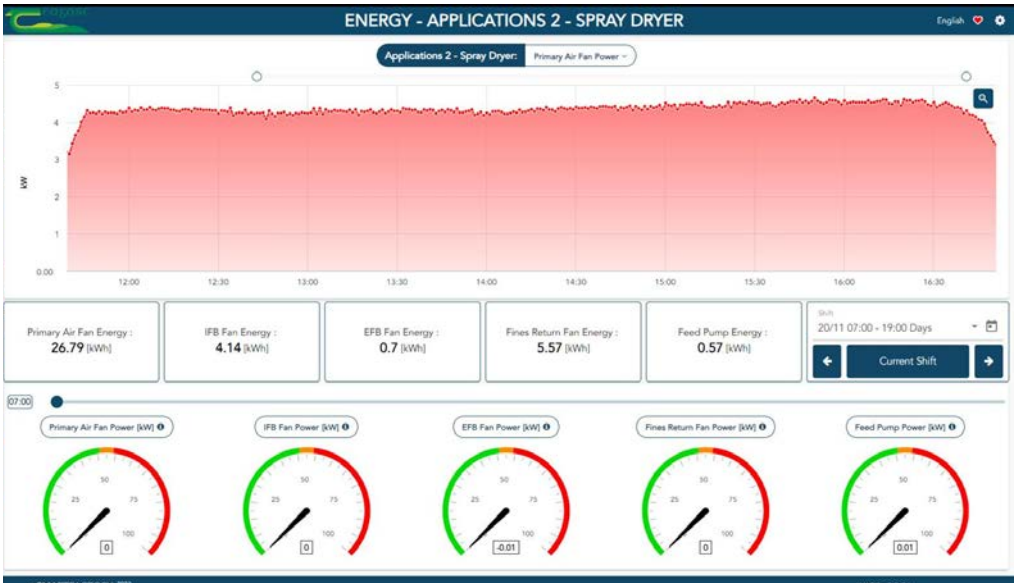
VistaMilk has access to a virtual pilot processing plant, offering insights into process and energy monitoring of major dairy processing unit operations.

Dairy processors are required to reduce their carbon dioxide equivalent by 35% from baseline 2018 figures by 2030. To achieve this, they will need to develop and implement a greater understanding of energy and water usage within their plant to allow them to develop conservation strategies. This can be advantageous in gaining greater process understanding, offering the opportunity for process and product optimisation.

Facility

Data streams from pilot scale unit operations like pasteurisation, membrane separation, evaporation and spray drying, have been integrated into an industrial data storage and visualisation platform. The raw data generated from measuring critical process parameters in the production of dairy beverages, ingredients, and infant formula, and the associated energy usage, can be visualised in the form of dashboards or extracted for advanced data analytics.





Benefits

- Ability to measure critical process parameters and energy usage from major energy intensive processes
- Flexibility to include additional advanced process analytical technologies
- Help optimise processes and quantify energy usage

Of Interest to

- Dairy processors
- Infant formula manufacturers
- Beverage and ingredient manufacturers

For further information contact:
norah.oshea@teagasc.ie

VIRTUAL REALITY SUITE

VistaMilk Infrastructure

A purpose built virtual reality space. is available to the VistaMilk center.

The AgriTech Center of Excellence (ACE) virtual reality suite is a purpose-built virtual and physical collaboration space located in the North campus of Munster Technological University, Kerry. The virtual reality suite including its support and consultation team can create a custom made immersive experience including presentations and pitches, workshops and ideation, unique media events and filming locations.

Facility

The facility is an immersive training space that includes a 180-degree curved screen that is 5m in diameter, has broadcasting capabilities and seating for 15 people to deliver impressive in-person and online presentations and webinars. The suite also houses 5 virtual reality training spaces with touchscreens and a range of state-of-the-art virtual, augmented, assisted and extended reality headsets and 360 degree cameras for content creation. The 70" touchscreen is perfect for smaller presentations and team ideation. Additionally, the facility has 3D scanners and other digital twin and asset creation hardware and software.

Benefits

- Immersive training space, presentation and broadcasting space
- Extended reality content creation and delivery
- Virtual reality headset trials, creation of digital twins and 3D assets, workshop hosting, high quality videography and editing

Of Interest to

- Multiple sectors from manufacturing to agritech to sales and services
- Training content developers
- Education and public engagement material development
- Sales and marketing departments
- Maintenance and health and safety departments

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VistaMilk Infrastructure

AGRICULTURAL MACHINERY TESTBED

Mechanical machinery for agriculture available for trialling of prototype sensing and systems.

Munster Technological University (MTU) has hosted the National Centre for Agricultural Engineering for over 45 years, delivering programmes in agricultural engineering and off-the-job training for agricultural mechanics apprentices. Over this time, MTU has amassed the country's largest collection of agricultural machinery in the Irish University sector.

Facility

The facilities includes a wide range of agricultural tractors, including a Stage 5 Massey Ferguson 7716S a self-driving global positioning system (GPS) guided lamborghini, as well as an array of forage harvesters, balers, bale wrappers, mowers, combine harvesters, crop-sprayers, fertiliser distributors, diet feeders, tillage and slurry handling equipment.

Benefits

The machinery is available for the trialling of sensing and other systems developed within VistaMilk on real-world agricultural machinery within the controlled environment of a University setting, with the added benefit of extended trials which will not interrupt on-farm work during initial trialling.

Of Interest to

Anyone developing agricultural sensing or other technology which requires trialling on agricultural machinery.

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INDUSTRIAL SENSOR SUITE & MOBILE DATA PROCESSING SERVER

VistaMilk Infrastructure

A wide array of quickly deployable sensors, with associated data capture and processing capability.

In recent years, the development and deployment of sensor systems has been somewhat hindered by the cost of sensing units and perceived complexity of digital systems to exploit the data. Intelligent Mechatronics and Radio Frequency Identification Research Centre (ImAR) hosts an extensive sensing suite and bespoke mobile data capture and processing unit to support VistaMilk research.

Facility

The range of sensors includes humidity, pressure, temperature, light, acoustics, voltage, current, vibration / acceleration, flow, liquid ph, liquid oxidation-reduction potential, dissolved oxygen in liquid, liquid conductivity and turbidity. Additionally, the suite includes magnetometers, global positioning systems and gyroscopes. Most popular communications protocols can be implemented and the suite is complemented by a industrial wireless suite for data capture and uniquely a mobile high-performance data capture and processing server, flight cases for ease of deployment on-site.

Benefits

Flexible, high-performance sensing deployment suitable for all agricultural and industrial settings. Both wireless and wired sensor deployment, with on-site data capture, processing and modelling capability.

Of Interest to

Anyone requiring precision measurement, data capture and processing on-site in an agricultural or industrial setting.

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VistaMilk Infrastructure

ROBOTICS TESTBED

Robotics testbed consisting of both industrial robotics arms and mobile autonomous robotic vehicles

Modern agriculture is moving more towards automation with robotic arms carrying out repetitive operations such as milking cluster attachment and mobile robotics carrying out assistive tasks such as scraping and feed distribution. To drive increased automation on-farm, Munster Technological University hosts a robotics testbed consisting of both autonomous vehicles and industrial robotic arms.

Facility

The facility consists of a high payload high precision robotic arm, and collaborative Yaskawa robotic systems dual-arm system and fleet of 3 mobile robots with an automatic conveyor system test-bed which is based in Munster Technological University Kerry Campus at the Intelligent Mechatronics and RFID Research Centre (ImAR). The facility is available for trialling the automation of various operations with varying formats, footprints and robotic end effectors.

Benefits

With this suite of robots and flexible conveying systems, VistaMilk can rapidly demonstrate the potential of these systems and trial how they can be deployed in agricultural settings and integrated into smarter, more efficient operations.

Of Interest to

Anyone requiring the research, development or trialling of robotic automation whether that be more traditional high-precision robotic arm actuators, collaborative robotics or mobile robotics.

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WIRELESS COMMUNICATIONS & RADIO FREQUENCY IDENTIFICATION TESTBED

VistaMilk Infrastructure

Wireless Communication and Auto-ID Radio Frequency Identification Testbed.

Short-range communications technology for agricultural and industrial environments is a key enabler of the 'Industrial Internet of Things'. Whether it is used for data collection or control, reliable communication is key. However, the choice of the optimum communication protocol within the shear number of protocols in use today can be complex.

Facility

Intelligent Mechatronics and Radio Frequency Identification Research Centre host a suite of wireless industrial communications and radio frequency identification auto identification platforms. The aim of this testbed is to assist in choosing the protocol that best suits their application by providing a trialling capacity covering the major low-power short-range (<500m) wireless communication platforms.

Benefits

This wireless and radio frequency identification testbed is used to determine the optimum wireless communication platform based on a specific application; final environment, minimising risk of disturbance, cost estimation, sensor and control network trial deployments, prototyping, on-site implementation.

Of Interest to

Anyone deploying wireless communications, data capture, remote sensing or Auto-ID applications.

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DRONES

Autonomous vehicles like drones can have a considerable role in monitoring performance for a range of features like pasture quality and quantity.

The AgriTech Center of Excellence (ACE) from Munster Technological University at VistaMilk is a registered drone operator with the Irish Aviation Authority. VistaMilk own and operate a suite of drones and have a drone pilot certified to EU Regulation Specific Category VistaMilk have a range of drones that have capabilities covering 360 video, thermal imaging and 3D modelling.

Facility

A range of drones including a Mavic 3 Pro Cine x 1, a Mavic 2 Enterprise Advanced . Phtogrammetry, thermal and high-quality 360 video. Additional payloads may be added with further sensors, for example LiDAR.

Benefits

Additional drone payloads to: 1) visual inspections/videography for: infrastructure and land inspection, aerial photography and videography. 2) Thermal inspection for herd tracking, heat leak inspection. 3) Photogrammetry for 3D modelling of large structures for inspection.

Of Interest to

Service providers (e.g., routine assessment of pastures) and farmers.

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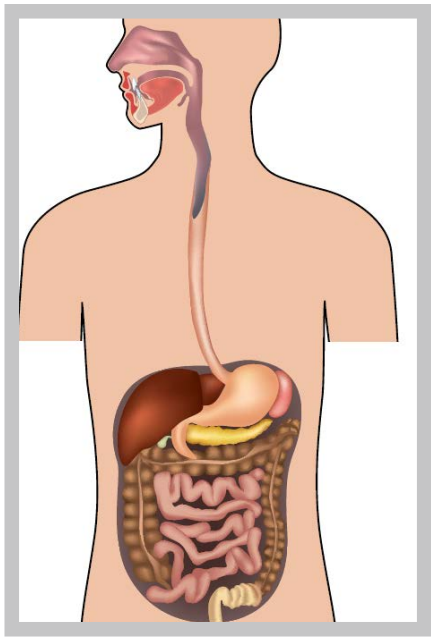
FOOD DIGESTION, BIOACCESSIBILITY AND BIOAVAILABILITY

VistaMilk Infrastructure

VistaMilk researchers at Teagasc are available to perform contract or collaborative research to map the fate of food during gastro-intestinal digestion.

With the development of foods for health, there is a need to understand how food and its components are digested. VistaMilk and Teagasc have developed a platform to digest food and assess if /when individual components are bioaccessible and bioavailable to the body.



Facility

VistaMilk at Teagasc has the capability to map the fate of food and its components during digestion. This can be achieved by providing information on digested food or food ingredients or by providing digested, freeze-dried samples for further testing. All necessary equipment for in vitro and in vivo digestion.

Benefits

- Assist clients in tracking food and its components during gastro-intestinal digestion to help modify food processing, food formulation and food design to improve efficacy of bioactives and nutrients
- Digested samples at various time points can be provided for further screening in bioassays. Information can also be used as a pre-cursor or selection aid for larger, more costly human intervention

Of Interest to

Manufacturers of food and food ingredients

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VistaMilk Infrastructure

METABOLOMICS

Metabolomics is the large scale measurement of metabolites to inform metabolic pathways in biological samples.

Metabolomics is the large scale measurement of metabolites to inform about metabolic pathways in biological samples. Metabolomics and the tailored analytical pipelines has many applications for evaluating dairy products.

Facility

VistaMilk at University College Dublin has a dedicated metabolomics core facility with expertise in dairy/bovine analysis. The facility is equipped with state-of-the-art mass spectrometry for high-throughput metabolite identification and quantification. It covers a large number of related metabolites present in diverse areas of metabolism such as amino acid metabolism and lipid metabolism. The resource has extensive expertise in sample preparation, data acquisition and data analysis.

Benefits

- Ability to assess the impact of different interventions and diets on a range of biological samples from animals to foods
- Expertise on data analysis and interpretation of metabolite data

Of Interest to

- Animal feed companies to evaluate different diets/supplements
- Food companies developing products for precision human and animal nutrition

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CASE STUDIES

The VistaMilk center prides itself on delivering cutting-edge scientific solutions to modern-day and evolving problem statements. A selection of these have been highlighted in our multidisciplinary research case studies. From precision farming and data-driven herd management to artificial intelligence-powered milk quality analysis, VistaMilk's case studies exemplify the convergence of agri-food, data science, and veterinary sciences. These case studies underscore our commitment to advancing dairy research through interdisciplinary collaboration and cutting-edge technological integration, marking a significant stride toward a more efficient and sustainable future for the dairy industry.

VistaMilk Case Study

CARBON SEQUESTRATION IN SOILS

Challenge

Determining carbon sequestration requires the gathering information on land use practices and the measurement of soil carbon at different depths across a range of soil types.

VistaMilk Solution

An archive and database of Irish agricultural soils will provide accurate baseline values of carbon stocks on Irish farms. This will allow researchers to monitor changes in carbon when management changes are applied to soils, and develop Irish-specific carbon sequestration rates that can offset emissions.

Benefits to Industry

Enhance our ability to accurately determine carbon sequestration for Irish agriculture and provide information for a carbon farming framework for Ireland. This data will support sustainable farm practice and help Irish agriculture reach the sector targets on emissions reduction.

Impact

- Database on Irish soils and their carbon sequestration rates
- Baseline values of soil carbon stocks in Irish agricultural soils
- Potential to include carbon sequestration rates in emissions trading and a carbon farming framework

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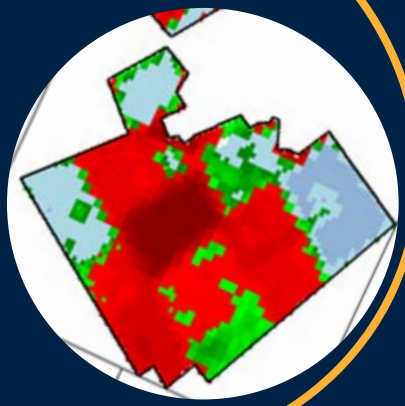

VistaMilk Case Study

SOIL MOISTURE

Challenge

Knowledge of soil moisture is imperative for effective farm management and for designing decision support tools. Current decision support systems in Ireland are based on soil moisture deficit alone which does not take into account spatial variability in soil moisture regime, thus limiting our understanding of the spatial and temporal dynamics of soil moisture.

VistaMilk Solution

A model was developed using high resolution optical satellite data from Sentinel-2 to estimate surface soil moisture on some of Teagasc farms. High resolution soil moisture maps were obtained at the farm scale which revealed spatial and temporal patterns of soil moisture variability. These estimates were combined with a soil moisture deficit model to define thresholds for safe trafficability, optimum grass growth and nutrient utilisation on these farms.

Benefits to Industry

This proof of concept of an improved decision support tool will benefit every dairy farm in the country and therefore the dairy industry. Farmers should be able to devise targeted management strategies and achieve economic and sustainability goals. The dairy industry would be able to achieve higher productivity with less economic losses and also support the environment by minimising nutrient losses from farms.

Impact

- Thresholds in soil moisture calculated for the first time
- Achieving environmental and financial goals
- Improved decision support tool for effective farm management

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VistaMilk Case Study

SOIL HEALTH

Challenge

Soil plays a crucial role in agriculture, essential for plant health and yield, with its microbial diversity significantly influencing these outcomes. A dedicated pipeline to extract meaningful insights from soil metagenomic data could revolutionise agricultural practices, enabling precise management and disease mitigation.

VistaMilk Solution

A comprehensive database and pipeline that optimises soil metagenomic analysis was developed, validated and executed enriching microbial identification from soil samples across Ireland. The soil genome database with detailed metadata, will also act as a valuable tool for soil studies in Ireland and globally.

Benefits to Industry

Enhance agricultural efficiency with optimised soil analysis. It provides industries with precise microbial profiles for targeted interventions, reducing fertiliser overuse, improving yields, and supporting sustainable practices. This database is a vital asset for progressive soil management and global agricultural innovation.

Impact

- A curated soil database for global application, enhancing soil management
- Swift profiling of soil microbes is currently used for anti-microbial detection and functional genomic studies in Irish soils
- Potential to boost yields, responsibly reduce fertilizer use, and drive precision farming innovations for sustainable agriculture

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VistaMilk Case Study

QUANTIFYING NITROGEN MINERALISATION IN SOIL

Challenge

To develop approaches to quantify plant nitrogen availability in the soil across the year in grassland swards. The supply of plant available nitrogen in the soil from mineralisation and biological nitrogen fixation needs to be quantified, and the factors influencing its supply identified.

VistaMilk Solution

Nitrogen extractions were collected and analysed every two weeks from March to October at varying sites across Ireland. These samples provided a profile of nitrogen mineralisation on different soil types across the growing season. Considerable variability existed between years. The goal is to enhance the nitrogen sub-model in the grass growth prediction model based on these figures to predict nitrogen mineralisation on farms.

Benefits to Industry

Predicting nitrogen mineralisation through the grass growth prediction model will identify periods of nitrogen deficits for grass growth and periods when sufficient nitrogen is being mineralised by the soil to support growth. Therefore, this prediction can quantify precise nitrogen requirements for grass growth, reduce chemical nitrogen applications and reduce nitrogen surpluses on farm. In turn there should be an increase in water quality by eliminating excessive nitrogen fertiliser applications.

Impact

Quantifying nitrogen mineralisation will enable more precise nitrogen fertiliser applications, only applying fertiliser in amounts needed to support grass growth, lowering nitrogen surpluses on farm and minimising excess nitrogen leaching to ground water.

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VistaMilk Case Study

ON-FARM PASTURE EVALUATION

Challenge

Perennial ryegrass is the most important forage species in pasture-based dairy systems but little information is available on the phenotypic performance of any pasture species on commercial grassland farms. Instead species, and varieties, are evaluated in mechanically-defoliated plot systems which do not capture the range of stresses or interactions that a sward is subjected to under commercial settings or over any period longer than four years.

VistaMilk Solution

Multi-year data from the Irish national PastureBase were available for analysis - these data present an opportunity to evaluate variety performance at the paddock level where they were sown as monocultures on farm. A robust statistical model was developed to analyse a large dataset of paddocks (and their sown perennial ryegrass varieties) from 98 farms across 7 years. This model allows for the ongoing evaluation of perennial ryegrass varieties, and any other pasture species, on commercial grassland farms.

Benefits to Industry

This research demonstrates that it is possible to evaluate pasture species and varieties on commercial farms. Moving forward, the persistence of novel species or varieties over time can be tested in real world scenarios which will provide a more reliable indication of their contribution to farm feed production. These data can be used to influence plant breeding decisions towards more productive and persistent material for the Irish pasture based ruminant production sector.

Impact

- Method of on-farm perennial ryegrass evaluation established
- Greater awareness of the long term persistence of perennial ryegrass
- Commercial farm data can be used to guide breeding decisions

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VistaMilk Case Study

GRASS IMAGING

Challenge

Rapidly quantifying sward characteristics such as yield and sward composition can help farmers with decision making and improve herbage quality and supply for grazing dairy cows. However, phenotyping of grassland is time consuming, labour intensive, requires a skill level, and can be costly.

