Sustainable Healthy Agri-Food Research Plan (SHARP)

A Strategic Research & Innovation Agenda for the ‘Sustainable Food Production and Processing’ and ‘Food for Health’ priority areas of the National Research Prioritisation Exercise
ACKNOWLEDGEMENTS

This document is the result of a comprehensive exercise that drew intelligence from research and innovation funders, performers, and end users across the entire *Food Production and Processing and Food for Health* stakeholder base. While it is not appropriate or indeed possible to individually mention all those who contributed to, or played a part in drafting this agenda, a special word of thanks is due to the members of the RPAG Food Working Group and the industry-led, DAFM-hosted, National Agri-Food Research and Innovation (NAFRI) Group who played a key role in its preparation.

Richard Howell
RPAG Food ‘Champion’ and Chair of the RPAG Food Working Group
MINISTER COVENEY’S FOREWORD

The agri-food sector is our largest indigenous industry with a gross annual output of €26 billion, exports in excess of €10 billion per annum and provides primary employment for 170,000 people. A central pillar of the Bioeconomy, it encompasses all terrestrial and water based primary production and harvesting of natural resources for food and those largely indigenous firms that produce food products. It also comprises a varied mix of actors across the food chain from individual farmers, big and small, producing the raw materials to micro, SME and multinational food processing enterprises. Guided by the multi-stakeholder development blueprint, Food Harvest 2020, the sector continues to prosper and play a key role in Ireland’s export led economic recovery.

While the sector is firmly poised for continued growth and expansion, it faces challenges at producer, processor and consumer level from a cost, efficiency, scale, profitability, and sustainability perspective. In addition, the sector must meet growing public good objectives in terms of strengthened food safety and supply chain integrity, health enhancement, improved natural resource management, whilst also meeting the demand for environmental goods and services. Nonetheless, there are tremendous opportunities for the sector in terms of new and growing market opportunities while, at the same time, addressing societal challenges, such as food security, climate change and an ageing population. Ireland is strongly positioned to develop novel high-value nutrition and wellness products and solutions to address growing population health conditions through its enviable natural resources, reputation, research strengths and enterprise base.

Against this backdrop, I welcome this new strategic agenda, ‘Sustainable Healthy Agri-food Research Plan (SHARP)’ for the ‘Sustainable Food Production and Processing’ and ‘Food for Health’ priority areas of the National Research Prioritisation Exercise. This Plan, developed by a cross-funder Working Group led by my Department under the Research Prioritisation Action Group (RPAG), is the result of an intensive year-long exercise drawing on the collective wisdom of relevant Government Departments, funding bodies, the research community, all parts of the industry and the broader society. It identifies a clear set of research priorities that will act as a blueprint to guide the funding decisions of all relevant funders over the next few years.

I welcome the fact that the strategy is built around three guiding principles - competitiveness, sustainability and citizen/consumer orientation – and, as such, recognises the need to maintain a strong collective focus on the production and processing of safe, high-quality, nutritious food in an efficient, competitive, and sustainable manner that benefits everyone from farm to fork. I commend the relevant funders for including an Implementation Plan whereby they commit to adopting a structured approach to future funding decisions so as to achieve a well coordinated, complementary and efficient use of public funds. In my view this is a novel, logical and strategic step forward in research prioritisation.

Simon Coveney, T.D.
Minister for Agriculture, Food and the Marine
MINISTER ENGLISH’S FOREWORD

Sustainable economic growth is a necessary precondition for quality employment, for world-class public services and ultimately, a high standard of overall socio-economic well-being. It is widely recognised that economic growth, in the long run, is driven by Research, Development and Innovation (RD&I). RD&I lead to technological progress and increase human capital i.e. skills. These two factors combine to improve productivity and productivity in turn, drives long-term economic growth.

In recognition of this vital role for RD&I in a developed economy, the Government adopted Research Prioritisation in 2012 as the framework for economically-motivated RD&I investment for the five-year period, 2013-2017. Research Prioritisation aims to deliver the greatest impact possible on jobs and socio-economic progress from this investment.

The Research Prioritisation Action Group, which I currently have the honour of chairing, was established in March 2012 to drive implementation of Research Prioritisation. The concerted efforts of the Government departments and State agencies represented on the Group over the past 2 ½ years are now bearing fruit and this Strategic Research & Innovation Agenda (SRIA) for the ‘Sustainable Food Production and Processing’ and ‘Food for Health’ priority areas is an excellent example of this. It is the first such document of its type.

There are two aspects to Research Prioritisation: firstly building capacity in the public research system in areas of greatest opportunity for Irish-based enterprise: fourteen such areas were identified. Secondly, Research Prioritisation is about intensifying the RD&I activity in Irish-based firms, large and small. The SRIA sets out a detailed and comprehensive programme for achieving both of these high-level objectives. The three principles underpinning the SRIA namely, Competitiveness; Sustainability; and Citizen-Consumer epitomise the approach of Research Prioritisation.

This body of work is particularly notable for both its comprehensiveness and its inclusiveness. It is the result of a collaboration led by DAFM, between the research funding agencies, the researchers and the enterprise base involved in the food, farming, fisheries and health sectors. This model of partnership between the state and private enterprise has proven to be particularly effective and I hope to see it adopted for the development of SRIs in other priority areas.

Damien English T.D.
Minister of State for Skills, Research & Innovation
Chairperson, Research Prioritisation Action Group
# TABLE OF CONTENTS

ACKNOWLEDGEMENTS .............................................................................................................................. 1
MINISTER COVENEY’S FOREWORD ........................................................................................................... 2
MINISTER ENGLISH’S FOREWORD ............................................................................................................ 3
TABLE OF CONTENTS ............................................................................................................................... 4
EXECUTIVE SUMMARY ............................................................................................................................. 6
  Guiding Principles in the Development of this Strategic Research and Innovation Agenda ....................... 6
  SRIA Goals: ............................................................................................................................................ 7
1. Introduction ........................................................................................................................................... 9
2. From a Vision to a Strategic Research and Innovation Agenda ............................................................. 16
  Guiding Principles in the Development of the Strategic Research and Innovation Agenda ................... 20
  Research & Innovation Thematic Areas: ............................................................................................... 20
  SRIA Goals: ........................................................................................................................................... ZZ
2.1. Animal Production ............................................................................................................................. 24
  Key Investment Area: 2.1.1 Animal Breeding & Reproduction ............................................................... 24
  Key Investment Area: 2.1.2 Animal Well-being, Animal Nutrition & Product Quality ......................... 27
2.2. Grass, Clover, Forage, Crops & Food Horticulture .......................................................................... 30
  Key Investment Area: 2.2.1 Plant Production ...................................................................................... 30
  Key Investment Area: 2.2.2 Plant Health & Breeding .......................................................................... 32
2.3. Sustainable Management of Natural Resources .............................................................................. 34
  Key Investment Area: 2.3.1 Management of Natural Resources, Biodiversity and Ecosystem Services .... 34
  Key Investment Area: 2.3.2 Soils, Land Use, Climate Change & Trans-boundary Gases ...................... 36
2.4. Food Processing Technology and Engineering .............................................................................. 38
2.5. Food Product Development, Formulation & Sensory Science ....................................................... 41
2.6. Food Chain Integrity & Safety ........................................................................................................... 43
EXECUTIVE SUMMARY

This is the first time Irish research funding bodies, the Irish research base and the food, farming and health sectors have come together to identify and develop research and innovation opportunities for Sustainable Food Production and Processing and Food for Health.

Guiding Principles in the Development of this Strategic Research and Innovation Agenda

The Irish agri-food sector must maintain a strong collective focus on the need to produce safe, high-quality, nutritious food in an efficient, competitive, and sustainable manner. More importantly, it must ensure that its successes will benefit everyone from farm to fork; hence the three guiding principles, of equal importance below apply:

- **Competitiveness**
  - Maintain and further enhance the competitiveness of the Irish agri-food sector

- **Sustainability**
  - Ireland to become a world leader in sustainable food production.

- **Citizen-Consumer**
  - To develop a consumer / citizen orientated agri-food industry.
SRIA GOALS:

This SRIA, which was complied following an extensive consultative exercise as outlined in Appendix 3, captures the food-related research needs of the agri-food and fisheries industry and health sector and is designed to fulfil a number of high-level goals:

1) Guide the content of relevant competitive calls operated by all relevant funders and, therefore, strategic research investments in food research and innovation undertaken by Irish research performing organisations and the industry.

