"Teagasc Together"

Harnessing the Power of Research, Advisory and Education to Create a Sustainable Food System

Teagasc Statement of Strategy 2021 – 2024

Teagasc

Agriculture and Food Development Authority

Liam Herlihy
Chairman, Teagasc

Foreword

Sustainability will dominate the agricultural and food processing agenda for the foreseeable future and Teagasc intend to harness its research, advisory and education services to support the sector to successfully navigate through the undoubted challenges that lie ahead. That's why the overriding ambition of the organisation for the next three years is to make sustainability 'front and centre' of all of our activities. We espouse a holistic concept of sustainability that enshrines four dimensions: economic, social, environmental and innovation. Supporting farmers and food companies to innovate and being innovative ourselves lie at the core of delivering on the ambitions for sustainability that are set out in *Farm to Fork*, the *Programme for Government and AgClimatise*.

Delivering on economic sustainability means identifying profitable opportunities for all our farming systems and supporting farmers to enable them to create better livelihoods for themselves and their families. Teagasc's €40m VistaMilk project is the only SFI Centre in the agrifood sector. It's focused on bringing the best in precision science to bear on pasture-based dairy systems. Over the period of this Strategy we plan to establish a test bed for agri-tech companies to translate the research in VistaMilk onto farms and into food companies.

Our beef sector is challenged by low profitability. We plan to demonstrate a low intensity profitable blueprint for suckling. We also want to exploit the interdependence between beef and dairy systems by establishing a dairy-beef demonstration farm and to promote this enterprise through an innovative advisory campaign.

The welfare of male dairy calves will be enhanced through the development of a profitable dairy beef enterprise. And the welfare agenda will be underlined by the commitment in this Strategy to set up a *Sexed Semen Laboratory*.

The tillage sector has also experienced profitability challenges in recent years. We plan to focus on reducing protein imports with the substitution of Irish grown alternatives while also exploiting niche opportunities for the production of high- value crops. Over the period of this strategy we also intend to establish a *Brewing and Distilling Centre* at Oak Park.

This proactive approach to seeking out new opportunities for successful farming, backed up by the best in research, advice and education will characterise our approach across all other sectors.

Our role in the development of Ireland's agri-food sector is our primary responsibility but we're mindful of the need for Teagasc to support government policy in its drive to achieve the *Sustainable Development Goals*. Over the period of this Strategy we will increase the resources assigned to overseas agricultural development in furtherance of this objective.

Our commitment to social sustainability is captured primarily by our plans for making farms safe for work and home life and in greatly enhancing the educational opportunities for young and adult learners. Early in the period of this plan we will launch the first agricultural-based CPD Programme in Ireland which will be known as Evolve. We've also actively sought to establish a number of apprenticeships right across the sector and we hope that these will be delivered next year.

The environmental agenda is challenging in terms of reducing and adapting to gaseous emissions, improving water quality and enhancing farm biodiversity. Our path-breaking science has led to the creation of green-house gas and ammonia MACCs. This science underpins public policy. But research doesn't stand still. Our scientists are looking to future technologies to suppress methane. We also intend to establish a *National Agricultural Soil Carbon Observatory* which will in future contribute to reducing national net emissions as

well as laying the scientific foundations for potential "carbon farming". But for research to be effective it has to be adopted. And to ensure that the measures in the MACCs become embedded as routine farming practices, we will be launching our *SignPost* demonstration programme later this year.

In this Strategy Teagasc fully embraces the "One Health" concept and we set out how we plan to enhance the nexus between soil, animal and human health.

Frontier research requires frontier facilities. This Strategy commits to establishing a *National Agricultural Sustainability Research and Innovation Centre* at Johnstown Castle.

At the epicentre of a sustainable food system lies the powerful concept of the circular economy. Agriculture is a natural laboratory for circularity and this will be fully exploited throughout this strategy period. As an example, we expect to shortly commission a demonstration AD plant at Grange to produce biomethane from slurry and grass silage. But the exciting opportunities for the future lie in using biofermentation processes to add value to a host of conventional crops, including grass and wood. This is a priority area of research in our Food Programme.

Our ability to service the needs of Ireland's food companies to diversify export markets post Brexit, will be greatly facilitated by the almost €40m. recent investment in infrastructure. This investment has already seen a major extension to MTL Ltd and the establishment of the *National Prepared Consumer Foods Centre*. We expect to see the completion of the *National Food Innovation Hub* shortly and the *Bia Innovator* before the end of the year. These facilities will be fully leveraged over the period of this Strategy.

Teagasc must itself innovate if it's to drive the ambitions of our farmers and food companies. It must ensure, as a priority, that it has the best available scientists, advisors, teachers, administrators and support staff to respond to the challenge of creating a sustainable food system. And we intend to promote the greatest diversity that's possible in our staff profile, particularly at senior level.

Greatly enhanced internal collaboration, through realising the powerful concept of "Teagasc Together", and enhanced national and international external collaboration will also be essential to successfully meeting the "Grand Challenges" facing our sector.

Covid 19 has helped us realise the power of online communications in transferring knowledge. We will build on this experience over the next three years through setting up a Teagasc App and investing in a 'state of the art' studio for the production of videos and webinars, as a well as increasing the level of professional staff dedicating to public engagement.

This is an ambitious plan for a future that requires ambition. But it's achievable. It's success will require the continued support from our parent department and our stakeholders, especially Ireland's farmers and food companies.

Liam Herlihy
Chairman Teagasc

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Contents

1. Teagasc's Mandate, Mission, Vision and Values

Mandate

Teagasc – the Agriculture and Food Development Authority – is the national public body providing integrated research, advisory, education and training services to the Irish agri-food sector. It was established under the Agriculture (Research, Training and Advice) Act 1988, which states that its principal functions shall be:

- To provide, or procure the provision of educational, training and advisory services in agriculture, including such educational, training or advisory services in agriculture as may be specified by the Minister for the purpose of giving effect to any directive, regulation or other act adopted by an institution of the European Communities.
- To obtain and make available to the agricultural industry the scientific and practical information in relation to agriculture required by it.
- To undertake, promote, encourage, assist, co-ordinate, facilitate and review agricultural research and development (including research and development in relation to food processing and the food processing industry).

This mandate gives Teagasc responsibility for supporting the knowledge and technology needs of the entire food chain and the authority to integrate research, advice and education services to deliver the innovation support necessary to add significant value to Ireland's agri-food sector.

Our Mission

"To provide scientific leadership and support to Irish farmers and food companies in achieving a sustainable food system."

"A sustainable food system (SFS) is a food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised." [1]

Our Vision

"For Teagasc to be a globally recognised leader in developing innovative science-based solutions for the sustainable transformation of our land resources into products and services for the benefit of society."

Our Values

"Teagasc seeks to be professional, responsive, efficient, innovative, accountable, independent and scientifically excellent in carrying out its functions."

> *"A sustainable food system (SFS) is a food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised."*

1 *www.fao.org/3/ca2079en/CA2079EN.pdf*

2. Statement of Strategy 2021-2024 Process

Teagasc is obliged to publish a Statement of Strategy (SoS) at regular intervals as set out in the Public Service Management Act, 1997. This statement outlines the high-level priorities for our research, education and advisory functions up to 2024. The details will be spelled out in our Annual Business Plans and in specific projects that will be devised in alignment with this SoS. However, we do outline here the more significant projects and directions that we plan to pursue over the period up to 2024. Implicit in this strategy is a continuation of existing activities that have worked well. Its principal focus, however, is on the identification of existing areas we need to change and new areas that we need to develop in order to meet the challenges and harvest the opportunities for Ireland's agri-food sector and wider bioeconomy over the next three years and beyond.

The Strategy was informed by extensive consultation with internal and external stakeholders. The internal consultative process was primarily conducted through engagement with our National Partnership Committee, supplemented by a comprehensive online staff survey and a series of staff workshops. We also conducted a survey of key external stakeholders. In addition, we engage in on-going consultation with the agri-food industry on our strategies and programmes through a network of consultative committees and through the input from industry representatives on the organisation's Authority.


The Paddy O'Keeffe Innovation Centre

3. Teagasc Capabilities

- Our People
- Our Organisation
- Research, Advisory Services
- Education & Training

Our People

As a knowledge-providing organisation, our capability to deliver our mandate effectively is hugely dependent on our highly engaged and high quality human resources. We constantly strive to enable every staff member to self-improve and to enjoy a healthy work-life balance. Over the period of this strategy we are committed to implementing in full the Agile Working policy that has been adopted by the Teagasc Authority.

We are also committed to being an organisation that recognises the value of diversity among its staff and where all staff feel included and valued, irrespective and indeed, because of their uniqueness. We have recently adopted a comprehensive People Strategy which *inter alia* contains a Diversity and Inclusion strategy as a key module. That module acknowledges the proven value of having a diverse and inclusive organisation in nurturing an innovative organisational culture in being responsive to the needs of stakeholders. We are fully committed to achieving improvements in all aspects of this particular module and especially in respect of gender balance over the period of this SoS.

Our Organisation

The organisation's current workforce compliment is 1,200, comprising permanent and contract workers. We also have almost 270 PhD and MSc Walsh Scholars which provide talented students from Ireland and elsewhere with the opportunity to obtain higher-level degrees. These resources are distributed across our research, advisory services education and training and operations' functions.

As a public research and innovation organisation, Teagasc is recognised internationally as being unique in having, within the same organisation, the three critical components of research, advisory and education activities that are considered essential to ensuring that research knowledge supports practice. The EU-funded PRO AKIS report (2014)[2] shows that the Irish Agricultural Knowledge and Innovation System (AKIS) is both strong and well-developed relative to other European countries.

2 *https://proakis.hutton.ac.uk/sites/proakis.hutton.ac.uk/files/Final%20Draft-%20Country%20Report%20Ireland(4).pdf*

Research

Our internationally competitive research programme is delivered by 250 researchers trained to PhD level and supported by technical, farm and administrative staff. Our researchers have access to expansive areas of experimental farmland supporting experimental work on livestock and crop enterprises. They also benefit from ongoing investment in cutting-edge research laboratories, unique pilot plant facilities, and other significant scientific and innovation-support research platforms such as the Next Generation Genome Sequencing Facility and the National Farm Survey.

The organisation's highly innovative Walsh Scholarship Programme enables the training of the future generation of scientists and professional farm advisors. These scholars, some 270 of them at present are an important component of our research and advisory capability and facilitate our researchers to collaborate with colleagues all over the world.

Teagasc research is highly competitive at national and international level. In comparison with all other research organisations and universities across Europe, Teagasc has ranked 5th in terms of the number of projects awarded in the agri-food stream of European funding since Horizon 2020 began in 2014.

All of our scientists are expected to publish their results in the best international scientific journals and each year we undertake a detailed bibliometric analysis covering the number of papers published, citations and citations' impact. The analysis for the period 2014-2018 in Agricultural, Dairy & Animal Sciences, shows that Teagasc ranked 6th of all organisations across the EU by number of publications and 4th by number of citations. Over 20% of Teagasc published papers are ranked in the top ten percentile for this category. Compared to Irish universities, Teagasc ranks first by the number of publications and also by the number of citations. Over 20% of our articles in this category rank globally in the top 10 percentile for citations and have the highest citation impact.

Teagasc is also a much sought-after research partner by international research organisations – currently we have close relationships with more than 150 research institutes and universities around the world, including with all of the leading European institutions.

During this strategy period, we are committed to strengthening partnerships and collaboration in order to access the broader range of skills and capabilities, data and infrastructure, networks and stakeholders, which will be required to address new challenges and opportunities. In particular, we are committed to developing new collaborations embracing expertise from disciplines which, traditionally, we would not have featured prominently, if at all, in agriculture and food research.

Teagasc ranked 6th of all the organisations across the EU by number of publications and 4th by number of citations

RV

Research

Global Standing

Citations in Top Ten Percentile Globally*

20%

Global Impact for Citations*

1st

European Ranking

5th

For Number of Funded Projects

4th

For Number of Citations

6th

For Number of Publications

20% in Top Ten Percentile

Research Figures

Number of Teagasc Researchers

Trained to PhD Level

250

Number of Walsh Scholars

270

Ranking for Publications & Citations

Compared with Irish universities

Number of Collaborations

with research institutes & universities around the world

150

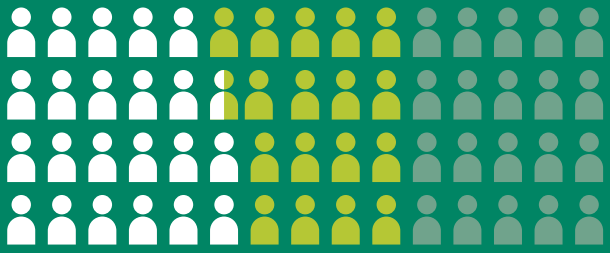
* Analysis for the period 2014-2018 in Agriculture, Dairy and Animal Sciences

Advisory Services

Key Figures

Teagasc Front Line Advisors **340**

12 Regional Advisory Areas



= 120,000 Farmers

= 80,000 Availing of Advisory Services

= 45,000 Availing of Intensive Advisory Services

Front Line Advisors supported by **45**

Subject-matter Specialists or 'Knowledge Brokers'

Support for Farmers

Strengthen Adoption of Technology

Nutrient Management Planning Online Tool

Certificate for European Consultants

e-Profit Monitor: Financial Analysis Tool

Environmental Sustainability Training

PastureBase Ireland: Pasture Management

Advisory Services

Our advisory services support farmer innovation in the management of their farms and provides access to the technologies they can apply to improve their competitiveness and address the sustainability challenges on their farms. The advisory programme is delivered by about 340 'front-line' advisors located in 12 regional advisory areas. These advisors are in contact with some 80,000 farmers and rural dwellers each year, of whom approximately 45,000 avail of our intensive farm advisory services. The services are delivered through one-to-one engagement and interactive innovation approaches, including Discussion Groups that focus on 'peer to peer' learning. Increasingly, in line with the Government's proposed National Digital Strategy and accelerated by Covid-19, services are being delivered through various digital channels and we are committed to enhancing our digital service delivery over the coming years. Front-line advisors are supported by 45 subject-matter specialists or 'knowledge brokers' who provide a bridge between our researchers and 'front-line' advisors.

Knowledge transfer activities and programmes have responded to the needs of farmers to provide the science-based innovation support required by the sector in light of challenges posed by Covid-19, climate change, and environmental, economic and social sustainability. This new model includes a number of key components designed to strengthen the adoption and implementation of technology at farm level. Intensive training in the environmental dimensions of sustainability is being prioritised for all advisors and we will continue to roll out the professional training of advisors through the Certificate for European Consultants in Rural Areas.

Teagasc has developed a number of innovative decision-support tools, including, the e-Profit Monitor, the Nutrient Management Planning Online tool and PastureBase Ireland to assist farmers in optimal pasture management.

> *We are committed to enhancing our digital service delivery over the coming years.*

Education and Training

Education and training lie at the heart of our mission, and the organisation is the main provider of education and training for the land-based sector as well as being a significant training provider to the food industry. Teagasc is a registered training provider with Quality Qualifications Ireland and works in partnership with many other education stakeholders, including the universities, Technological Universities, Institutes of Technology and others to deliver quality-driven, applied education and training programmes.

Our recent Education Vision report[3] sets out the roadmap to address the future knowledge, skills and capability requirements of the land-based sector. It envisages the introduction of new and innovative teaching and learning approaches and the extension of the curriculum content to embrace the development of skills in sustainability, entrepreneurship, innovation and digital technologies. It also provides a clear mapping between the achievement of education qualifications and the acquisition of specific skills relating to farm management.

We have recently begun to develop a new 'continuous professional development' (CPD) service, known as Teagasc Evolve, that will enable farmers and others to continue to upskill and adapt to challenges and opportunities in the industry.