VistaMilk Solution

Thousands of images (photos) were captured using a phone camera and a digital single-lens reflex camera of grassland plots. Herbage mass and sward composition in each image was quantified. Machine learning techniques were used to develop prediction equations to provide estimates of herbage mass and sward grass and clover content from photographs. An additional dataset was used to validate the equations. The equations predicted herbage mass and sward botanical composition with ~95% accuracy.

Benefits to Industry

This proof of concept work, when further developed, can benefit every grassland farmer in Ireland enabling farmers or a service provider to rapidly measure grass yield and sward composition which will increase herbage quality and allow farmers make more informed decisions.

Impact

More informed decision making which will:

- Increase herbage quality and utilisation thereby reducing the requirement for supplementation
- Enable farmers to make strategic decisions around fertiliser use

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VistaMilk Case Study

DAIRY-BEEF BREEDING STRATEGIES

Challenge

Interest in the generation of more valuable calves from dairy females is intensifying, and the most likely vehicle of delivery is the use of appropriately selected beef bulls for mating to the dairy females (along with sexed semen to generate the dairy replacement heifers).

VistaMilk Solution

An index to rank beef bulls based on suitability for mating to dairy females taking cognisance of both the expected calving performance (of interest to the dairy producer) and subsequent carcass merit and efficiency (of interest to the beef producer) was developed, validated and deployed along with a mating advice system to recommend matings of each bull to the herd of females.

Benefits to Industry

All tools developed are now routinely used by Irish dairy producers to select suitable beef bulls to mate accordingly to their dairy females. The developed breeding index also provides a roadmap for the breeders of beef bulls, including artificial insemination breeding companies, for suitability for mating to dairy females.

Impact

- A dairy-beef index value now available on all beef breeding bulls in Ireland
- An easy-to-use tool for dairy farmers to increase the value and saleability of their surplus calves
- Contributed to the observed acceleration in genetic gain of beef bulls used in dairy herds

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VistaMilk Case Study

EXPLOITING GAMETIC VARIANCE FOR DAIRY-BEEF TRAITS

Challenge

Dairy producers currently use the VistaMilk-developed dairy-beef breeding index to identify beef bulls for mating to dairy females. This index reflects the average expected performance of the progeny of the bull but does not provide any information on the expected variability of those progeny. A genetically homogenous group of calves is desirable for calf management. Gametic variance is the expected variability in the gametes of individuals - gametes are either the sperm (male) or oocytes (females).

VistaMilk Solution

Estimates of the gametic variance for beef sires of different breeds were generated based on their genotypes. For example, a bull with a more heterogenous genotype is expected to produce more heterogenous sperm which, in turn, could translate to more heterogenous progeny. The genotype heterogeneity of a bull was compared to the actual variability in its dairy-beef progeny; an association was observed.

Benefits to Industry

Selection of bulls for lower gametic variance could reduce the heterogeneity of their progeny; the actual benefit, however, based on the used beef bulls, was relatively small. This would have implications for both the dairy producer (i.e., for calving performance) and the beef producer (i.e., for beef performance).

Impact

- Producing more uniform groups of genetically elite calves could simplify herd management for dairy and beef producers
- Gametic variance could also be exploited to breed for extremely high genetic merit sires by breeding from high genetic merit sires with high levels of gametic variance

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VistaMilk Case Study

CARBON BREEDING INDEX

Challenge

The contribution of animal agriculture to the global carbon footprint necessitates a whole myriad of alternative and potentially complementary strategies to reduce the carbon footprint of the sector. Animal breeding is a technology proven to deliver cumulative and long-lasting gains in performance.

VistaMilk Solution

VistaMilk developed a carbon breeding sub-index for the two national index tools that rank both dairy and beef bulls for mating to dairy females. Both ranking indexes (i.e., the economic breeding index [EBI] and dairy-beef index [DBI]) are both profit based. The developed carbon component of both indexes penalises animals that are genetically predisposed to have a greater carbon output based on a complete life-cycle analysis.

Benefits to Industry

Because all dairy females are bred, the adoption of breeding tools that rank sires for suitability boasts an almost complete adoption rate. The carbon sub-indexes will therefore reduce the carbon footprint of both the dairy and dairy-beef sector while also increasing the profitability of both sectors.

Impact

- An improvement to the current breeding indexes to now contain a carbon element thereby aiding in reducing the carbon footprint of the agri-food sector
- The first country in the world to include such carbon sub-indexes in their ranking tools

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VistaMilk Case Study

MASTITIS DETECTION

Challenge

Mastitis is the most costly disease in dairy cattle. Being able to detect the onset of mastitis in dairy cows sufficiently early to enable a mitigation strategy would be extremely useful. Not needing any additional equipment to be able to generate these predictions would also be beneficial to adoption.

VistaMilk Solution

A tool was developed to predict, within 7 days of infection, the likelihood of an animal succumbing to sub-clinical mastitis with a sensitivity and specificity of 69.45% and 95.64%, respectively. The model predictive ability reduced as the frequency of recording of data reduced. The information required for the modelling is generally available on most farms who milk record.

Benefits to Industry

There is growing interest among consumers in how their food is produced - this includes reassurance of high quality animal well-being but also minimising the use of anti-microbials in food production. Any tool, like developed here, that can trigger remedial action in advance of the infection can help address both concerns. Delivering it automatically without producer input using available technology will maximise adoption.

Impact

- Automated detection of pending health issues without any producer input
- Improved animal health and welfare through quicker action
- Potential reduction in the requirement for antibiotic use to treat mastitis

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VistaMilk Case Study

PREDICTING MILK SOMATIC CELL COUNT USING FLOW PROFILES

Challenge

To accurately forecast individual cow somatic cell count in a cost effective way using milking data from individual animals.

VistaMilk Solution

Milk flow profiles were used as input data to a developed machine learning model to detect subclinical mastitis. Results indicated that a gradient boosting decision tree performed best in detecting subclinical mastitis. A model performance score (area under the curve) of 0.69 was achieved using milk flow profiles as an input data source, which was deemed appropriate for the intended application.

Benefits to Industry

This study was the first to introduce milk flow profile data for subclinical mastitis detection in a conventional milking system, providing an opportunity to diversify the input indicators for data-driven mastitis studies and demonstrating that subclinical mastitis can be well identified by applying easily collected data from readily available milk meter technology.

Impact

This innovation has the potential to change the way farmers manage the somatic cell count of their bulk milk tank by having advanced visibility of their problem cows and enabling preventative action to be taken at the cow level while maintaining product quality.

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VistaMilk Case Study

CALF ACTIVITY COLLARS

Challenge

Calf welfare is of interest to consumers. However, assessing the welfare of each calf objectively on the basis of observation is challenging. Evaluating calf welfare objectively and automatically would therefore be very helpful to producers, enabling them to adapt their management and interventions; such a solution is also useful for consumers by providing information on animal welfare. Although many tools exist to monitor the behaviour of cattle, nothing yet exists for calves.

VistaMilk Solution

A tool based on machine learning models was developed to generate meaningful information on calf welfare using activity data collected from a neck-collar. For each calf, the tool provides data on activity, inactivity, lying down, running and milk consumption behaviours expressed on an hourly basis, as well as a summary of the behaviours expressed over the day or the week. The tool will be validated under farm conditions and will provide increasingly detailed information for farmers.

Benefits to Industry

Consumers increasingly expect to be reassured that farm practices guarantee animal welfare. Any tool that can be used to assess animal welfare and thus encourage appropriate welfare management by farmers can help to meet this expectation. Adopting practices that promote animal welfare could also provide direct added value for farmers (e.g. creation of welfare labels on dairy products) which may facilitate the adoption.

Impact

- Automatic monitoring of calf welfare on farm
- Improving animal welfare through early intervention and management tailored to each individual
- Promoting animal welfare on farms to reassure consumers while adding value for farmers

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VistaMilk Case Study

WIRELESS ANIMAL HEALTH MONITORING

Challenge

Wireless animal health monitoring will help monitor the well-being of cows. However, current wireless monitoring systems are costly and bulky. These limitations hinder widespread adoption. The need for an affordable, streamlined solution is imperative.

VistaMilk Solution

A novel solution was developed: an artificial intelligence-enabled batteryless and chipless radio frequency identification (RFID) and sensing system. This innovative approach aims to revolutionise cow health monitoring by offering a low-cost, efficient alternative to current systems. By eliminating the need for batteries and chips (electronics) on tags, this system reduces both operational complexity and maintenance requirements, making it an ideal solution for large-scale dairy farms.

Benefits to Industry

The implementation of this batteryless, chipless RFID sensing system presents significant benefits to the dairy industry. It offers a cost-effective approach to animal health monitoring, reducing financial burdens on farmers. The system's minimalistic design ensures ease of use on different body parts with improved animal comfort. Moreover, it streamlines the data collection process allowing for more effective herd management and quality control.

Impact

- The broader impact of this technology extends beyond basic health monitoring. One of the possible application is its integration into a smart contact lenses, designed to analyse ocular fluids for early disease detection
- This innovation has the potential to significantly enhance animal health management. Ultimately, it paves the way for more sustainable wireless health monitoring practices in the dairy industry

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VistaMilk Case Study

MID INFRARED SPECTROSCOPY FOR AUTHENTICATION OF "GRASS-FED" MILK

Challenge

The prevalence of “grass-fed” labeled food products on the market has increased in recent years, often commanding a premium price. To date, the majority of methods used for the authentication of grass-fed source products are driven by auditing and inspection of farm records. As such there is currently no routine, rapid testing method for the authentication of grass-fed dairy products from Ireland.

VistaMilk Solution

Mid-infrared spectroscopy is widely used in the dairy industry as a rapid method for the routine monitoring of individual herd milk composition and quality. VistaMilk has developed a machine learning algorithm that can be applied to routinely collected and unprocessed mid-infrared spectra that can distinguish between pasture versus indoor feeding systems derived milk with >90% accuracy.

Benefits to Industry

Harnessing the data from individual spectra offers a promising and readily implementable strategy to authenticate the milk source at both farm and processor levels. As such, the ability to verify grass-fed source claims could be of significant benefit to support the Irish grass-fed standard, claims and labelling and ensure consumer confidence into the future.

Impact

- Easily implementable strategy to support Irish grass-fed standard, labelling and traceability of Irish dairy produce
- Increased consumer confidence in the purchasing of Irish grass-fed dairy products at premium prices on the international market

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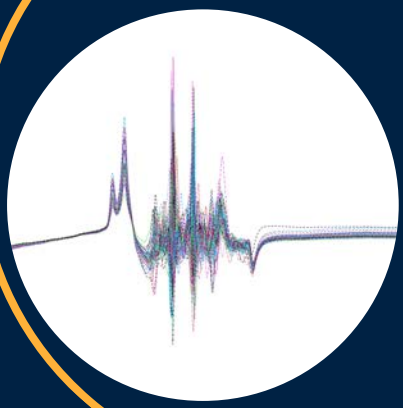
VistaMilk Case Study

USE OF MILK SPECTRAL DATA TO PREDICT ANIMAL TRAITS



Challenge

Some dairy cow phenotypes are expansive and difficult to measure limiting their use in dairy-to-day farm management but also in national breeding programs. Infrared spectroscopy data are routinely available from milk samples of individual cows and there is a biological rational as to how these data could potentially predict animal-level traits of interest.

VistaMilk Solution

Machine-learning approaches were developed to predict cow body condition score change and individual cow methane emissions from routinely taken milk samples. These data are already available for all milk-recorded cows representing approximately 66% of Irish dairy cows.

Benefits to Industry

The predicted values for body condition score change can help producers make bespoke animal decisions. The predicted values of both body condition score change and methane emissions can be incorporated into breeding programs to breed more socially and environmentally responsible animals.

Impact

- Quantification of body condition score and methane emissions for over 60% of the Irish dairy cows without any additional costs
- Possible implementation in the national breeding index

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VistaMilk Case Study

UNCERTAINTY QUANTIFICATION IN PREDICTIONS FROM MILK SPECROSCOPY DATA

Challenge

There is a growing interest in utilising routinely taken milk spectroscopy measurements to predict milk parameters such as heat stability or nutrient content. Two main sources of uncertainty in predictions are the data quality used for training the prediction models and the natural variation in the milk. Depending on the trait of interest, industry-standard prediction tools can have varying accuracy but currently there is little consideration of the inherent uncertainty.

VistaMilk Solution

A statistically principled method for generating milk features predictions from spectral measurements was developed which takes uncertainty into account but without compromising prediction accuracy. The ability to generate prediction intervals alongside the predictions reflects their credibility. The developed method can be extended to settings where highly correlated data are generated.

Benefits to Industry

Over-reliance on point predictions may have costly repercussions if there is a disparity between the predicted trait and the ground truth. Prediction intervals can indicate if it is unwise to proceed with business decisions based on the current predictions and if more data collection is required to increase credibility.

Impact

- Robust prediction tool which quantifies inherent uncertainty
- Prediction of multiple traits from spectral data at once
- More certainty when using prediction tools in decision-making

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VistaMilk Case Study

DIGITAL MILK MAP

Challenge

Ireland's milk supply is seasonal and milk composition varies over the lactation period; it can also be regionally affected by environmental factors such as weather, diet and animal health. These short term changes in composition often impact milk processing. At certain times of the year, milk yield can also complicate milk processing when the intake of milk exceeds what processors can manage.

VistaMilk Solution

A visualisation tool was developed to portray milk composition and milk yield in real time at a local level. This allows a milk processor to identify areas of high milk yield or low milk solids at different times of the year. Additional features to the milk map are planned to include short term forecasting of milk yield and composition by including weather and grass growth data.

Benefits to Industry

In its current form, if a milk processor receives milk with poor heat stability or an usual protein to lactose ratio, they can use the milk map to identify where this came from and determine if it was due to weather conditions, diet or farm management. The milk map would also allow processers to provide tailored advice to farms if it is seen that there is a trend of an erosion in milk quality in a specific location.

Impact

- Simple visualisation tool of milk yield and composition at a local level
- More consistent quality products due to enhanced knowledge of composition
- Reduce energy use and waste at processing sites by streamlined production

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VistaMilk Case Study

MILK SUPPLY FORECASTING

Challenge

Milk supply forecasting for a single farm is difficult given the multitude of variables that can impact weekly yield from changes in herd management, cow age, time-of-year or even disease outbreaks. It is even more difficult when a processor wants to predict a year ahead, rather than next week or next month.

VistaMilk Solution

A predictive model was developed to solve the full-year prediction problem for individual farms using various time-series techniques. Interestingly, using the previous year's supply to predict the next year's worked very well. However, a time-series method combined with profile comparisons performed better.

Benefits to Industry

The use of such techniques could substantially improve processors predictions of milk supply for year. Also, the method enables the profiling of top farms with a view to diagnosing the basis for their success (e.g., controlled early calving), providing a basis for improving husbandry on other farms.

Impact

- Automated detection of pending health issues without any producer input
- Producer advice on best practice from analysing farm profiles

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VistaMilk Case Study

PERSONALISED NUTRITION

Challenge

There is demand to reduce sex-specific body fat in humans.

VistaMilk Solution

VistaMilk discovered an approach to reduce body fat that is stored differently in males and females. The solution involves whey proteins, which interacts with other ingredients in the diet and cause a reduction in fat stored around the abdomen area (generally seen in males), or the specific dietary interaction can be changed to reduce fat stored around the hip and thigh area (generally seen in females).

Benefits to Industry

Exploiting the interactions between whey proteins and other ingredients in the diet, and by further processing whey proteins to deliver the related bioactivity more into the body, the body shape of males and females can be changed. This specificity of whey proteins cannot be delivered by dieting or bariatric surgery, both of which reduce both types of body fat.

Impact

- Reducing fat stored around the abdomen area will improve health (e.g. reduces the risk of diabetes).
- There is a societal burden to have specific body shapes for males and females.
- Dietary whey proteins can be tailored to deliver bioactivity for health or costmatic reasons.

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EXPERTISE

VistaMilk researchers, driven by a shared passion for sustainable digital dairy practices, explore collaborations at the intersection between soil, pasture, animal and food science with emerging technologies in sensing systems and data science. As catalysts for change, their collective efforts aim to enhance efficiency, minimise environmental impact, and elevate the dairy industry into a new era of precision breeding and management, ensuring a more sustainable and responsible future.

VistaMilk Expertise

SOIL IMAGING AND MODELLING

Soil is crucial not just to feed grass growth but also has benefits in the sequestration of carbon from the atmosphere. Because of Ireland's climate, understanding water flow through the soil and how this can be used to predict soil moisture deficit is important. Therefore, through a greater understanding of the soil component of grassland systems, we can explore opportunities to enhance grassland management.

Background

Mathematical models are useful to quantify water flow through soil at a variety of scales – from the pore scale to the catchment scale. A data-driven approach can be used to link in with other components of the entire production system.

Benefits to Industry

Better predictions throughout the growing season will enhance existing and develop new decision support tools, leading to improved grassland management which will contribute to sustainable milk production systems which efficiently utilise inputs to optimise output. A model, tailor-made to the Irish context, to describe the large-scale spatio-temporal transport of water, nutrients, and carbon dioxide through the soil, can be developed.

Areas of Expertise

- 3D non-destructive soil imaging (X-ray CATSCAN)
- Image based modelling
- Modelling of two-phase flow in a complex soil geometry
- Soil science
- Solving simulations on high-powered computers

Facilities/Equipment

- Research farms for plot research
- Soil science laboratories and equipment
- World class X-ray CASCAN facility for soil imaging
- High spec computers for image analysis and simulations
- Modelling software solutions

Range of Solutions

Bring personnel with specialist expertise and a track-record in this area. As well as state-of-the-art research infrastructure, operated for soil science research and access to super computers.

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SOIL SCIENCE

VistaMilk Expertise

VistaMilk has expertise in providing management solutions that can be adopted by farmers to enhance carbon capture, protect soil health and the expertise to model the interactions of Irish agriculture on water quality, nutrient efficiency,carbon sequestration and soil biological function.

Background

VistaMilk and Teagasc has developed capacity in understanding soil microbiome, carbon flux and sequestration in Irish soils. This will facilitate the development of baseline carbon stocks and sequestration for grassland management and carbon farming and protecting soil health.

Benefits to Industry

VistaMilk can provide measurement of soil carbon stocks and sequestration rates in Irish soils and can model these data with carbon flux determined continuously from a national network of Eddie Covariance towers. This will refine emissions factors and support carbon farming.

Areas of Expertise

- Soil analysis & understanding of mechanistic processes in Irish soils
- Ecosystem modelling
- Carbon sequestration modelling
- Data analytics and spatial analysis

Facilities/Equipment

- Access to national network of carbon towers
- High performance computing capabilities
- Soil database of Irish soil sequestration rates for agriculture
- Facilities and equipment for soil analysis

Range of Solutions

VistaMilk have access to flagship programmes such as Signpost Farms and the National Agricultural Soil Carbon Observatory network of carbon towers. Modelling expertise and soil expertise.