2) Intensify the innovation capability of Irish food production systems to contribute to the development of new/improved management practices, products, processes and services which allow for increased market share for premium products and services.

3) Develop and manufacture new high-value nutrition and wellness products aimed at improving consumer/citizen well-being.

4) Develop economically and environmentally sustainable food production and processing systems across all enterprises that support profitability and international competitiveness and contribute to enhancing the quality of our environment and so meet national and international environmental targets.


6) Strengthen the existing knowledge base in key strategic areas thereby increasing the developmental capacity of publicly funded Research Performing Organisations (RPOs) enabling them to leverage additional support for their research from EU research programmes and other International sources.

7) Help address the 15 metrics listed in Appendix 6 and so contribute to achieving the set of high-level, overarching national targets adopted by Government.
Fostering research and innovation (R&I) is widely accepted as the key to success and so increasing investment in R&I is a proven driver of economic growth\(^1\). By drawing on the collective intelligence of national research and innovation funders\(^2\) and undertaking industry wide stakeholder consultation, the R&I needs of the sector have been identified to develop this strategic research and innovation agenda (SRIA). Through shared national ownership, it will ensure strategic investment in research and innovation to enable the sector realise these ambitions and achieve its full potential in a sustainable manner thereby contributing to the achievement of the overall Food Harvest 2020 Vision of Acting Smart, Thinking Green, and Achieving Growth.

This SRIA also contains a methodology for its coherent and coordinated implementation by national funders and indeed industry on the priority research and innovation opportunities identified. It serves as a foundation on which all funders will build as they work collectively for the benefit of the sector going forward.

\(^2\)DAFM, EI, EPA, HEA, HRB, MI, Teagasc and SFI.
1. INTRODUCTION
1. INTRODUCTION

The agri-food and fisheries sector is one of Ireland’s most important indigenous manufacturing sectors. It encompasses all terrestrial and water based primary production and harvesting of natural resources for food and those largely indigenous firms that produce food products. As such, it is critically important as a domestic driver of economic growth:

- It provides the primary employment for 170,000 people, or 8.8% of all those employed in the State.
- The primary sector comprises 140,000 family farms with gross output of over €7bn.
- There are almost 1,300 enterprises in food & beverage processing with a turnover of over €26bn annually.
- There were €10bn worth of food & beverage exports in 2013 and the sector exports to more than 170 countries.

Our temperate climate; our green countryside, our extensive marine environment give us a head start on the global food production stage. However, we must learn to exploit these natural competitive advantages in a profitable and sustainable manner that meets and exceeds changing consumer/citizen demands.

Irish Agri-Food Industry Ambitions

To become a world leader in the production & processing of sustainable high quality food products

Sustainability is fast becoming the platform on which Irish food production and processing systems are aspiring to grow and expand. The SUSFOOD\(^3\) ERA-NET effectively defines sustainability as: ‘a food system that supports food security, makes optimal use of natural and human resources and respects biodiversity and ecosystems for present and future generations, which is culturally acceptable and accessible, environmentally sound and economically fair and viable, and which provides the consumer with nutritionally adequate, safe, healthy and affordable food’.

\(^3\) SUSFOOD is the acronym for the ERA-NET on SUSTainable FOOD production and consumption. The European transnational research cooperation project consists of a network of 25 partners from 16 European countries. The strategic goal of SUSFOOD is to reinforce the scientific cooperation between EU member and associated states in order to maximise the contribution of research to the development of food systems aiming at more sustainability from production to consumption. [https://www.susfood-era.net/Home](https://www.susfood-era.net/Home)
Over the last decade, DAFM, Teagasc, other state agencies and the agri-food sector have worked to build up a sustainable vision at farm and industry level which is verifiable and builds on a solid and credible foundation. Bord Bia’s Origin Green*, operating at farm and industry level is a world first for the delivery of sustainable high quality food and drink products. More recently, the establishment of Sustainable Food Systems Ireland (SFSI) will ensure that the expertise and services within Ireland’s agri-food government agencies is developed on a commercial basis to address requests for assistance in the agri-food sector from international customers whether they be governmental agencies, international organisations or international private sector companies. SFSI will act as a vehicle to promote Ireland’s global image as a place in which the production of high quality food is underpinned by world class science, research and food safety standards.

**To excel in the development and manufacture of new high-value nutrition and wellness products**

Exciting new opportunities for Ireland’s food sector exist in the development of novel high-value nutrition and wellness products and functional ingredients. Food for health products or functional foods are foods or ingredients that provide health benefits in addition to providing basic nutrition. Today’s consumers are becoming more aware of the link between diet and health and this is leading to increased interest and demand for functional foods. Consumers are willing to pay a premium price for food products with credible claims for health benefit. The main areas of focus are dairy products, marine ingredients, baby foods, fruits and cereals with applications directed at improving digestive health, performance nutrition, weight control and bone and brain health.

Ireland has significant strengths in food for health research. This, coupled with the presence here of a growing international industry base, should provide the means to enable innovative product development aimed at targeting health conscious consumers.

**To develop a consumer / citizen orientated agri-food Industry**

Understanding the demands and desires of consumers in terms of food safety, quality, nutrition, health and well-being, animal welfare standards and ethics, provision of public goods and the components of a healthy diet for citizens are important elements of future success for Ireland’s agri-food industry. Possessing insights helps the industry to be forward looking, and market success is achieved when this insight is translated quickly and effectively into new management practices, products, processes and services. Acknowledging that the needs of the consumer/citizen are paramount in the development of new innovations, integration of consumer/citizen behavior in research & innovation investments is key in order to integrate their interests and values and to increase the quality, relevance, social acceptability and sustainability of research and innovation outcomes in various fields of activity from social innovation to areas such as biotechnology and nanotechnology.

*http://www.origingreen.ie/*
Our strategy for realising these ambitions

Fostering research and innovation (R&I) is widely accepted as the key to success and so increasing investment in R&I is a proven driver of economic growth. By drawing on the collective intelligence of national research and innovation funders and undertaking industry-wide stakeholder consultation, the R&I needs of the sector have been identified to develop this strategic research and innovation agenda (SRIA). Through shared national ownership, it will ensure strategic investment in research and innovation to enable the sector realise these ambitions and achieve its full potential in a sustainable manner thereby contributing to the achievement of the overall Food Harvest 2020 Vision of Acting Smart, Thinking Green, and Achieving Growth.

The Road ahead for the Irish Agri-Food Industry

DAFM is a large complex organisation, with a broad remit which covers policy, regulatory and developmental roles in relation to the primary production and processing sectors of the agriculture, food, forestry and fishery industry. The Department’s Mission is “To lead the sustainable development of the agri-food and marine sector and to optimise its contribution to national economic development and the natural environment”. DAFM supports research and innovation in the agri-food sector through its own competitive funding programmes (FIRM and Stimulus) and through the core grant-in-aid funding provided to agencies under its aegis namely Teagasc and the Marine Institute (MI) while other bodies, co-funded by DAFM, such as the Irish Cattle Breeders Federation (ICBF), are also involved in these activities. Other State agencies that support innovation in the sector include EI, EPA, HRB, IRC and SFI.

Food Harvest 2020, the industry-led development blueprint for the agri-food industry, recognises and emphasises the importance of research and innovation as a prerequisite to achieving the growth targets for the agri-food industry. This is reflected in its overall Vision of Acting Smart, Thinking Green, and Achieving Growth. While the Irish agri-food sector is firmly poised for continued growth and expansion, it faces challenges at producer, processor and consumer level from a cost/efficiency, scale, productivity, profitability, innovation capability, sustainability and competitiveness perspective. In addition, the sector must meet growing public good objectives in terms of enhanced food safety and supply chain integrity, improved natural resource management, biodiversity protection, and meet the demand for environmental goods and services. It operates within a global context addressing grand societal challenges related to food security, energy security, ageing population, chronic diseases, resource efficiency and climate change.

A key factor in addressing all these challenges is strategic State investment in agri-food research, development and innovation. National research policy responses to these challenges require significant input, cooperation and collaboration from a multiplicity of key government departments, national funding bodies, state agencies and industry players. Moreover, robust research coupled with an effective knowledge exchange system that is integrated with stakeholders has a key role to play in the sustainable development and competitiveness of the sector and in meeting a range of public good objectives. The statutory based roles of Teagasc and the Marine Institute are of particular relevance in this regard.