The organisation is equally committed to transferring its latest discoveries to the food industry through facilitation of access to cutting-edge research, infrastructure and highly qualified and skilled employees. The organisation has a well-established innovation management system in its food directorate, which focuses on the conversion of public research into useful products and processes for industry. We operate a variety of mechanisms for engagement with industry in knowledge transfer, mostly funded directly by industry, but also involving funding from Enterprise Ireland through, for example, 'competence centres' and 'innovation partnerships'.

Leader in Education and Training

Main Provider of Education & Training for Land Based Sector

QQI AWARD

Registered Training Provider with Quality Qualifications Ireland

Education Vision Report

Embraces the development of skills in...

- Sustainability
- Entrepreneurship
- Innovation
- Digital Technologies

Life Long Learning

teagasc Agriculture and Food Development Authority | Evolve Lifelong Learning for Farmers & Growers

teagasc Agriculture and Food Development Authority | ConnectEd Professional Knowledge Network

3 *www.teagasc.ie/publications/2018/teagasc-education-vision---meeting-future-needs.php*

Teagasc is a registered training provider with Quality Qualifications Ireland and works in partnership with many other education stakeholders including the universities, Technological Universities, Institutes of Technology and others.

A market trend to be noted is the growth in plant-based and artificial meat and dairy products: these products are one of the fastest-growing food areas and the market is expected to grow by 15.8% per annum over the next seven years.

4. Medium Term Drivers of Change

- Global Trends and Market Context
- Policy Context
- Sustainable Development Goals
- Implications of Global Market and Policy

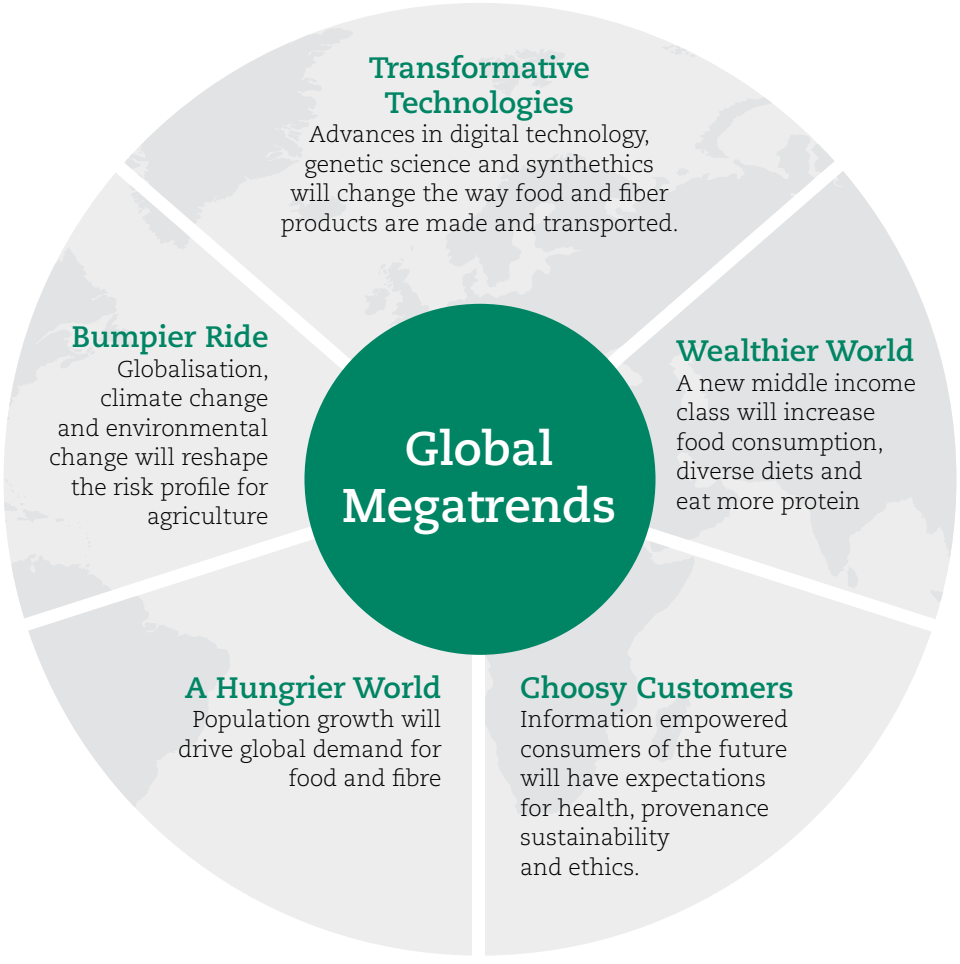


Figure 1: *Global Megatrends. Hajkowicz, S and Eady, S (2015), Rural Industry Futures. Megatrends impacting Australian agriculture over the coming twenty years. www.agrifutures.com.au/wpcontent/uploads/publications/15-065.pdf*

Global Trends and Market Context

The agri-food sector accounted for 7.5% of modified GNI (€14.8 bn)[4], 10% of total merchandise exports and 7.7% of employment in 2018. Irish food products are exported to over 180 countries worldwide and are generally perceived as high-quality, safe products with strong "Green" credentials as highlighted in recent years through the Bord Bia *Origin Green* programme, which is underpinned by food quality and assurance schemes at producer and processor level.

Ireland's food system is highly connected to the global economic system through our economic dependence on international trade with approximately 80% of our production exported. We are also highly reliant on imported inputs, particularly energy. Accordingly, Ireland's continued growth and success, and the innovation support required from Teagasc, will be heavily influenced by the so-called global 'megatrends'. These trends will present both challenges and opportunities for Ireland as they drive significant change in the production, processing, marketing, distribution and consumption of food (Fig. 1).

Agri-food production and processing activity is particularly important to the economic wellbeing of rural areas where other economic opportunities are more limited. Outside of the main urban centres, it accounts for a much larger share of income and employment; for example, the share of agriculture in the regional economies of the North and West is more than double that of the national average.

Despite its strengths and importance to the national and regional economies, the industry is currently facing a number of significant economic, environmental, production and social challenges which will influence its future development.

At market level, the current outlook due to Covid-19 and Brexit[5] is difficult to predict. The medium term market outlook to 2027 is for global food demand to grow in line with population. For most agricultural commodities, prices adjusted for inflation are not expected to grow due to the growth in global supply. Volatility in output and input prices will continue to be a challenge.

The recent conclusion of a Brexit trade deal removes a major threat to food exports and wider trade. However, new non-tariff barriers to apply to UK/EU trade from January 1st, 2021 will mean that delays are likely as goods move in both directions, with consequential cost implications. Exporting companies will therefore want to focus on market diversification and this requirement will be reinforced if the UK were to reactivate its traditional 'cheap food' policy over the medium term. The centrality of market diversification to the post-Brexit strategy of Ireland's food-exporting companies will require greater innovation support from Teagasc and other organisations.

4 *Modified GNI is an indicator that excludes globalisation effects that are disproportionally impacting the measurement of the size of the Irish economy.*
5 *Teagasc economists continue to analyse the impact of Brexit and other potential trade disruptions using a variety of modelling tools (e.g. www.teagasc.ie/publications/2020/outlook-2021--economic prospects-for-agriculture.php).*

> *The market for plant-based meat alternatives, in particular, is on a strong upward trajectory. The sector's global value had grown to $4.5 billion by 2018, and is expected to rise to $85 billion by 2030.*

The medium-term market outlook for higher value products and food ingredients is for continued growth, based particularly on ongoing growth in population and in incomes in middle-income economies and increased demand for quality assured foods with a known and trusted provenance. Continued access to such high-growth markets will require high food safety and environmental sustainability standards and resource efficient food-production systems. There may also be opportunities to develop novel by-products and new products arising from exploiting the potential of the sustainable circular bioeconomy.

A further market trend to be noted is the growth in plant-based and artificial meat and dairy products: these products are one of the fastest-growing food areas and the market is expected to grow by15.8% per annum over the next seven years.[6] However, contrary to what many consumers claim about their individual habits, plant-based foods are not yet replacing a large amount of meat. Globally, meat consumption is on the rise (1.4% per year through 2023), while in Europe the market remains stable.

Nevertheless, the market for plant-based meat alternatives, in particular, is on a strong upward trajectory. The sector's global value had grown to $4.5 billion by 2018, and is expected to rise to $85 billion by 2030. A broader shift has been occurring toward more plant based diets as a whole, including the consumption of more vegetables, grains and legumes.

While plant-based meat alternatives have attracted headlines, the market for plant-based dairy alternatives has experienced dramatic change in recent years. Until 2015, soy was the number one ingredient for milk alternatives in Europe, for instance, but almond has taken over with an estimated compound annual growth of 16.7% from 2020 to 2025.

Animal-free yoghurts, desserts and cheeses, have followed on from the boom in milk alternatives; however, there is still a long way to go in terms of consumer acceptability.

In addition to the plant-based products, cultured or lab-grown or cell-based meat products (and also milk-based products) are being developed. In 2020, Singapore became the first country in the world to approve the sale of cultured chicken products. Again, much research remains to be done and high levels of investment will be required for these products to begin to make an impact in the market place.

6 *This section is based on data from: www.figlobal.com/content/dam/Informa/figlobal/fieurope/en/2020/documents/HLN20FIE-GM-Plant-based-ingredients-are-here-to-stay.pdf*

Policy Context

Our programmes are fully aligned with and supportive of government and EU policies, in particular the following: *Programme for Government-Our Shared Future (PFG), The European Green Deal*, and the *EU Farm to Fork Strategy for a Fair, Healthy and Environmentally-friendly Food System*. We will, of course also be strongly guided by the report and recommendations which will emanate from the Agri-Food 2030 process.

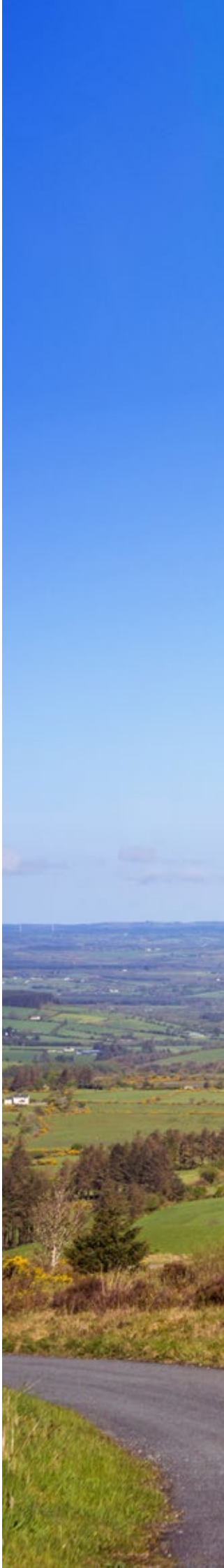
The European Commission in December 2019 published its European Green Deal[7] and this was followed in May 2020 by the publication of its Farm to Fork[8] and Biodiversity strategies[9]. These policy developments, together with the ongoing CAP reform process, will shape the policy landscape for the Irish agriculture and food industries for the medium term. The CAP post 2020 will include nine strategic objectives. The commitment to the support of farm incomes remains a central objective of the EU model of agriculture, but the European Commission strategy documents also signal a clear reordering of policy priorities. The status of policy on the impact of agricultural production on the environment and of food on human health and wellbeing has attained a much higher level of priority in the EU policy and political agendas.

These specific CAP objectives are underpinned by a commitment to support a more integrated and effective Agricultural and Knowledge Innovation System (AKIS) based on stronger research, advice, education, business, service and CAP networks.

The PFG also reflects the increased EU emphasis on environmental matters. The PFG sets a substantially greater challenge to reduce GHGs by 2030 than in the Climate Action Plan (2019). While detailed sectoral targets have yet to be established, it is likely that the target of a 10%-15% reduction set in the Climate Action Plan will be significantly increased. The successor to Food Wise 2025 (Irish agri-food sector development strategy 2030) is also expected to emphasise the need to address the environmental challenges facing Irish agriculture and food. DAFM's recently published AgClimatise paper, which builds on the Teagasc Marginal Abatement Cost Curves (MACCs) for GHGs and ammonia, sets out a roadmap and actions to realise the following vision:

"By 2050, we want to develop a climate neutral food system compatible with the Paris temperature goals, whereby the climate impact of biogenic methane is reduced to zero and remaining agricultural emissions are balanced by removals through land use and a significant contribution to renewable energy."[10]

While much of the national discourse on the challenges facing our agriculture and food sector has been concerned with mitigation, we need to be also mindful of the resilience of the sector to adapt to climate change.



7 *https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en*
8 *https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/farm-fork_en*
9 *https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/eu-biodiversity-strategy-2030_en*
10 *www.gov.ie/en/publication/07fbe-ag-climatise-a-roadmap-towards-climate-neutrality/*

The status of policy on the impact of agricultural production on the environment and of food on human health and wellbeing has attained a much higher level of priority in the EU policy and political agendas.

Sustainable Development Goals

Figure 2: *Sustainable Development Goals*

In 2015, the United Nations (UN) proposed and adopted the 2030 Agenda for Sustainable Development (UN, 2015) and identified 17 Sustainable Development Goals (SDGs) with 169 targets and over 230 indicators. In January 2016, the SDGs came into force. The SDGs are designed to refocus efforts towards policies that directly help people and communities toward sustainable development. They aim to provide both a pathway out of poverty and hunger for millions of people in the world, and a pathway to a sustainable future for all countries and peoples. A key message is that the SDGs are not just another list of suggestions for poor countries; they can be a tool for all countries, informing decision making and public policy.

In this regard, the SDGs have become an important benchmark in the assessment of economic, social and environmental progress and have given governments clear economic, social and environmental standards against which established and prospective policies should be judged. Ireland's SDGs' National Implementation Plan[11] provides a whole-of-government approach to their implementation and commits Ireland to fully achieving all 17 of the Goals by 2030.

Teagasc, together with our international academic partners, the private sector and NGOs, are committed to global agendas, particularly the SDGs. We are especially committed to the SDGs' Zero Hunger; Good Health and Well-Being; Quality Education; Clean Water and Sanitation; Responsible Consumption and Production; Climate Action; Life on Land; and Partnerships. From our perspective, the production of knowledge and know-how and their conversion into drivers of technological, economic and social innovation is an essential strategic component in delivering on the SDGs.

11 *https://assets.gov.ie/19344/32f9bdd2aae2464caae37760edd1da04.pdf*

Implications of Global Market and Policy Developments

The overall picture that emerges from an analysis of these drivers is one of great opportunity for Ireland, but with many attendant risks:

- Many of these drivers are bolstering momentum for global growth in demand for food and fibre products. Income growth in Asia will lead to significant diversification of diets, a rise in protein consumption and the emergence of niche markets for boutique foods as well as for mainstream products.
- The environmental costs of food production regarding water quality, climate change, deterioration in soil quality and biodiversity losses are not consistent with the expectations of many of our global consumers.
- New technologies and production systems will create opportunities to reduce costs, improve product quality, improve circularity, manage risk and lead to greater efficiency in entire supply chains. However, new disruptive technologies also have the capacity to disrupt the existing markets and products by, for example, enabling synthetic foods and so-called plant-based 'meats and milks' compete alongside traditional crop and livestock products.
- The advent of knowledgeable and information hungry consumers in certain regions will lead to greater demands for products of proven provenance and health benefits that are produced in an ethical and sustainable manner. This will represent a challenge for some producers and industries but an opportunity for others.

The key message emerging from the analysis of drivers is that there is an urgent need to accelerate the global transformation of food and land use systems in order to achieve the targets for climate and sustainable development set out in the 2015 Sustainable Development Goals and the Paris Agreement on climate change.

The Irish agri-food system as it evolves will thus need to be part of this global transformation. In light of this overarching requirement, the key priority for Teagasc over the coming strategy period will be to provide leadership and support for the transformation of our agri-food system to a sustainable food system such that it delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised.

The challenges are complex and systemic and will require a combination of interconnected actions at local, national, regional and global levels.