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VistaMilk Expertise

MICROBIOME

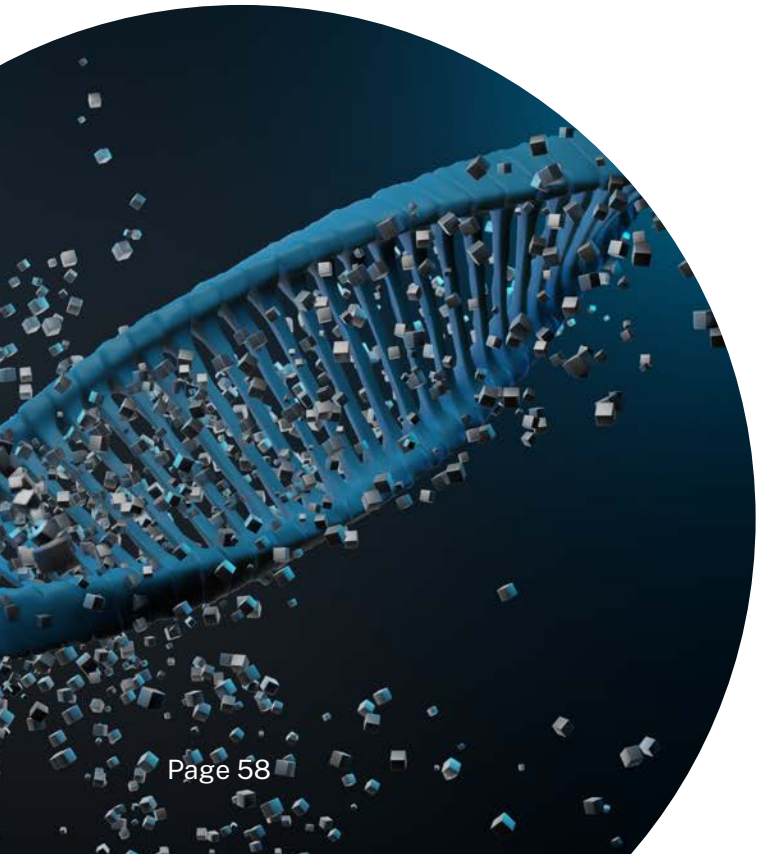
Microbes exist in every environment on earth from soil to food, and gut to rumen. These microbes play a role in essential functions including nitrogen fixation in soil, reducing methane production by livestock, impacting on the quality, safety and flavour development in foods and digestion of food in human gut and the rumen.

Background

To understand the DNA scaffold of a microbe, VistaMilk has access to world class sequencing technologies which enable us to profile these microbial communities (microbiomes) in order to understand how they function in their specific environments and how we can exploit this knowledge for improved soil and food quality and human and animal health.

Benefits to Industry

Knowledge of the DNA profile of a microbe allows us to predict how that microbe will function in an environment. We can then determine if the presence of a microbe or group of microbes will benefit an environment)e.g alter the flavour profile of a cheese). Furthermore we can identify microbes which may be causing undesirable effects such as the presence of a spoilage microbe in a processing plant.



Areas of Expertise

- Next generation sequencing
- Microbiome profiling
- Synthetic consortia (i.e. combinations of microorganisms with the potential to have desirable impacts) development
- Tailored foods
- Safety assessments of microbes for use in foods
- Data analysis

Facilities/Equipment

- Next generation sequencing facility
- High performance computing capabilities
- Culture collection
- Established pipelines for microbiome analysis

Range of Solutions

We have a suite of protocols for microbiome sequencing analysis from a variety of environments including foods, processing plants, soil, gut and rumen. Furthermore, we have robust data analysis pipelines for these microbiomes. Crucially, we can then inform partners as to how best to apply this knowledge to develop meaningful solutions.

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GRASSLAND IMAGING

VistaMilk Expertise

Ireland has a pasture-based dairy industry reliant on the supply of high quality pasture in sufficient quantities to feed dairy cows. Tools to assist farmers and advisors in grassland management are of key importance. Developing rapid phenotyping methods, such as the machine learning vision analysis developed in VistaMilk, will increase the accessibility of grassland measurement for farmers.

Background

The collaboration between University College Cork, Teagasc and the image analysis teams at Dublin City University and University College Dublin has developed machine learning models to predict herbage mass and sward composition from grassland images and ground truthed data. This will facilitate the development of image analysis methodologies for grassland measurement and management.

Benefits to Industry

We can provide accurate ground truth data and images to further develop the use of image analysis in grassland management using smart phone and/or camera images captured with drones. This will facilitate greater precision in grassland management and promote informed decision making.

Areas of Expertise

- Grassland phenotyping
- Grassland management
- Database of images and ground truth data
- Data analytics

Facilities/Equipment

- Access to national grassland database
- High performance computing capabilities
- Test-bed of research and commercial farms
- Facilities and equipment for grassland phenotyping

Range of Solutions

We have access to research farms and commercial farms. We have many plot based and grazing experiments which can contribute data, and from which images can be captured.

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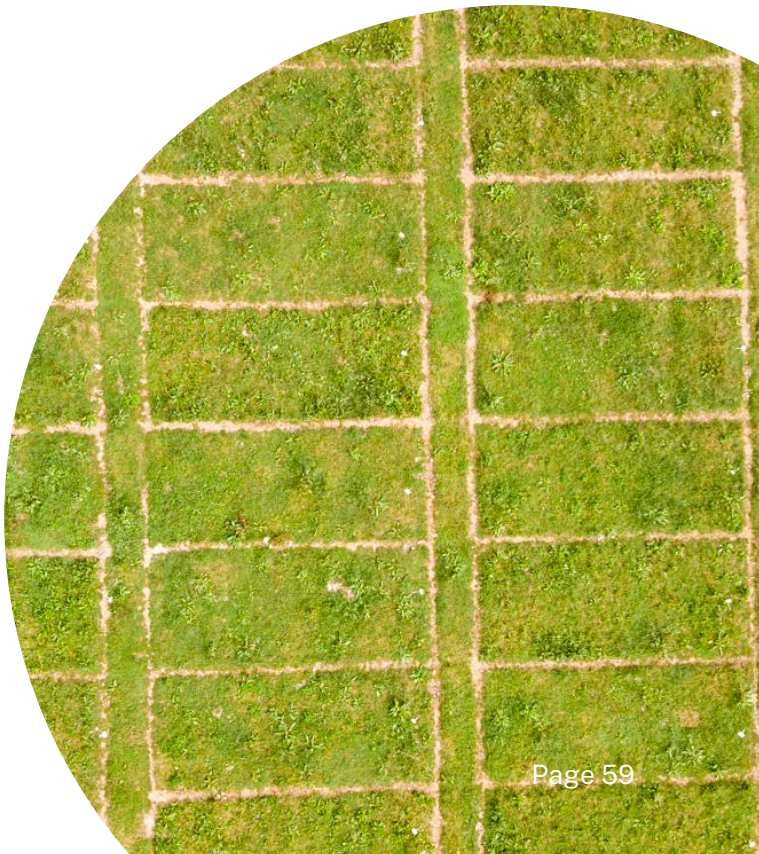

VistaMilk Expertise

GRASSLAND MANAGEMENT

Ireland has a range of grassland management tools and systems, many of which have been enhanced through VistaMilk, including PastureBase Ireland, the national grassland decision support system and national grassland database.

Background

The collaboration between University College Cork and Teagasc has developed many tools within PastureBase Ireland to enhance farmers capacity for grassland management and contribute to increasingly sustainable pasture-based milk production systems.

Benefits to Industry

We can explore opportunities to enhance grassland management through novel and traditional methods, and enhance existing and develop new decision support tools, leading to improved grassland management which will contribute to sustainable milk production systems which efficiently utilise inputs to optimise output.

Areas of Expertise

- Grassland phenotyping
- Grassland management
- Grazing research
- Measurement of dairy cow dry matter intake
- Data analytics

Facilities/Equipment

- Research farms and land area for plot research
- Grassland laboratory
- Near-infrared spectroscopy
- Wet chemistry laboratory
- Capacity to estimate grazing dry matter intake in grazing dairy cows
- Equipment and facilities to phenotype grassland swards

Range of Solutions

We have access to research farms for grassland management research, as well as the national grassland database (PastureBase Ireland), land area for plot based research and commercial farms.

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MECHANISTIC MODELLING

VistaMilk Expertise

Mechanistic models are based on the fundamental laws of natural sciences including physical and biochemical principles thereby trying to mimic reality. Mechanistic modeling generally requires less data to be developed and evaluated than other types of model. As they are based on natural laws, they can be used within reason outside of their calibration space.

Background

The VistaMilk team is developing a mechanistic model mainly in the area of grassland and dairy production. The models have been widely used including the weekly predictions of grass growth at farm level to evaluate different farm management scenarios. VistaMilk also merged a machine learning and mechanistic approach to improve grass growth predictions.

Benefits to Industry

Access to accurate models to predict the impact of different management or external factors such as climate change on the Irish systems. Mechanistic models driven by different technologies can be used in precision farming with, for example, the prediction of timing and quantity of fertiliser required for a specific location.

Areas of Expertise

- Grass growth
- Soil dynamics
- Animal intake and productivity
- Environmental impact
- System modelling
- Forecasting including climate change

Facilities/Equipment

- Usable models: grass growth, soil, animal, dairy farm
- High performance computing capabilities
- Database available for model creation and evaluation

Range of Solutions

VistaMilk has access to a range of models at different scales (soil, grass, paddock, animal, farm). The models are flexible and can be used to evaluate different *what if* scenarios and forecasting.

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VistaMilk Expertise

FORAGE BREEDING

Ireland has a significant competitive advantage in the form of an environmentally sustainable rain-fed, grass based production system that is underpinned by high-performing forage cultivars. Using new breeding tools developed within VistaMilk, we can support forage breeders in accelerating genetic gain for traits of key importance to Irish production systems, such as seasonal yield and forage quality.

Background

The collaboration between the Teagasc forage breeding group and data scientists at University College Dublin has contributed to the advancement of near-infrared spectroscopy for measuring forage quality, and the development of genomic tools to enable breeding programmes to exploit DNA based selection schemes to accelerate genetic gain.

Benefits to Industry

VistaMilk can explore opportunities to develop high-throughput phenotyping strategies for novel and traditional traits, and develop and empirically validate genomic evaluations. This will lead to the development of a strategy for forage breeding to accelerate genetic gain.

Areas of Expertise

- Phenotyping strategies
- Genomic evaluations
- Genome assembly and targeted genotyping-by-sequencing
- Practical application of genomic selection in forage breeding

Facilities/Equipment

- High performance computing capabilities
- Well-tuned pipelines for genetic & genomic analyses
- High-throughput phenotyping with a harvester-mounted near-infrared spectrometer

Range of Solutions

VistaMilk has developed high-throughput assays for targeted genotyping-by-sequencing and robust data analysis pipelines to predict breeding values from genomic evaluations and near-infrared spectroscopy.

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ANIMAL BREEDING

VistaMilk Expertise

Ireland boasts the advantage of having a centralised animal database providing one source of the truth as well as a well-accepted vechicle for the delivery of decision support to farmers. Many of the technologies developed by the VistaMilk animal breeding expert group have already deployed through these already established channels at the Irish Cattle Breeding Federation.

Background

The collaboration between Teagasc, The Irish Cattle Breeding Federation, and data scientists at University College Dublin has contributed to advancements in strategies to measure and predict performance in animals (with associated uncertainty measures) underpinned by emerging technologies like genomics, machine learning and Bayesian statistics.

Range of Solutions

We have access to large quantities of a plethora of different animal-level (and environment-level) data which, when complemented by our data analytical capabilities and capacity, can be used to quantify the usefulness and achievable deliverables from optimised breeding programs complemented by a return-on-investment analysis.

Benefits to Industry

We can explore opportunities to develop phenotyping strategies for novel and traditional traits, quantify how much of the observed inter-animal differences is due to genetic differences, develop and validate genetic evaluations with the results all leading to the development of an optimised roadmap for breeding programs to achieve genetic gain.

For Further Information Contact

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Areas of Expertise

- Phenotyping strategies
- Genetic evaluations
- Genomic evaluations
- Derivation of breeding objectives
- Breeding scheme design
- Validation of genetic evaluations

Facilities/Equipment

- Access to national database of >52m animals
- High performance computing capabilities
- Test-bed of >2,000 deeply phenotyped cattle
- Well-tuned pipelines for genetic & genomic analyses

VistaMilk Expertise

SPECTROSCOPY

Spectral data are already available for individual cows, as well as being routinely generated in milk processing industries. The potential of spectral data is not currently being fully exploited, used only for the quantification of the major milk characteristics. Many new predictions have been developed within VistaMilk and are being implemented by the Irish Cattle Breeding Federation.

Background

Researchers in Teagasc and University College Dublin collaborated to develop new prediction equations for traits like milk quality, milk coagulation properties, cow energy balance, cow methane emissions, and others. A series of traditional and machine learning approaches were explored when developing the prediction equations.

Benefits to Industry

Spectral data can be used for the determination of fine milk composition, as well as for the quantification of individual cow energy status, methane emissions, and nitrogen efficiency. Being able to quantify such information can be useful for milk processors to identify the most suitable production pathway for the milk as well as being useful for aiding decision making by farmers.

Areas of Expertise

- Generate phenotypes
- Fine milk quality composition quantification
- Prediction of individual cow traits
- Use of traditional and machine learning approaches

Facilities/Equipment

- A national milk spectral database from individual cows and bulk milk samples
- Pipeline for individual cow trait prediction

Range of Solutions

Many prediction equations have been developed for both the quantification of fine milk composition and individual cow features. Once implemented by the Irish Cattle Breeding Federation, predictions can be available for all the bodies generating spectral data.

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EPIDEMIOLOGY

VistaMilk Expertise

Epidemiology is the study of patterns of disease and infection occurrence, as well as the associations between exposures and both health and disease with the explicit aim of preventing disease and/or infection and improving animal health. In Irish dairy cattle, the data collected on indicators of infection or disease is growing.

Background

Existing collaborations exist between veterinary clinicians, epidemiologists and statisticians at VistaMilk as well as colleagues in the human health fields to translate state of the art and novel approaches in epidemiological analyses.

Range of Solutions

VistaMilk is experienced in the development of programmes and solutions at animal-, farm- and national-level for the prevention of animal infection and disease, bringing novel analytical solutions together with sound veterinary epidemiological.

Benefits to Industry

VistaMilk can explore the burden of animal health in the Irish dairy cattle population; understand drivers and predictors of infection and disease; develop epidemiological models to predict disease trajectories and inform decision making and preventive strategies with the overall aim of improving animal health through disease prevention and mitigation.

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Areas of Expertise

- Veterinary epidemiology
- Epidemiological analyses including statistical and mathematical modelling approaches
- Animal health preventive strategy development

Facilities/Equipment

- Data from various databases in VistaMilk including the VistaMilk research portal and the national cattle database

VistaMilk Expertise

CALF REARING

Calves are the building blocks of the future herd. Ensuring healthy, well-grown animals is of paramount importance to the future viability of the industry. VistaMilk has already created successful collaborations between research institutes and commercial companies to improve calf health and welfare, enhancing the sustainability of the dairy industry.

Background

Collaboration between Teagasc and commercial companies enabled the investigation of different calf management regimes to help promote calf health and welfare; examples of this include investigation of cow calf contact systems and assessing current welfare status on commercial Irish dairy farms. Teagasc and University College Dublin combined their expertise to use machine learning to develop tools to assess calf welfare.

Benefits to Industry

Approximately 1.6 million calves are born annually in Irish dairy herds. Improving calf health and welfare will help increase overall farm sustainability, thereby enhancing Ireland's reputation as a leading dairy producing nation. Consumer sentiment is growing in importance; VistaMilk provides a platform to bring industry players together in a cohesive manner to tackle issues and provide solutions to improve welfare standards on farms throughout the country.

Areas of Expertise

- Calf nutrition
- Calf health
- Calf welfare
- Calf housing/facilities
- Replacement heifer rearing
- Grazing management of young stock

Facilities/Equipment

- Access to animals on research and commercial farms
- State-of-the-art calf rearing facilities
- Databases for machine learning
- Capacity and knowledge for testing new/emerging technologies

Range of Solutions

Using VistaMilk's knowledge and experience, a wide range of issues can be explored and solutions devised. Pathways are also in place to disseminate the information to a wide audience to ensure maximum impact and uptake of technologies.

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ANIMAL HEALTH AND WELFARE

VistaMilk Expertise

Animal health and welfare is key in ensuring efficient, sustainable, and profitable production systems. In addition, the benefits of high health and welfare extend beyond the farm gate, helping to secure Ireland's position as a producer of high quality, high value dairy produce. The monitoring of animal heath allows for more informed decision making on farm, driving production, and reducing the need for reactive treatments such as antibiotics.

Background

VistaMilk's previous work has delivered technological and analytical solutions to predict health events such as mastitis and the monitoring of calf and cow behaviour via precision wearable and wireless chipless sensors. All these outcomes enable the practice of preventative medicine as well as rapid diagnosis and treatment, thus safeguarding animal welfare and enhancing the potential for reduced antimicrobial use on farms.

Benefits to Industry

Through the continued work of VistaMilk, we can drive improvements in animal welfare by enhancing and integrating previously developed solutions, coupled with new solutions, to the prevention and control of diseases such as lameness and metabolic diseases. These improvements will not only minimise losses due to disease but also provide opportunities to optimise the production efficiency, sustainability and maximise animal welfare on farm.

Areas of Expertise

- Veterinary medicine, animal welfare, and production systems
- Population medicine including herd diagnosis, preventive measures and disease control strategies
- Development and evaluation of on farm precision diagnostic sensors and machine vision systems for the detection of disease and monitoring animal behaviour
- Data analytics, machine learning and predictive modelling, and epidemiological analysis
- Creation of decision support tools for farmers
- Epidemiology and disease modelling including modelling the impact of animal health in farm systems

Facilities/Equipment

- Research farms
- Access to a network of commercial dairy herds for field based research
- State of the art diagnostic research facilities
- Clinical facilities for diagnostic imaging and diagnostics
- High performance computing capabilities

Range of Solutions

Utilising our broad range of expertise we can develop a range of precision diagnostic tools, data analytics platforms and predictive models, and decision support systems. Bring new and innovative solutions to improving animal health to the dairy industry.

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VistaMilk Expertise

METHANE

Methane emissions from enteric fermentation are a by-product of feed digestion within the animal's rumen and account for 62.5% of agricultural greenhouse gas emissions. Given that the agricultural sector needs to reduce its greenhouse gas emissions by 25% by the year 2030, developing strategies to accurately quantify and mitigate methane will be crucial to meeting Ireland's agricultural climate targets.

Background

VistaMilk has invested in a comprehensive work programme which aims to better understand and ultimately mitigate enteric methane output in Irish pasture dairy systems. This research has shown that there can be large discrepancies between predicted versus actual enteric methane emissions in dairy cows over the course of a grazing season. This research has also evaluated a range of feed additives and genetics as avenues to reduce methane output with the results incorporated in the recent iteration of the Teagasc marginal abatement cost curve.

Benefits to Industry

Generate country specific emission factors and prediction models for grazing dairy cows leading to more accurate baseline methane levels for the Irish dairy industry. VistaMilk can also evaluate the potential of differing pasture species types and management practises as well as feed additives and genetics to reduce methane output while simultaneously developing methods of capturing the abatement potential of these technologies within farm-gate and national greenhouse gas models.

Areas of Expertise

- Methane measurement using GreenFeeds
- Generation of country-specific emission factors for Irish dairy cows
- Nutritional mechanisms influencing methane output in pasture-based systems
- Evaluation of feed additives within grazing dairy systems
- Evaluation of current breeding objectives on methane output
- Development of grazing management strategies to reduce methane output in pasture-based systems

Facilities/Equipment

- Six pasture based GreenFeed units for methane measurement
- Facilities/animals to evaluate various methane mitigation strategies
- Capacity to deeply phenotype dairy cows for rumen fermentation and microbial dynamics
- Access to large scale grazing cow methane database

Range of Solutions

We can develop/evaluate a range of technologies to mitigate enteric methane output under grazing settings from differing sward types to feed additives and animal genetics.