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2 DAFM, EI, EPA, HEA, HRB, IRC, MI, SFI and Teagasc.
Health Policy and connection with Food

The Healthy Ireland strategy launched in early 2013, presents a framework for improving the nation’s health and well being over the next decade. The overall achievement of the vision and goals of this strategy requires that due regard be given to food and the role it can play in positively influencing the diet and nutrition of citizens, and thereby health and wellbeing, while also being cognisant of the health challenges that can arise through the inappropriate consumption of foods. Continued food for health research as an action, is therefore of extreme importance in supporting the achievement of Healthy Ireland. In support of this view a recent report by the Joint Research Centre, European Commission, highlighted the key contributing role of nutrition to healthy ageing and the need for further research in this area.

Existing food R&I landscape

In line with its general positive attitude to public investment in R&I, successive Governments have been very supportive of research and innovation in the agri-food sector over the past several years. This has resulted in the building and maintenance of significant capacity and capability in the publicly supported Research Performing Organisations (RPOs). As this has been comprehensively captured and documented during the NRPE process and is summarised in earlier documents such as Food Research Ireland, SSAPRI, and the Action Plans for the two NRPE food priority areas, there is no need to deal with it in any further detail here. Suffice to say that today there is a very significant national agri-food research and innovation programme being conducted by Teagasc, several Universities, and a number of the Institutes of Technology which is internationally recognised. One of the strengths of this research infrastructure is a very high degree of collaboration and joint research planning between RPOs developed over the past decade through competitively allocated funding for strategic, large scale inter-institutional activities. A further noteworthy aspect of the agri-food research landscape is the extent to which RPOs are already working closely and in a highly integrated manner with companies, for example through Moorepark Technology Limited, EI and SFI centres, etc.

The level of funding provided by the state and the outcomes from the research conducted are reflected in the recent UCD study which found that Ireland had the 5th most innovative agri-food sector in the EU, lying behind Denmark, Finland, the Netherlands and Germany. State funding has contributed to the development of this capability, critical mass and infrastructure.

However, private investment in R&I by food businesses is quite low, with FH2020 recommending a doubling of industry investment by 2020. The challenge now is to facilitate further integration of the research base with enterprise. Harnessing the potential that exists within our research and commercialisation network and exploiting synergies across sectors and firms, and building capabilities where necessary, are crucial for the delivery of results for economic and social impact. As a major exporting economy with a skilled workforce, we must also continue to attract inward investors to collaborate with our research base to develop new and innovative products, with the eventual manufacture of such products on the island.

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Furthermore, through the convergence of a broad range of disciplines, technologies and sectors, research and innovation can be strengthened in the agri-food sector, as Ireland has a vast array of technologies at its disposal in close proximity to each other; the main ones being food, biotechnology, nanotechnology, bio/pharma, ICT and medical devices. This convergence offers huge potential for transforming agri-food production in the coming decade. Transforming knowledge generated into tangible products, processes, practices and services that producers, processors, businesses and consumers/citizens alike can use is vital for the success of the Irish agri-food sector. In this area too, the sector is well served by entities such as Knowledge Transfer Ireland, Teagasc and MI which have statutory mandates to undertake a range of research, advice, education and testing activities needed to deliver the innovation support necessary to add value to Ireland’s agri-food sector.

At a European level, Horizon 2020 - the EU’s programme for research and innovation - is part of the drive to create new growth and jobs in Europe, addressing people’s concerns about their livelihoods, food security, climate change, environment, healthy ageing, safety and strengthening the EU’s global position in research, innovation and technology. Implementing a SRIA relating to the ‘Sustainable Food Production and Processing’ and ‘Food for Health’ areas of the NRPE will enable Ireland to align its agri-food R&I activities with the EU’s 2020 Flagship Initiative - Innovation Union and make a positive contribution to delivery of its targets, whilst also leveraging funding and capability from Horizon 2020, thereby building on our excellent performance in its predecessor, the Seventh EU Framework Programme (FP7).

**Government’s Commitment to Research & Innovation relating to Food**

In February 2012 the Government adopted the Report of the independent Expert Group on the National Research Prioritisation Exercise (NRPE) as part of an overarching strategy aimed at accelerating the economic and societal returns from public investment in research. This report sets the agenda for the five-year period, 2013-2017.

The report identifies fourteen Priority Areas for future, competitively-awarded public investment in research that drives the achievement of economic objectives. Four criteria were used in selecting the areas:
The Priority Area is associated with a large global market or markets in which Irish-based enterprises already compete or can realistically compete.

Publicly performed R&D in Ireland is required to exploit the Priority Area and will complement private sector research and innovation in Ireland.

Ireland has built or is building (objectively measured) strengths in research disciplines relevant to the Priority Area.

The Priority Area represents an appropriate approach to a recognised national challenge and/or a global challenge to which Ireland should respond.

In addition to the 14 priority areas outlined in the NRPE report, the report acknowledges the importance of continued research funding to support:

a) Research for Policy and Practice (research that Government Departments and their agencies undertake or commission in pursuit of specific policy objectives and mandates), and

b) Research for Knowledge (support for excellent basic research in new and unanticipated research areas.)

Together these areas address the important societal challenges of ensuring the wellbeing of Irish citizens and protecting our environment.

In recognition of its continued success and growth potential, a number of the NRPE priority areas are applicable to the agri-food sector in particular 'Sustainable Food Production and Processing' and 'Food for Health'. The rationale for prioritising these two areas is set out in the NRPE Report together with a broad outline of the recommended strands of future focus. Action Plans for each priority area were subsequently developed and endorsed by Government in July 2013. The plans provide further detail on the steps necessary in order that Ireland can realise the opportunity associated with these Priority Areas grouped around four broad objectives. The first of these objectives is the development of Strategic Research Agendas, and this is now realised through the detailed research priorities and outline implementation modalities presented in this document.

Food Harvest 2020 together with Healthy Ireland and the NRPE report provide the context against which Ireland’s State investment activities in agri-food and food for health research is and will continue to be undertaken.
2. FROM A VISION TO A STRATEGIC RESEARCH AND INNOVATION AGENDA
2. FROM A VISION TO A STRATEGIC RESEARCH AND INNOVATION AGENDA

The Vision:

‘Invest strategically in Sustainable Food Production & Processing and Food for Health research to drive innovation and enable the agri-food sector to achieve its full potential in a sustainable manner thereby contributing to the achievement of the overall Food Harvest 2020 Vision of Acting Smart, Thinking Green, and Achieving Growth, and increasing public awareness of the role of nutrition, thereby supporting population health’.

The process for realising the Vision for Sustainable Food Production and Processing and Food for Health as outlined in their respective action plans:

OBJECTIVE 1
To develop a Strategic Research Agenda, in line with Food Harvest 2020: which draws on existing relevant research plans which have been informed by the needs of all relevant stakeholders to facilitate growth within the Irish food sector on the one hand and at the same time to contribute to the mutual goal of improved population health through improved diet, nutrition and lifestyle strategies, and facilitate active participation in EU and International Research activities.

OBJECTIVE 2
To ensure that the skill sets of graduates, postgraduates and researchers are relevant to the needs of the stakeholders and ensure that a critical mass of researchers is in place to deliver on the Vision.

OBJECTIVE 3
To ensure that research outputs from State funded research are exploited, in accordance with National IP Policy for the maximum benefit of the State, society and enterprise.

OBJECTIVE 4
To ensure existing infrastructure is fit-for-purpose and managed appropriately and that future infrastructure needs are identified.

Combined vision for Sustainable Food Production and Processing and Food for Health priority areas as contained in their respective action plans.
Delivering on the Vision

Delivering on the above vision is dependent on government, public and private sector leading, participating and co-investing.

Objective 1: ✓ Responsibility for this objective rests with all funders led by DAFM. Finalisation of this document fulfils this objective.

Objective 2: Responsibility for leading this objective rests with the HEA. Appendix 1 provides some information on developments to date in this area.

Objective 3: Under its Terms of Reference the DAFM-hosted, industry-led, National Agri-Food Research and Innovation (NAFRI) Group is being tasked with informing and monitoring the outputs of the initiatives funded in line with the SRIA to ensure that the outputs of agri-food research is translated into enterprise enhancing innovative activities as articulated by Knowledge Transfer Ireland38. Teagasc’s advisory programme is also a key part of the State’s apparatus to achieve impact from agri-food research. EI’s Technology Transfer Strengthening Initiative which supports the technology transfer activities of RPO’s is also of considerable relevance.