> *The key priority for Teagasc over the coming strategy period will be to provide leadership and support for the transformation of our agri-food system to a sustainable food system.*

5. Key Strategic Directions

- Sustainability – a Holistic Concept
- Innovation the Key to Improving Sustainability
- The Agricultural Knowledge Innovation System (AKIS)
- Disruptive Technologies
- 'From Farm to Gut'- a Systems' Approach to Innovation
- Farm Diversification Opportunities

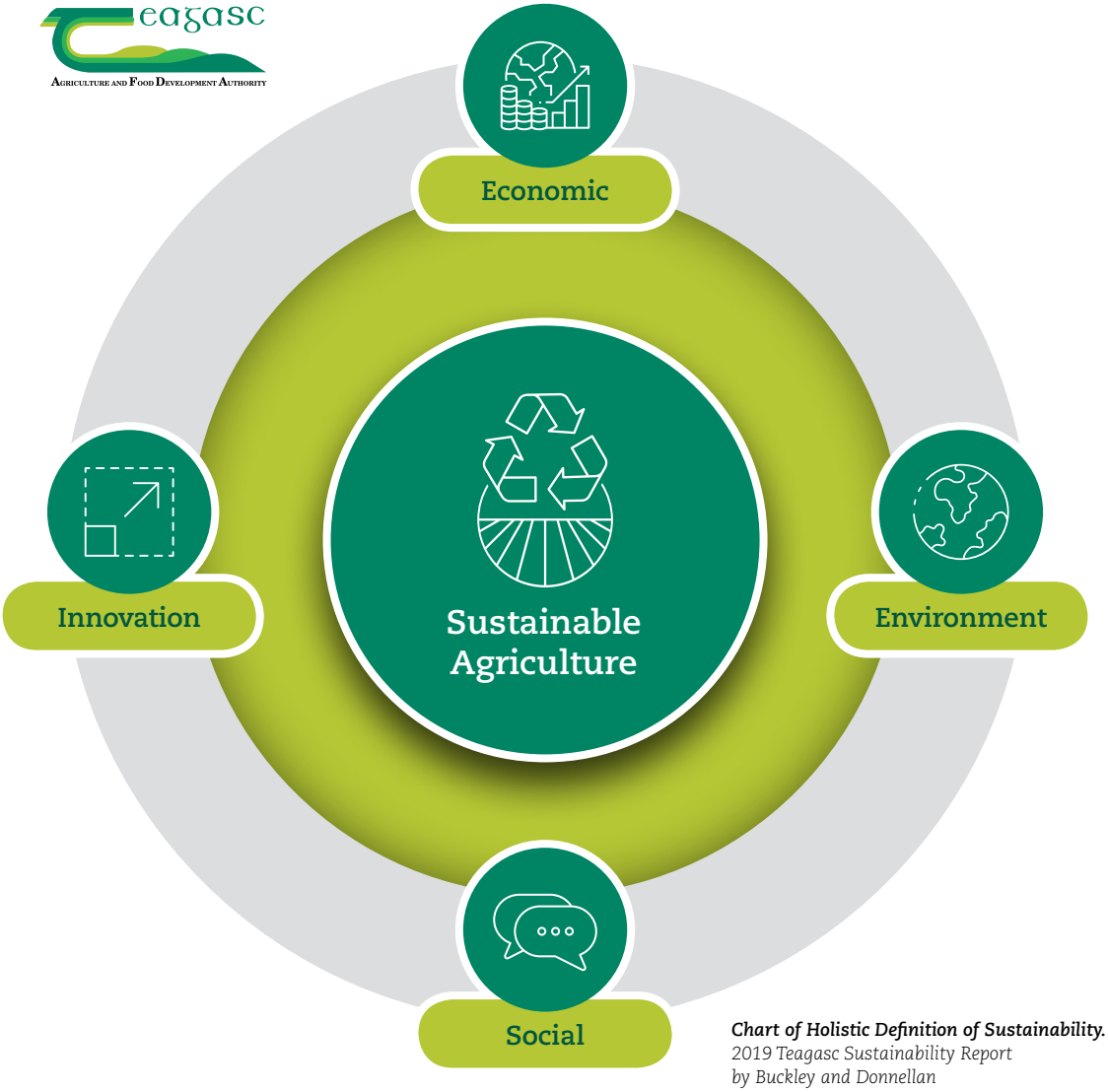


Chart of Holistic Definition of Sustainability.
2019 Teagasc Sustainability Report by Buckley and Donnellan

Sustainability – a Holistic Concept

Teagasc has for some time advocated a holistic concept of sustainability. According to our perspective, the term sustainability should embrace four interrelated dimensions, namely, economic, social, environmental and innovation.[12] All of our research and advisory activities are geared towards achieving a balanced improvement across these four dimensions. This approach is central to the creation of a truly 'Sustainable Food System' (SFS).

Too many of our farmers are economically "vulnerable"[13] as a result of low levels of economic "viability" and lacking access to off-farm employment. About 40% of our beef and sheep farmers fall into this category. This is compounded by many farm households also having a poor age profile and being isolated.

The environmental challenges facing the agri-food industry include meeting national and international commitments to reduce gaseous emissions and to successfully adapt to climate change, improve water quality and enhance biodiversity. There is also an urgent need to address Antimicrobial and Anthelmintic Resistance and other animal health and welfare challenges within the wider framework of the "One Health" strategy of the WHO.

As well as addressing the mitigation challenges posed by Greenhouse Gases, the already evident impact of Climate Change leading to wetter winters and drier summers and the increased frequency of extreme weather events requires equal prominence to be given to the challenge of adaptation to, and resilience in the face of, Climate Change.

A number of farm-level social and sectoral capacity challenges that are influenced in a significant way by an aging farm population are also noted. These challenges include the need for measures to improve farmer health and the safety and the quality of life on many farms. Actions are also needed that enable improved female participation in farming and in support of earlier farm succession planning and management.

The agri-food sector will additionally need to improve the sourcing, management and retention of a high quality, well-educated labour resources; increase its use of cost-effective automation and the exploitation of large data sets and digital technologies to support management decisions in relation to both improved farm income and environmental performance.

12 *Buckley, C. and Donnellan, T. (2020) Teagasc National Farm Survey Sustainability Report 2019, Teagasc, www.teagasc.ie/media/website/publications/2020/NFS-2019-Sustainability-Report.pdf*

13 *A farm is defined as vulnerable if the farm business is not economically viable and the farmer or farmer's spouse has no off-farm employment income source.*

Research and innovation will continue to be key inputs in speeding up the transition to a sustainable Irish food system from production to consumption.

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Innovation the Key to Improving Sustainability

The achievement of sustained improvements in living standards is driven in the first instance by the ability of economic sectors to drive improvements in productivity. In turn productivity is driven by research and innovation. Boosting innovation will thus be critical in enabling the Irish agri-food system to transition to a lower carbon future and to capture the opportunities and avoid the risks in this new era.

Research and innovation therefore will continue to be key inputs in speeding up the transition to a sustainable Irish food system from production to consumption. Moreover, knowledge and advice will be critical in enabling all stakeholders in the food system to become sustainable. In particular, primary producers will more than ever need the support of independent advisory services to enable them to transition to the farming management systems and sustainable practices to achieve the challenging national and EU objectives and targets for gaseous emissions, nutrient management efficiency, water quality, and biodiversity improvement as well as building the necessary resilience into farming system to withstand ongoing climate change. This transition will need to be underpinned by a much changed innovation paradigm relative to what we've been used to in the Irish agri-food sector. Three key perspectives at least need to be embedded in this new paradigm.

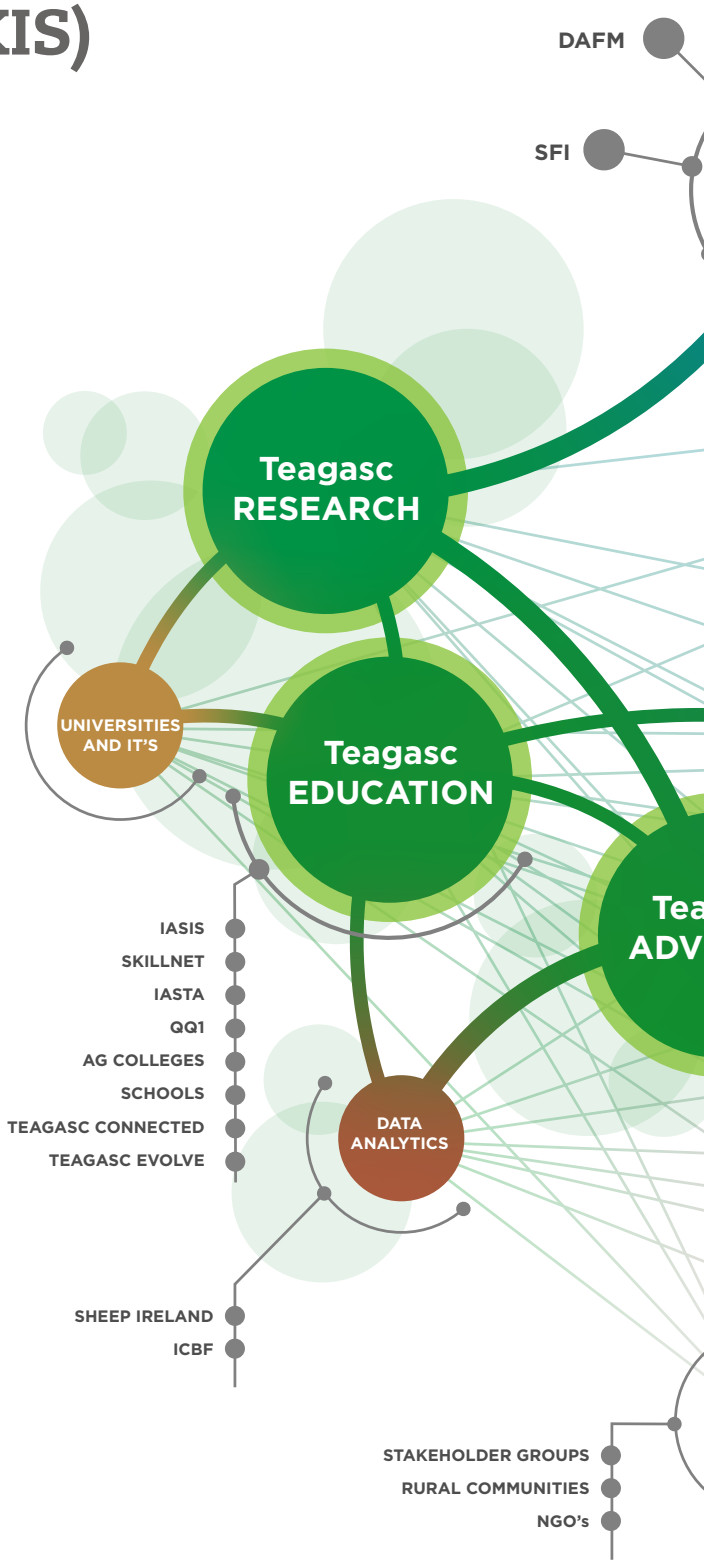
The Agricultural Knowledge Innovation System (AKIS)

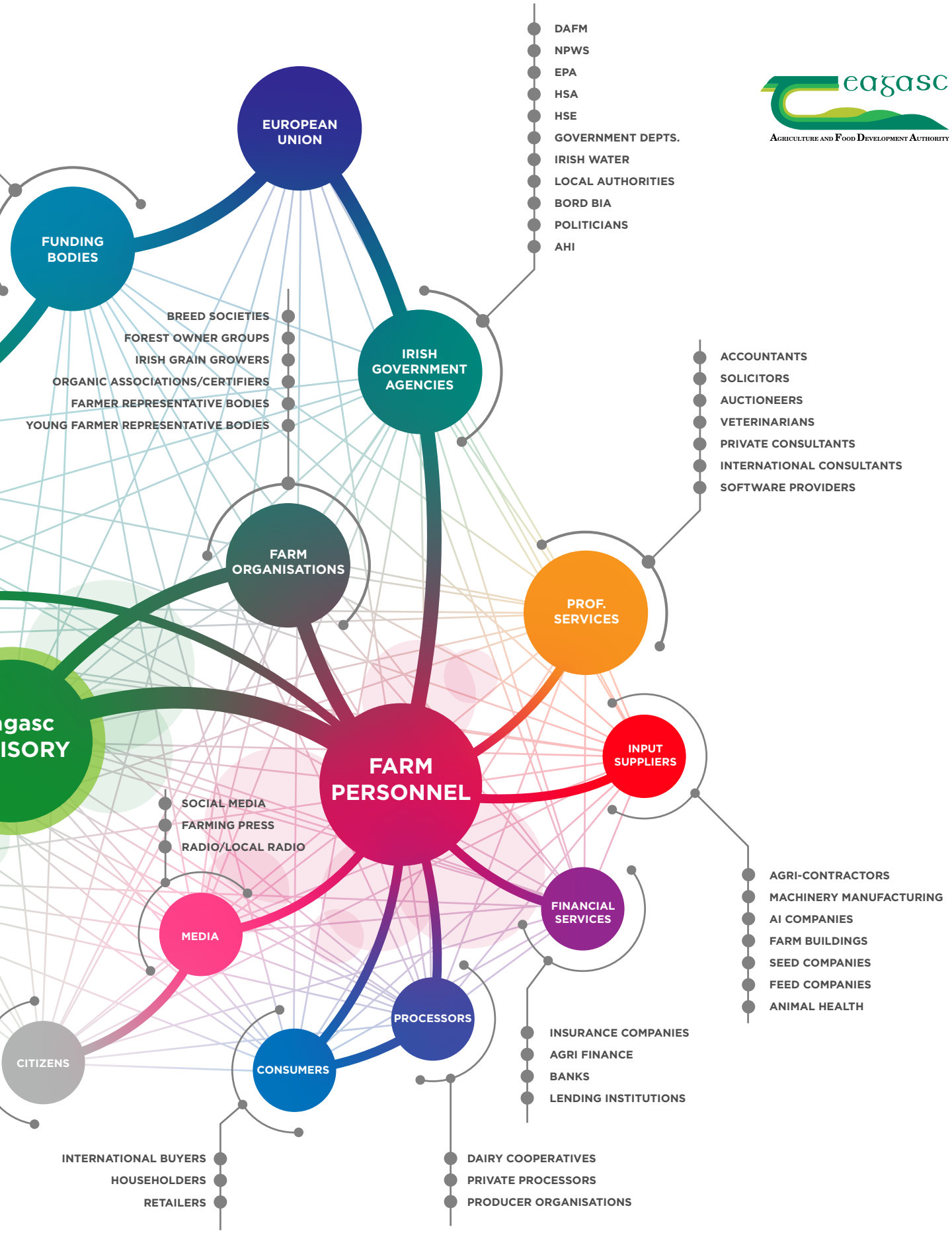
The first is to recognise that the traditional supply-driven innovation model needs to give way to a more inclusive, interactive and participatory demand-driven Agricultural Knowledge Innovation System (AKIS) involving a wide range of actors that will guide, support, create, transfer knowledge and embrace innovation. The strength of the AKIS network linkages need to be improved between public sector agencies and between public and private sectors, and the primary producer must be placed at the core of the system.

In this regard Teagasc has been active in the support of various European Innovation Partnerships (EIPs), e.g. the Burren and Aran Life EIPs and the SUAS partnership in the Wicklow uplands. The EIPs are embedded in the same philosophy as the AKIS and the diversity of programmes that are now in place throughout the country have all developed a variety of networks with farmers playing very active roles as co-innovators.

The scale of the challenges facing the agri-food sector thus requires a shift from traditional 'top down' knowledge transfer approaches to more 'bottom up' approaches. These approaches are not exclusive of each other. The 'bottom up' approach leverages the vast strength of experience and knowledge in the AKIS system and provides channels for communities of practice and new solutions to emerge to address new challenges. The experience of EIP operational groups in Ireland and from other member states give us confidence that using more participatory and interactive innovation approaches can be effective in identifying innovation solutions.