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METHANE REMOVAL AND CONVERSION

VistaMilk Expertise

Methane is emitted by ruminant livestock. Hence any technology to reduce or remove the quantity of methane released would have societal benefits.

Background

VistaMilk has extensive experience in the development of chemical catalysts and device prototyping to design, produce and test catalysts that convert methane initially to carbon dioxide and ultimately to methanol, as a valuable chemical. VistaMilk will integrate the catalysts with energy harvesting into a mask worn over the animal's mouth to convert the emitted methane.

Range of Solutions

Materials synthesis and characterisation. Catalysis testing. Device prototyping.

Benefits to Industry

Demonstrating the power of a sustainable and integrated "atoms to systems" approach to discovery, development and testing of new materials, in this case for methane removal. The design and testing is driven by simulations which reduce lead time from 10+ years to less than 4 years. Furthermore, we can integrate these materials into prototype devices for field testing and deliver cost/societal analysis of the entire technology. This saves time, reduces cost and delivers on sustainability.

For Further Information Contact

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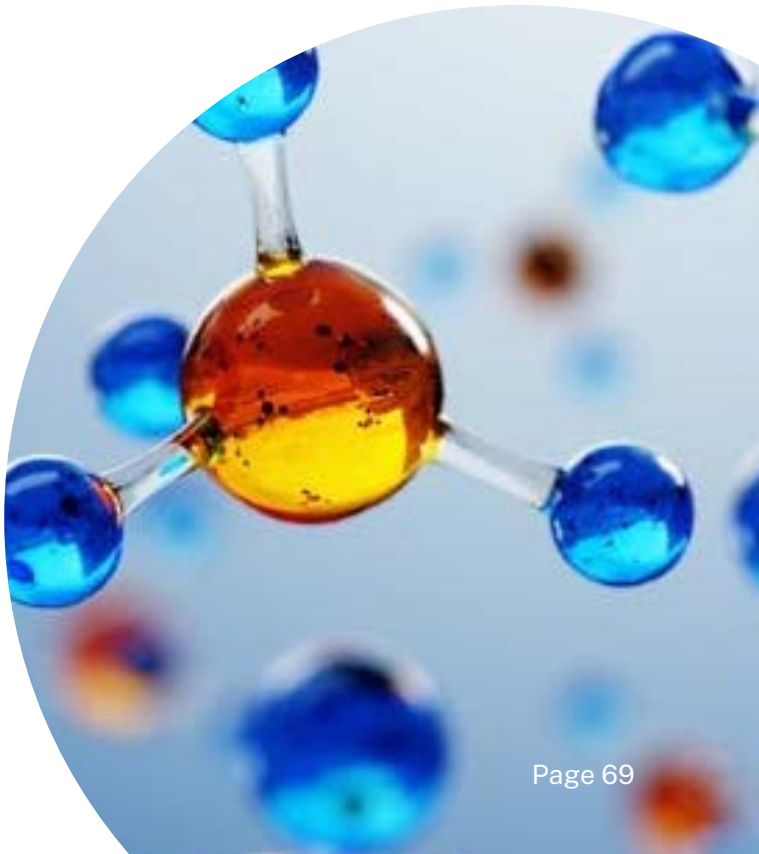
Areas of Expertise

- Chemical catalysis
- Methane conversion
- Materials design
- Device prototyping
- Life cycle analysis

Facilities/Equipment

- Local, national and European high performance computing capabilities
- State of the art simulation tools
- Materials processing and testing
- Catalysis testing
- Device prototyping



VistaMilk Expertise

PROCESS ANALYTICAL TECHNOLOGIES

VistaMilk researchers can provide specialist expertise and facilities for evaluating commercially available and novel process analytical technologies (PAT). This includes commercial PAT tools that meet industrial standards. VistaMilk offer expert knowledge and experience in the implementation of PAT for process optimisation and ensuring consistent product quality.

Background

Process analytical technologies refers to any strategy, method or instrument that maximises efficiency within a process. The adoption of cost effective, retrofittable, robust and sanitary PAT tools (e.g. inline flow properties and composition measurements) that offer tangible gains for process efficiencies are currently under-utilised in the dairy industry. The benefits of PAT include increased process and product understanding by monitoring and control of the major steps in dairy processes.

Benefits to Industry

A range of PAT tools are available in Teagasc, which can be utilised at laboratory or pilot scale, using purpose-built test beds. They can be used to measure concentrate / product behaviour from varying process conditions or different test formulations (e.g. inline composition, energy usage, viscosity. Incorporation of PAT tools) into a commercial scale process reduces waste while allowing greater process understanding (e.g. optimisation of evaporation and spray drying processes).

Areas of Expertise

- Process viscometry
- Near-Infrared
- Univariate measurements i.e. temperature, flow & pressure
- Data analysis

Facilities/Equipment

- Inline process viscometer
- Inline transflection probe with spectrometers
- Inline digital microwave sensor
- Laboratory and pilot scale test skids for evaluating performance of different process analytical technologies

Range of Solutions

The use of advanced process analytical technologies in lab or pilot scale trials for determining changes in raw milk, concentrate and final product behaviour (e.g. inline composition, process viscosity, moisture).

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EDGE COMPUTING

VistaMilk Expertise

Edge computing is the processing of data closer to where it is being generated, harnessing in-device computing capability to provide deep insights and predictive analysis in near-real time.

Background

VistaMilk has developed an industrial internet of things platform using various edge devices with optimised artificial intelligence models for on-site data analysis. As the models are optimised and implemented on power efficient and compact edge boards, they can be deployed on drones/ mobile phones.

Benefits to Industry

Opportunities to develop optimised artificial intelligence-based models for different use cases like deployment on drones, onsite monitoring of machine health for condition monitoring and predictive maintenance, and cobot gesture verification in the dairy processing chains.

Areas of Expertise

- Artificial intelligence/machine learning
- Edge computing
- Internet of things
- Wireless sensor networks
- Computer vision

Facilities/Equipment

- Industrial Internet of Things boards and edge devices
- High performance computing capabilities

Range of Solutions

Access to vast quantities of data to develop optimised models. The solutions provide analytical capabilities using drones and edge-based platforms.

For Further Information Contact

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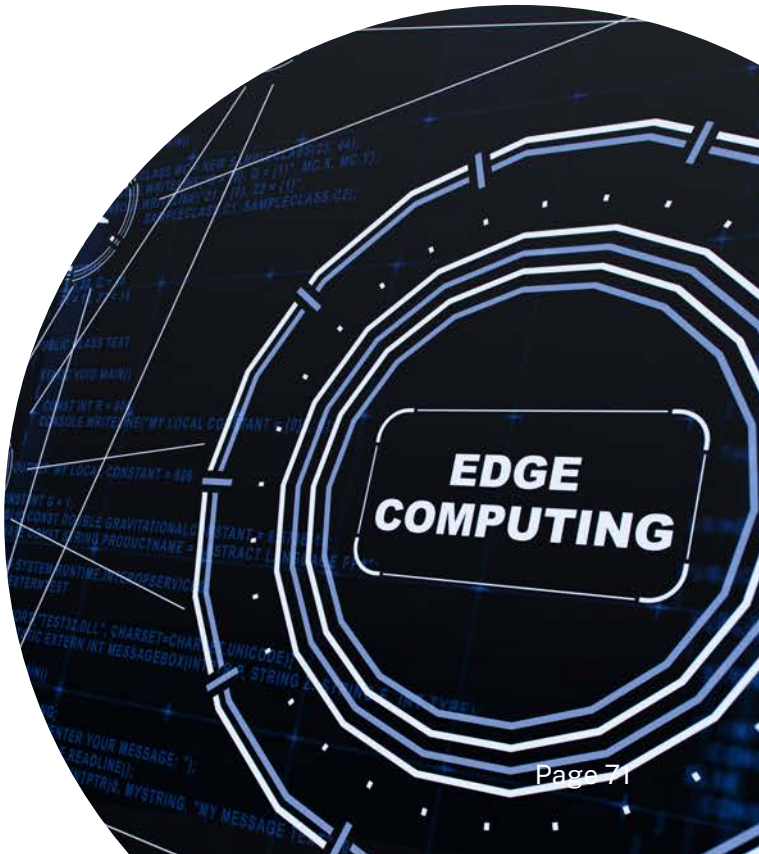


VistaMilk Expertise

MONITORING ANIMAL/GUT HEALTH USING SYNTHETIC BIOLOGY

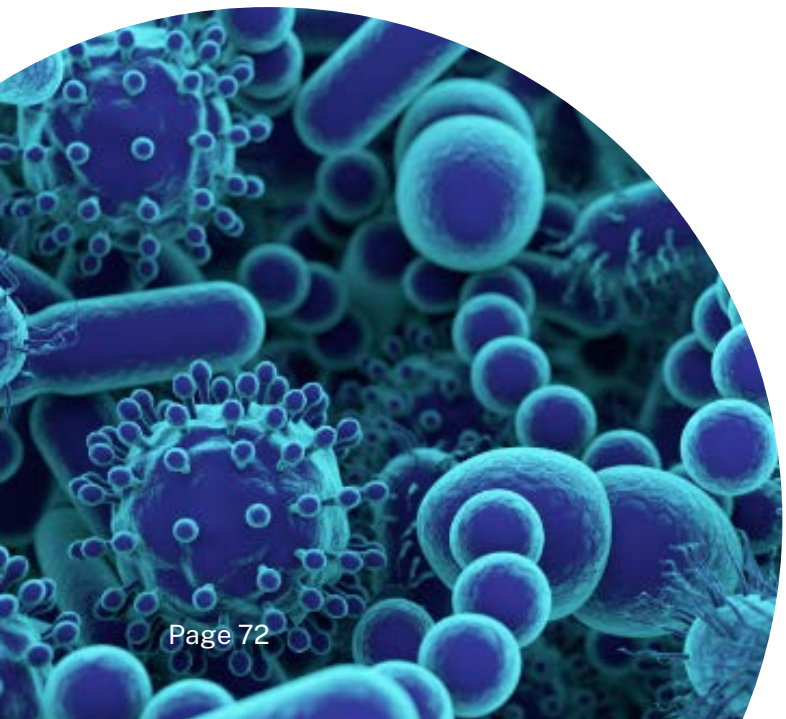
Being able to model and monitor animal health is of obvious importance, with the ability to treat or adjust factors such as feed or gut microbiome conditions offering various advantages. The use of biological reporters, being completely green and sustainable, with no power needs, can provide a very desirable solution.

Background

VistaMilk has developed synthetic biology products; microbial cells that produce proteins as a signalling event if the correct input is detected or introduced. Future work including organ-on-a-chip and custom 3D scaffolds, will develop this technology further towards novel implantables or ingestible bio-devices to monitor and improve animal health. Work is underway to produce complex cell populations that can interact with each other and the host, with an ultimate goal of releasing therapeutics as required.

Benefits to Industry

The aim is to develop these biological reporters into ingestible capsule devices, which can be recovered and provide feedback on a range of biomarkers or microbiome conditions detected, allowing action to be taken promptly. Further development is underway to produce more complex biotech which can also release therapeutic molecules or microbiome supplements/signals immediately when triggered by detection events. These devices would be custom, green, sustainable and provide immediate feedback and treatment.



Areas of Expertise

- Molecular biology techniques including gene screening, expression, genome editing
- Synthetic biology, directed evolution
- Enzymes for food/feed/agritech/environmental/pharma/health/industrial applications
- Biological molecular communications for DNA data storage and biological health monitoring

Facilities/Equipment

- Complete molecular biology suite, including gene detection and expression – real-time polymerase chain reaction systems & DNA sequencers
- Protein chromatography purification systems
- Cell bioreactors
- Complete biological analysis suite including flow cytometry

Range of Solutions

This work will develop biological monitoring/reporting devices to a certain stage, which can report on and potentially treat animal health and any detected issues. Custom devices and biomarker targets can be designed with companies.

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IMMERSIVE AND EXTENDED REALITY CONTENT AND ASSET DEVELOPMENT

VistaMilk Expertise

Immersive reality has the potential to allow users experience a physical space in an engaging, safe and accessible virtual environment. Interactive immersive experiences can be created using 360 video cameras with location-specific annotated content or using software to realise a graphic-based digital twin. These experiences can be used for virtual 'on-the-job' training, marketing and educational purposes. Additionally, data collected from scanners including drones can be incorporated.

Background

VistaMilk has a strong history of engaging with industry partners within and outside of the AgriTech sector in developing bespoke immersive reality training content for their employees with the reported benefit of improving training outcomes and quality of training materials.

Benefits to Industry

Opportunity to create bespoke digital content for immersing trainees in safe training environments to deliver improved learning outcomes through experiential learning. Digital assets for education, increased public engagement, as well as promotional activities to better showcase technologies and educate viewers. Capability to undertake aerial site surveying for tracking of factors impacting sustainability, herd management and more.

Areas of Expertise

- Audio/visual-based virtual reality content creation
- Augmented reality content and asset creation
- 3D asset creation
- Digital media production
- Drone technology

Facilities/Equipment

- Virtual Reality Suite w/ 180 degree 5m curved screen training environment
- 5 Oculus Quest 2 and 2 Pico Neo 3 Virtual Reality Headsets
- 2 HoloLens and 1 Navigator 500 assisted reality headsets
- 5 x Enterprise and domestic use drones
- Digital media 360 cameras, green screens, 3D scanners, mics

Range of Solutions

Creation of digital immersive content including 3D digital assets for training, remote assistance and education. Use of drone fleet for digital scanning, media production and broadcasting.

For Further Information Contact

sara.morrisseytucker@mtu.ie

VistaMilk Expertise

SENSOR SYSTEM DEVELOPMENT AND INTEGRATION

In the ever-evolving dairy industry, sensor technology and effective instrumentation, data capture and processing are needed to understand the intricate dynamics of animals, farms, soil, feed-stocks, milk and milk products. With access to a suitable array of sensors, agri-researchers can gain unprecedented insights into the mechanics of the dairy industry, stimulating and enabling research in precision farming, environmental impact, animal welfare and nutritional optimisation.

Background

Since inception, the Intelligent Mechatronics and RFID (IMaR) Research centre at MTU have developed rugged and deployable sensor systems to bespoke agricultural and industrial requirements for the purpose of precision measurement, data capture and processing to gain insights for the benefit of research projects.

Benefits to Industry

VistaMilk can explore opportunities in the sensing of various on-farm parameters including animal monitoring, animal housing monitoring, water quality, milk quality and parameters with industrial environments associated with food processing and process optimisation and efficiency.

Areas of Expertise

- Bespoke sensor system development: water, soil, animal health/activity, milk, industrial processing
- Sensor deployment on-farm / within processing industry
- Wireless/wired data capture - wireless/wired data capture

Facilities/Equipment

- Extensive sensor suites for agricultural, water and industrial process monitoring
- Wireless data capture base-stations and storage
- On-site, high-performance data analytics capability

Range of Solutions

VistaMilk has sensor solutions available from existing equipment and outcome of research projects which can be quickly deployed. Other bespoke sensing solutions can be developed.

For Further Information Contact

Daniel.Riordan@mtu.ie
Joseph.Walsh@mtu.ie

PROCESS DEVELOPMENT AND PROJECT MANAGEMENT

VistaMilk Expertise

Development of efficient and effective processes are critical for future agricultural production and food processing systems. Innovative process development enhances product quality, ensures compliance with regulations, streamlines operations, and reduces waste. Project management is an systematic approach to lead the work of a team to achieve project goals within given constraints. These expertise engage people to integrate technology, drive cost-effectiveness, and fast-track sustainability.

Background

Collaboration between Munster Technological University and Teagasc through VistaMilk holds transformative potential for the Agri-Food processing industry. The combined expertise can drive innovation in sustainable practices, advanced processing technologies, and product development. This synergy can result in a more resilient and competitive agricultural and food processing sector, while fostering economic growth and addressing evolving consumer demands.

Benefits to Industry

Technology solutions and manufacturing industry experience to support advancement in agricultural production and food processing sector through process design, automating processing lines, streamlining operations, enhancing efficiency and reducing labor costs. Support integration of emerging solutions to enable the development of advanced processes in areas like production, packaging and logistics to ensure food safety and quality standards.

Areas of Expertise

- Process development, validation and optimisation via lean techniques and digitialisation
- Engineering - process, manufacturing and systems focused
- Industrial automation and robotics
- Project management
- Product development

Facilities/Equipment

- Robots: for validating automation ideas
- 3D printers: for tools & fixtures design & testing for process development
- Internet of Things infrastructure: for network connectability testing

Range of Solutions

Lead transformational projects. Automate processes, reduce costs and enhance productivity. Ensure product quality and food safety, by eliminating non-value add. Integrate circular solutions.

For Further Information Contact

bobby.woods@mtu.ie

VistaMilk Expertise

DAIRY PROCESSING

The Irish dairy industry continues to be driven by high quality consumer products such as butter and cheese in addition to commodity powders including whole and skimmed milk powders, whey concentrates/isolates and caseinates. Whether Irish milk is converted into commodity or consumer products, the interplay between product and process is a key research focus at VistaMilk.

Background

VistaMilk has extensive experience in dairy processing. The core research team in the Teagasc, Food Chemistry and Technology Department have strong industry collaborations with many of the team having worked in industry roles previously. The VistaMilk team have already produced a variety of dairy isolates, butter, cheese and nutritional products utilising this expertise.

Benefits to Industry

The VistaMilk team can provide advice and research support to the Irish dairy industry in the area of energy and water use efficiency in the dairy factory, validation of innovative process analytical technologies, development of new structured and fermented foods. Also providing advanced analytical support focused on understanding the linkages between the chemistry of the milk (a complex biological system) and its behavior behavior in the process as it is converted a variety of finished product formats.

Areas of Expertise

- Mechanical and size based separation technologies
- Thermal, evaporative and drying technologies
- Process data mapping (digital shadow)
- Energy efficiency

Facilities/Equipment

- 5000 sq meter state of the art dairy pilot plant
- Dairy processing test bed
- Accredited wet chemistry and advanced analytical laboratories

Range of Solutions

Access to state of the art pilot plant processing infrastructure and associated research and analytical expertise, to convert milk into any existing or novel product format.

For Further Information Contact

john.tobin@teagasc.ie
norah.oshea@teagasc.ie

IMPROVING THE EFFICACY OF FOOD INGREDIENTS TO AFFECT HUMAN HEALTH

VistaMilk Expertise

VistaMilk can test dietary ingredients for their efficacy in affecting body tissues in order to achieve health outcomes. This efficacy can be improved to deliver the bioactivity in the food ingredients precisely to specific tissues or parts of the tissues, in order to further enhance the health outcomes.

Background

Food consumed allow tissues to grow and to carry out their biological functions. Changing the dietary components affect this process, leading to different health outcomes. VistaMilk has developed a range of food matrices that can precisely affect specific tissues and their functions. This allows new food ingredients to be tested within these matrices in order to assess how tissues and their biological functions respond.

Benefits to Industry

Our food matrices have a range of bioactivity, which (1) allow delivery of bioactives to the gut, (2) alter body fat stores in different parts of the body, (3) drive specific immune responses or (4) alter overall growth. Food ingredients of interest can be tested within these matrices, or they can be tailored to affect other biological functions.

Areas of Expertise

- Diet
- Tissue growth
- Tissue communication
- Health outcomes
- Molecular mechanisms

Facilities/Equipment

- Model systems of tissue growth and functions
- Range of assays to measure tissue activity

Range of Solutions

Test and improve the bioactivity in dietary ingredients of interest to affect specific tissues or parts of tissues, in order to enhance health outcomes.