Objective 4: Responsibility for this objective rests with all funders. Appendix 2 provides some information on developments to date in this area.

38 http://www.knowledgetransferireland.com/
This SRIA document relates mainly to delivering Objective 1 above. It was developed by the multi-funder RPAG Food WG with the help of the industry-led, DAFM-hosted National Agri-Food Research and Innovation (NAFRI) Group and is the result of an exercise that drew on the collective intelligence of all relevant national R&I funders and an industry wide stakeholder consultation to identify the research & innovation needs of the agri-food and food for health sectors (See Appendix 3 for Methodology). Through shared funder ownership, this SRIA (in conjunction with the Teagasc Grant-in-Aid Core Programme) will ensure strategic State investment in research and innovation to enable the agri-food sector achieve its full potential in a sustainable manner thereby contributing to the achievement of the visions contained in a number of over-arching agriculture, marine, food and health policy documents\(^{28}\) notably Food Harvest 2020.

Building on existing industry led strategic research agendas within the agri-food space specifically Food Research Ireland (FRI)\(^{23}\), Stimulating Sustainable Food Production and Processing through Research and Innovation (SSAPRI)\(^{22}\) and Harnessing Our Ocean Wealth\(^{21}\), this SRIA for Sustainable Food Production and Processing and Food for Health will guide future actions in public research funding programmes to ensure that research in the agri-food sector is adequately supported and funded and appropriately targeted. As it is an agenda compiled at a particular point in time, it will need to be revisited and reviewed at regular intervals (e.g. every 2 years) in order that it can be updated to take account of economic, scientific and technological developments.

The SRIA spans the entire food production system from primary animal, crop and marine production, sustainable management of natural resources to food processing right through to food consumption, and impact on health and diet related diseases. By involving all key stakeholders in Ireland’s agri-food and healthcare system, it is well placed to strengthen research links and exploit research capacity and critical mass in support of a more focused approach to future agri-food and food for health research thereby ensuring maximum economic and societal impact. Actions undertaken on foot of this SRIA will contribute to increased innovation and competitiveness in the Irish agri-food sector and ensure sustainable production, processing and use of safe, nutritious, high quality food for a diverse, growing and increasingly sophisticated population.

The SRIA is intended to both guide and stimulate Irish agri-food and food for health research on national, European and international agendas. In so doing it will reinforce scientific cooperation amongst Irish Funding Bodies and with European/International Funding Bodies allowing for the use of initiatives and/or flexible funding instruments in order to exploit and maximize impact of such research. Some of the research funded as a consequence of being prioritized in this document will contribute to Ireland’s participation in a number of EU initiatives, such as the EU Bioeconomy Strategy\(^{24}\), JPIs\(^{25}\), ERA-NETs\(^{26}\) and EIPS\(^{27}\). Furthermore this SRIA provides for the adoption nationally of the relevant agri-food components of the SRAs for the FACCE and HDHL JPIs.

\(^{23}\) http://www.agriculture.gov.ie/media/migration/research/FoodResearchIreland.pdf
\(^{22}\) http://www.agriculture.gov.ie/media/migration/research/SSAPRI.pdf
\(^{21}\) http://www.eurooceanwealth.ie/SiteCollectionDocuments/Harnessing%20Our%20Ocean%20Wealth%20Report
Guiding Principles in the Development of the Strategic Research and Innovation Agenda

The Irish agri-food sector must maintain a strong collective focus on the need to produce safe, high-quality, nutritious food in an efficient, competitive, and sustainable manner. More importantly, it must ensure that its successes will benefit everyone from farm to fork; hence the three guiding principles, of equal importance below apply:

- **Competitiveness**
  - Maintain and further enhance the competitiveness of the Irish agri-food sector

- **Sustainability**
  - Ireland to become a world leader in sustainable food production.

- **Citizen-Consumer**
  - To develop a consumer / citizen orientated agri-food industry.

Research & Innovation Thematic Areas:

At the outset, the Research Prioritisation Action Group (RPAC) Food WG decided that the SRIA should contain two major parts: (1) the specification of the R&I prioritised for funding going forward (the ‘what’ part) and (2) an Implementation Plan (the ‘how’ part). The WG also agreed that, owing to the inter-related and inter-dependent nature of the two food priority areas, the information should be combined into a single SRIA. Moreover, for presentational and operational reasons, when drafting this SRIA, the WG & NAFRI Group categorised the identified priority R&I activities into 9 broad research themes (Figures 21); however, they championed an integrated approach across all thematic areas reflecting the farm-to-fork nature of the food sector to maximise the impact of research and innovation and to benefit the Irish agri-food industry, the Irish population and wider economy and society. In the course of the exercise priority investments that are, strictly speaking, outside the scope of the NRPE in that they relate more to ‘research for evidence-based high level policy formation’ were also identified and, since these are considered complementary to the more economically driven priorities, they have been captured and presented in Appendix 4.

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24 http://www.era-platform.eu/
Fig. 2.1: Key Research and Innovation Thematic Areas for Sustainable Food Production and Processing and Food for Health priority areas

Socio-economic type research identified during this exercise that is directly relevant to delivering the economic objectives of the two NRPE priority areas has been included in the cross-cutting theme. This type of research encourages innovation, and supports productivity and fiscal integrity by minimising the resources we have to spend on achieving objectives by actively encouraging new and better ways of doing things. It also plays a vital role in agenda setting and increases the likelihood of translating important findings in relation to agriculture, health, education, the terrestrial and ocean environments, social and societal development and other research domains into feasible and implementable services and systems.
Key Investment Areas

Within each of the nine thematic research areas above, key investment areas have been identified and information set out captured under the following headings:

- High Level Objectives that R&I can play a part in achieving
- Priority Research and Innovation Areas
- Expected Impacts

SRIA Goals:

This SRIA, which was compiled following an extensive consultative exercise as outlined in Appendix 3, captures the food related research needs of the agri-food industry and health care sector and other stakeholders and is designed to fulfil a number of high level goals:

1) Guide the content of relevant competitive calls operated by all relevant funders and, therefore, strategic research investments in food research and innovation undertaken by Irish research performing organisations and the industry.

2) Intensify the innovation capability of Irish food production systems to contribute to the development of new/improved management practices, products, processes and services which allow for increased market share for premium products and services.

3) Foster the development and manufacture of new high-value nutrition and wellness products aimed at improving consumer/citizen well-being.

4) Develop economically and environmentally sustainable food production and processing systems across all enterprises that support profitability and international competitiveness and contribute to enhancing the quality of our environment and so meet national and international environmental targets.

6) Strengthen the existing knowledge base in key strategic areas thereby increasing the developmental capacity of Research Performing Organisations (RPOs) enabling them to leverage additional support for their research from EU research programmes and other international sources.

7) Help address the 15 metrics listed in Appendix 6 and so contribute to achieving the set of high-level, overarching national targets adopted by government.
### 2.1. ANIMAL PRODUCTION

Key Investment Area: 2.1.1 Animal Breeding & Reproduction

**High Level Objectives**

1. Maximise genetic gain (€) for key profit traits (both current and future) for farmers and industry.
2. Develop breeding programs, including relevant strains and where appropriate new species that support long-term sustainable genetic gain.
3. Provide the necessary breeding tools to rapidly increase sustainable and high quality food production.
4. Develop breeding and management strategies that support optimal female fertility performance, in terms of age at first breeding/calving, compactness of calving and culling levels.
5. Support the development of new reproductive technologies that encourage profitable expansion.
Priority Research & Innovation Areas

Animal Breeding

1. Develop indigenous breeding programs that support long-term genetic gain, including: (i) evaluation and design of such programs, and (ii) identification of breeds and strains for traits of priority to Irish farming systems. Where appropriate these should be supported by genetic material from outside Ireland.

2. Focus on traits of increasing economic importance in future. Specifically, health and disease traits, animal welfare, milk quality, meat quality, feed intake, environment (carbon, methane, nitrogen & water) for the purpose of maximising economic and genetic gain.

3. Incorporation of large volumes of high density sequence data (including whole genome information) into routine genomic evaluations and breeding schemes.

4. Development of low cost genomic selection systems for animals.

5. Greater integration of genomic, animal breeding and reproductive technologies to advance gains in profitability at farm level, including potential use of precision breeding tools, e.g., genomics mating plans & culling indexes.