> *The 'bottom up' approach leverages the vast strength of experience and knowledge in the AKIS system.*




DAFM
NPWS
EPA
HSA
HSE
GOVERNMENT DEPTS.
IRISH WATER
LOCAL AUTHORITIES
BORD BIA
POLITICIANS
AHI
EUROPEAN UNION
FUNDING BODIES
BREED SOCIETIES
FOREST OWNER GROUPS
IRISH GRAIN GROWERS
ORGANIC ASSOCIATIONS/CERTIFIERS
FARMER REPRESENTATIVE BODIES
YOUNG FARMER REPRESENTATIVE BODIES
IRISH GOVERNMENT AGENCIES
ACCOUNTANTS
SOLICITORS
AUCTIONEERS
VETERINARIANS
PRIVATE CONSULTANTS
INTERNATIONAL CONSULTANTS
SOFTWARE PROVIDERS
FARM ORGANISATIONS
PROF. SERVICES
gasc
ISORY
FARM PERSONNEL
INPUT SUPPLIERS
SOCIAL MEDIA
FARMING PRESS
RADIO/LOCAL RADIO
MEDIA
FINANCIAL SERVICES
AGRI-CONTRACTORS
MACHINERY MANUFACTURING
AI COMPANIES
FARM BUILDINGS
SEED COMPANIES
FEED COMPANIES
ANIMAL HEALTH
PROCESSORS
CITIZENS
CONSUMERS
INSURANCE COMPANIES
AGRI FINANCE
BANKS
LENDING INSTITUTIONS
INTERNATIONAL BUYERS
HOUSEHOLDERS
RETAILERS
DAIRY COOPERATIVES
PRIVATE PROCESSORS
PRODUCER ORGANISATIONS

Disruptive Technologies

The innovation system also needs to significantly change is its capability of assimilating potentially disruptive technologies that have the capacity to transform our food system. The Teagasc Technology Foresight 2035[14] study concluded that recent advances in potentially disruptive technologies (e.g. digitalisation) present a major opportunity to accelerate the transformation of our food system and bioeconomy. These technologies could fundamentally reshape the demand landscape, enhance value-chain linkages and increase the sustainability of production systems. Until now, the food and agriculture sectors have been slow to harness the power of these technologies, attracting significantly lower levels of investment and inspiring fewer technology start-ups than other sectors.

We anticipate that over the next decade or so opportunities will be presented through the exploitation of the principle of the sustainable circular bioeconomy (SCB). We anticipate that these opportunities are most likely to arise initially in the valorisation of food wastes. But it is likely that alternative and more valuable uses may be identified for bio-based raw materials, such as, grassland and other crops, including wood. Teagasc will need to ensure that it has the required expertise and programme resources to aid the exploitation of these opportunities as they arise.

14 *www.teagasc.ie/media/website/publications/2016/Teagasc-Technology-Foresight-Report-2035.pdf*

'From Farm to Gut'- a Systems' Approach to Innovation

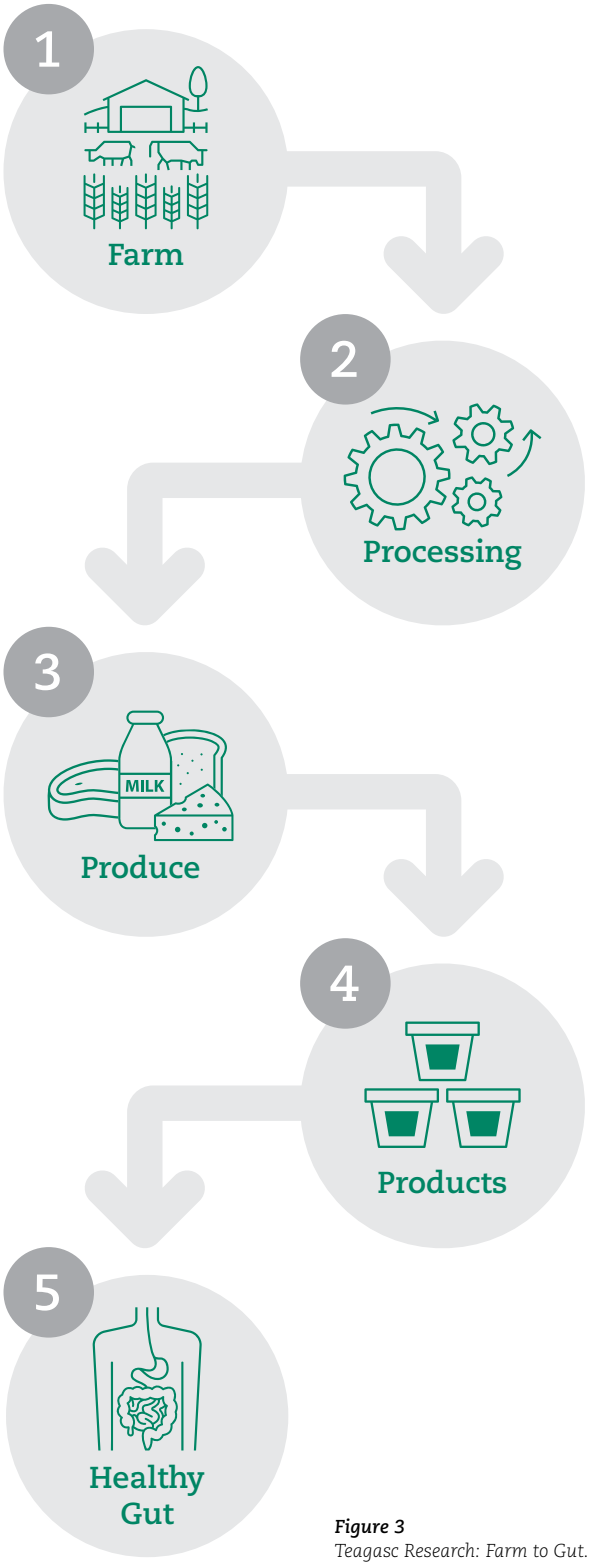


Figure 3
Teagasc Research: Farm to Gut.

A further requirement of the new innovation paradigm is the need to view the issues that arise along the food value chain through a 'systems' lens. This is the essence of the 'Sustainable Food System' (SFS) concept. The food value chain stretches from 'farm to fork', or, perhaps more comprehensively, from 'farm to gut', where the latter explicitly embraces the important component of human health and nutrition. In other words, our innovation and research structures need to capture this system dimension in the conduct of research and innovation activity.

Systems research is, of course, not unknown in the Irish agri-food sector. Teagasc has for many years adopted this approach as a core feature of its research activity and this Strategy will adopt an innovative, integrated multi-disciplinary systems-based approach to problem solving which acknowledges the complexity of the challenges and opportunities across global, regional and local scales; the diversity of actors in the AKIS; the availability of new scientific tools; and the focus on impacts at all stages along the food value chain.

> *Our innovation and research structures need to capture this system dimension in the conduct of research and innovation activity.*

The sustainable foods system approach stresses the interlinkages between the nodes along the value chain and the feedback loops that operate between adjacent and remote nodes. The concept furthermore embeds the notion of the sustainable circular bioeconomy (SCB). The SFS can be operationalised at local, regional, national and international levels. We consider that this approach will involve framing our research programme in terms of a few high level challenges that emphasise the interrelationships along the food value chain. This is turn will require a higher level of collaboration both within Teagasc and externally within Ireland and internationally. Teagasc will thus adapt its research structure and system to embrace the implications of the SFS approach over the lifetime of the Strategy.

Farm Diversification Opportunities

Given the viability challenges on many of our farms, and the associated concerns around the environmental impacts of livestock agriculture, the need for farms to diversify their production base has been identified (e.g. the *Citizen's Assembly, the Report of the Oireachtas Committee on Climate Change and the Programme for Government*.) Market realities, land quality and climatic conditions severely restrict the potential diversity of Irish agriculture on a national basis. Our relatively small cereals sector, for instance, has been severely challenged to generate adequate levels of profitability for several years. While niche opportunities will always emerge to be exploited by individual farmers, the critical diversification challenge is always to identify opportunities that can be taken up by relatively large groups of farmers.

In the context of achieving balanced regional development, the Programme for Government proposes to assist rural economies to diversify into new sectors and markets and capitalise on emerging job opportunities by taking advantage of high-speed broadband and new technologies. Teagasc has well-established activities to support this ambition through, for example, its Options Programme, and by collaborating with a variety of partners that work in this area.

In this regard, the PFG is committed to a focus particularly on maximising potential opportunities in the tillage and horticultural sector. Domestic demand for grain and protein crops remains strong, with ample potential to increase production. There is potential to increase the inclusion of Irish grains in livestock diets and the drinks industry, to support 'Brand Ireland' and *Origin Green* credentials and thus potentially achieve a premium over internationally-traded commodities. Rotational crops have the potential to increase supply to high-value food markets such as: cold pressed oil; salad and chipping potatoes; and oats for the human market. There is also opportunity to increase the scale of the organic tillage sector.

The PFG also commits to reviewing the supports available to the horticulture sector and encouraging greater expansion and growth, supplying both the domestic and international market. The demand for horticulture fresh produce is growing in line with changing diet trends and market demand for more plant-based nutrition. The development of profitable domestic production capacity is required to meet this demand as relying more and more on imports will amount to a missed opportunity. There is currently potential for greater import substitution (and eventually the creation of export markets) for certain products such as onions, apples, tomatoes, potatoes and berries, using the new varieties and technologies for intensive and sustainable production. Teagasc has invested in some of these new technologies at its Food Centre (Ashtown) and will build on these investments in support of the PFG commitments.

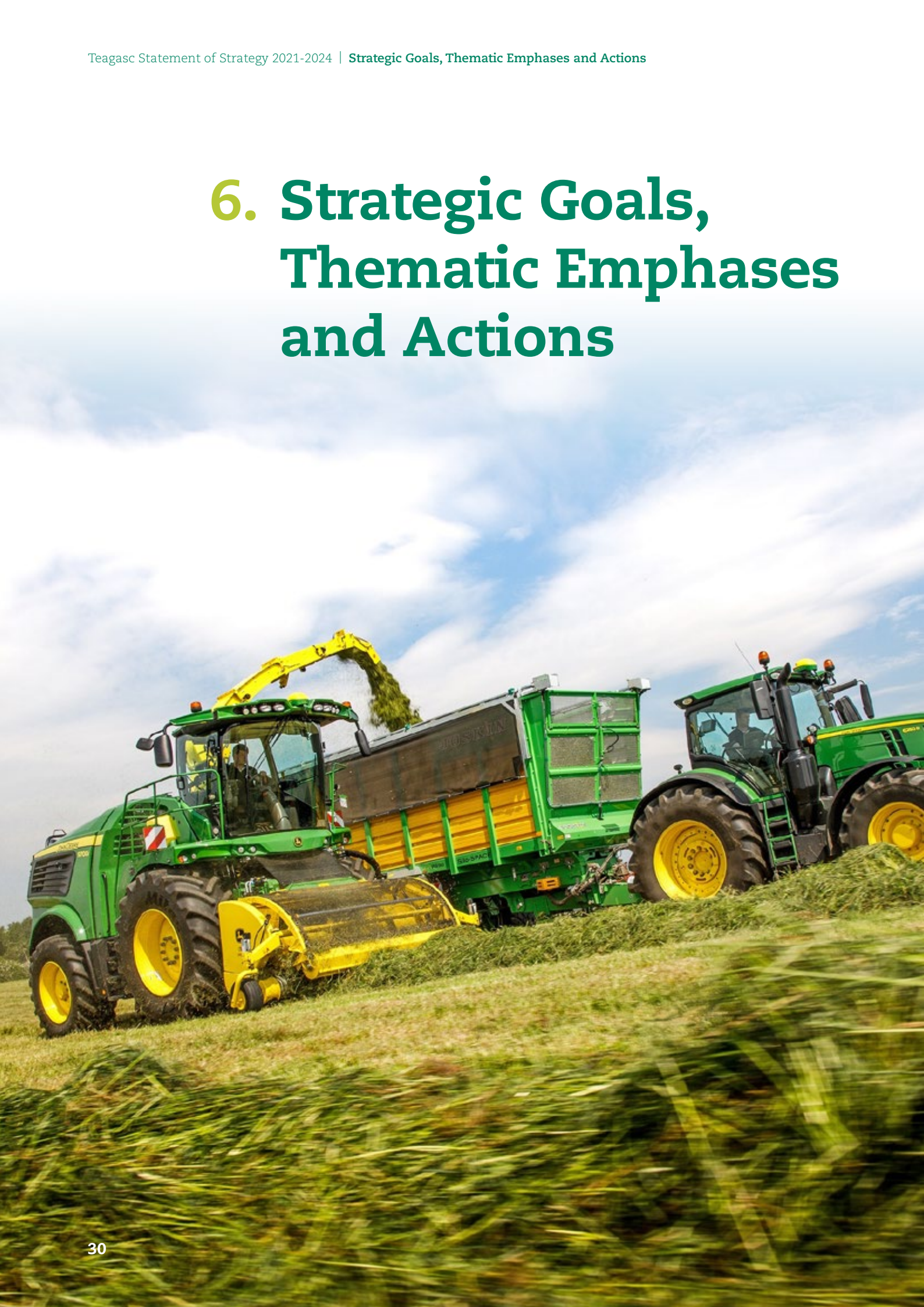
> *In the context of achieving balanced regional development, the Programme for Government proposes to assist rural economies to diversify into new sectors and markets*

Forestry also presents a diversification option for landowners as well as representing a very important carbon sink. The national target is to expand forestry cover to 18% of the land area by 2046 The Government Climate Action Plan targets 8,000 hectares of afforestation per annum as a contribution towards climate change mitigation goals to 2030 and beyond. However, for several years now, the annual planting levels have been running at about 4,000 hectares and the recent trend is lower. While the contribution of historic planting will deliver carbon sequestration benefits up to 2030, without a sustained pick up in planting over several years the contribution of the sector beyond this date, and possibly earlier, will be negative. The promotion of farm forestry, grant schemes and incentives will continue to play an important role for farmers considering forestry as a land use option. Teagasc will continue to support the achievement of these challenging planting targets.

The promotion of other diversification options will be a key element of our future strategy to support greater economic, social and environmental resilience on farms and in rural communities. We will expand our diversification focus and reallocate resources to enhance our service provision. We propose to enhance, rebrand and market the existing Teagasc Options Programme, including strengthening links with local and community groups and organisations.

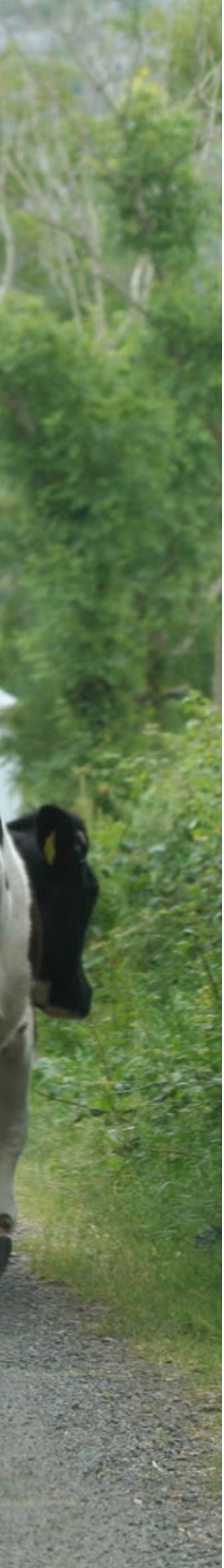
We see particular opportunities in supporting the development of small food businesses, organic crop and livestock production and the production of ecological goods and services. We will build on the very successful small food processing supports we have in place and consider how we can reallocate further resources in support of the ambitious targets set for organic production in the PFG. Both the current CAP reform proposals and the PFG also identify opportunities for the production of ecological goods and services and we will also address these opportunities in so far as resources permit.