For Further Information Contact

kanishka.nilaweera@teagasc.ie

RESEARCHER PROFILES

VistaMilk scientists are dedicated to developing novel innovative solutions to help deliver on the center's three strategic goals of food security, sustainability and prosperity and societal enrichment. The team are globally recognised subject matter experts excelling across a whole range of domains. The value-add of the center, however, what is often referred to as the center effect, is realised when these scientists cooperate and collaborate in the pursuit of VistaMilk's shared goal.

Lizy Abraham

Wireless Sensor Networks
Walton Institute, South East Technological University
Researcher
E-mail: lizy.abraham@waltoninstitute.ie

Expertise

- Wireless sensor networks
- Artificial intelligence and machine learning
- Computer vision
- Internet of Things
- Edge computing

Research focus in VistaMilk

Assessing the heterogeneity of farms in real-time with a focus on anomaly detection using edge computing

Research outcomes

Onsite monitoring of machine health of dairy equipment for condition monitoring and predictive maintenance

Research Theme

Pasture

Donagh Berry

Animal Genetics

Teagasc

Director of VistaMilk & Senior Principal Research Officer

E-mail: donagh.berry@teagasc.ie

Phone: +353 (87) 6955714

Expertise

- Animal phenotyping strategies
- Genetic analyses (all animal species)
- Genomic analyses
- Derivation of breeding objectives
- Breeding scheme design

Research focus in VistaMilk

Contribute to animal breeding research - phenotyping tools & modelling, breeding objective development, genetic & genomic predictions, mating system, validation, and breeding scheme design

Research outcomes

- Impact of research to date worth €2.62b to the Irish dairy industry through national breeding goals, breeding schemes and genomic evaluations
- Led development of the first ever national bovine custom genotyping platform
- Lead investigator in the national dairy cow and dairy-beef breeding objectives used by 17,000 farmers
- Developed mating advice decision support tools deployed via a webservice and actively used by Irish dairy and beef producers
- 5 invention disclosure forms and 1 filled patent (P12895PC00)

Graham Benham

Mathematical Modelling

University College Dublin

Lecturer/Assistant Professor in Applied and Computational Mathematics

E-mail: graham.benham@ucd.ie

Phone: +353 (0)1 716 6815

Expertise

- Mathematical modelling
- Groundwater flow, flow in porous rocks and soils
- Upscaling heterogeneities
- OpenFoam numerical simulations

Research focus in VistaMilk

Building an OpenFoam numerical model for modelling moisture content in soils based on relative permeability data extracted from soil core samples

Research outcomes

- Designed code written in Matlab for upscaling two-phase flow in heterogeneous rocks used for geological carbon storage
- Designed new approach to perform uncertainty analysis for relative permeability of heterogeneous sandstones
- Built a mathematical model and optimisation routine to improve water management for a coastal aquifer in Cyprus (used by the Cyprus water department)
- Built an OpenFoam simulation for commercial hydropower use by VerdErg Renewable Energy

Research Theme

Soil

Lorraine Brennan

Nutritional Metabolomics

University College Dublin

Professor and College of Health and Agriculture Science Vice Principal for Research

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Phone: +353 (0)1 716 6815

Expertise

- Metabolomic profiling for understanding metabolism
- Human nutrition
- Precision nutrition
- Strategies for prevention of metabolic diseases
- Food systems research

Research focus in VistaMilk

Aligned to the food theme, bringing together expertise in metabolomics and human nutrition. Contributing expertise linked to the development of innovative dairy products for optimal consumer health

Research outcomes

- Development of novel statistical packages for metabolomic analyses
- Establishment of evidence to support development of innovative foods (vitamin D enhanced mushrooms)
- Advisory role for development of EU Food2030 policy documents

Fiona Brennan

Soil and Plant Microbiome
Teagasc
Senior Research Officer
E-mail: fiona.brennan@teagasc.ie
Phone: +353 (0)25 42431

Expertise

- Soil and plant microbiome
- Agricultural impacts on soil health, microbial-soil-plant interactions and microbial functioning
- Indicators and tools for assessment of soil health
- Impact of climate stressors on microbial function
- Microbial biogeochemical cycling and greenhouse gas emissions

Research focus in VistaMilk

The identification of microbial consortia involved in important soil functions. The identification of impacts of agriculture practice on soil microbiome and subsequent functions. The development of a microbiome database and biobank for Irish soils

Research outcomes

- Development of national advice for farmers/advisors for enhancing the health of soils
- First report of E. coli naturalisation in temperate maritime soils, with important implications for use as an indicator of water quality
- Development of largest global collection of soil persistent E. coli isolates
- Identified microbial communities associated nitrogen oxide sink capacity in soil

Research Theme

Soil

John Breslin

Interoperable and FAIR data
University of Galway
Professor, College of Science and Engineering
E-mail: john.breslin@universityofgalway.ie

Expertise

- Semantic web and knowledge graphs
- Electronic engineering
- Artificial intelligence and machine/deep Learning
- Internet of things and sensors
- Social media

Research focus in VistaMilk

Facilitating interoperability through the design and development of ontologies using standardised methodologies and tools, resulting in semantic knowledge graphs connecting data across the VistaMilk system of systems

Research outcomes

- 20 years expertise in the semantic interoperability area
- Investigator at the Insight SFI Centre for Data Analytics, DERI SFI CSET
- €10 million budget held, PI/co-PI for University research funding of c. €50 million
- Co-created the SIOC interoperability framework, implemented in hundreds of applications (by Yahoo, Boeing, Vodafone, etc.) on at least 65,000 websites with 35 million data instances
- Founding member of the Knowledge Graph Alliance
- Director of the AgInnovate master's programme

Giulia Bondi

Soil Carbon Sequestration
Teagasc
Senior Research Officer
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Phone: +353 (0)53 917 1250

Expertise

- Soil health and soil function
- Soil carbon cycling, carbon sequestration, carbon inventory
- Soil ecosystem services and threats
- Development and testing soil quality monitoring tools at a national level
- Sustainable soil management practices development

Research focus in VistaMilk

Contributing to measure, understand, model, and exploit the benefits of optimum soil health and management in promoting carbon sequestration

Research outcomes

- Leader of the soil sampling campaign for carbon inventory of the Teagasc Signpost Programme
- Impact of research to date worth ~€4.13m; personal €~2.15m
- Led development of the first national database on soil quality and carbon sequestration, over 3,200 field points, including soil, management, climatic and spatial data
- Led development of methodologies and tools to easily assess soil quality by various stakeholders
- Developed activity of knowledge transfer and training for advisors/consultants and industry reps on soil quality assessment techniques

Research Theme

Soil

André Brodkorb

Food Digestion
Teagasc
Principal Research Officer
E-mail: andre.brodkorb@teagasc.ie
Phone: +353 (0)25 42431

Expertise

- Structure/function of food proteins
- In vivo and in vitro food digestion
- Dairy food structures
- Alternative food proteins

Research focus in VistaMilk

To lead the in vitro digestion platform of dairy and non-dairy protein foods

Research outcomes

- Technology transfer from Teagasc patent to licencing and Startup company Anabio Technology Ltd.
- Research income of €27.1m, of which €7.96m as project coordinator or major pillar/work package lead, plus >€1.6m direct client income (as coordinator only)
- Invited expert on Joint FAO/WHO Expert Meetings on Nutrition, nitrogen to protein conversion factor (JEMNU), WHO Headquarters, Geneva, Switzerland, July 2019
- Host to >20 live international webinars with over 5,000 live views and more than 20,000 international views on YouTube Infogest channel; administrator of the food digestion LinkedIn group with 1,800 followers and YouTube channel on food digestion with over 91,000 views

Caroline Brophy

Statistics

Trinity College Dublin

Professor in Statistics, School of Computer Science and Statistics

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Phone: +353 (0)1 896 1830

Expertise

- Statistical modelling
- Modelling agri-ecosystems
- Modelling the biodiversity and ecosystem function relationship
- Climate change mitigation in agricultural ecosystems
- Modelling hierarchical data

Research focus in VistaMilk

Statistical modelling in the Pasture theme, including the assessment of increased species diversity in productive grasslands for improved agronomic and environmental outcomes and species persistence in such swards over time

Research outcomes

- R statistical software packages: Dimodels (>12k downloads since publication in 2020), PieGlyph (published in 2023, several hundred downloads already)
- Developed statistical methods that are state-of-the-art in modelling the biodiversity and ecosystem function relationship
- The provision of multiple lines of evidence of the multifunctional benefits of increased species and functional group diversity in productive grasslands that is impacting on policy decisions for on-farm practices

William Burchill

Sustainable Agriculture
University College Cork
FBD Lecturer in Sustainable Agriculture
E-mail: WBurchill@ucc.ie

Expertise

- Nitrogen use efficiency
- Biological nitrogen fixation
- Nitrous oxide emissions
- Manure management
- Ammonia emissions

Research focus in VistaMilk

Quantifying strategies to reduce greenhouse gas and ammonia emissions from the manure management chain within Irish pasture based systems. Identifying alternative drought tolerance forage legume to develop more sustainable and resilient swards for Irish pasture based systems

Research outcomes

- Development of the marginal abatement cost curve for ammonia emissions from Irish agriculture
- Contributed to the revised Teagasc Greenbook - a guide for nutrient management planning in Ireland
- Developed a nitrogen use efficiency calculator which has been incorporated into Pasturebase Ireland
- Research has led to the refinement of Ireland's national ammonia emissions reporting to the EU

Lee Coffey

Molecular Biology
South East Technological University
Lecturer and Researcher, Department of Science
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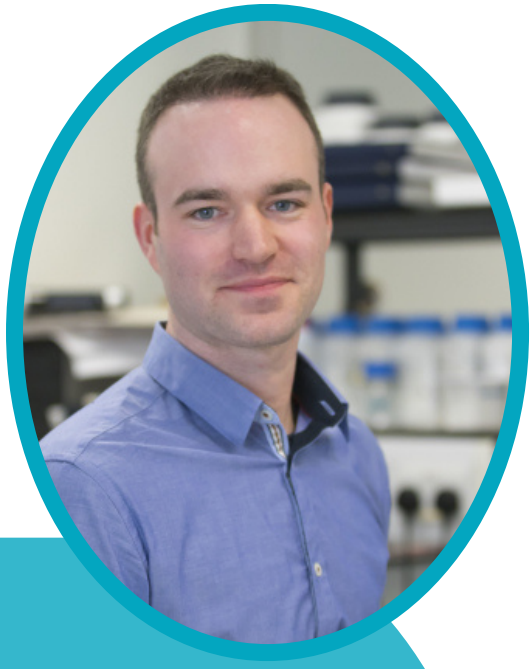

Expertise

- Molecular biology techniques including gene screening, expression, genome editing
- Synthetic biology, directed evolution
- Enzymes for food/feed/agritech/environmental/pharma/health/industrial applications
- Biological molecular communications for DNA data storage and biological health monitoring

Research focus in VistaMilk

Use of synthetic biology, organ-on-a-chip and novel implantables/ingestible bio-devices to monitor and improve animal health

Research outcomes

- Developed bacteria that act as information relays and base stations
- Successful use of synthetic biology for a range of applications such as to enhance gene therapy and in molecular communications
- Founder of an EI-funded spin-out company, with >4000 biological technologies licensed and patent pending technologies developed
- Principal Investigator for previous SFI Project 20/COV/0097
- Published two articles *'Modulated Molecular Channel Coding Scheme for Multi-Bacterial Transmitters'* and *'Hydrogel-based Bio-nanomachine Transmitters for Bacterial Molecular Communications'*

Paul Cotter

Microbiology

Teagasc

Head of Food Biosciences/Senior Principal Research Officer

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Phone: +353 (0)25 42694

Expertise

- Food and health microbiome research
- Gut microbiome
- Fermented/functional foods
- Food and food chain microbiomes
- DNA sequencing

Research focus in VistaMilk

Food and health research, gut microbiome digital twin

Research outcomes

- Establishment and ongoing management of Teagasc DNA Sequencing Centre (including lead of Irish Coronavirus Sequencing Consortium)
- Extensive engagement (including multiple projects) with industry including Danone, Novozymes, PepsiCo, Kerry, Tirlan, Carbery, Dairygold, DSM, FrieslandCampina and many others
- Co-ordinator of EU innovation action 'MASTER' focus on microbiome applications of relevance to sustainable food systems (29 partners, €10.9m) that generated 24 impactful outputs relating to marine, plant, soil, rumen, fermented foods, waste valorisation and gut health (strains, consortia, protocols, kits, products, databases and pipelines)
- 9 patents and 21 Invention Disclosure Forms, relating to novel antimicrobial peptides, food quality and safety, new probiotics and biotherapeutics and functional foods
- Chief technical officer and co-founder of SeqBiome Ltd.

Silvia D'Angelo

Statistical Modeling
Trinity College Dublin
Lecturer/ Assistant Professor in Statistics
E-mail: dangelos@tcd.ie

Expertise

- Statistical modeling
- Statistical network analysis
- Latent variable models for clustering and dimension reduction
- Statistical methods for nutrition and metabolomics
- Bayesian statistics

Research focus in VistaMilk

Development of statistical methods starting from data-motivated problems, with applicaton to complex/ high-dimensional data, where either the existing methods are not adequate or there is no methodology for data analysis

Research outcomes

- Development of new statistical models and applied statistical methods that have lead to publication in top statistical and scientific journals
- Development of open source statistical software and web applications

Karen Daly

Soil Science
Teagasc
Senior Research Officer
E-mail: karen.daly@teagasc.ie
Phone: +353 (0)53 917 1283

Expertise

- Developing indicators of soil health
- Spectroscopy
- Chemometrics
- Mitigation measures for water quality at farm and catchment scale
- Soil carbon sequestration

Research focus in VistaMilk

Develop strategies to improve soil health to increase soil carbon sequestration, increase soil biodiversity levels, protect water quality, increase nutrient use efficiency and grass growth, develop proximal sensing for soil data and upscaling models

Research outcomes

- Developed an Invention Disclosure Form and commercialisation plan for licensing soil spectral libraries for rapid analysis of 11 soil attributes using infrared spectroscopy
- Fund awarded for market analysis and customer discovery

Research Theme

Soil

Michael Dineen

Animal Nutrition
Teagasc
Senior Research Officer
E-mail: michael.dineen@teagasc.ie
Phone: +353 (0)25 42378

Expertise

- Animal nutrition
- Feed chemistry
- Nutritional modelling
- Animal physiology
- Pasture-based systems

Research focus in VistaMilk

Contribute to the pasture and animal themes, as well as, the system of systems - reduce environmental nitrogen emissions, reduce enteric methane emissions, improve nutritional modelling software, optimise pasture-based systems

Research outcomes

- New analytical feed chemistry and digesta flow quantification procedures
- Quantified novel bacterial and protozoal rumen dynamics as well as amino acid supply in pasture-fed cows
- Modified the Cornell Net Carbohydrate and Protein System (CNCPS) model for Irish dairy cows
- Demonstrated efficacy of a number of nutritional strategies to reduce enteric methane and environmental nitrogen emissions

Research Theme

Animal

Katarina Domijan

Statistical Modelling
Maynooth University
Assistant Professor, Mathematics and Statistics
E-mail: katarina.domijan@mu.ie
Phone: +353 (0)1 708 3374

Expertise

- Statistical modelling
- Statistical machine learning
- Data and model visualisation

Research focus in VistaMilk

Contributing to the analysis of data originating from the different thematic areas and platforms as well as advancing statistical modelling techniques

Research outcomes

- Author (and co-author) of 28 peer reviewed papers, zenodo published datasets and six software packages in R with over 150,000 downloads
- Contributed in the role of a collaborator and co-investigator to interdisciplinary projects that secured over one million euro in funding
- Contributed to two published reports to Safefood and New Zealand Ministry of Agriculture and Fisheries.

Kevin Doolin

Information Systems
Walton Institute, SETU
Executive Director
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Phone: +353 (0)51 302 935

Expertise

- Internet of Things / Pervasive computing
- Data and interoperability
- Outreach and commercialisation

Research focus in VistaMilk

Introduction of new projects addressing multi-system interoperability

Research outcomes

- Coordination of large scale (60 partner) agri interoperability project (h2020-demeter.eu)
- Engagement with regional and international stakeholder communities for research valorisation

Research Theme

System-of-systems

Denis Dowling

Manufacturing Processes
University College Dublin
Professor, I-Form Centre Director
E-mail: denis.dowling@ucd.ie
Phone: +353 (0)1 716 2970

Expertise

- Additive manufacturing
- Materials processing
- Digitalisation of manufacturing processes
- Surface engineering

Research focus in VistaMilk

Digitalisation of manufacturing processes to the spray drying process. Specifically the application of a recommender system to provide operator feedback based on sensor data obtained during dairy powder spraying. Amongst the data collected will be the inlet and outlet air humidity and temperature, these parameters will in-turn be correlated with parameters such as powders moisture content

Research outcomes

- 8 technology licences to companies
- 2 start-up companies directly associated with my research group
- 2 spin-in companies associated with my research group, researchers in my group have received 19 awards for best posters, conference presentations etc.
- Actively involved in developing and implementing introductory 3D printing programmes, for both primary and secondary schools in Ireland, as well as internationally

Michael Egan

Grassland Management
Teagasc
Research Officer
E-mail: michael.egan@teagasc.ie
Phone: +353 (0)25 42700

Expertise

- Legume agronomy
- Grassland management
- Factors affecting animal dry matter intake and methane emissions
- Nitrogen fertiliser application
- Biological nitrogen fixation

Research focus in VistaMilk

Improve the establishment and production of legume swards by increasing the agronomic understanding of individual plants; quantifying biological nitrogen fixation in grass/legume swards and develop nutrient application strategies to optimise grass/legume production and persistence; identify rhizobial inoculants to enhance N fixation

Research outcomes

- Led seasonal grazing management programme in Moorepark for 7 years
- Redefined grazing management targets and early lactation management for grassland farmers
- Developed and led the on farm 'Clover150' programme for the past 4 years
- Developed a clear blueprint for the establishment of legumes on farms and a chemical nitrogen reduction strategy

Research Theme

Pasture

Rowan Fealy

Climate Modelling
Maynooth University
Professor
E-mail: rowan.fealy@mu.ie
Phone: +353 (0)1 708 4562

Expertise

- Land surface & climate modelling
- Energy, water, carbon exchanges
- Biogeochemical modelling
- In-situ monitoring

Research focus in VistaMilk

Biogeochemical & land atmosphere modelling

Research outcomes

- Co-Lead Terrain-AI project
- Artificial Intelligence Award for Sustainability 2021 (co-recipient)
- US-Ireland Research Innovation Award - Innovation in Sustainability 2022 (co-recipient)

Research Theme

System-of-systems

Mark Fenelon

Food Processing
Teagasc
Head of Food Programme
E-mail: mark.fenelon@teagasc.ie
Phone: +353 (0)25 42355

Expertise

- Dairy chemistry and processing (thermal, separation and dehydration)
- Dairy ingredient functionality
- Food protein, carbohydrate and mineral interactions
- Processing of liquid and dehydrated dairy and plant based formulations
- Dairy ingredient and nutritional beverage manufacture (including infant formula)

Research focus in VistaMilk

Dairy chemistry and processing - the impact of animal, grass and soil on milk composition / functionality during processing and effect on the quality of finished dairy products. Effect of variation in milk composition on the processability and functionality of dairy ingredients and use in food applications. Use of chemistry and spectroscopy tools to predict changes in milk heat stability and rennet / acid coagulation of milk - link to the digital milk map from VistaMilk phase 1

Research outcomes

- Spectroscopy-based methodology for determination of heat stability in milk using attenuated total reflectance developed
- Invention Disclosure Form on milk stability sensor
- Trend analysis and prediction of seasonal changes in milk composition from a pasture-based dairy herd completed (published/client work)
- Prototype for a digital milk map developed with University College Dublin
- Study completed on the impact of whey source on head-induced aggregation of casein and whey protein mixtures - relevance to infant formulation
- Lead on €3m plant based valorisation project - developed process for valorisation of protein, starch and fibre from plant-based materials.