6. Feasibility study to investigate large-scale collection of difficult to measure phenotypes, e.g., feed intake, health and disease, for genetic improvement.

7. National genetic conservation: Development of protocols and tools for identifying, collecting, storing and analysing animals and populations of interest. Create the capability for the development of theory and applications to deliver predictive understanding of phenotypic expression in livestock using, for example, functional genomics and systems biology tools.

8. Investigate the potential for alternative animal genotypes to increase animal productivity from a limited feed base.
Animal Reproduction

1. Identify genetic, nutritional and management strategies for improved reproductive performance (including calving/lambling patterns) in cattle and sheep. This should include, suitable genotypes, optimal rearing strategies, therapy strategies for uterine disease, predictive modelling and appropriate cost benefit analysis.
2. Development of novel automated methods to accurately and efficiently detect oestrus, adverse health events and onset of parturition in cattle.
3. Development of diagnostic techniques and biomarkers to identify animals at risk and those experiencing clinical and subclinical uterine disease.
4. Evaluate the effect of concurrent disease (e.g., lameness, mastitis, production-related and infectious diseases) on fertility performance in animals.
5. Development of early predictors and monitoring tools of male fertility in livestock (both for natural service and AI, including bulls being used for sexed semen).
6. Development of management protocols to ensure natural service bulls on farms are healthy, fertile and functional.
7. Development and evaluation of strategies to incorporate sexed semen usage into herd reproductive management, while minimising adverse effects on herd reproductive performance.

Expected Impacts

Contribute to increased profitability at the producer, processor and national level through greater quality product produced from more profitable animals under a more sustainable and consumer accepted environment. Achieved through: development of world class breeding programs to help support and underpin the growth of Ireland’s food industry; greater uptake of breeding tools from the provision of more accurately evaluated genetically elite animals; precision breeding to fine-tune gains in performance dependent on the breeding strategy and environmental conditions; improved animal performance through multi-level integration of data from alternative sources (genetic, genomic, other omic, environment); creation of Irish fish and shellfish hatcheries leading to enhanced competitiveness of Ireland’s aquaculture sector.

Increased farm profitability as a result of increased milk and meat production (earlier and more compact calving) and reduced cost (greater proportion of milk produced from grazed grass), underpinned by increased reproductive performance through the provision of high quality semen (from genetically elite animals). In addition, reduced replacement rate will result in greater farm profitability as well as lower carbon emission from Irish agriculture.
Key Investment Area: 2.1.2 Animal Well-being, Animal Nutrition & Product Quality

High Level Objectives

1. Develop management strategies that reduce the use of treatments for microbial and parasitic infections in Irish animal production systems.
2. Support sustainable control of economically important endemic and emerging diseases including increasing the role of existing and new diagnostic tools.
3. Develop sustainable solutions to optimise animal welfare (including objective measures of animal well-being) appropriate to Irish food production systems.
4. Increase livestock productivity from pasture-based systems using precision feeding systems.
5. Better evaluate and understand the economic impact of alternative/contrast farming systems for food producing animals.
6. Ensure that future product quality payment systems are based; (i) on strong supporting research and (ii) phenotypes that can be easily recorded at the farm/animal level.

Priority Research & Innovation Areas

Animal Well-Being

1. Development of early warning data/surveillance systems, improved diagnostics, vaccines, and intervention strategies for the rapid recognition and control of new and endemic infectious diseases of livestock.
2. Development of biosecurity strategies to protect the health status of expanding animal production systems, e.g., contract rearing of replacement stock and share farming arrangements.
3. Identify factors leading to excessive use of antimicrobials and anthelmintics in Irish animal production systems and develop and evaluate practices to minimise their use, including a greater understanding of resistance.
4. Development of alternative strategies for parasite control to deal with both long-established and new/emerging parasitic diseases, in the context of changing husbandry systems, climate change and increasing resistance to anthelmintics.
5. Develop management strategies that reduce the incidence of lameness in Irish livestock production systems including the use of sensor technology.
6. Investigate currently used biocides and other pathogen reduction techniques and their role in biosecurity and bio-containment on farm including an examination of levels of tolerance and resistance amongst common on-farm microbes.
7. Develop objective measures of animal welfare status across the full spectrum of animal production systems.
8. Welfare assessment to address specific enrichment and enhancement aspects of Irish animal production systems, e.g. animal housing systems and systems for dairy reared calves pre-weaning.
9. Development of management strategies and/or effective treatments for Amoebic Gill Disease (AGD), Sea Lice and other disease/parasites that affect the economic competitiveness of farmed fish.
10. Develop sustainable aquaculture production systems focused on competitiveness, use of different aquaculture species, enhanced fish welfare, reduced diseases and parasites, reduced biosecurity risks, reduced escapes, incorporating novel technologies and engineering solutions.
11. Enhance the understanding of the interactions in the gut between digestion products of animal feeds, residing microbes, and host immune cells so as to identify routes for the implementation of this knowledge in the management of improved immune competence in livestock and reduced health risk for humans.

Animal Nutrition & Product Quality

1. Investigate the influence of plant structural characteristics on voluntary DM intake of grazing livestock
2. Investigate the influence of forage chemical composition on rumen fermentation, total tract digestion and product quality (milk and meat).
3. Investigate the requirement and optimum delivery mechanism for mineral supplementation of grazing livestock on various soil types
4. Investigate ingredient processing and/or the use of feed enzymes to increase nutrient availability and the inactivation of anti-nutritional factors in ingredients and by-products for inclusion in pig diets.
5. Investigate alternatives to unsustainable high protein ingredients in animal diets.
6. Develop and establish a net energy and available amino acid approach to pig diet formulation, so that there is increased accuracy in diet formulation and greater transparency in the marketplace.
7. Examination of current and future use of surplus food and novel animal feed materials, taking due consideration of consumer acceptance and impact on food quality parameters.
8. Examination of current use of in-feed medication and factors influencing it. Examine economically feasible alternatives including the development of novel feed sources and functional ingredients for aquaculture.
9. Deepen our knowledge on the interaction between genetics and nutrition, and exploit the differences between individual animals in feed efficiency by matching their input to their needs as these change with time (and the animals physiological state).
10. Establish opportunities for improved product quality, including, (i) understanding potential for production differentiation, as a consequence of improvements in breeding, feeding and management of animals, (ii) development of rapid/easy to record phenotypes to assess product quality, including their potential application in price payment systems and (iii) quantifying the relationship between diet composition and product quality.

11. Quantify the effect of diet on economically important components of animal produce, including their sensory and nutritional quality.

Expected Impacts

Achieve progress towards animal production systems that are more sustainable and welfare-friendly. The establishment of credible data on animal health and welfare status of Irish animal production systems will underpin the marketing of Irish food at home and abroad and contribute to metrics that enable us to benchmark Irish production systems against those of competitor countries and best international practice.

Greater insight will contribute to enhanced preparedness for dealing with the incursion of an OIE listed disease or a novel disease entity and to the development of cost-efficient and effective industry-led disease control initiatives and more efficient returns for Government investment in disease control.

Increased animal performance from home produced feedstock, resulting in increased farm profitability. The production of animal based food products that meet customer requirements for price, quality and availability and increased environmental sustainability.
2.2. GRASS, CLOVER, FORAGE, CROPS & FOOD HORTICULTURE

Key Investment Area: 2.2.1 Plant Production

NB. 'Crops' below includes grass, forage, tillage and food relevant horticultural crops including mushrooms and algae.

High Level Objectives

1. To improve competitiveness by developing systems of crop production that exploit Ireland’s high yield potential environment.
2. To improve the prediction of input requirements to maximise profitability and sustainability.
3. To develop crop production systems that target product quality to end user requirements.
Priority Research & Innovation Areas

1. Improve understanding of crops’ growth and development and nutrient requirements and identify key growth phases limiting productivity specific to the Irish climate.
2. Develop and test methods of accounting for variability in soils and requirements for a range of external nutrient and soil amendment inputs to maximise productivity and profitability.
3. Determine the potential of novel methods of incorporating nitrogen fixing species into crop/graass systems to reduce fertiliser nitrogen requirements.
4. Identification and development of alternative/novel crops suitable for Irish conditions that can profitably exploit existing or novel markets and increase crop diversity.
5. Further develop production systems for large-scale area break crops (proteins, oilseeds) to improve their reliability in Irish conditions facilitating more stable sustainable production using crop rotation.
6. Develop low cost and reliable alternative crop establishment and reseeding technologies.
7. Develop improved costing methodologies for all crop production elements that would allow improved decision making about all inputs (land, machinery and variable inputs) leading to improved competitiveness in crop production.
8. Identify (and, where required, provide information needed for registration) both artificial and natural products for the manipulation of crop growth.
10. Evaluate the benefit of incorporating white clover into grazing pastures in terms of pasture production, and quality, animal performance and nutrient use efficiency.