6. Strategic Goals, Thematic Emphases and Actions



Overarching Strategic Goal

"To make sustainability front and centre of all Teagasc activities."



Strategic Goals

Strategic Goal 1

To support improvements in farmers' living standards and well-being.

Strategic Goal 2

To enhance the production and processing of safe, nutritious and flavoursome foods in line with sustainable circular bioeconomy principles.

Strategic Goal 3

To provide science-based evidence and technologies to enable Ireland meet commitments in regard to gaseous emissions, water quality and biodiversity.

Strategic Goal 4

To ensure, through science-based innovation, healthier soils, animals and people.

Strategic Goal 5

To constantly improve organisational excellence and efficiency in the delivery of our services.

Strategic Goal 1

To support improvements in farmers' living standards and well-being

- Supporting Viable Farming
- Securing Farmer Health and Safety and Wellbeing
- Enhancing Human Capital
- Supporting Rural Development
- Supporting Overseas Agricultural Development and SDGs

While Irish agriculture is dominated by pasture-based livestock production, considerable diversity exists in terms of the scale of operation and the full versus part-time status of farming activity. Shifts are also taking place in the ownership structure of farms with the emergence of partnerships and a small number of corporate entities. Also a small number of land holders are operating multiple farms. The once universal profile of 'family farms' is therefore undergoing change. One consequence of these new structures is that many farms are now highly dependent on employed labour and this imposes particular requirements on management systems. It also places challenges on the responsiveness of advisory and research services. The emphasis and actions set out below may not be exactly relevant to every farm situation but many of them can be adapted to the circumstances of individual farms and regions.

Supporting Viable Farming

Teagasc has recently published a series of sectoral Roadmaps[15] for Ireland's main farming enterprises and for the food-processing sector that set out in detail how our research, advisory and education services propose to respond to the challenges and opportunities facing the industry up to 2027. In this section therefore we set out the high-level strategic initiatives that will be undertaken over the next three years.

In regard to ruminant livestock enterprises our research and advisory activity will continue to prioritise improvements in grassland management and animal breeding. These technologies are key foundations for Ireland's Sustainable Food System. We also intend to develop Sustainability Blueprints for our main farm enterprises.

1. In the **Dairy** sector we plan the following key initiatives:
   - The establishment of a Dairy-Calf-to-Beef commercially operated Demonstration Farm;
   - Devise a Dairy-Calf-to-Beef Advisory Campaign.
   - The setting up of a Sexed Semen Laboratory at Teagasc Moorepark, operated by a private entity;
   - The development of an Agri-Tech Test Bed to complement VistaMilk, our flagship pasture-based precision agri-tech research and innovation programme.
2. Develop a moderate stocking intensity (1.7-2 LUs/ha blueprint for Suckler Beef production.
3. For **Pig** production we will aim to achieve a crude protein rate of 16.5% in pig rations
4. Establish and deliver new education programmes in **Poultry** production.
5. Focus on genetic improvement in **Sheep** production in collaboration with Sheep Ireland.
6. In the **Equine** sector, the focus will be to implement the recommendations of the Equine Advisory and Education Review which has recently commenced.
7. Implement the following for the **Tillage** enterprise:
   - The creation of a Brewing and Distilling Centre in collaboration with stakeholders;
   - The identification and provision of support for new high-value crops; replacement of imported proteins;
8. In **Horticulture** promote the production of fruits to replace imports. We plan to use apples as a pilot initiative.
9. Promotion of afforestation will be a key priority for our **Forestry** activities and a number of Agro-Forestry Demonstration Farms will also be established.

15 *www.teagasc.ie/publications/2020/teagasc-sectoral-roadmaps-2027.php*

VistaMilk

VistaMilk is a unique agri-tech research and innovation Centre to harness the benefits of precision science and data analytics for pasture-based agriculture and food systems.

VistaMilk, is a Science Foundation Ireland (SFI) Research Centre for precision-based dairy production and processing that is hosted by Teagasc and co-funded by Science Foundation Ireland and the Department of Agriculture, Food and the Marine (DAFM), was launched in September 2018.

The €40m VistaMilk Centre consists of over 200 scientists across 7 research organisations and currently has 50 committed industry partners. The industry partners span the whole value chain and represent several domain areas of expertise. A total of 30 companies have committed in excess of €2.8m in cash and in-kind across 15 signed targeted project agreements. Since 2018, VistaMilk researchers have also secured over €9.5m in additional European funding to expand their research activities.

The Centre leads the agri-food technology sector through innovation and enhanced sustainability across the entire dairy supply chain. The vision of the VistaMilk Centre aspires to be a world leader in the agri-food technology sector through innovation and enhanced sustainability across the entire dairy supply chain from soil to society, positively impacting the environment, animal well-being and the health of consumers. This will be achieved by greatly improving the 'soil to gut' supply chain connectivity; thereby improving resource efficiency, better meeting consumers' expectations and improving profitability and resilience.

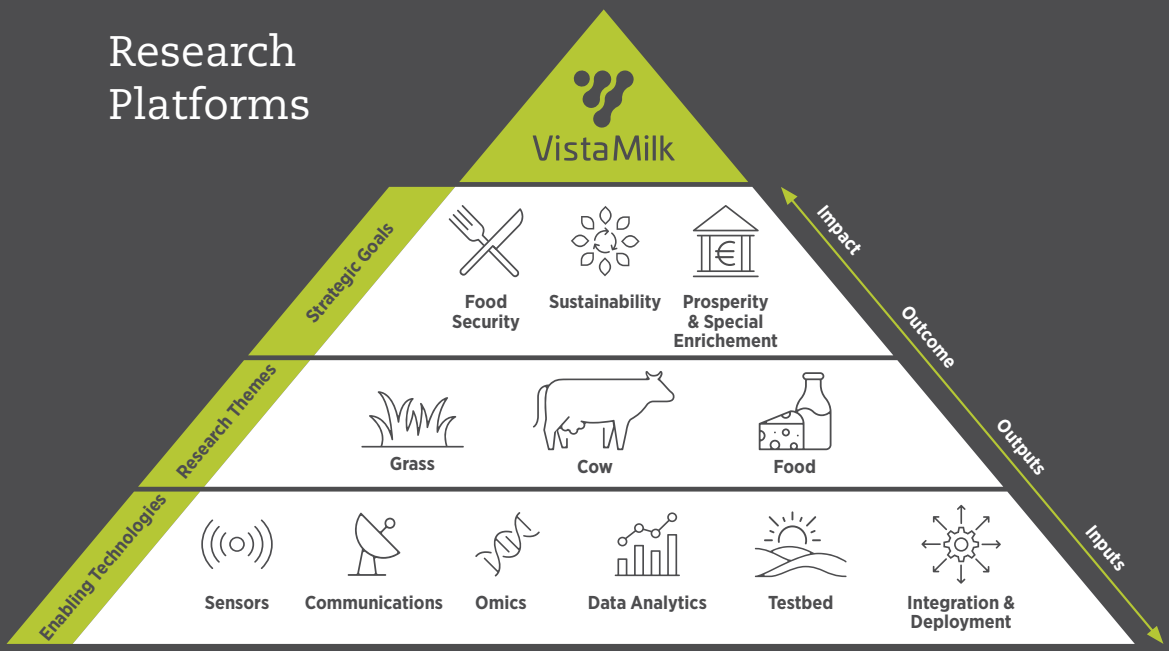
To advance the state-of-the-art in agri-food and information sciences, VistaMilk focuses on three main themes each with their own long-term goals, namely:

- **PASTURE:** knowledge and tools to understand soil dynamics in order to grow a greater quantity of consistently higher quality herbage for consumption by grazing cows, while reducing losses to the environment.
- **COW:** enabling the production of a greater volume of consistently higher quality milk through optimised management and breeding strategies, while improving health and welfare.
- **FOOD:** develop higher value-added dairy products for human consumption, optimised for the predicted milk supply and quality based on predicted grass growth profiles and cow performance.

VistaMilk pools domain expertise across a range of areas and technologies to create a truly unique collaboration to benefit the agri-tech and agri-food industries. VistaMilk is hosted by Teagasc in collaboration with the Insight SFI Centre (University College Dublin, Dublin City University, National University of Ireland Galway), the Telecommunications Software and Systems Group, hosted by the Waterford Institute of Technology, the Tyndall National Institute at UCC and the Irish Cattle Breeding Federation.

The Centre links the Irish agri-food industry with Ireland's leading technology research institutes in a large-scale innovation ecosystem. This linkage is facilitated by the vision of combining basic science and emerging technologies that can be translated to industry applications in a short period of time, making VistaMilk stand out compared to other internationally recognised agri-tech research centres.

Research Platforms



Securing Farmer Health and Safety and Wellbeing

Far too many people, young and old, are killed or seriously injured on our farms each year. Teagasc in partnership with the Health and Safety Authority and through its involvement with the Farm Safety Partnership maintains an innovative research programme and an on-farm knowledge advisory service to ameliorate the tragedy of farm casualties. Our approach to research and innovation in this area is hugely influenced by the 'One Health' and 'Total Worker Health' concepts. These concepts integrate occupational health and safety and health promotion and thus acknowledges the interconnection between farmer safety, health and well-being.

1. A key focus of the research and advisory programme will be to base all interventions on a thorough understanding of farmer behaviour in respect of risk.
2. We will continually seek to create and test a diverse set of innovative tools and approaches for communication of key health and safety messages to farmers.

Enhancing Human Capital

1. Implement the recommendations of our Education Vision report.
2. Implement the "People in Dairy Action Programme".
3. Continue to develop the extent of educational options available for pig farm and poultry operatives and management staff.
4. Establish five apprenticeships in agriculture, horticulture and equine.
5. Roll out the new CPD programme, Evolve.

Supporting Rural Development

Teagasc, together with partners in other rural development organisations including, LEADER, Local Enterprise Offices, Fáilte Ireland, National Rural Network, Education and Training Boards, Citizens Information, Mental Health Ireland, Organic Trust, Irish Organic Association, Horse Sport Ireland and the Royal Dublin Society and others, will continue to facilitate access by farm families to supports, information and resources that will allow them to improve the farm family's economic, social and environmental sustainability. Specific emphasis will be placed on:

1. Diversification
2. Organic farming
3. Whole Farm Planning

Supporting Overseas Agricultural Development and the SDGs

Teagasc recognises that while its primary responsibility is to support Ireland's farmers and food companies, it is also important that we strive to do all we can, within a resource constraint, to support the promotion of food security and the alleviation of hunger in the spirit of the UN's Sustainable Development Goals (SDGs).

In recent years, the organisation has developed a clear policy and strategy governing its international development role and this will be deepened over the period of this Strategy. Teagasc works in alignment with the *Department of Foreign Affairs and Trade* and *Irish Aid*, with whom it has signed a number of MOUs, along with its parent department. We also played a lead role in establishing the *Irish Forum for International Agriculture Development* and enjoy a close relationship with our large development NGOs. Our strategy is therefore firmly embedded within the policies driving the national 'whole of government' approach aimed at strengthening agricultural development and reducing hunger and under nutrition in underdeveloped countries This integrated national response is taken further in the *Report of Ireland's National Task Team on Rural Africa (NTTRA)*[16] which is fully endorsed by Teagasc. Over the period of this strategy we will:

1. Continue to draw on the expertise of current and recently-retired staff to support our international development strategy.
2. Continue to use our internationally renowned Walsh Scholarships Postgraduate Programme to support the training of graduates in developing countries to Masters and PhD level.
3. Develop and encourage staff exchange and training programmes with comparable institutions in Irish-Aid-designated countries.
4. In line with the thinking in the *National Task Team* on Rural Africa (NTTRA) Report Teagasc will examine a more sustainable resourcing of this activity over the period of this Strategy.

16 *A Report to the Government of Ireland. Ireland's National Task Team on Rural Africa: Findings and Recommendations (2020).*

Teagasc Involvement in Overseas Agricultural Development

In 2014, Teagasc signed an MoU with the Department of Foreign Affairs and Trade (DFAT) to act as a partner with Irish Aid in delivering on its agricultural development programmes. The MoU has proved to be very successful in re-engaging Teagasc in international development support. In Ireland, Teagasc has played a key role in the formation of the Irish Forum for International Agricultural Development and continues to actively engage in the network. Teagasc was also one of several State Agencies to participate in the National Task Team for Rural Africa in 2020. A positive consequence of the engagements has been the development of 'soft skills' within Teagasc and learning to speak the development language which are hugely important for relationship building. Through its engagement in 12 projects across seven countries, Teagasc has also built strong relationships with Irish NGOs and institutional partners in target countries, especially in Eritrea, Ethiopia, Tanzania, Vietnam and Kenya. The project developed in Kenya with support from the Irish embassy, Sustainable Food Systems Ireland and Self Help Africa, is particularly interesting. In 2020, Teagasc, as part of a consortium, was successful in obtaining €4 million in funding from the EU for a four year programme in Eritrea. Teagasc has also used its Walsh Scholarships Programme in supporting capacity building programme in a number of countries, and to date, has supported close on 20 PhD and MSc students from Ethiopia, Kenya and Eritrea. While Teagasc has a clear and defined mandate for international development initiatives within its Statement of Strategy and has support from its Authority, it is hamstrung in its ability to allocate resources to initiatives due to the primacy of its national mandate to develop the Irish agri-food sector. Teagasc is keen to build on the successes of the partnership so far and to develop a more strategic approach with DAFM and DFAT and other stakeholders. Institutionalising the development agenda within Teagasc will ensure that the progress that has already been made in recent years will be sustained and built upon.

Strategic Goal 2

To enhance production and processing of safe, nutritious and flavoursome foods in line with sustainable circular bioeconomy principles

- Processing Safe, Nutritious and Flavoursome Foods
- Providing Scientific Leadership in the Development of an Agri-food Sustainable Circular Bioeconomy (SCB)

Processing Safe, Nutritious and Flavoursome Foods

Teagasc will:

1. Leverage recently completed and ongoing 'Brexit Ready' investments in Moorepark Technology Ltd, the National Food Innovation Hub and the Biotest Facility at Teagasc Moorepark; the National Prepared Consumer Food Centre at Ashtown; and the Bia Innovator, in collaboration with Galway County Council and a number of local development organisations, at Athenry to enable Irish-based food companies to grow and diversify export markets.
2. Apply advanced food processing, preservation, and extraction technologies for sustainable and efficient processing and preservation of safe and nutritious foods for the benefit of consumer health.
3. Support industry in diversifying into ingredient cheese applications for new markets.
4. Develop on-site or near time testing for key pathogens, anti-microbial resistance and total microbial composition.
5. Build on the work of Meat Technology Ireland to establish a test bed to examine the feasibility of new meat automative processing equipment, such as, laser cutters.
6. Continue and develop integrated production, processing and sensory research on dairy and beef products that will create opportunities for the development of differentiated and premium products.

'Brexit Ready' Investments

With the support of the Department of Agriculture Food and the Marine, Teagasc has invested nearly €40m in both proof-of-concept and pre-commercial processing pilot-plant facilities at its food research centre at Ashtown and Moorepark. When coupled with the extensive research capability from the food scientific programme, these pilot-plant units provide unique scale-up opportunities for the food industry. The new infrastructure includes a National Prepared Consumer Foods Centre at Ashtown Dublin, involving an investment of about €10m; a €10m expansion to Moorepark Technology limited (MTL); €8.8m for a National Food Innovation Hub at Teagasc Moorepark; and an investment of about €6m in Bia Innovator in Athenry in collaboration with Galway Co. Co. and a number of local development organisations which has been funded by Enterprise Ireland. All of these investments are designed to assist food companies located in Ireland to diversify markets post Brexit through enabling new product and process development to underpin their competitiveness.