Research Theme

Food

Michael Fop

Statistical Modeling
University College Dublin
Lecturer/Assistant Professor in Statistics
E-mail: michael.fop@ucd.ie

Expertise

- Statistical modeling
- Model-based unsupervised and supervised learning
- Latent variable models for clustering and dimension reduction
- Variable selection
- Statistical network analysis
- Bayesian optimisation and analysis of computer experiments

Research focus in VistaMilk

Contribute to applied and methodological research through the development of novel application-motivated statistical and machine learning methods for the analysis of complex and high-dimensional data

Research outcomes

- New statistical and machine learning approaches which have led to publications in top statistical and scientific journals
- Production of impactful statistical software and code

Paul Galvin

Sensing Systems

Tyndall National Institute, UCC

Head of ICT for Health Strategic Programmes, Head of Life Sciences Interface Group, and Head of Bioelectronics Cluster

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Phone: +353 (0)21 234 6030

Expertise

- Development of biosensors and systems for wearable, minimally invasive and implantable applications
- Development of sensors and systems for liquid bioprocess monitoring
- Development of sensors, systems and artificial intelligence for monitoring animal welfare
- Biosensors for monitoring of selected biomarkers indicative of health and wellbeing.

Research focus in VistaMilk

Renewable energy and energy efficiency in agriculture, Agri-photovoltaics, energy data analytics, electrification of farming, energy system integration in agriculture, electrical infrastructure utilisation and smart grids

Research outcomes

- Prototype miniature electrochemical instrument
- Prototype smart bolus system for microbiome sampling and pre-processing
- Prototype biosensor system for inline processing of complex media
- AI solution for identification of animal posture from wearable sensor devices
- Electrochemical sensors for monitoring of stress and other biomarkers

Research Theme

Emerging Technology

Linda Giblin

Molecular/Cellular Biology
Teagasc
Principal Research Officer
E-mail: linda.giblin@teagasc.ie
Phone: +353 (0)25 42614

Expertise

- Food digestion and bioavailability
- In vitro models of gut barrier
- Foods for health at different life stages (infant and older adult)
- Bioactive peptides
- Assessment of environmentally sustainable food systems to deliver healthy foods

Research focus in VistaMilk

Contribute to food research, evaluate foods and processes on human health

Research outcomes

- Impact of current research has resulted in >€5m funding allocated to lab including 12 industry projects
- Lead international investigator in developing protocols for food digesta studies on human cells
- >70 peer reviewed publications (37 as senior author), 5 invited book chapters, h-index of 33 (i10index=55), 1 Invention Disclosure Form
- Core group & work group 3 leader within INFOGEST network (400 scientists international network)
- Industry Advisory Panel for Munster Technology University BSc (hons) Nutrition and Health Science programme

Claire Gormley

Statistics
University College Dublin
Professor, in School of Mathematics and Statistics
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Expertise

- Statistical modelling
- High-dimensional data
- Modelling spectral data
- Bayesian methods

Research focus in VistaMilk

Develop novel, next generation analytical techniques to appropriately model the multimodal, multiresolution and multipurpose data generated across the soil to society pathway

Research outcomes

- Development of probabilitic approaches to predict milk traits from spectral data, providing predictions and their associated uncertainty
- Provision of open source software to facilitate widespread use of developed tools

Research Theme

AgriFood Informatics

Caitriona Guinane

Applied Biosciences

Munster Technological University

Lecturer and Principal Investigator, Department of Biological Sciences

E-mail: caitriona.guinane@mtu.ie

Phone: +353 (0)21 433 5598

Expertise

- Bacterial genomics
- Antimicrobial peptides (Bacteriocins)
- Probiotic traits and genomic safety analysis
- Gut microbiome and impact on health/simulated colon models
- Functional food development

Research focus in VistaMilk

Food and Health. Development of prebiotics and probiotics. Functional food development & novel dairy foods for personalised nutrition

Research outcomes

- Two Invention Disclosure Forms on probiotic strains
- A European and International PCT application on a probiotic strain has been filed by MTU and Teagasc (Publication No: WO 2023/118232)
- Member of NutRI research group, Munster Technical University
- In vitro bioassay pipelines developed for streamlined screening of probiotic traits

Mark Healy

Civil Engineering
University of Galway
Professor
E-mail: mark.healy@nuigalway.ie

Expertise

- Fate of contaminants in soil-plant-water systems
- Effects of agricultural management on soil and water quality
- Flow and remediateion of nutrients and contaminants in the environment

Research focus in VistaMilk

Soil - carbon sequestration, nutrient cycling, water purification/regulation

Research outcomes

- Awarded a Doctorate in Engineering based on published research and contribution to the state-of-the-art
- Principal investigator for more than 30 research projects that have focused on various aspects of soil, water, wastewater, and their interaction with the environment
- Three Invention Disclosure Forms based on the output from my research group's research
- Received funding for feasibility funding from Enterprise Ireland for all three IDFs (EI reference: IV-2017-2060 for two technologies; CF-2017-0643-Y and SI 2020 3014 for the third)

Research Theme

Soil

Deirdre Hennessy

Grassland
University College Cork
Lecturer
E-mail: deirdrehennessy@ucc.ie
Phone: +353 (0)21 490 4696

Expertise

- Grassland management
- Grassland agronomy including grass and clover growth
- White clover
- Nitrogen fertiliser management
- Grassland phenotyping

Research focus in VistaMilk

Contribute to pasture research - rapid phenotyping - image analysis to predict herbage mass, sward composition, herbage quality; quantifying biological nitrogen fixation in grass white clover swards; quantifying nitrogen mineralisation in grassland swards; development of nutrient sensors

Research outcomes

- Led white cover research programme at Teagasc for 10+ years
- Secured Department of Agriculture, Food and Marine Research Stimulus Funding that ultimately led to development of the MoSt grass growth model
- Lead the research team working on using image analysis for grassland phenotyping in VistaMilk
- 3 Invention Disclosure Forms

Rita Hickey

Food Science
Teagasc
Research Officer
E-mail: rita.hickey@teagasc.ie
Phone: +353 (0)25 42227

Expertise

- The biological properties of sugars/oligosaccharides isolated from food sources
- The effect of food derived oligosaccharides on host-microbial interactions in the gut
- The extraction, enrichment, fractionation and structural analysis of oligosaccharides
- Development of bioassays for investigating the bioactive glycans

Research focus in VistaMilk

Identifying high value milk components at high concentrations from individual cows (e.g. levels of immunoglobulin G, lactoferrin, gangliosides) and understanding the genetic basis for increased production of these bioactives. Investigating factors impacting the levels of glycosylation in milk

Research outcomes

- 3 patents and 5 Invention Disclosure Forms
- External funding >€2.6m, Current funding =50% Industry, recent Start fund awarded
- 47 journal publications, 15 book chapters, 8 invited reviews,
- Editorial board-Journal of Functional Foods

Research Theme

Food

Sean Hogan

Dairy Chemistry
Teagasc
Research Officer
E-mail: sean.a.hogan@teagasc.ie

Expertise

- Dairy chemistry
- Dairy ingredients processing and functionality
- Milk fat chemistry and analysis
- Effects of seasonality on dairy products manufacture and quality
- Physico-chemical characterisation of foods

Research focus in VistaMilk

Seasonality, dairy chemistry, milk fat, butter, proteins, fatty acids phospholipids, processing, dietary-compositional relationships, dairy products quality, functionality, structure, infant formula, nutrition

Research outcomes

- Lead investigator in Teagasc milk fat research platform
- Development of improved process efficiencies in industrial butter manufacturing
- Investigator in national and EU projects
- Establishment of state-of-the-art food structure characterisation methods.

Research Theme

Food

Daniela Iacopino

MicroNano Systems
Tyndall National Institute, UCC
Senior Researcher
E-mail: daniela.iacopino@tyndall.ie
Phone: +353 (0)21 234 6182

Expertise

- Nanomaterials synthesis and self-assembly
- Printing and writing fabrication (laser, pen, inkjet printing, screen printing)
- Electrochemical (sustainable) sensing and energy storage
- Lateral flow devices
- Raman and surface enhanced raman scattering

Research focus in VistaMilk

Development of lateral flow devices with dual detection, sensors for food quality monitoring, electrochemical sustainable sensors, wearable sensors

Research outcomes

- Developed novel lateral flow systems with dual visual/ surface enhanced raman scattering detection.
- Decreased the production cost of the device by using direct pen writing techniques to deposit the diagnostic components of the test
- Demonstrated detection of residual penicillin B in milk
- Developed dual electrochemical/surface enhanced raman scattering detection of food contaminants melamine in milk and antibiotics in tap water
- Currently developing flexible electrochemical sensors for detection of antibiotics
- Developed low cost supercapacitors for the powering of small IoT devices

Felicity Kelliher

Socio-Economics
South East Technological University
Professor of Management Practice
E-mail: felicity.kelliher@setu.com

Expertise

- Management capability development
- Rural network development
- Action research
- Living labs
- Change management

Research focus in VistaMilk

Socio-economic perspective when considering supply chain. Study of longer term impact of power-based relationships within the supply chain

Research outcomes

- Engaged with over 1,200 small and medium sized enterprises through research using living labs
- Work closely with rural innovators and small and medium sized enterprises to co-design and delivery plans that directly impact participant organisation owner/ managers' management, innovation, and strategic capability development
- Contribute to the wider academic and practice communities and am a member of the Rural Development Expert Group, Department of Rural and Community Development, Government of Ireland, 2019-current

Margaret Kelleher

Animal Genetics
Irish Cattle Breeding Federation
Genetics Operations Manager
E-mail: mmkelleher@icbf.com

Expertise

- Genetic evaluations for dairy and beef cattle in Ireland
- Breeding objectives
- Genetic analysis on the national population
- Decision support tools like the cow's own worth index for dairy cows
- Applying research outcomes into useable industry applications

Research focus in VistaMilk

Contribute to animal breeding research with a focus on wider application to industry

Research outcomes

- Development a culling index for dairy cows and successfully deployed to industry via the national database
- Led a team of researchers across various organisations to update and upgrade the beef breeding objectives which has deployed to industry
- Part of a team that introduced and deployed carbon into the national dairy and dairy-beef breeding objectives
- Genetic analysis involving sexed semen with results shared nationally and internationally
- Run routine national and international genetic evaluations that are published bi-monthly

Research Theme

Animal

Emer Kennedy

Calf Welfare
Teagasc
Senior Research Office, Dairy Enterprise Leader
E-mail: emer.kennedy@teagasc.ie
Phone: +353 (0)25 42382

Expertise

- Calf health
- Calf welfare
- Calf management
- Replacement heifer rearing
- Grazing management

Research focus in VistaMilk

Contribute to animal disease and well-being research. Smart technologies to weigh, assess animal health and welfare of calves and youngstock. Strategies to reduce antimicrobial use

Research outcomes

- Colostrum management protocols for improved calf health
- Developed on-farm calf welfare assessment protocol
- Replacement heifer rearing guidelines
- Tools to improve calf welfare

Research Theme

Animal

John Kenny

Food Science
Teagasc
Senior Research Officer
E-mail: john.kenny@teagasc.ie
Phone: +353 (0)25 42283

Expertise

- Microbial genomics
- Microbial engineering
- Bacteriophage
- Sequencing technologies and associated automation
- Synthetic biology

Research focus in VistaMilk

Contribute to research on fermented food, microbiome work, including application of sequencing technologies

Research outcomes

- Manager at Centre for Genomic Research, University of Liverpool
- Developed automated solutions for various liquid handling manufacturers and reagent providers
- Technique and database developed for Next Generation Sequencing applications

Research Theme

Food

Kieran Kilcawley

Food Chemistry
Teagasc
Principal Research Officer
E-mail: kieran.kilcawley@teagasc.ie
Phone: +353 (0)25 42245

Expertise

- Flavour chemistry foods and beverages
- Cheese biochemistry
- Fatty acid analysis
- Gas chromatography mass spectrometry
- Sensory analysis and olfactometry

Research focus in VistaMilk

Factors influencing sensory quality of dairy foods - focus on volatilome and fatty acid profiles, lipid oxidation, consumer perception

Research outcomes

- Identifying volatiles that impact sensory perception and consumer acceptance
- Impact of bovine diet on fatty acid profile, volatilome and sensory perception milk dairy products
- Impact of pasture and concentrate diets on volatilome of beef and lamb meat
- Application of 2 dimensional gas chromatography mass spectrometry in foods and beverages
- Technical services to industry regarding lipid oxidation, fatty acids, volatiles and olfactory analysis

Anastasia Ktenioudaki

Wireless Sensors
South East Technological University
Researcher, Department of Land Sciences
E-mail: anastasia.ktenioudaki@wit.ie

Expertise

- Supply chain management
- Wireless sensor networks
- Analytics
- Digital supply chain

Research focus in VistaMilk

Food quality integrated sensors - support cutting edge data acquisition and analytical techniques that will translate into actionable solutions

Research outcomes

- Reduction in food waste
- Food security
- Sustainable food supply chains

Research Theme

Emerging Technology

Ben Lahart

Methane Measurement
Teagasc
Research Officer
E-mail: ben.lahart@teagasc.ie
Phone: +353 (0)25 42511

Expertise

- Methane measurement using GreenFeed technology
- Nutritional factors influencing methane output
- Grazing management
- Feed additives
- Animal phenotyping

Research focus in VistaMilk

Development of improved prediction models for methane output of grazing dairy cows as well as the development of strategies to reduce methane output in grazing dairy systems - specifically focusing on the evaluation of pasture type and management as well as feed additives and genetics

Research outcomes

- Generation of country specific emission factors for pasture-based dairy cows for use in greenhouse gas models
- Contribution of genetic and nutritional strategies to reduce methane output from dairy systems within the Teagasc marginal abatement cost curve
- Three Invention Disclosure Forms

Research Theme

Animal

Gary Lanigan

Carbon Sequestration
Teagasc
Research Officer
E-mail: gary.lanigan@teagasc.ie
Phone: +353 (0)53 917 1216

Expertise

- Quantifying mitigation strategies for gaseous emissions associated with agricultural practices
- Quantifying the effects of changes in land management and/or land use on nitrous oxide, carbon and ammonia fluxes
- Quantification of soil carbon sequestration across tillage, grassland, peatlands and forestry
- Modeling and stable isotope use to quantify carbon and nitrogen losses in farming systems to quantify emissions and carbon sequestration

Research focus in VistaMilk

Contribute to the soil research theme with a particular focus on measurement and modeling of carbon sequestration and greenhouse gas emissions

Research outcomes

- Developed and lead author of the Teagasc marginal abatement cost curve for carbon and ammonia for Ireland
- Co-leader in the establishment of the Irish National Agricultural Soil Carbon Observatory

Research Theme

Soil

Pierre Lovera

Electrochemistry
Tyndall National Institute, UCC
Researcher
E-mail: pierre.lovera@tyndall.ie
Phone: +353 (0)21 2346986

Expertise

- Surface enhanced raman spectroscopy
- Electrochemistry
- Sensors
- Surface functionalisation

Research focus in VistaMilk

To develop the surface enhanced raman sensors systems - explore combination of surface enhanced raman spectroscopy and electrochemistry and develop affordable readout systems

Research outcomes

- Development of surface enhanced raman scattering sensors based on electrochemical deposition of silver nanodendrites
- Development of functionalisation of surface enhanced raman scattering sensors for the detection of pesticides
- Combination of surface enhanced raman scattering based pH sensor with associated chemometrics
- Development of electrochemical sensors for detection of heavy metals (copper)

Pat Lynch

Modelling
South East Technological University
Director of RIKON Research Centre & Lecturer
E-mail: Patrick.Lynch@setu.ie
Phone: +353 (0)51 845 642

Expertise

- Market modelling
- Business modelling
- Value network analysis
- Value chain analysis

Research focus in VistaMilk

Modelling future agriculture ecosystems (e.g. data sharing) & supporting business bodels

Research outcomes

- Published industry cases and white papers (e.g. research on AgriDISCRETE project led to the *'Digitialisation Roadmap Opportunities for Agriculture'*.)
- Contribution to the innovation and business model literature and practice through the publication of a multi-sided business modelling methodology
- Over 1,350 companies from 14 different industry sectors have engaged with over 602 service innovation, market & business modelling and process optimisation projects and 750 training initiatives which has supported over 2,487 jobs.
- Spin-out company established as well as designated activity company for modelling and simulation

Research Theme

System-of-systems

Pádraig Lyons

Renewable Energy

Tyndall National Institute, UCC

Head of Group, International Energy Research Centre

E-mail: padraig.lyons@tyndall.ie

Expertise

- Renewable energy
- Energy storage (eletrical/thermal)
- Real-time digital simulation
- Energy policy
- Energy systems integration

Research focus in VistaMilk

Renewable energy and energy efficiency in agriculture, agri-photovoltaics, energy data analytics, electrification of farming, energy system integration in agriculture, electrical infrastructure utilisation and smart grids

Research outcomes

- Development of a research programme that informed the development of system services for Transmission System Operators that support the integration of renewables on the electrical power system. The approach utilised co-simulation using laboratory based energy storage to emulate grid-scale storage in collaboration with real-time digital simulation known as Power Hardware in the Loop
- Led research that led to unique data set that provided insights into the real world operation of heat pumps in retrofitted Irish homes
- Led research as part of Energy Policy Insights for Climate Action (EPICA) programme that was funded by the Department for Energy Climate and Communications that has influenced the development of the Irish Government's Climate Action Plan and other government policy

Jonathan Magan

Food Chemistry
Teagasc
Research Officer
E-mail: Jonathan.Magan@teagasc.ie
Phone: +353 (0)25 42339

Expertise

- Effect of cow diet on milk composition
- Milk chemistry
- Seasonal milk compositional factors
- Functional properties of milk
- Dairy product processing

Research focus in VistaMilk

Develop research on the effect of primary production factors at farm level on milk and end-product composition and quality - analysis of unique genetic profiles for protein composition, methane-reducing food additives and alternative forage sources

Research outcomes

- Contribution to substantial body of data underpinning the point-of-difference of Irish grass-fed dairy products
- Contribution to establishment of seasonal milk compositional and functional databases and mitigation strategies for seasonal processing issues
- One Invention Disclosure Form

Research Theme

Food

Laura G. Gómez-Mascaraque

Food Science
Teagasc
Senior Research Officer
E-mail: Laura.Mascaraque@teagasc.ie
Phone: +353 (0)25 42241

Expertise

- Food microstructure
- Microscopy
- Raman spectroscopy

Research focus in VistaMilk

Contribute to food research - impact of animal, feed, seasonality and processing on the structure and functionality of dairy products and ingredients

Research outcomes

- Developed new imaging methods applied to food (including dairy products) using advanced microscopy techniques
- Use of Raman spectroscopy to study differences in milk fat composition
- Provide external microscopy analysis services to dairy companies
- 3 Invention Disclosure Forms (EI Refs: 2018-Teagasc-012-I, 2019-Teagasc-017-I, 2021-Teagasc-009-I) and one patent application (EP22171944.6)

Conor McAloon

Animal Health/Epidemiology
University College Dublin
Associate Professor
E-mail: conor.mcaloon@ucd.ie
Phone: +353 (0)1 716 6083