Expected Impacts

Improve the productivity in terms of quantity, quality and value of crop output, whilst minimising the costs of production. This would increase both overseas revenue generation and reduce reliance on imported products and thus improve the balance of trade. Increased productivity would also reduce the risk of supply/demand imbalances associated with poor seasonal growing conditions such as occurred during the fodder crisis.
Key Investment Area: 2.2.2 Plant Health & Breeding

High Level Objectives

1. Develop resilient (IPM) production systems combining varieties/clones and husbandry systems which reduce reliance on inputs of plant protection products (PPP).
2. Monitoring of pest and disease populations to identify population changes or mutations which will impact on control measures and to identify/predict novel alien pest and disease attacks, in the context of climate change for example.
3. Increase the rate of genetic improvement in key crop species (tillage, grass/forage and horticultural), exploiting conventional and advanced breeding tools and technologies, to accelerate production potential and reduce reliance on external inputs, and evaluate the potential impact of the introduction of crops produced using advanced breeding techniques.
4. Develop variety evaluation and indexing systems which attribute production and economic values to the full range of phenotypic traits.

Priority Research & Innovation Areas

Plant Health

1. Develop improved prediction systems which determine the impact of key pests/pathogens of crops in Irish conditions and to develop improved Integrated Pest Management (IPM) strategies.
2. Improve targeting of PPP (plant protection products) according to the risk of yield or product quality loss.
3. Identification and deployment of improved husbandry practices (e.g. planting practices, nutrient use etc) which reduce a crop’s susceptibility to economically damaging levels of pest and disease incidence and are compatible with high yield potential.
4. Identify mutations of extant pests and disease with reduced sensitivity to PPP.
5. Investigate the impact of currently uncontrolled pests and diseases on forage crops such as maize and grass in Ireland.
6. Develop improved surveillance strategies and where appropriate epidemiological studies, for new and emerging pests and pathogens of crops.
7. Identify economically viable biological/bio-control/non-chemical options for pest and disease control with levels of efficacy acceptable to the market.
Plant Breeding

1. Understanding the biology, physiology and genetic architecture of key productivity and quality traits important to crop plants in Ireland
2. Development of genome-based approaches (genomic selection, marker assisted selection) in crop (including grass, clover, mushrooms and algae) breeding programmes from proof of concept phase to implementation phase.
3. Identify and deploy durable resistance to the key pests and diseases of crops.
4. Identification and development of new cultivars and strains for annual and perennial crop production.
5. Develop on-farm evaluation systems for perennial rye-grass and white clover to increase the rate of genetic progress under Irish grassland farming systems.
6. Development of more accurate, high throughput, phenotyping of desirable plant characteristics (e.g. FTIR and NIRS).
7. Investigating the exploitation of genetic variation in native and exotic crop relatives in breeding and genetic improvement of Irish crop species
8. Develop a comprehensive national profit-focused breeding objective for perennial ryegrass-white clover swards.
9. Selection of forage genotypes to maximise the ecological benefits of fibre-based nutrition.
10. Assess and monitor the impact of integrating novel technologies into future crop breeding programmes.

Expected Impacts

Maintaining and improving the yields and quality of our crops through better crop health and good pest/disease control will contribute to reduced requirements for PPP inputs, reduced risk of losses to the environment and reduced risks and costs of crop production, thus meeting Ireland’s obligations under the Sustainable Use Directive, the Water Framework Directive and other current and future relevant legislation. The proposed innovations will also contribute to reduced risk from the advent of new pests and diseases particularly for perennial crops such as newly established horticultural crops.

The deployment of crop species or strains with improved genetic potential will aid the achievement of Food Harvest 2020 targets as well as longer term economic and environmental sustainability objectives, by increasing production whilst reducing reliance on external inputs. Improved plant health and improved genetic potential will also contribute positively to profitability on Irish farms.
2.3. SUSTAINABLE MANAGEMENT OF NATURAL RESOURCES

Key Investment Area: 2.3.1 Management of Natural Resources, Biodiversity and Ecosystem Services

High Level Objectives

1. Enhance the efficiency of renewable and finite natural resources in the food chain, including research that will deliver solutions for more efficient use of natural resources.
2. Develop strategies and technologies to reduce the impact of food production on water quality, including supporting the delivery of the Water Framework and Marine Strategy Framework Directives and other policy instruments related to water quality.
3. Identify and evaluate tailored measures which impact positively on biodiversity in contrasting terrestrial farming and marine ecosystems, and which support the 2011 EU Biodiversity Strategy and the National Biodiversity Action Plan (2011-2016), and develop cost-effective and targeted prescriptions to improve the status of threatened habitats and species.
Priority Research & Innovation Areas

1. Develop strategies and technologies to improve nutrient efficiency and recycling in the entire food chain.
2. Improved energy efficiency and reduce fossil fuel use in food production systems, identifying and avoiding any adverse effects from the substitution of fossil fuels with biofuels.
3. Optimise water use in agriculture including water conservation strategies and quantification of water footprint across food production systems.
4. Mapping and assessment of Ireland’s wild seaweed resources and other marine biodiversity.
5. Generate knowledge on multi species interactions, maximum sustainable yields (MSY) management targets, mixed fisheries and the use of marine biological resources and develop prediction and modelling tools that support an integrated approach in management and decision making in implementing an ecosystems approach to fisheries.
6. Develop long-term management plans for fish stocks having regard to the need for environmental and social sustainability.
7. Develop efficient fishing gear and methods that contribute to reductions in by-catch and discards and enable greater selectivity of species.

Expected Impacts

Contribution to more efficient use of finite and renewable resources in food production, to increased productivity and profitability while at the same time reducing the impact of food production on water quality and biodiversity loss. It will provide Ireland’s food sector with a competitive advantage through the protection of Ireland’s ecosystem and compliance with national and international environmental legislation. It will therefore support the delivery of the Water Framework and Marine Strategy Framework Directives and will support the EU Biodiversity Strategy and the National Biodiversity Action Plan (2011-2016). The costs and benefits of proposed measures will be analysed so that the most cost effective measures can be implemented where necessary. This research will also contribute to the preparation of management plans that facilitate the sustainable exploitation of Ireland’s food production systems.
Key Investment Area: 2.3.2 Soils, Land Use, Climate Change & Trans-boundary Gases

High Level Objectives

1. Improve understanding of soil processes, and their interactions with land use, that impact on soil and landscape functionality and productivity, and on the rural environment.
2. Develop soil husbandry and land management strategies and practices that are economically and environmentally sustainable, and that simultaneously improve the productive and environmental performance of farming and food production systems at field, farm, catchment and national scales, across all soil types.
3. Develop and support actions that (i) reduce or offset greenhouse gas emissions, maximise carbon uptake, and optimise carbon/greenhouse gas efficiency in the agriculture and land use sectors in Ireland, bearing in mind the need for resilience in agriculture to climate change and weather volatility and (ii) contribute to meeting air quality targets under the National Emissions Ceiling Directive and Gothenburg protocol.
4. Assess vulnerabilities to current and future climate and weather and develop appropriate responses and technologies that contribute to building the resilience of terrestrial and aquatic food production systems to both weather volatility and climate change, bearing in mind the need to reduce or offset greenhouse gas emissions/maximise carbon uptake.