- Bia Innovator, Athenry
- National Prepared Consumer Foods Centre, Ashtown
- National Food Innovation Hub, Moorepark
- Moorepark Technology Limited

THE NATIONAL FOOD INNOVATION HUB

The concept of the National Food Innovation Hub is to integrate state of the art pilot plant facilities at MTL and the scientific research emanating from the Teagasc Food Research Centre with custom designed secure company laboratory and office units, i.e., the "National Food HUB". Occupants of the HUB will benefit from working adjacent to Teagasc research and scale-up facilities, fostering innovations and solutions in food. Opportunities for clients can include participation in company-specific, collaborative (with Teagasc) or multi-partner (Teagasc, University and/or industry) projects. The HUB will be supported by expertise resident in the Teagasc Food Research Programme that is relevant to national and international food companies.

BIA INNOVATOR

In collaboration with Galway County Council and a number of local development organisations and supported by Enterprise Ireland funding, Teagasc are involved in the establishment of the Bia Innovator Campus at its Athenry site in Co. Galway. This new food innovation and entrepreneurship ecosystem, which will be closely linked to Teagasc Ashtown and Moorepark food processing research facilities and pilot plants, will provide technical and commercial support for food business start-ups in the artisan and SME sectors.

BIA
INNOVATOR CAMPUS

Providing Scientific Leadership in the Development of an Agri-food Sustainable Circular Bioeconomy (SCB)

The concept of the Sustainable Circular Bioeconomy (SCB) is at the core of the 'sustainable food systems' paradigm. The key principles in exploiting the potential of the SCB concern i) the 'cascading' principle which emphasises the requirement to exploit the highest possible value from a given source of biomass initially and progressively extract lower and lower values from successive rounds of processing and ii) the valorisation of 'waste' streams.

Teagasc will pursue a number of approaches in exploiting the potential of the SCB over the period of the Strategy:

1. We have undertaken considerable research on the valorisation of animal manures and the potential of their exploitation to minimise the use of chemical fertilisers and thereby improve sustainability. This will be a key measure in the SignPost Farms Programme which is elaborated on below.
2. There is also considerable scope for valorising pig and poultry manures by using them in cropping and grazing systems and in Anaerobic Digestion (AD). We plan to commission a Demonstration AD facility on our Grange Campus in the coming year to produce biomethane using cattle slurry and forage as the feedstock.
3. Many agricultural systems are inherently circular such as the dairy-beef system whereby dairy calves provide the raw material for the beef sector. We consider that there is considerable scope to expand this system into the future. Other systems that have scope for development are the pig and poultry grain systems whereby pig and poultry manures are used to produce cereals which are then used to feed pigs and poultry.
4. In the food processing sector, we will continue our path-breaking research to valorize waste streams in the dairy, meat, marine and crop sectors and in identifying novel new and blended protein sources for food ingredients.
5. We also intend to utilise and develop our capabilities in bio-fermentation and bio-refining to extract higher value from non-human-food biomass in accordance with the 'cascading' principle. We are about to commence a highly innovative research programme (U-Protein) to extract utilisable protein from grass and a range of other forage crops and this capability could be extended to other types of biomass, e.g. wood.
6. While our main focus will be to exploit the SCB principle to produce novel new foods and animal feeds, we envisage that opportunities may also emerge for the creation of non-food materials.

In the food processing sector, we will continue our path-breaking research to valorize waste streams in the dairy, meat, marine and crop sectors and in identifying novel new and blended protein sources for food ingredients.

'U-Protein': Unlocking new protein sources from native grown crops

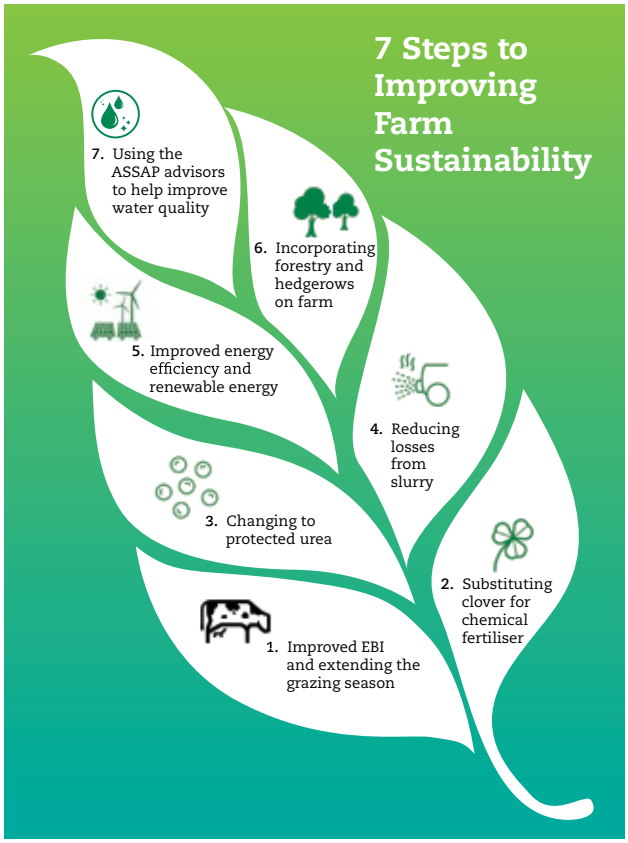
Unlocking new sources of protein from crop and marine resources is the objective of a €3 million new project called 'U-Protein' (Unlocking Protein Resource Opportunities. To Evolve Ireland's Nutrition), that is funded by the Department of Food, Agriculture and the Marine with the aim of establishing new knowledge to support the development of Ireland's bioeconomy. This multi-disciplinary project will be a collaboration between five Teagasc research centres, as well as University College Cork, Maynooth University, NUI Galway, University of Limerick and Queens University Belfast. The overall objective of U-Protein is to identify and exploit existing and novel protein sources within the Irish agro-ecological system, in particular crop sources (grassland, cereals, legume, oilseed and niche crops) and the marine. Protein is the key driver of human health, growth and development, and by investigating compositional and functional properties of alternative proteins, U-Protein ultimately aims to deliver quality nutrition for the food consumer. The project will support enterprises such as dairy, beef and cereal production, ultimately aiming to become part of the agricultural ecosystem in Ireland.

By concentrating on crop and marine protein resources, U-Protein intends to develop an alternative, economically-viable and sustainable agricultural enterprise. The development of scientific and technological knowledge will aid in the production of proteins to meet nutritional and market demands, while also reducing carbon footprint. U-Protein will add to the diversity of Ireland's agri-ecosystem and support the circular bioeconomy through the biotransformation of biomass to valuable food and other co-products.

Strategic Goal 3

To provide science-based evidence and technologies to enable Ireland meet commitments in regard to gaseous emissions, water quality and biodiversity.

- Mitigating Gaseous Emissions
- Pipeline Research
- SignPost Farms Programme
- Adaptation to Climate Change
- Improving Water Quality
- A More Biodiverse Agriculture



Mitigating Gaseous Emissions

Teagasc will utilise its published Greenhouse Gas (GHGs) and Ammonia MACCs to identify and promote technological solutions for the mitigation of gaseous emissions in line with national targets and the policy framework set out in the recently published AgClimatise paper.

> *Teagasc research has identified solutions to enable Ireland to transition towards a low-carbon future. The challenge now is to deliver this research into practice on farms.*

Pipeline Research

We have several research initiatives underway that will provide a pipeline of technologies to mitigate GHGs and Ammonia emissions in the medium term, including, feed additives, slurry additives, animal genetics, bio-based fertilisers and alternative low-emission fertilisers.

A range of technologies are also being investigated to reduce the need for chemical nitrogen fertiliser, including multi species swards (MSS) and optimising soil health which will reduce emissions and also promote carbon sequestration.

We also intend to expand the scope of the National Farm Survey to collect more granular data on prescribed farming practices that affect agricultural gaseous emissions and to capture robust indicators of biodiversity.

SignPost Farms Programme

Teagasc research has identified solutions to enable Ireland to transition towards a low-carbon future. The challenge now is to deliver this research into practice on farms.

We plan to establish a network of farms, covering all major enterprises and a range of operational intensities, to demonstrate the implementation of our MACC measures in collaboration with dairy,meat processors, the tillage sector and relevant state agencies, such as, Bord Bia. This network will in essence constitute a 'Living Lab' in the assessment of the potential impact of a variety of mitigation actions. A key component of the SignPost Farms Programme will be to develop a 'Farm Sustainability Plan' for each of the demonstration farms and subsequently to scale up this service to a wider group of farms. This Plan will also inform the generation of sustainable farming blueprints for Ireland's main farming enterprises.

National Agricultural Sustainability Research and Innovation Centre

Within the period of this strategy Teagasc intend to construct new research facilities at its Johnstown Castle Research Centre in Wexford to replace its outdated laboratories and to build on the extensive sustainability research programme that has been ongoing for several years. A significant capital programme will commence in 2021 and will establish state of the art laboratories to house the current analytical research facilities and the new ones that will be developed into the future. The investment will facilitate the increasing expansion of the research programme to deliver the evidence base to support strategic national commitments to increase the sustainability of agricultural systems.

The National Agricultural Sustainability Research and Innovation Centre will focus on the development, testing and implementation of innovative technologies to facilitate farmers to combine economic and environmental sustainability. NASRIC will provide practical integrated solutions for farmers and other stakeholders to improve soil health, restore and protect biodiversity, improve water quality, reduce emissions of greenhouse gases and ammonia and enhance soil carbon sequestration. The Centre will also provide technical support to policy makers and the wider agri-food and land-use sectors to achieve better sustainability outcomes.

The Centre will house the current compliment of 85 staff, consisting of research scientists, technical and support staff and will build on this expertise through recruitment and collaboration with research scientists in Ireland's universities and Institutes of Technology. The new laboratories will be equipped with cutting-edge instrumentation in the areas of soil, crop, water and gaseous emissions.

The research programme at the new Centre will utilise the existing range of state of the art field facilities including, dairy, beef, forestry and agro-forestry research trials and component facilities including, long-term soil fertility experiments, the national lysimeter platform and climate change control rooms.

> *The impacts of the projected weather events will vary across the globe but given Ireland's geographical location the more likely climate effects will require more agile management of sowing and harvesting dates and, in particular, our pasture-based systems.*

Adaptation to Climate Change

Adaptation to the ongoing manifestation of climate change was recognised as a key component of the global response in the Paris Agreement.[17] Yet it's probably a fair comment that the appreciation of adaptation is much less than for mitigation. Even if mitigation is successful there will be substantial lags in the climate response and systemic adaptation actions will be required over a prolonged adjustment period. Agriculture is no different in not having prioritised adaptation to date. A recent report by the EPA has provided evidence that Ireland is already experiencing a pattern of dryer summers and wetter winters augmented by more extreme weather events.[18] This pattern will be exacerbated into the future if global mitigation efforts are not successful. While a benign aspect of the projections from an Irish perspective is the likelihood of longer grazing periods, the excessive volatility associated with more extreme weather events will place pressures on the management of our farming systems. This will require a systematic response in terms of our research and KT activities. The overarching objective will be to enhance the resilience of our farming systems and to ensure that we have well established risk-mitigation strategies in place for the sector.

The impacts of the projected weather events will vary across the globe but given Ireland's geographical location, the more likely climate effects will require more agile management of sowing and harvesting dates and, in particular, our pasture-based systems. We cannot however discount the emergence of new animal and crop diseases or the increased prevalence of existing ones. Water restrictions could also be evident in some regions during excessively dry periods and water quality may also be impaired during both extreme wet and dry periods.

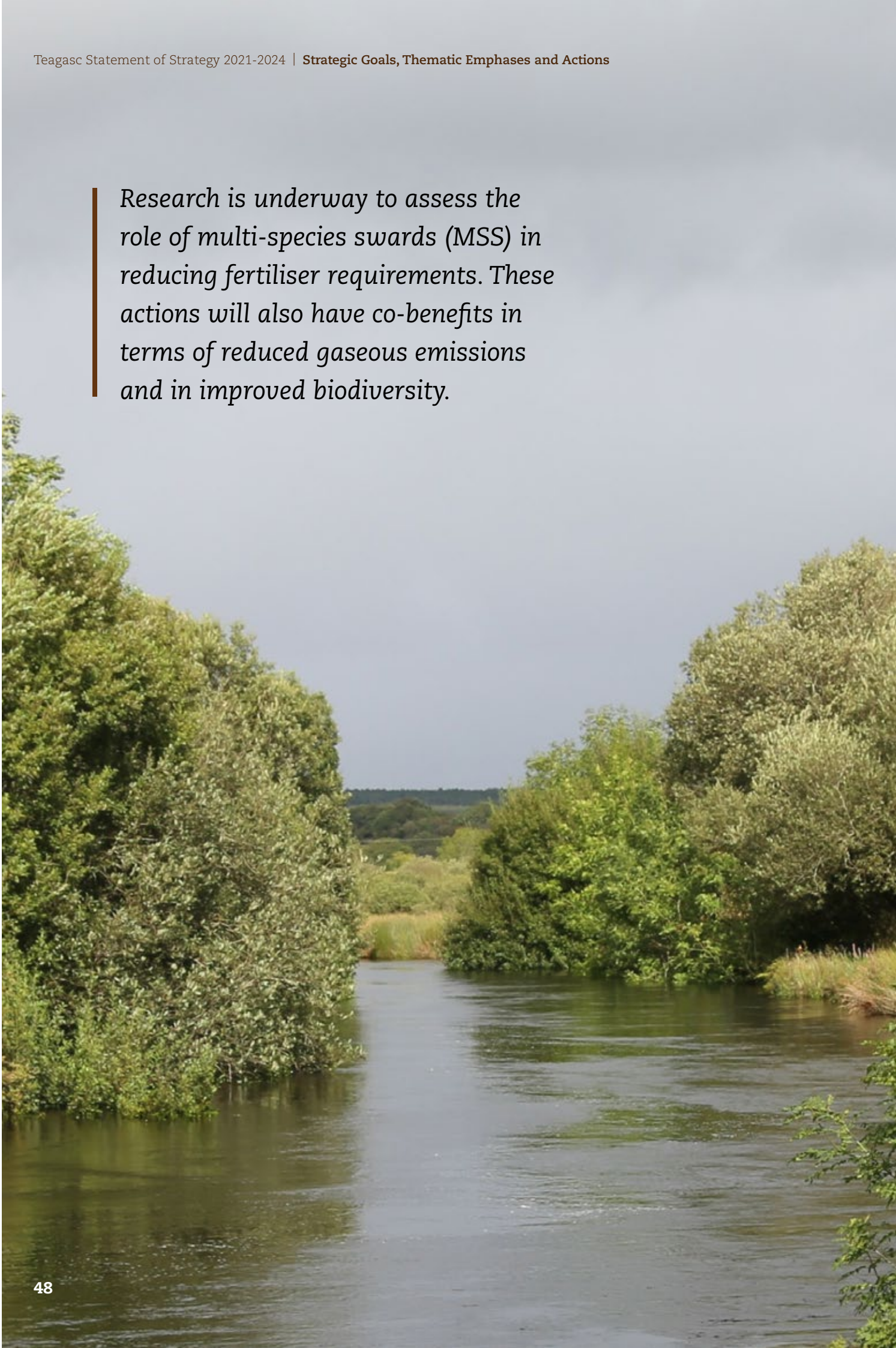
To date our research and advisory activity has concentrated on buttressing the resilience of our grassland systems to avoid the recurrence of the "fodder crisis" of 2018.[19] Teagasc will actively use regular Fodder Surveys to provide early warning communications to farmers on the adequacy of their fodder reserves. Recommended risk management practices include the maintenance of feed reserves over and above normal feed reserves. During the grazing season farmers are being supported to use digital-based grassland management tools such as PastureBase Ireland to improve grass production and utilisation on farms. Improved grazing infrastructure on farms and in the storage of animal feed will also be prioritised. Teagasc will also re-focus its research and advisory activities on the production of higher quality silage.

We will also continue to collaborate with Met Eireann to promote our grass growth prediction model.