Expertise

- Veterinary medicine
- Bovine health management
- Epidemiology
- Data analysis

Research focus in VistaMilk

Developing a suite of tools to enable improved disease prediction, facilitating early, targeted and non-antibiotic interventions to improve health and welfare in dairy cattle

Research outcomes

- Development of an early warning system for exotic disease incursions using national databases
- Development of epidemiological models that can be tailored to specific characteristics of novel emerging diseases in cattle
- Use of accelerometers as an aid to positive welfare indicator measurements in calves
- Investigation of accelerometers for the detection of foot conditions in dairy cattle

Research Theme

Animal

Olivia McAuliffe

Cultures, Fermentation and Biotransformation
Teagasc
Principal Research Officer
E-mail: olivia.mcauliffe@teagasc.ie
Phone: +353 (0)25 42609

Expertise

- New strain discovery and applications
- Microbial genomics
- Fermentation applications
- Bioprocessing
- Bacteriophage - biology and applications

Research focus in VistaMilk

Further develop novel biorefinery concepts combining valorisation of dairy waste with waste streams from other food-based industries, targeting production of high-value bio-based products

Research outcomes

- Led the development of the Bioprocess Innovation Suite at Teagasc
- Lead investigator on projects with commercial enterprises to the value of €2m since 2015
- Technology transferred to industry in the form of cultures with improved technological properties
- Irish delegate at the International Dairy Federation and Standing Committee on Microbiological Hygiene
- Senior Editor of the *Journal of Dairy Science*

Mary McCarthy

Social Science
University College Cork
Professor, Cork University Business School
E-mail: M.McCarthy@ucc.ie
Phone: +353 (0)21 490 2075

Expertise

- Consumer, user and citizen behaviour
- The impact of practices on behavioural change
- Consumer acceptance of novel foods and technologies
- Consumer motivations, risk perception and trust
- Investigation into social and cognitive responses to food

Research focus in VistaMilk

Contribute to impact research and actions - risk perceptions, information assimilation, cognitive and unconscious response to stimuli (such as product, information, concepts), public engagement and participation

Research outcomes

- Interrogation of household food practices through a social practice lens - Identification of 1) sustainability consequences and 2) potential environment based solutions
- Investigation of the impact of emotions and cognitive dissonance on sustainable food choices and behaviours
- Use of 'disorienting dilemma' triggers to prime sustainable healthy eating behaviours change

Noel McCarthy

Food Chemistry
Teagasc
Senior Research Officer
E-mail: Noel.McCarthy@teagasc.ie
Phone: +353 (0)25 42202

Expertise

- Milk protein chemistry
- Designing nutritional formulations (e.g., infant and medical nutritional formulas)
- Dairy processing (filtration, heat treatment, emulsification, evaporation and drying)
- Impact of bovine milk protein genetic variants on dairy processing and product functionality

Research focus in VistaMilk

Tailoring the nutritional and techno-functional properties of milk through selective breeding for specific protein genetic variants

Research outcomes

- Research on β-casein genetic variants and its impact on yogurt and cheese production is the first study to detail how a change to A2 milk production would affect the Irish dairy industry, specifically milk processors
- Led a number of industry funded research projects with a value of ~€2 million
- Lead investigator on Enterprise Ireland and DAFM funded projects with a total value of ~€3.5 million

Research Theme

Food

Ultan McCarthy

Integrated Sensors
South East Technological University
Lecturer, School of Science & Computing
E-mail: Ultan.McCarthy@setu.ie

Expertise

- Supply chain management
- Wireless sensor networks
- Analytics
- Digital supply chain

Research focus in VistaMilk

Food quality integrated sensors - support cutting edge data acquisition and analytical techniques that will translate into actionable solutions

Research outcomes

- Reduction in food waste
- Food security
- Sustainable food supply chains

Research Theme

Emerging Technology

Sinead McParland

Genetics
Teagasc
Senior Research Officer
E-mail: sinead.mcparland@teagasc.ie

Expertise

- Genetics
- Breeding scheme design
- Chemometrics
- Genetic conservation
- Genetic diversity

Research focus in VistaMilk

Contribute to spectroscopy research program as well as animal breeding research program

Research outcomes

- Developed contract mating system used by Irish cattle breeding companies
- Equations to predict 24-hour milk composition from part-day samples routinely used nationally
- Global first predictions of energy balance in dairy cows from milk infrared spectroscopy data
- Model to predict bull fertility used nationally for artificial insemination sires
- Member of global dry matter intake initiative that developed international genetic and genomic evaluations for feed intake in dairy cows

Research Theme

Animal

Matteo Menolotto

Sensing Systems
Tyndall National Institute, UCC
Senior Postdoctoral Researcher
E-mail: matteo.menolotto@tyndall.ie
Phone: +353 (0)21 234 6447

Expertise

- Wearable sensing technology
- Data analytics
- Motion analysis
- Image processing
- Robotics

Research focus in VistaMilk

Development of an image processing solution and wearable sensor aimed at enhancing precision in the monitoring of cows and their calves. Harnessing the capabilities of cost-effective camera systems, coupled with embedded artificial intelligence technology, this research endeavours to provide an efficient and affordable solution for the accurate tracking of cattle

Research outcomes

- Task classification via wearable sensors for industrial applications
- Use of wearable sensors to enhance teleoperation and human-robot interaction
- Open access datasets of motion tracking data for biomechanics and task classification
- Development of proposals on wearable sensors and artificial intelligence-based data analytics for collaborative robotics and wellbeing applications

Research Theme

Emerging Technology

Dan Milbourne

Plant Genetics and Genomics
Teagasc
Senior Research Officer
E-mail: dan.milbourne@teagasc.ie
Phone: +353 (0)59 917 0291

Expertise

- Plant genetics and genomics
- Plant breeding
- Genotyping
- Phenotyping

Research focus in VistaMilk

Development of optimal plant breeding strategies supported by genome-based approaches, forages and Irish-adapted grain protein crops

Research outcomes

- Development and application of genome based breeding approaches to commercial breeding programmes
- Variety candidates submitted for registration (perennial ryegrass) and released (potato) from genome-based breeding initiatives
- Project co-ordinator of the VICCI project which developed an Irish adapted foundation breeding population of faba beans

Research Theme

Pasture

Sara Morrissey Tucker

Digital Immersive Media
Munster Technological University
Research Fellow
E-mail: Sara.MorrisseyTucker@mtu.ie

Expertise

- Digital immersive media
- Virtual reality
- Augmented reality
- Machine translation
- Sign languages

Research focus in VistaMilk

Contribute to the development of immersive reality technology solutions including annotated digital 360-video-based based content and graphic virtual training environments

Research outcomes

- >€850k in research funding brought to AgriTech sector and partners for the development and delivery of training and digital immersive technology solutions
- Amelioration of training practices in industry partners in terms of standardisation, resourcing, and quality through the creation and delivery of immersive employee training experiences
- Development of the first example-based data-driven machine translation system for sign languages

Brendan Murphy

Statistics
University College Dublin
Professor of Statistics
E-mail: brendan.murphy@ucd.ie
Phone: +353 (0)1 716 2382

Expertise

- Cluster analysis
- Classification
- High dimension data
- Bayesian methods
- Near and mid infrared spectroscopy

Research focus in VistaMilk

Development of new statistical models for agrifood data. Development of mathematical models for agrifood applications. Implementation of system of systems

Research outcomes

- Contributor to a number of open source software packages (mclust, BayesLCA, mixggm, MoEClust, pgmm, LCAvarsel, ...)
- Development of methods for distinguishing cow diet from mid infrared spectroscopy of milk

Michael Murphy

Energy
Munster Technological University
Lecturer, Sustainable Energy Engineering
E-mail: MichaelD.Murphy@mtu.ie

Expertise

- On-farm energy optimisation
- Integration of renewable energy systems
- Calculation of carbon dioxide emissions offsets
- Open-source tools for farmers and researchers
- Grass measurement optimisation

Research focus in VistaMilk

Contribute to on-farm energy optimisation, integration of renewable energy systems and the development of open-source tools to aid farmers, researchers and policy makers in decision making

Research outcomes

- Investigator on several agri-engineering projects. Secured €2.5m in research funding
- Investigator on national project which developed the on-line farm energy optimisation tool which is currently being used by farmers and researchers (messo.shinyapps.io/Farm_Energy)
- Extensive industry-based research through several commercially co-funded projects
- Developed several open-source tools in agriculture and energy domains such as: GMOT, DRAF & elmada

Kanishka Nilaweera

Diet and Health Outcomes
Teagasc
Senior Research Officer
E-mail: kanishka.nilaweera@teagasc.ie
Phone: +353 (0)25 42674

Expertise

- Tissues communication in the body
- Diet and health outcomes
- Weight management, immune responses and age-appropriate growth

Research focus in VistaMilk

Dietary strategies to improve human health. Modelling how diet affects human health outcomes. Predicting new health promoting diets

Research outcomes

- Established a new research facility in Teagasc Moorepark to screen for health-promoting dairy ingredients
- Attracted over €2m research funding to support dairy research
- Established that dairy proteins can be tailored to target the activity of specific tissues e.g. showed the potential of whey to be developed as a health and/or cosmatic ingredient for reduction of fat that are stored differently in males and females in the body
- 3 Invention Disclosure Forms filed

Research Theme

Food

John Nolan

Novel Dairy Based Foods
South East Technological University
Professor
E-mail: john.nolan@setu.ie
Phone: +353 (0)51 834 074

Expertise

- Human vision
- Longitudinal human trials
- Statistics
- Carotenoids
- Biochemistry

Research focus in VistaMilk

Development of novel dairy-based foods to enhance human health

Research outcomes

- Development of a lutein-fortified yoghurt to enhance health
- Technology licensing
- Engagement with third party company to establish further research in the field
- Longitudinal human trials expertise development

Research Theme

Food

Michael Nolan

Materials Modelling
Tyndall National Institute, UCC
Head of Group and Interim Chief Scientist
E-mail: michael.nolan@tyndall.ie
Phone: +353 (0)21 2346983

Expertise

- First principles simulations
- Surface chemistry
- Catalysis
- Methane conversion

Research focus in VistaMilk

Use state of the art atomistic simulation and experiment to develop new catalysts to promote low temperature methane activation in a prototype wearable device

Research outcomes

- Developed new atomistic simulation methodologies for prediction of the chemistry of etching and deposition in materials processing. Now widely used in the community
- Industry supported projects on developing new processes for (1) metal, (2) polymer, (3) metal oxide dielectric deposition: implemented into process flows through these partners
- Development of new low friction polymer coating and a deposition process - Invention Disclosure Form with MedTech company
- SFI-AMBER project on new low friction coatings
- Development of new chemical catalysts and Invention Disclosure Form of same.

Tom O'Callaghan

Dairy Science
University College Cork
Senior Lecturer
E-mail: tom_ocallaghan@ucc.ie
Phone: +353 (0)21 490 2144

Expertise

- Dairy science
- Food chemistry
- Food processing
- Food and agricultural metabolomics
- Links between primary production practises and milk composition, quality and processablity

Research focus in VistaMilk

Understanding the implications of farm practises (housing, diet, breeding programme) and strategies (feed additives, nitrogen use efficiency and methane) on the composition and functionality of the rumen and composition, processability and quality of milk and dairy products across the supply chain

Research outcomes

- Invention disclosure submitted for mid-infrared spectroscopy analysis based grass fed milk authentication algorithm
- Development of underlying features and unique characteristics for marketing of Irish grass fed dairy
- Developing of the Irish milk metabolome database
- In excess of €3m in research funding

Research Theme

Food

Michael O'Donovan

Grazing Systems
Teagasc
Professor, Head of Grassland Science in Teagasc
E-mail: Michael.ODonovan@teagasc.ie
Phone: +353 (0)25 42395

Expertise

- Grass production/nutrient use efficiency/grassland management
- Grass/clover - plant animal interactions
- PastureBase Ireland - national grassland database
- Pasture Profit Index
- Grass intake measurement/modelling

Research focus in VistaMilk

Precision nitrogen management, linking nitrogen inputs to nitrogen mineralisation, nitrogen fixation and grassland output

Research outcomes

- Creation of PastureBase Ireland
- Pasture Profit Index to rank grass varieties on expected profit
- Understanding effects of herbage mass on methane emissions of dairy cows
- New traits for grass variety selection indices

Brendan O'Flynn

Sensing Systems
Tyndall National Institute, UCC
Head of Group - Wireless Sensor Networks
E-mail: brendan.oflynn@tyndall.ie
Phone: +353 (0)21 2346041

Expertise

- Embedded systems design and deployment
- Flexible sensors
- Wearable sensors
- Data analytics, robust edge artificial intelligence
- Smart sensing

Research focus in VistaMilk

Animal – Sensing Technologies : Chipless radio frequency identification RFID and wearable solutions for real time monitoring of cow and calf reproduction and health care. Emerging Tech – Methane sequestration systems and embedded systems integration for deployment

Research outcomes

- Currently exploring and developing novel smart sensing technologies which develop, define and lead the research activities of the Wireless Sensor Networks group at Tyndall National Institute developing smart sensing systems
- As part of these academic and industry partnerships, the circuits, and systems, developed using a hardware software co-design approach and including complex data fusion algorithms to analyse multiple sensor streams, and the exploitation of the relevant IP licensed to commercial partners in the form of:
  - ~60 Inventions Disclosure with 20 licenses/assignments to industry Partners
  - Enabling 3 Start-up companies out of WSN related research activities - Tyndall /NMRC
    - Inpact Microelectronics 1999. Miniaturised (MCM) wireless systems (Founder & Co-Owner)
    - ENDECO – 2010. Building energy management for the retail sector
    - GRASP – 2014. Gait monitoring systems for athletes

Luke O'Grady

Veterinary Medicine
University College Dublin
Assistant Professor in Population Medicine
E-mail: luke.ogrady@ucd.ie
Phone: +353 (0)1 716 6075

Expertise

- Nutrition, health, production, and welfare of dairy cattle
- Epidemiology and disease control at farm and national scales
- Animal health economics
- Machine learning and statistical analysis
- Simulation modelling and decision support tools for farmers and vets

Research focus in VistaMilk

Advancing cutting edge data acquisition and analytical techniques into actionable solutions

Research outcomes

- The creation of the REMEDY whole farm simulation model of UK dairy production systems, modelling the interactions between nutrition, genetics, health, production, and greenhouse gas emissions.
- Using social science and simulation modelling to explore the interactions of bovine viral diarrhoea control across all 4 national control programs within the UK
- Using computer vision to monitor behaviour and lameness in dairy cattle in on farm tools.
- Co-author in the stability section methodology for mixed models incorporated into the "stabilizer" R package.
- Multiple research activities and outputs that have informed the development and direction of Animal Health Ireland's bovine viral diarrhoea and mastitis control programmes

Seamus O'Mahony

Dairy Nutrition
University College Cork
Professor, in Food and Nutritional Sciences
E-mail: sa.omahony@ucc.ie

Expertise

- Food and dairy ingredients
- Food formulation and design
- Specialised nutrition products (e.g., infant and life stage nutrition)
- Education and training in food and dairy science
- Specialised training pathways for dairy professionals

Research focus in VistaMilk

Adding value to milk and dairy products using science-based innovation and building absorptive capacity for innovation amongst the dairy processing community

Research outcomes

- Impact Award in the 2019 UCC University Staff Recognition Awards
- Contribute strongly to the positioning of Dairy Science as the Number 2 Research Topic Cluster at UCC and to UCC's position in the Top 100 (ranked 59th) Universities in the Agriculture & Forestry subject area (QS World Rankings, April 2022)

Lennon Ó Náraigh

Mathematical Modelling

University College Dublin

Associate Professor, School of Mathematics and Statistics

E-mail: onaraigh@maths.ucd.ie

Phone: +353 (0)1 716 2546

Expertise

- Mathematical modelling
- Fluid mechanics
- Multiphase flow
- Computational fluid dynamics
- Industrial drying

Research focus in VistaMilk

Develop mathematical models of water flow in soil at the pore scale, paddock scale, and catchment scale, to interface with the VistaMilk grass growth model. Also interested in applying mathematical modelling to industrial problem statements

Research outcomes

- Developed a mathematical model
- Developed an open-source multiphase flow model for simulating fluid, simulations run on 1000s computer processing units on Irish and UK national supercomputers, leading to highly-cited works in Journal of Fluid Mechanics
- OpenFOAM modelling of multiphase flow on a consultancy basis
- With a commercial collaborator, developed a mathematical theory for optimal control of an industrial disc drier

Norah O'Shea

Process Analytical Technologies
Teagasc
Senior Research Officer
E-mail: norah.oshea@teagasc.ie
Phone: +353 (0)1 805 9717

Expertise

- Process Analytical Technologies - inline process measurements
- Dairy processing
- Near-infrared spectroscopy
- Low cost sensors
- 3D food printing
- Rheological properties of dairy concentrate and gels derived from dairy ingredients

Research focus in VistaMilk

Digitalisation of dairy processes and products: real-time sensor selection (e.g. spectroscopy based sensors), integration and validation. Advance use of data from dairy processes for optimisation and improved efficiencies. Understanding the rheological properties of dairy fluids for 3D food printing applications

Research outcomes

- Four Invention Disclosure forms
- Technology transfer of process analytical technologies into commercial scale dairy processes
- Securing national and commercialisation funding

Research Theme

System-of-systems

Orla O'Sullivan

Computational biology
Teagasc
Senior Research Officer
E-mail: orla.osullivan@teagasc.ie
Phone: +353 (0)25 42556

Expertise

- Food for health
- Gut, rumen, food and soil microbiome
- "-omic data integration"
- Emerging omics technologies
- Microbiome data analysis

Research focus in VistaMilk

Contribute to microbiome profiling of soil, food, gut and rumen; both in technology development and data analysis. Development of novel dairy foods for personalised human nutrition

Research outcomes

- Development of robust bioinformatics pipeline to profile soil microbiome
- Scientific advisor for SeqBiome Ltd
- Scientific advisor for Open Research Europe
- Co-Coordinarote of EU RIA "DOMINO" which focuses on developing novel sustainable fermented foods for health

Alan O'Riordan

Electrochemistry

Tyndall National Institute, UCC

Research Lead, Research Cluster on Agri-Foods & the Environment

E-mail: alan.oriordan@tyndall.ie

Phone: +353 (0)21 2346403

Expertise

- Sensor system design, fabrication and characterization
- Chemical materials development sensor modification and assay development
- Sensor integration, remote sensing and data analysis
- Molecular diffusion simulation modelling

Research focus in VistaMilk

Development of novel chemical and biochemical sensor systems to address key use cases defined by end-users and stakeholders

Research outcomes

- Built a strategic cluster of research groups working on all aspects of sustainable development of agri-food and the environment
- Lead the Advanced Nanosensors Group that focuses on monitoring solutions
- Successfully secured 29 research projects worth circa €23m in total research funding
- Two patent applications and an additional 16 invention disclosure forms

Research Theme

Emerging Technology

Andrew Parnell

Statistics and Machine Learning
Maynooth University
Professor, Director of the Hamilton Institute
E-mail: andrew.parnell@mu.ie
Phone: +353 (0)1 708 6801

Expertise

- Bayesian modelling
- Spatio-temporal data analysis
- Quantitative ecology
- Missing data
- Anomaly detection

Research focus in VistaMilk

Tools for routinely monitoring data collected from Irish dairy farms. Accurately accounting for missing data in complex data sets. Detecting anomalies in temporal or spatio-temporal data

Research outcomes

- World's most widely used statistics packages for estimating animal diets remotely (>150k downloads)
- Winner of 2017 University College Dublin VentureLaunch prize for highest potential start-up in the area of genomic breeding analysis
- New software for Bayesian Machine Learning of agricultural data with complex interactions