Priority Research & Innovation Areas

Soils/Land Use

1. Develop and support actions to improve our understanding of soil physical, chemical (including nutrients dynamics) and biological processes to maximise functionality and productivity.
2. Improve the identification of critical source areas for nutrient and sediment loss and minimise/manage these environmental loss pathways.
3. Develop biological and molecular markers as indicators of soil functionality.
4. Improve soil fertility assessment techniques at both laboratory and in-field sensing scales.
5. Identify indicators of soil quality for a range of soil functions, land uses and soil types and practices that improve these indicators.
6. Develop best management practices to enhance soil functionality and productivity across contrasting soil and land use types.
7. Diagnosis and design of drainage systems for heavy soils, taking into the consideration productivity benefits as well as the potential impact on run-off of nutrients and sediments, flash flooding hydrology of rivers, and ecological impacts.
Climate Change and Trans-boundary Gases

1. Development and assessment of existing and emerging technologies for reducing GHG emissions and/or enhancing carbon sequestration in Ireland’s soils, biomass and agricultural systems.
2. Understanding the extent to which methane emissions can be reduced either through feeding strategies or breeding or other technologies.
3. Reduce N₂O emissions by shifting gaseous N losses from N₂O to N₂, and reduce uncertainties in N₂O emissions via spatial integration from field to catchment scale.
4. Measuring the impacts of land use and management options on carbon stocks (in soils and biomass) and sequestration across multiple spatial scales, including coupling of measurements to remote sensing data.
5. Investigate the impact of climate change and weather volatility on animal and crop production systems, the marine environment and ecosystem and marine food products, and develop appropriate management strategies and responses to future-proof these systems.
6. Integrating actions to reduce ammonia loss and develop decision support tools to improve nitrogen use efficiency.

Expected Impacts

Improved understanding of soil productivity processes and interactions with land use will lead to improved soil quality and productivity and a sustainable improvement in the productive and environmental performance of farming and food production systems. Identification and development of sustainable pathways and systems to reduce net greenhouse gas emissions will help Ireland to comply with international agreements on greenhouse gas emissions and air quality while allowing us to contribute to both global food security and reducing the GHG footprint of global food production. Research in this area will provide Ireland with the capability to model the potential impact of climate change and improve the understanding of the likely impacts of climate change on Irish agriculture and marine foods production, and identify appropriate responses and decision making. It will also help to establish Ireland as a global centre of climate solutions and information services for the agriculture, land use and fisheries sectors, and will enhance branding of Ireland as a leader in sustainable food production and use of natural resources, thus contributing to the market image of Irish foods abroad.
2.4. FOOD PROCESSING TECHNOLOGY AND ENGINEERING

High Level Objectives

1. Establishment of world class efficient processing, packaging and preservation technologies for the Irish food sector.
2. Development of novel processing technologies to produce SMART Irish food products.
3. Building and deployment of advanced integrated food process analytical tools and methodologies and engineering principles in the Irish food sector to enhance competitiveness.
4. Support adoption of advanced environmentally sustainable End-to-End Irish food processing.
Priority Research & Innovation Areas

1. Development of novel processes and interventions to enhance storage and transport of food products with particular focus on microbiological safety, quality and nutritive stability.
3. Development of novel manufacturing technologies to automate and optimise food processing.
4. Investigation of new food dehydration technologies and expansion of understanding of powder technologies and models.
5. Enhancement and development of lipid process technology in food applications.
7. Investigation and development of novel mixing, dissolution, shearing and solubilisation technologies of food materials.
8. Development of advanced thermal and non-thermal novel technologies for food applications.
10. Development of production systems and technologies to optimise and extend the seasonality of Irish production and processing of food materials and products to more accurately match consumer and market requirements.
11. Exploitation of Irish food materials as a source of novel enzymes.
12. Development, validation and application of process analytical technology (PAT) tools for food processing applications to facilitate adoption of an advanced process control philosophy in the food industry (with initial focus on the infant / advanced nutrition arena).
13. Investigation and application of Quality by Design (QbD) principles to enhance efficiency within the food industry.
15. Reduction in Irish food industry’s water usage, increase in energy efficiency and reduction of carbon footprint by development of new technologies and processes across the food supply chain.
16. Maximisation of recovery of value from discarded, under-utilised and returned food materials and co-products.
17. Investigation of alternative management technologies for treatment and use of food waste.
Expected Impacts

The Irish food industry's need for food processing systems that deliver efficient, natural, safe, efficacious products that meet growing global customer and consumer expectations will be met. Ireland’s food sector will be able to access food processing expertise to support the development of unique, timely, competitive and safe technology solutions to market-led Irish food processing challenges, demands and opportunities. The competitiveness of Irish food companies will be significantly increased by the development and adoption of new processing methodologies and integrated analytical tools that are applicable at all stages of the sustainable food production chain. Ireland’s food sector’s ability to maximise utilisation of natural food raw materials with minimal environmental impact will be considerably enhanced.
2.5. FOOD PRODUCT DEVELOPMENT, FORMULATION & SENSORY SCIENCE

High Level Objectives

1. Develop state-of-the-art technology platforms for design and characterisation of food structures & formulation matrices and models to predict food interactions, particularly in advanced, nutritional food and beverage products.
2. Further develop Irish sensory science and it’s application in food product and process development.
3. Maximise the use of minimally processed materials in food products.
Priority Research & Innovation Areas

1. Development of world-leading sensory capability and systems for the Irish food industry.
2. Enhance the capability to understand and interpret the biochemistry of proteins, carbohydrates, lipids & congenors and their interactions in innovative food matrices.
3. Optimise and enhance eating quality of fresh foods.
5. Development of model food matrices for bioactive protection, delivery and taste masking.
7. Develop and validate deep food formulation capability for bioactive ingredients and extracts to optimise organoleptic attributes, extend shelf-life and survival during processing.
9. Development of food texture and physical structure research tools and technology to enhance the understanding of structure-function relationship for application in food design and development.
10. Development of food fermentation formulation technology and applications.
11. Development of molecular and structural understanding of colloid interactions in food systems particularly in enhancing emulsification applications capability.
12. Develop and enhance the understanding of the science behind food molecular and structural interactions in the development of new foods.
13. Development of soft matter (physical structures) understanding and application approaches for the creation of novel food systems and products.

Expected Impacts

Investment in the area of Irish food product biochemistry, formulation and sensory science to fully understand our raw material attributes from primary to advanced formulations will significantly enable development of world-class products for global marketing.
2.6. FOOD CHAIN INTEGRITY & SAFETY

High Level Objectives

1. Improve the efficacy of traceability systems within Irish food processing and reduce the costs of ensuring product safety and integrity.
2. Enable Ireland’s food sector to demonstrate the safety, authenticity and provenance of Irish foods.
3. Establish best-in-class approaches to the identification and assessment of risks associated with biological and chemical contamination of foods and develop innovative food safety controls, and tools that mitigate these risks.
Priority Research & Innovation Areas

1. Development and application of innovative solutions to enhance the traceability of foods, guarantee provenance and improve the efficacy and validity of traceability systems.
2. Development of new cutting edge techniques to determine the authenticity of raw materials and finished foods using molecular and analytical approaches including high throughput DNA-identification methods, stable isotope technology and similar innovative technologies.
3. Development of enhanced methods of analysis with broad spectrum for contaminants, residues and toxins for improved surveillance and risk management of foods and animal feeds.
4. Development of quantitative risk assessment methodologies including risk/benefit approaches to underpin and evaluate the impact of risk management solutions with a focus on emerging areas of concern like the safety of fresh produce.
5. Development of novel toxicological approaches to emerging issues like the safety of nanomaterials and low-dose effects of certain chemicals in food.
6. Development of enhanced methods for detection, characterisation and elimination of pathogenic bacteria, enteric viruses and other harmful microorganisms throughout the food and feed chain.
7. Development of novel systems including data analytics for the identification and evaluation of emerging food safety risks at national level and support for threat assessment at production and processing level.
8. Develop an enhanced understanding of the risks posed by antimicrobial resistance (AMR) to the food chain and potential management tools for same.
9. Development of shelf-life testing capabilities and challenge testing capabilities to support Irish food industry.