Outside of grassland management, we intend to step up our research on climate resilient crop varieties, including grasses. We also strongly support the Green Deal measures to research "Nature based" solutions to climate change on wetlands and peatlands. And as noted above, a key "nature based" research initiative will involve the measurement of the potential for carbon removal in our mineral soils.

17 *SEC(2021) 89 final, "Forging a climate-resilient Europe – the new EU Strategy on Adaptation to Climate Change.*
18 *www.epa.ie/pubs/reports/research/climate/researchreport339/*
19 *Adaptation Strategies on Ruminant Farms in Extreme Weather Conditions*
www.teagasc.ie/publications/2021/adaptation-strategies-on-ruminant-farms-in-extreme-weather-conditions-.php

Research is underway to assess the role of multi-species swards (MSS) in reducing fertiliser requirements. These actions will also have co-benefits in terms of reduced gaseous emissions and in improved biodiversity.



Improving Water Quality

Reduce the Application of Chemical Nitrogen

In line with the thrust of the EU *Farm to Fork* strategy our research and knowledge transfer programmes will seek to reduce the application of chemical N by *inter alia* promoting greater use of white clover, better liming practices, improved soil health, better optimisation of soil nitrogen supply with crop requirements and thereby promoting improvements in nitrogen use efficiency and reduced nitrogen surpluses. Research is also underway to assess the role of multi-species swards (MSS) in reducing fertiliser requirements. These actions will also have co-benefits in terms of reduced gaseous emissions and in improved biodiversity.

Agricultural Catchments Programme (ACP)

Teagasc will:

1. Integrate gaseous emissions, water quality and biodiversity measures into the work of the ACP.
2. Scale up the findings from the six ACP catchments to a river basin level in collaboration with the EPA.

Agricultural Sustainability and Advisory Programme (ASSAP)

1. Seek to renew the ASSAP Programme when the current phase is concluded at end 2021 and aim to deliver over 1,500 detailed individual farm plans per annum.
2. Provide upskilling, support and training to over 600 Farm Advisory System accredited advisors and to 7,000 derogation farmers on new innovative solutions to protect water through the ConnectEd Programme.

A More Biodiverse Agriculture

1. In accordance with EU and national policies, we will prioritise the protection of Ireland's biodiversity and the prevention of further losses.
2. Ensure that all Teagasc research, college and demonstration farms conform to the highest standards of biodiversity management.
3. Encourage farmers to plant additional hedgerows and native woodlands and to maintain existing hedgerows and woodlands in such a manner so as to optimise biodiversity and to maximise carbon sequestration.
4. Contribute to the restoration of Annex 1 habitats and species to favourable conservation status by 2027 (including the freshwater pearl mussel).
5. We will strive to maintain viable economic activity on our uplands through support to farmers to enable the judicious management of farming activity, especially sheep production,that is compatible with the unique habitats in these areas.

Strategic Goal 4

To ensure, through science-based innovation, healthier soils, animals and people

- Healthy and well-cared for animals
- Healthy Soils
- Human Health and Nutrition

Teagasc fully endorses the UN-World bank concept of 'One Health'. This concept recognises that the health of our soils and our physical environment, our animals and humans are all interrelated.

Healthy and Well-cared for Animals

Antimicrobial and anthelmintic resistance

Addressing the emerging phenomenon of antimicrobial and anthlemintic resistance is core to the principle of the 'One Health' UN-World Bank initiative. Teagasc in partnership with Animal Health Ireland will draw on its research on selective dry-cow therapy, its work on the use of anthlemintics in sheep and antibiotic use on pig farms to ensure that its advisory service are promoting a reduced use of these powerful medicines.

Healthy Animals

1. In collaboration with the Irish Cattle Breeding Federation (ICBF), we will continue research to identify relevant animal-health traits to inform the national cattle-breeding strategy.
2. The role of new genomic technologies to reduce bovine respiratory diseases will be evaluated including improved diagnostics and more targeted interventions.
3. Teagasc will continue its highly successful partnership with Animal Health Ireland in combating animal diseases that can have a devastating impact on animal health, profitability and environmental footprint.
4. We will also renew our knowledge transfer efforts to encourage all livestock farmers to prepare and implement a Farm Health Plan as a key component of the Farm Sustainable Plan initiative that will be an integral feature of the SignPost Farms Programme.

Animal Welfare

1. In line with the recommendations of Ireland's first *National Animal Welfare Strategy*, we are committed to mainstreaming welfare considerations across all relevant research, knowledge transfer and training programmes.
2. We have developed an international reputation for work on the management of pig welfare, the management of cattle transportation and management of dairy calves.
3. Over the period of the Strategy a major focus will be placed on calf welfare in particular. We consider that the innovations that are underway on the contract-rearing of male and female dairy calves can be scaled across the majority of our dairy farms.
4. Planned initiatives such as the establishment of a Dairy-Beef Demonstration farm and a knowledge-transfer campaign to promote sustainable dairy-beef production systems will underpin the highest welfare standards in the management of dairy calves.
4. In addition we consider that continued research on the use of sexed-semen, including the establishment of a dedicated sexed-semen laboratory at Teagasc Moorepark, will enable the technology to be more widely adopted. We will also strongly promote the use of the Dairy-Beef index and will work with ICBF to develop DNA-based information that will provide more information to calf buyers.

Healthy Soils

1. Adapt the learnings from our ground-breaking research on 'regenerative agriculture', including, soil microbiology, soil structure, including compaction, and nutrient management into effective knowledge transfer programmes.
2. Focus on management of soils to improve a range of outcomes including land productivity, long term soil health and their ability to be multi-functional.
3. Further develop Teagasc's Nutrient Management Planning online tool (NMP Online) to aid improving farm sustainability and continue to roll out NMP Online to drive improvements in soil fertility and to minimise the use of chemical N and P.
4. Focus research and KT activity on quantifying crop requirements for macro- and micro- nutrients, on evaluating fertiliser formulations which can deliver positive environmental outcomes, on developing soil specific nutrient recommendations and on maximising nutrient recycling and recovery from organic fertilisers and soil reserves.

Human Health and Nutrition

We will:

1. Build on our expertise to undertake targeted research on food and health in the area of degradation and absorption of food within the human body;
2. Leverage in furtherance of understanding the fate of food within the human body scientific expertise from our academic partners such as the APC Microbiome Institute[20] and Food for Health Ireland[21];
3. Continue to invest in advanced analytical capability, including the already established Sequencing Centre and the imminent construction of a Biotest Facility, to underpin genomic and metagenomic studies, bioactive protein discovery for peptide purification, identification, analysis and generation.

20 *www.apc.ucc.ie*
21 *www.fhi.ie*

Strategic Goal 5

To constantly improve organisational excellence and efficiency in the delivery of our services

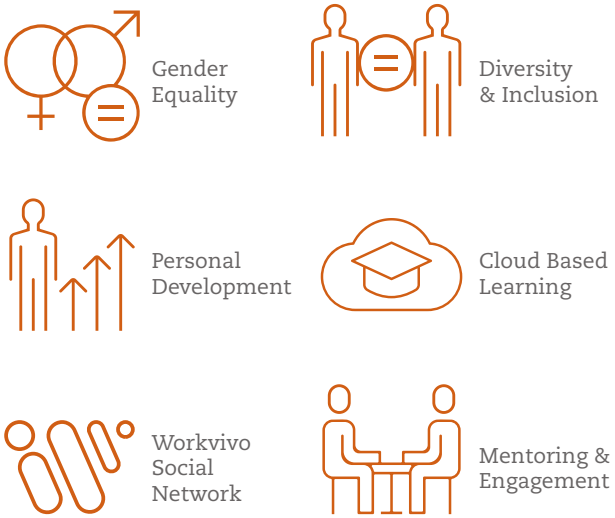
- Resourcing and Managing Current Expenditure
- 'Teagasc Together': Building a More Agile Organisation
- Human Resources
- Collaboration
- Infrastructure Investment
- Digitalisation and ICT Resources
- Communications and Engagement

Resourcing and Managing Current Expenditure

1. Teagasc is privileged to receive significant financial resources in the form of State-funded Grant-in-Aid, other public funds and from its stakeholders. These funds will continue to be used prudently in line with best practice in financial auditing and value for money assessment for the benefit of Ireland's agri-food sector.
2. We will embrace a multi-annual financial management framework in line with this Statement of Strategy.

'Teagasc Together': Building a More Agile Organisation:

1. A recognized strength of the Teagasc model is its ability to integrate research and knowledge transfer. There is considerable scope to enhance this capacity through embracing, what we refer to as the 'Teagasc Together' ethos which captures *inter alia*:
   - A clear vision and mission that is applicable to all of our functions;
   - A clear definition of what 'Teagasc Together' behaviours entail in terms of day-to-day operations, e.g. the use of cross-functional working groups; an investment in promoting awareness, understanding and recognition of 'Teagasc Together' internally; and a clear statement of the team ethos at all levels.
2. With these factors in place, 'Teagasc Together' will stimulate internal collaboration by removing barriers, enhancing internal mobility and providing a more flexible physical and digital working environment.



Human Resources

1. Teagasc is a community of highly trained permanent and contract scientists, Walsh Scholars (PhD and Masters' students), advisors, specialists, educators, technicians, administrative and support staff. These diverse and talented people are the bedrock of our organisation and we recognise that building an efficient, agile and resilient organisation can only be achieved through engaging these staff fully in the goals of the organisation.
2. Through the Walsh Scholarships programme Teagasc will continue to provide post-graduate research opportunities for our best graduates in the agri-food sector in collaboration with higher education institutions in Ireland and abroad. Our post-graduate training programme aims to develop the research and transversal skills of students to enable them to contribute to the development of the scientific and technical capacity of the Irish agri-food sector. To ensure the programme continues to reflect best practices in education and research we will develop a new strategy for the Walsh Scholarships Programme to 2026
3. The organisation also seeks to constantly renew its staff compliment to ensure that it maintains its relevance in the face of an ever-changing innovation landscape. Our intention to have a relentless focus on sustainability over the period of this Strategy and beyond requires us to fill evident expertise deficits in areas such as, climate change, carbon sequestration, biodiversity, advanced processing technologies and digitalisation. We want to create a workplace that is open, diverse and inclusive where everyone has the opportunity to achieve their potential. We have adopted the following values to ensure that Teagasc is gender balanced, diverse and inclusive all all levels of the organisation:
   - Equal Opportunities
   - No Barriers
   - Active Inclusion
4. We are implementing an ambitious People Strategy (2018-2022) initiative which includes commitments to gender equality and the promotion of diversity and inclusion.
5. Spurred by the Covid experience, we have adopted an innovative 'agile working' policy that is designed to promote flexible working arrangements to enhance productivity and create a greater 'work-life' balance.
6. Other 'People Strategy' initiatives include the development of a cloud-based learning platform to facilitate online and blended learning opportunities for staff.

Collaboration

1. The 'sustainable food system' approach which underlies this SoS emphasises a requirement for extensive collaboration in the performance of research and in its communication to potential end users. Teagasc is absolutely committed therefore to widen and deepen the extent of its collaborative networks both internal and external to the organisation.

2. Our intent to re-double our efforts on collaboration is underlined by our commitment to open research. We are fully committed to implementing the National Framework on the Transition to an Open Research Environment that was launched by the Government in July 2019. The framework sets out Ireland's ambitions for open research across five strategic areas: open access to research publications; enabling access to research data; infrastructures for access to and preservation of research; skills and competencies; and incentives and rewards. We will continue to develop our open access repository, T-Stór, and to support the change in research culture and behaviour that's needed to fully embrace the open research ethos.

3. We have created a number of internal networks comprising research and advisory colleagues that have proved very effective in elucidating research-based policy initiatives, e.g., the Greenhouse Gaseous Emissions' Working Group that led to the development of the Marginal Abatement Cost Curves for Greenhouse Gases and Ammonia and the Water Quality Working Group which informed several research-based submissions on the EU Nitrates Action Programmes. These working groups will be refreshed as required and new ones developed as necessary. They are also totally consistent with the 'Teagasc Together' ethos.

4. The organisation already enjoys several productive partnerships with collaborators within Ireland and across the world. Many of these partnerships have been forged through opportunities that have been presented for the funding of research projects at national and EU level. Outside of such research consortia, Teagasc has also extensively leveraged its Walsh Scholarship Programme to establish partnerships with several prestigious research institutions across the world. Over the period of this SoS we will intensify these approaches to collaboration and in addition identify other opportunities for collaboration outside of Ireland. Initiatives such as the successful Teagasc Technology Foresight and institutional partnerships with other research organisations outside of Ireland (e.g. the annual conferences jointly organised with Scottish Rural College) will be implemented over the period of the Strategy.

Infrastructure Investment

Teagasc as a dynamic organisation has on going requirements to invest in its physical infrastructure, especially in its research and education facilities. The financing of capital has come from three main sources: the sale of assets, once-off capital grants from the State and a small contribution from our annual capital Grant-in-Aid. The organisation is at a disadvantage relative to institutes of higher education which can avail of relatively generous financial State and philanthropic support for new research and teaching facilities, as well as having the sanction to borrow. For the future, we will endeavour to access more sustainable sources of multi-annual capital funding as an over-reliance on the sale of assets is clearly not sustainable.

Over the period of the strategy, we plan to complete and commence a number of priority capital projects, including, the completion of the National Food Innovation Hub at Moorepark; the construction of new environmental laboratory facilities at Johnstown Castle; the development of conference facilities at Oak Park; the development of college facilities, particularly at Ballyhaise College; the roll out of up-to-date ICT systems; on-going upgrades of facilities on Teagasc farms and Teagasc advisory offices; and the development of ICT-based decision-support tools for farmers and food companies.

Digitalisation and ICT Resources

1. Over the next three years we plan to produce a Digitalisation Transformation Strategy that will be designed to deliver transformative change in a number of areas across the organisation, to include:

   – **Internal Administrative Processes**: finance, procurement, HR, corporate services and general management support.

   – **Internal and External Communications**: a lot of progress has been achieved on both dimensions during the pandemic but there are significant additional opportunities to be exploited through greater investment in digitalisation.

   – **Advisory Services**: the use a variety of digital and social media tools has greatly expanded in the wake of Covid. The next step will be to develop automated access to advisory information and to work towards a more 'data driven' advisory service.

   – **Client Access to Services**: we aim to transform how clients and stakeholders will access services in the future with a much greater emphasis on self-service provision.

   – **The Development and Roll out of Digital Advisory Decision-support Tools**.
   We have developed several digital-based tools that are being used by farmers and a host of agri-consultants, such as, the eProfit Monitor, Nutrient Management Planning Online, PastureBase Ireland and a special effort will be made to greatly increase the use of these tools. It is expected that the VistaMilk research project will generate several new digital tools that can greatly facilitate decision making on Irish farms. The production of these tools will be greatly facilitated by the planned development of the Agri-Tech Centre

   – **The Testing and Development of Highly Sophisticated Digital Tools for Ireland's Food-processing sector**.
   The Food Research Programme has already assessed the use of highly sophisticated robotics in its infant-formula research and has begun to assess the potential of applying Virtual Reality and Augmented Reality technologies. This research work will be considerably advanced over the period of the Strategy.

   – **Education.** Like our advisory services due to Covid-19, we have greatly expanded its use of digital tools and platforms in all of its teaching programmes. There is considerable scope to enhance the effectiveness of these platforms in both theory and practical sessions. New digital tools, including the expanded use of machine simulators, will be tested and used to the fullest possible extent over the next three years.

2. A number of innovations in our ICT platform will be implemented over the next three years, including, the development of an innovative delivery model, involving automated information provision and a more bespoke advisory service; support for the evolution of a blended learning platform in the provision of Teagasc education and training; the establishment of a toolset and guidelines for cataloguing, describing and archiving Teagasc research data; ensuring robust risk management systems are in place to protect sensitive information and continuity of service; securing adequate investment in the existing suite of ICT services while making provision for investments in new areas.

3. Significant investment in both human and physical resources to develop its ICT service capability over the period of the Strategy to ensure that its level of service approaches comparable public sector organisations.