Alfonso Prado-Cabrero

Biochemistry
South East Technological University
Senior Research Fellow
E-mail: Alfonso.Prado-Cabrero@setu.ie

Expertise

- Biochemistry
- Carotenoids
- Zooplankton
- Microalgae
- Human physiology

Research focus in VistaMilk

Development of novel dairy-based foods to enhance human health

Research outcomes

- Development of a lutein-fortified yoghurt to enhance health
- Technology licensing
- Engagement with third party company to establish further research on the field
- Longitudinal human trials expertise development

Research Theme

Food

Dimitra Psychogiou

MicroNano Systems

Tyndall National Institute, UCC

Professor of Microwave Engineering and Head of Group

E-mail: dimitra.psychogiou@tyndall.ie

Expertise

- Filter synthesis
- Adaptive tuning methods
- Radio frequency passive (filters, phase shifters, couplers) and active (circulators) components
- Antenna design

Research focus in VistaMilk

Centered around low-cost, low-power and self-packaged radio frequency electronics and radio frequency -based sensors for undisruptive condition monitoring and radio frequency communications. Develop novel radio frequency sensors and communication devices, additive manufacturing techniques enabling low-cost and versatile integration concepts for radio frequency electronics and radio frequency -based sensors by combining 3D printing, flexible and rigid materials for sensing and communications

Research outcomes

- The research of my group has led to > 230 publications in high impact factor papers, 3 patents
- Multiple investigator and student awards including the 2023 IEEE MTT-S Young Engineer Award and the SFI Professorship,
- Developed novel integration concepts for RF filters with 10X smaller size and 10X lighter weight,
- Developed radio frequency components with unprecedented levels of radio frequency tuning
- Developed new types of radio frequency co-designed filters and isolators enabling power efficient and spectrally efficient communications

Áine Regan

Social Science
Teagasc
Senior Research Officer
E-mail: aine.regan@teagasc.ie
Phone: +353 (0)91 845 253

Expertise

- Psychology
- Behavioural science
- Behaviour change models & interventions
- User-centered technology design
- Participatory research

Research focus in VistaMilk

Support the translation of research into societal impact through social and behavioural science and innovative participatory instruments that ensure stakeholder dialogue and bottom-up behaviour change

Research outcomes

- Implemented design thinking approach for development of 'AgriSnap' geotagged imagery app employed by Department of Agriculture, Food and the Marine
- Development of behavioural science communication training courses in collaboration with Animal Health Ireland
- Development of risk communication e-resource centre for food safety outbreaks in collaboration with the European Food Information Council
- Co-design of specialised industry communications for farming community and general public

Research Theme

Impact

Karl Richards

Nitrogen Dynamics in Soil

Teagasc

Senior Principal Research Officer, Head of Teagasc Climate Centre

E-mail: karl.richards@teagasc.ie

Phone: +353 (0)53 917 1261

Expertise

- Greenhouse gas emissions
- Greenhouse gas mitigation
- Low emission fertilisers and additives
- Nitrate leaching

Research focus in VistaMilk

Contribute to the soil and system of systems; testing new measures to reduce nitrous oxide emissions from soil; evaluating fertiliser and additives to reduce emissions from soil; enhance carbon sequestration

Research outcomes

- Led the establishment of the national agricultural soil carbon observatory and the national soil greenhouse gas testing facility
- Led the science around protected urea, one of the top 3 measures to reduce greenhouse gas emissions from Irish agriculture.
- Identified the greenhouse gas mitigation associated with optimising lime application and improving soil phosphorus levels
- Identified the role that cover crops have for reducing nitrate leaching and enhancing groundwater denitrification

Daniel Riordan

Sensing Systems

Munster Technological University

Head of Department - Technology, Engineering & Mathematics

E-mail: Daniel.Riordan@mtu.ie

Phone: +353 (0)53 917 1261

Expertise

- Development and deployment of sensors systems (electronics and software)
- Data amalgamation and analytics
- Autonomous agricultural systems
- Digital signal processing
- Vision systems

Research focus in VistaMilk

Development and deployment of sensors systems and process automation systems for application within the dairy sector (electronics and software)

Research outcomes

- PhD supervision leading to novel inventions; automated animal health monitoring, machine monitoring & autonomous agri-vehicles navigation
- 4 Invention Disclosure Forms and 2 Patents filed (EP4018362A2 & DE102015101508 - Both licenced to industrial Partners)
- Development & deployment of sensor systems in agriculture; water quality, machine monitoring, animal monitoring (on & off animal), animal housing monitoring, soil health/composition

Research Theme

Emerging Technology

James Rohan

Electrochemistry
Tyndall National Institute, UCC
Senior Staff Researcher
E-mail: james.rohan@tyndall.ie
Phone: +353 (0)21 234 6224

Expertise

- Electrochemistry of catalytic materials
- Micro and nanoelectrochemical sensors
- Electrochemical simulations for device design
- Metal and alloy deposition for sensor applications
- Interdigitated electrodes for enhanced sensing with local environment control

Research focus in VistaMilk

Abundant and non-toxic catalyst materials deposition for low temperature and efficient conversion of methane to a fuel such as methanol aligned to climate action plans

Research outcomes

- Novel electrochemical sensors simulated, microfabricated and then demonstrated to enhance sensor performance
- Novel low-cost catalytic sensor materials have been identified and deposited for efficient sensing with lower limits of detection
- Redox cycling using interdigitated sensor arrays used to enhance signal outputs
- Local environment control such as modifying pH demonstrated and utilised to enhance the sensor performance

Elodie Ruelle

Systems Modelling
Teagasc
Research Officer
E-mail: elodie.ruelle@teagasc.ie
Phone: +353 (0)25 42686

Expertise

- Mechanistic modelling
- Dairy grazing systems
- Nitrogen use efficiency, nitrogen leaching
- Grass growth forecasting
- Climate adaptation

Research focus in VistaMilk

Improving the grass growth prediction program to incorporate new grass species, improve the soil component and be part of the system of system development

Research outcomes

- Live grass growth prediction on 84 commercial farms disseminated every Sunday on national television
- Model develop enabling the prediction of the impact of different farm management on nitrogen leaching used for the nitrate derogation
- Prediction of the impact of climate change on Irish grasslands

Tomás Russel

Agriculture Extension and Innovation

University College Dublin

Associate Professor, School of Agriculture and Food Science

E-mail: tomas.russel@ucd.ie

Phone: +353 (0)1 716 7702

Expertise

- Farmer behaviour change
- Farmer adoption
- Generational renewal in agriculture
- Farmer mental health

Research focus in VistaMilk

Impact platform - Farmer engagement and adoption of agri tech

Research outcomes

Psychological interventions for farmer

Laurence Shalloo

Systems Modelling

Teagasc

Head of the Animal & Grassland Research and Innovation programme & Deputy Director of VistaMilk

E-mail: laurence.shalloo@teagasc.ie

Phone: +353 (0)25 42306

Expertise

- Dairy systems economics
- Modelling sustainability in grass-based systems
- Dairy production systems
- Greenhouse gas emission from livestock production

Research focus in VistaMilk

Enteric methane research and the system-of-systems model and platform development

Research outcomes

- Developed the milk pricing system in Ireland
- Generated new dairy cow enteric methane emission factor
- Evaluated the impact of genetics on enteric methane
- evaluated the impact of feed additives for enteric methane
- Created a system to generate a carbon footprint for all participating Irish farms

Research Theme

System-of-systems, Pasture & Animal

Han Shao

Electrochemistry
Tyndall National Institute, University College Cork
Researcher
E-mail: han.shao@tyndall.ie
Phone: +353 (0)21 2346033

Expertise

- Nanomaterial development
- Electrochemical sensor fabrication and characterisation
- Analytical chemistry

Research focus in VistaMilk

Develop multi-function sensors to provide real time data on nutrients monitoring in both soil and slurry to enable reducing fertiliser usage and efficiently utilising slurry to increase farmer income and mitigate environmental risks

Research outcomes

- Soil sensor 6 months employment in field
- Patent submitted UK2309536.7, June 23, 2023
- Enterprise Ireland Innovation Arena 2022 – Research Emerging from a 3rd Level Award
- Award for Innovator of the Year in Physical Sciences, University College Cork 2022
- Enterprise Ireland Feasibility Study Grand funded 2023

Diarmuid Sheehan

Food Chemistry
Teagasc
Principal Research Officer
E-mail: diarmuid.sheehan@teagasc.ie
Phone: +353 (0)25 42232

Expertise

- Cheese chemistry and technology
- Processing challenges of a seasonal milk supply
- Diversification of the € 1.3 bn national cheese product export portfolio
- Research platforms to optimise the quality and sustainability of Irish cheese exports
- Technology transfer and scale up to industrial scale

Research focus in VistaMilk

Contribute to interfacing of dairy product matrices with sensor technology to develop remote systems to monitor ripening and quality metrics for the global cheese industry

Research outcomes

- 8 Invention Disclosure Forms, 2 patents and 2 Non Exclusive, Royalty-Free licences
- Development of > 300 cheese types for commercial exploitation including product launch under Kerrygold brand
- Development of national milk compositional database
- Top 5 published researcher in field, globally
- Supported growth of Irish cheese exports to > €1.3b

Research Theme

Food

Emily Sitko

Animal Physiology
Teagasc
Research Officer
E-mail: Emily.sitko@teagasc.ie
Phone: +353 (0)25 69091

Expertise

- Reproductive physiology
- Dairy cow reproductive management
- Precision technologies
- Epidemiology

Research focus in VistaMilk

Evaluation of precision technologies for pasture-based dairy production systems and the development and implementation of data-driven solutions for herd management

Research outcomes

- Evaluated precision management based on genomic merit of fertility on reproductive performance and profitability of dairy cows
- Elucidated the underlying physiology contributing to differences in reproductive performance for cows divergent in genomic merit of fertility

Research Theme

Animal

Catherine Stanton

Nutrition
Teagasc
Senior Principal Research Officer
E-mail: catherine.stanton@teagasc.ie
Phone: +353 (0)25 42606

Expertise

- Gut microbiome
- Milk microbiota
- Probiotics
- Human studies
- Animal studies

Research focus in VistaMilk

Early life nutritional interventions and effects on gut microbiome development, health and disease

Research outcomes

- Investigating the effects of different early life nutritional interventions on gut microbiome development and health outcomes from birth to adulthood in a pig models
- The impact of environmental factors and maternal stress exposure on the developing gut microbiota in piglets - manuscripts in preparation

Research Theme

Food

James Sweeney

Statistics

University of Limerick

Associate Professor in Dept of Mathematics & Statistics

E-mail: james.a.sweeney@ul.ie

Phone: +353 (0)61 202 609

Expertise

- Spatio-temporal statistical modelling
- Statistical models for disease spread
- Design of experiments in field trials and animal studies
- Bayesian statistics
- Applied statistical modelling including non-parametric modelling

Research focus in VistaMilk

Contribute to development of spatial statistical models for geo-referenced data including soil, water, fertiliser. Disease modelling, particularly the spread of bovine tuberculosis amongst cattle herds

Research outcomes

- Lead investigator on SFI Challenges project GREEN-GRID. The project is focused on the development of spatio-temporal maps for wind and solar resources nationwide with a view to expediting the move to 100% electricity generation from renewables
- Lead investigator on SFI New Frontiers project 3-EX. The project is focused on the development of the next generation of respiratory disease spread models to ensure preparedness for future pandemics
- Contributor to World Health Organisation (WHO) proof-of-concept project on COVID-19 integrated epidemiological-economic modelling.

Salvatore Tedesco

Sensing Systems
Tyndall National Institute, University College Cork
Senior Researcher
E-mail: salvatore.tedesco@tyndall.ie
Phone: +353 (0)21 234 6286

Expertise

- Wearable technology
- Artificial intelligence and data analytics
- Edge analytics
- Project management
- Applied artificial intelligence for engineering

Research focus in VistaMilk

Artificial intelligence models for several contexts. Low-power edge analytics for animal behavior

Research outcomes

- Invention Disclosure forms (>20) on research activities
- New approaches for artificial intelligence applied to radio frequency identification in agri-tech
- 3 past licenses to spin out
- 3 open datasets publicly available

Research Theme

Emerging Technology

Ines Thiele

Metabolic modelling
University of Galway
Personal Professor, School of Medicine
E-mail: ines.thiele@nuigalway.ie

Expertise

- Computational metabolic modelling
- Human and microbial metabolism
- Human nutrition

Research focus in VistaMilk

Develop gut microbiome/health models to predict the response of the gut microbiome to consumption of different dairy products (with different macronutrient content and quality e.g. whey protein versus casein)

Research outcomes

- Extensive database of nearly 250k genome-scale metabolic models for microbes
- Organ-resolved, whole-body models of adult and infant metabolism
- Nutrition modelling toolbox
- Microbiome modelling toolbox
- Diet designer tool

John Tobin

Dairy Science and Process Engineering

Teagasc

Head of Department Food Chemistry and Technology

E-mail: john.tobin@teagasc.ie

Phone: +353 (0)25 42366

Expertise

- Dairy chemistry, milk functionality and processability
- Dairy processing including thermal, evaporative and drying technologies
- Membrane separation technologies for the selective partition, concentration and isolation of milk components
- Impact of genetic variation among milk proteins on the chemistry and functionality of dairy products
- Optimisation of process efficiency and energy utilisation in food processes

Research focus in VistaMilk

To create dairy products with improved functional, digestive, nutritional and sensorial properties through identification of the impact of genetics relative to the milk protein profile

Research outcomes

- Filed 4 patents with high commercial impact, describing new process designs for fractionation of milk and whey, which has led to 3 subsequent innovation filings based on the technologies developed.
- Delivering targeted process and technological innovations for energy reduction and water reuse for sustainable dairy processes within the Enterprise Ireland funded Dairy Processing Technology Centre
- Delivery of the Teagasc milk standards program, and proficiency/split sampling schemes, which ensures transparency surrounding determination of milk composition in milk testing laboratories throughout the country
- Led multiple wholly industry projects as project coordinator (both collaborative and contract) with a total value €2.65m

Research Theme

Food

Saoirse Tracy

Soil Science

University College Dublin

Assistant Professor, School of Agriculture and Food Science

E-mail: saoirse.tracy@ucd.ie

Phone: +353 (0)1 716 7728

Expertise

- Soil Science
- X-ray Computed Tomography
- Root systems
- Plant phenotying
- Image analysis pipelines

Research focus in VistaMilk

The soil system and generating X-ray catscan images to feed into the modelling of soil processes

Research outcomes

- Working in intersectoral teams to solve food security challenges
- Network building in Ireland for soil networks
- Invention disclosure form submitted for biostimulant work
- Unique expertise in Ireland on X-ray catscan facility operation

Research Theme

Soil

Pat Tuohy

Soil Science
Teagasc
Senior Research Officer
E-mail: patrick.tuohy@teagasc.ie
Phone: +353 (0)25 42366

Expertise

- Soil physical/hydrological properties
- Peatland hydrology
- Land drainage systems
- Management of poorly drained soils
- Land management/water quality interactions

Research focus in VistaMilk

To contribute to decision support systems that can provide more temporally and spatially explicit advice to farmers to manage their soils to help achieve the multiple targets of soil health, nutrient resource efficiency, productivity and to minimise nutrient losses to the environment

Research outcomes

- Drainage status of grassland peat soils in Ireland: Extent, efficacy and implications for greenhouse gas emissions and rewetting efforts
- The influence of phosphorus application and varying soil pH on soil and herbage properties across a range of grassland soils with impeded drainage
- A novel hybrid coagulation-intermittent sand filter for the treatment of dairy wastewater

Research Theme

Soil

John Upton

Milking Efficiency
Teagasc
Senior Research Officer
E-mail: john.upton@teagasc.ie
Phone: +353 (0)25 42670

Expertise

- Milking machines
- Milking management strategies
- Milking efficiency
- Energy efficiency
- Renewable energy technologies

Research focus in VistaMilk

Deliver milking management strategies optimised at the cow level and allow for adjustment in milking machine settings within individual milkings to reduce milking times and improve milk quality

Research outcomes

- Developed technologies that have been deployed to market to improve milking efficiency and cow comfort during milking
- Delivered research programmes on dairy energy use which have been used to design national energy policy around solar energy
- Developed dairy energy decision support tool deployed via a webservice and actively used by Irish dairy farmers and advisors
- 3 Invention Disclosure Forms

Ainhoa Valldecabres

Animal Health
Teagasc
Research Officer
E-mail: Ainhoa.Valldecabres@teagasc.ie
Phone: +353 (0)87 707 6813

Expertise

- Veterinary medicine
- Dairy cow and calf management and health
- Metabolic health
- Lactation physiology

Research focus in VistaMilk

Contribute to animal health research - development of antimibrobial treatment decision tools, evaluation of a variety of strategies to enhance health in ruminants under the Irish production system

Research outcomes

- Several publication recognitions
- Concluded on the importance of monitoring of dietary cation-anion difference programs in dairy cows
- Determined the production and reproduction responses for dairy cattle supplemented with oral calcium bolus after calving

Research Theme

Animal

Sara Vero

Soil
South East Technological University
Assistant Lecturer
E-mail: Sara.Vero@setu.ie

Expertise

- Nitrate time lags
- Soil physics
- Catchment management
- Field-based research
- Nutrient transport and availability

Research focus in VistaMilk

Estimating spreading opportunities for slurry and soiled water based on soil moisture deficit. Maximising draw-down of soil phosphorus from Index 4 to optimal levels. Planning to increase grazing efficiency

Research outcomes

- Estimate of slurry spreading windows based on soil moisture deficit across drainage classes for 14 locations.
- Ongoing supervision of PhD student research including pot trial on Phosphorus drawdown from high index soils and runoff experiment investigating different flow generation mechanisms
- Establishment of soil physics facilities at South East Technological University

Joseph Walsh

Intelligent Mechatronics and Sensors
Munster Technological University
Professor, Head of the School of STEM
E-mail: Joseph.Walsh@mtu.ie

Expertise

- Intelligent mechatronics and sensors
- Dairy technology
- Robotics and automation
- Autonomous systems
- Immersive technologies

Research focus in VistaMilk

Contribute to the development of AgriTech engineering solutions, sensor integration with data analytics/machine learning and using immersive technologies for agricultural training

Research outcomes

- Have received €25m in research funding as a principle investigator over the past 10 years
- IP on a number of AgriTech industry targeted projects Invention Disclosure Forms and Patent (S2019/0142)
- Led the development of the AgriTech Centre of Excellence (ACE)
- Established and lead the intelligent mechatronics and RFID (IMaR) Research Centre which currently has over 50 researchers
- Awarded funding of €8.95m under the Irish Government's Human Capital Initiative Programme (HCI) Pilar 3, to lead engineering education project

Bobby Woods

Process Development
Munster Technological University
Lecturer, School of STEM
E-mail: bobby.woods@mtu.ie

Expertise

- Process development, validation and optimisation via lean and digitialisation approaches
- Engineering - process, manufacturing and systems focused
- Industrial automation and robotics
- Product development

Research focus in VistaMilk

Work with projects that require new process development. These projects can range from industry-based process transformation to development and validation of new agricultural value-streams

Research outcomes

- Implementation of a process optimisation programme within the Irish AgriTech SME's sector to reduce waste and costs. Engaged 30 employees across 10 companies through training and continuous improvement project delivery support within the last 2 years
- Published two papers on lean in small medium enterprise's *'Adoption of Lean by AgriTech Companies in Ireland'* and *'An evaluation of Lean deployment in Irish micro-enterprises'*

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VistaMilk's

Contact Details

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www.vistamilk.ie