Communications and Engagement

The overarching aim of our external communication activities is to provide an understanding of where our food comes from and how it is produced and to outline how Teagasc's knowledge transfer and research programmes can contribute to addressing the global challenge of sustainable food production. Our activities engage a variety of audiences including, farmers, food processors, policy makers, primary and secondary school students, university students and the general public.

1. We use a range of media and events to communicate all aspects of our research, advisory, education and training programmes and will seek to greatly enhance our external communications profile over the period of the Strategy and this will involve a systematic review of all of our communication channels.

2. An effective structure will need to be considered to ensure that the great depth of research and advisory knowledge is put to maximum effect in supporting the livelihoods of farm families and the competiveness of our food businesses. In recent years, communication *via* various digital media has become increasingly significant and Covid-19 and attendant restrictions has driven an enormous growth in digital communications. This progress will be built on during the current strategy period through, as noted already, the development of a comprehensive digital transformation strategy.

3. Over the period of the Strategy we plan to invest *inter alia* in the production of a Teagasc App and the establishment of a permanent broadcasting studio. We also intend to supplement our existing limited personnel with additional recruitment of the required expertise.

4. We plan to utilise our new Customer Relationship Management System to the maximum in targeting our advisory messages to our highly diverse audiences.

An effective structure will need to be considered to ensure that the great depth of research and advisory knowledge is put to maximum effect in supporting the livelihoods of farm families and the competiveness of our food businesses.

7. Programme Relevance, Quality & Performance Evaluation

The Annual Programme of Activities over the next three years will be derived from this multi-annual Statement of Strategy and the Annual Business Plans which, in turn, rely on organised interactions with customers, stakeholders, partners and staff and are designed to address high priority national policy and industry needs and are directly relevant to achieving Teagasc's long-term goals. Our SoS, associated annual organisational level Business Plan and Annual Programme of Activities are approved by the Teagasc Authority and form the basis of regular performance reviews between the organisation and DAFM under the terms of the Oversight and Performance Delivery Agreement.

The organisation has well-recognised and established management procedures and processes in place to ensure that its scientific output, advisory and educational activity conform to the best international standards.

We have a dedicated Evaluation Unit and undertake regular evaluations of all programmes and activities. The framework depicted in Figure 4 below informs our evaluation approach. It shows how Teagasc activities contribute to impact in the agri-food sector through three interconnected impact pathways. These are interlinked with self-reinforcing feedback loops around the capacity development pathway, which builds the capacity of the agri-food sector to innovate and transform.

Our research programmes are peer reviewed by a panel of international and national experts as part of a wider process designed to ensure their scientific quality and relevance to the needs of stakeholders.

In addition, a biennial review of our scientific activities is undertaken by an International Scientific Advisory Board (ISAB). Our education activities have been externally reviewed by the Department of Education and Skills. Also, since 2013, each of our 12 Advisory Regions has been peer reviewed in a process reflecting the approach taken for Research Programmes. In addition to peer reviews, other best practice evaluation approaches and methodologies are used, as appropriate, depending on the programme or activity being evaluated.

Ongoing monitoring of business performance is conducted through the annual business planning process and all Business Plans are subject to mid-year and end-year reviews reporting against specific KPIs.

Over the period of the current Strategy it is intended to establish an international review panel for its KT functions that is comparable to ISAB.

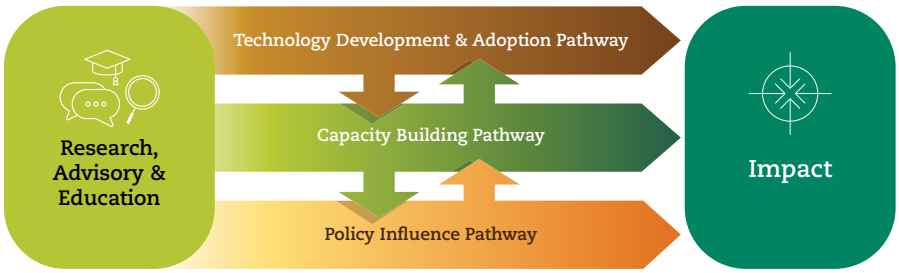


***Figure 4**: Evaluating Teagasc's Impact on the Agri-food Sector. Douthwaite et al (2017)*[22]

22 *Douthwaite, B., Mayne, J., McDougall, C. and Paz-Ybarnegaray, R. (2017) Evaluating complex interventions: A theory-driven realist-informed approach, Evaluation, Vol. 23(3) 294–311*

8. Timelines for the Implementation of the Strategy to 2024

Overarching Strategic Goal: **'To make sustainability front and centre of all Teagasc activities'**

Strategic Goal 1: Support Improvements in Farmer's Living Standards and Wellbeing

Thematic Emphasis: **Supporting Viable Farming**

No.	Action	Delivery
1	Establish a Dairy-Calf-to-Beef Demonstration Farm.	Q1 | 2022
2	Devise a Dairy-Calf-to-Beef advisory campaign.	Q4 | 2021
3	Set up a sexed semen laboratory at Teagasc Moorepark.	Q4 | 2021
4	Develop an Agri-Tech test bed to complement VistaMilk.	Q3 | 2023
5	Develop a moderate stocking intensity blueprint for suckler beef production.	Q4 | 2022
6	Achieve a crude protein rate of 16.5% in pig rations.	Q2 | 2023
7	Collaborate with Sheep Ireland to improve genetics.	Ongoing
8	Implement the recommendations of the Teagasc Equine Advisory and Education Review.	Q2 | 2022
9	Create a Brewing and Distilling Centre in collaboration with stakeholders.	Q2 | 2023
10	Identify and provide support for new high-value crops and support the replacement of imported proteins.	Ongoing
11	Promote the production of fruits that can replace imports.	Q1 | 2022
12	Promote afforestation and establish a number of Agro-Forestry Demonstration Farms.	Q1 | 2022

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Strategic Goal 1:
Support Improvements in Farmer's Living Standards and Wellbeing

Thematic Emphasis: Securing Farmer Health and Safety and Wellbeing

No.	Action	Delivery
13	Base all interventions on a thorough understanding of farmer behaviour in respect of risk.	Ongoing
14	Develop innovative communication of key health and safety messages to farmers.	Ongoing

Thematic Emphasis: Enhancing Human Capital

No.	Action	Delivery
15	Implement the recommendations of our Education Vision report.	Ongoing
16	Implement the People in Dairy Action Programme.	Ongoing
17	Develop the educational options available for pig farm and poultry operatives and management staff.	Q1 | 2022
18	Establish five apprenticeships in agriculture, horticulture and equine.	Q2 | 2022
19	Roll out the new CPD programme, Evolve.	Q3 | 2021

Thematic Emphasis: Supporting Rural Development

No.	Action	Delivery
20	Promote diversification, organic farming and whole farm sustainability planning.	Ongoing

Thematic Emphasis: Supporting Overseas Agricultural Development and the SDGs

No.	Action	Delivery
21	Support Ireland's international development strategy.	Ongoing
22	Use our Walsh Scholarships Postgraduate Programme to support the training of graduates in developing countries.	Ongoing
23	Develop staff exchange and training programmes with comparable institutions in Irish-Aid-designated countries.	Ongoing
24	Examine more sustainable resourcing of Teagasc's work on overseas development.	Q1 | 2022

Strategic Goal 2:
Enhance the production and processing of safe, nutritious and flavoursome foods in line with sustainable circular bioeconomy principles

Thematic Emphasis: Processing Safe, Nutritious and Flavoursome Foods

No.	Action	Delivery
25	Leverage 'Brexit Ready' investments to enable Irish-based food companies to diversify export markets.	Ongoing
26	Apply sustainable and efficient food processing, preservation and extraction technologies for safe and nutritious foods.	Ongoing
27	Support industry in diversifying into ingredient cheese applications for new markets.	Ongoing
28	Develop testing for key pathogens, anti-microbial resistance and total microbial composition.	Ongoing
29	Establish a test bed to examine the potential of innovative technologies such as sensors and robotics for Irish meat processing.	Q4 | 2024
30	Develop integrated production, processing and sensory research on dairy and beef products.	Ongoing

Thematic Emphasis: Providing Scientific Leadership in the Development of an Agri-Food Sustainable Circular Bioeconomy (SCB)

No.	Action	Delivery
31	Exploit the potential of animal manures to minimise the use of chemical fertilisers and improve sustainability.	Ongoing
32	Commission a demonstration anaerobic digestion facility on our Grange Campus to produce biomethane.	Q3 | 2021
33	Develop and support circular agricultural systems, such as dairy-beef, pig-grain and poultry-grain systems.	Ongoing
34	Continue research to valorize waste streams in the dairy, meat, marine and crop sectors and to identify new and blended protein sources for food ingredients.	Ongoing
35	Utilise and develop our capabilities in bio-fermentation and bio-refining to extract higher value from non-human-food biomass.	Ongoing
36	Exploit the SCB principle to produce new foods and animal feeds, and explore opportunities for the creation of non-food materials.	Ongoing

Strategic Goal 3:
Provide science-based evidence and technologies to enable Ireland meet commitments in regard to gaseous emissions, water quality and biodiversity

Thematic Emphasis: Mitigating Gaseous Emissions

No.	Action	Delivery
37	Utilise the Teagasc MACCs to mitigate gaseous emissions.	Ongoing
38	Expand the National Farm Survey capability to quantify key sustainability metrics, e.g. biodiversity.	Q3 | 2022
39	Establish the SignPost Farms Programme to encourage the adoption of the Teagasc MACC measures.	Q2 | 2021
40	Establish a National Agricultural Soil Carbon Observatory to measure carbon sequestration.	Q4 | 2021
41	Construct a National Agricultural Sustainability Research and Innovation Centre.	Q4 | 2022

Thematic Emphasis: Adaptation to Climate Change

No.	Action	Delivery
42	Use regular fodder surveys to provide early warning communications to farmers on the adequacy of their fodder reserves.	Ongoing
43	Re-focus research and advisory activities on the production of higher quality silage.	Ongoing
44	Collaborate with Met Eireann to promote the Teagasc-St Giles grass growth prediction model.	Q1 | 2022
45	Expand research on climate resilient crop varieties, including grasses.	Ongoing

Thematic Emphasis: Improving Water Quality

No.	Action	Delivery
46	Seek to reduce the application of chemical N.	Ongoing
47	Integrate gaseous emissions, water quality and biodiversity measures into the work of the APC.	Ongoing
48	Scale up the findings from the six APC catchments to a river basin level in collaboration with the EPA.	Q2 | 2022
49	Seek to renew the ASSAP Programme and aim to deliver over 1,500 detailed individual farm plans per annum.	Q2 | 2022
50	Provide support and training to accredited advisors and derogation farmers on innovative solutions to protect water.	Ongoing

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Strategic Goal 3:
Provide science-based evidence and technologies to enable Ireland meet commitments in regard to gaseous emissions, water quality and biodiversity

Thematic Emphasis: **A More Biodiverse Agriculture**

No.	Action	Delivery
51	Prioritise the protection of Ireland's biodiversity and the prevention of further losses.	Ongoing
52	Ensure that all Teagasc farms conform to the highest standards of biodiversity management.	Ongoing
53	Encourage farmers to plant and maintain hedgerows and native woodlands.	Q2 | 2021
54	Contribute to the restoration of Annex 1 habitats and species to favourable conservation status by 2027.	Ongoing
55	Support farmers to maintain viable economic activity on our uplands compatible with sustainability.	Q3 | 2021

Strategic Goal 4:
Ensure, through science-based innovation, healthier soils, animals and people

Thematic Emphasis: **Healthy Soils**

No.	Action	Delivery
56	Adapt the learnings from our research on 'regenerative agriculture' into effective knowledge transfer programmes.	Ongoing
57	Focus on management of soils to improve a range of outcomes.	Ongoing
58	Continue to develop and roll out the NMP Online tool.	Ongoing
59	Focus on the precision management of soil nutrients.	Ongoing

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Strategic Goal 4:
Ensure, through science-based innovation, healthier soils, animals and people

Thematic Emphasis: Healthy and Well-Cared for Animals

No.	Action	Delivery
60	Mainstream animal welfare considerations across all relevant research, knowledge transfer and training programmes.	Ongoing
61	Implement recent innovations in contract-rearing of calves across the majority of our dairy farms.	Ongoing
62	Promote the Dairy-Beef index and work with ICBF to develop DNA-based information to inform to calf buyers.	Ongoing
63	Continue research to identify animal-health traits to inform the national cattle-breeding strategy in collaboration with ICBF.	Ongoing
64	Evaluate the role of new genomic technologies to reduce bovine respiratory diseases.	Q2 | 2022
65	Continue in partnership with Animal Health Ireland to combat animal diseases.	Ongoing
66	Renew knowledge transfer efforts to encourage all livestock farmers to prepare and implement a Farm Health Plan.	Q2 | 2021

Thematic Emphasis: Human Health and Nutrition

No.	Action	Delivery
67	Undertake targeted research on food and health in the area of degradation and absorption of food within the human body.	Ongoing
68	Leverage expertise from APC-Ireland to further our understanding of the fate of food within the human body.	Ongoing
69	Continue to invest in advanced analytical capability in our food systems.	Ongoing

Strategic Goal 5:
To constantly improve organisational excellence and efficiency in the delivery of our services

Thematic Emphasis: Resourcing and Managing Current Expenditure

No.	Action	Delivery
70	Embrace a multi-annual financial management framework in line with this Statement of Strategy.	Q3 | 2021

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Strategic Goal 5:
To constantly improve organisational excellence and efficiency in the delivery of our services

Thematic Emphasis: Building a More Agile Organisation: 'Teagasc Together'

No.	Action	Delivery
71	Enhance our capacity to integrate research and knowledge transfer through embracing the 'Teagasc Together' ethos.	Q4 | 2021

Thematic Emphasis: Human Resources

No.	Action	Delivery
72	Prioritise staff recruitment in climate change, carbon sequestration, biodiversity, advanced processing technologies and digitalisation.	Q2 | 2021
73	Implement the commitments to gender equality and the promotion of diversity and inclusion set out in the People Strategy.	Ongoing
74	Implement the Teagasc Agile Working Policy.	Q3 | 2021
75	Develop a cloud-based learning platform, T-Learn, to facilitate online and blended learning opportunities for staff.	Ongoing
76	Develop a new strategy for the Walsh Scholarships Programme to 2026	Q2 | 2022

Thematic Emphasis: Collaboration

No.	Action	Delivery
77	Widen and deepen collaborative networks, both internally and at national and international level.	Ongoing
78	Develop creative internal networks comprising research and advisory colleagues to provide evidence-based policy advice.	Ongoing
79	Implement the National Framework on the Transition to an Open Research Environment	Ongoing

Thematic Emphasis: Infrastructure Investment

No.	Action	Delivery
80	Complete and commence a number of priority capital projects.	Ongoing

Thematic Emphasis: Digitalisation and ICT Resources

No.	Action	Delivery
81	Produce a Digitalisation Transformation Strategy to deliver transformative change across the organisation.	Ongoing
82	Implement a number of innovations in our ICT platform.	Ongoing
83	Invest in human and physical resources to develop our ICT service capability.	Ongoing

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Strategic Goal 5:
To constantly improve organisational excellence and efficiency in the delivery of our services

Thematic Emphasis: Communication and Engagement

No.	Action	Delivery
84	Greatly enhance our external communications profile and carry out a systematic review of all of our communication channels.	Ongoing
85	Produce a Teagasc app, establish a permanent broadcasting studio and recruit additional expertise required in this area.	Q4 | 2021
86	Utilise our new Customer Relationship Management system in targeting advisory messages to our diverse audiences.	Q4 | 2021

Thematic Emphasis: Programme Relevance, Quality and Performance Evaluation

No.	Action	Delivery
87	Establish an international review panel for Teagasc KT functions that is comparable to ISAB	Q3 | 2022


Teagasc
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