Expected Impacts

Development and deployment of world-leading technologies and tools to fully underpin the unique traceability, safety and sustainability attributes of Irish foods will significantly enhance the food industry’s ability to compete as a trusted quality food exporter selling into ever-more competitive and regulated global markets to sophisticated and media-savvy consumers. The expected outcome from investment in this arena would be a significant increase in the Irish food industry’s ability to leverage value from food industry’s ability to leverage value from food industry’s ability to leverage value from food industry’s ability to leverage value from sustainably produced safe food.
2.7. FUNCTIONAL FOODS & HEALTH

Key Investment Area: 2.7.1 Functional Foods/Bioactives

High Level Objectives

1. By 2020 Irish consumers will have a broader range of healthy foods to select from: the healthy choice will be the obvious choice.
2. Increase the number of Irish food ingredients and products on the global market with approved health claims in accordance with the regulatory environment.
3. Increase the number of new and innovative Irish high value added, health enhancing food products with sensory attributes that meet consumer requirements.
4. Ireland will be a world leader in the discovery and development of bioactives for food use.
Priority Research & Innovation Areas

1. Research to support the development of food ingredients and foods (including fortified foods) for cohorts of the population with specific nutritional needs. These cohorts will include:
   - infants, young children and adolescents
   - pre-pregnant, pregnant and lactating women
   - physically active individuals and elite sport’s athletes
   - older people

In addition, research to develop foods to enhance health and wellness throughout the lifecourse e.g. foods to enhance healthy ageing and performance. The research should be informed by market intelligence, consumer needs and behaviour, national dietary databases, other relevant health databases and taking account of the global regulatory framework that governs food production and nutritional policy.

2. Research to support the development of value-added food products with superior quality and health benefits through increasing the rate of the discovery, identification, extraction, targeted delivery and incorporation of novel bioactive compounds. The bioactive research should address health benefits/issues including:
   - muscle strength and muscle mass
   - bone health
   - inflammation
   - cardiovascular health
   - weight management
   - glycaemic response
   - cognitive health
   - physical performance
This research would also review existing evidence for bioactive efficacy, explore possible synergistic effects between bioactives and identify more cost-effective sources and production processes.

3. Increase the rate of discovery of bioactive compounds with potential health benefits from a variety of materials from terrestrial and marine sources (e.g., milk, plant, animal, microorganisms, insects or food waste streams), by enhancing the rate of screening of bioactive compounds and investigating their use as functional ingredients.

4. Develop food formulations/food structures/delivery systems to enhance the stability and efficacy of a range of bioactives (e.g., phenolics, peptides, lipids, oligosaccharides) or optimise sensory attributes of foods with an aim to enhance human health.

5. Assess the molecular, cellular and human response to functional foods/food ingredients to assess safety, impact on human health and to substantiate possible health claims. Consumer response to functional foods/ingredients will be assessed and used to focus further research.

6. Develop medical foods; linking pharma and food manufacturing for functional foods. This will link pharma production standards with the production of foods for vulnerable consumers that will go beyond the standard food hygiene and other food safety measures to produce a safe source of nutrition for select cohorts.

Expected Impacts

Increased knowledge and understanding of the role of functional foods and efficacy of bioactives in promoting health. Provision of tools for identifying, assessing and investigating the efficacy of bioactive compounds for use in innovative foods or as food ingredients. An enhanced capacity to develop and produce medical foods, functional foods or food ingredients and a strengthened capacity to conduct research into the determinants of diet and nutrition leading to improved product, process and service innovation for Irish enterprise as well as contributing to improved population health in nutrition and food. Therefore, Ireland will gain international recognition as a leader in the area of functional food research and lead to the development of a suite of novel, reformulated or newly sourced medical foods, functional foods or food ingredients which can be utilised by food companies for economic gain and that can, in addition, enhance human health.
Key Investment Area: 2.7.2 Gut Health

High Level Objectives

1. Continued mining of the human gut microflora to identify further microorganisms with a positive influence on the health of the host and examining ways to enhance the positive effect of beneficial gut microorganisms
2. Significant increases in our understanding of the role of food in influencing gut health and disease prevention
3. Development of food processing innovations and new food products based on food ingredients that promote gut functioning and the development of a healthy microbiota.

Priority Research & Innovation Areas

1. Identify microorganisms or groups of microorganisms working alone or in concert with other microorganisms or gastrointestinal entities to maintain a healthy gut.
2. Identify dietary factors that improve the barrier function of the intestine (including the impact of intestinal microbes) and the resistance to infections (common, food borne, etc.) and its inflammatory sequelae.
3. Establish gut microbiota biomarkers of human health and understand the role of the microbiota in the onset or mitigation of particular medical conditions and in protection against infection.
4. Examine the effects of dietary intervention on the gut microbiota. Areas of interest include but are not limited to - understanding the effects of infant milk formula on the gut microbiota; examining the effects of micronutrients and macronutrients on the gut microbiota and designing nutrition regimes to enhance health; establishing how nutrition effects the efficacy of orally administered drugs and developing nutrition solutions to help restore it.
5. Further understand the ability of gut microbiota to modulate the rate of uptake or absorption of nutrients
6. Develop biomarkers of intestinal and related functions to define and improve ‘intestinal health’; improvement of e.g. ‘abdominal comfort’, digestive function, systemic immune function and decreased risk of colorectal cancer.
Expected Impacts

Increased knowledge and understanding of the role of food and gut microorganisms in promoting gut health, and in the role of gut health in supporting human health more broadly. Tools for identifying, assessing and investigating the efficacy and influence of foods on gut health and disease prevention. The development and design of innovative foods, food ingredients, processes or nutrition regimes to enhance health and which are acceptable to consumers. New products or processes which can be absorbed by the Irish food industry thereby enabling new product offerings and enhancing capability of the sector to compete globally and to grow through an increased number of jobs and exports.
2.8. NUTRITION, HEALTH & DIET-RELATED DISEASE

Key Investment Area: 2.8.1 National food consumption and other food and health related databases

High Level Objectives

1. Develop and exploit national food consumption and other nutrition related databases, to support improved population health and the development of the Irish food sector.
2. Deliver a coordinated, integrated and sustained national nutrition surveillance system in Ireland that meets the needs of industry and the public health policy/practice community.
3. Further understanding of the nutritional intake of the Irish population.
4. Support the development of a harmonised European Food consumption database, through Horizon 2020.
5. Further our understanding of consumer needs and behavioural responses to healthy foods/food choices.
Priority Research & Innovation Areas

1. Further develop, update and exploit Irish national food consumption databases, related food compositional and other food and health data, for all population groups from infants to elderly to address both nutrition and food safety issues. Appropriate biofluids should be collected to determine biomarkers of nutrition and health status and of food intake, as well as phenotypic and genotypic characteristics. Where appropriate, databases should include data on attitudes to food and health and other determinants of food choice and eating behaviour.

2. In order to address food safety risk assessment and regulatory issues, databases should be designed to facilitate investigation of exposure to food ingredients, food packaging, additives, contaminants, allergens, bioactives and microorganisms. For example, a reliable database of confirmed food allergies in Ireland would identify the prevalent food allergies in Ireland, which food allergens are associated with the more severe reactions and which food allergens relevant to the Irish population are not covered by specific EU labelling requirements. This would assist consumers, food businesses and regulatory bodies to focus on those food allergens important for Irish consumers.

3. Use databases to investigate food, nutrient and dietary patterns to determine dietary role of key foods (such as dairy, marine, fermented foods, fortified foods & others) and bioactives, with health outcomes such as obesity and metabolic health, chronic diseases and nutrient deficiencies and excess.

4. Harmonisation of research methods, tools and measures for monitoring and evaluation of existing and new nutritional interventions.

5. Statistical modelling of the potential impact on consumers of new and reformulated foods and changes in eating behaviour in order to inform development of healthy eating guidelines and new food products. Working with food businesses and regulatory authorities to identify new or reformulated foods brought to market and linking those to changing consumer or food business trends.

6. Development and validation of tools/techniques for the remote collection of diet and phenotypic parameters in future research, for example identification of novel biomarkers of food intake or development of novel food intake assessment techniques.

7. Develop insights into consumer needs and responses to healthy food choices.
Expected Impacts

Increased knowledge and understanding of the Irish diet, determinants and modifiers of food choice and other food-related behaviors across the lifecourse, to support improved population health and the development of the Irish food sector. State-of-the-art databases on diet and health to support effective development of nutrition policies and programmes for improved public health. Enhanced databases, and new tools and techniques to support new food product development and promotion by Irish industry. Data to support and underpin evidence based policy and regulatory development with strengthened capacity for food safety risk assessment by government agencies.

Key Investment Area: 2.8.2 Diet and Lifecourse/Chronic Disease

High Level Objectives

1. New dietary strategies targeted at preventing disease and enhancing human health and wellbeing across the lifecourse
2. Ireland recognised in Europe as a focal point for public health nutrition research.
3. Reduced health care costs associated with diet-related diseases.

Priority Research & Innovation Areas

1. Inflammation: Further the knowledge and tools to positively modify systemic inflammatory activity by diet, especially with regard to the intestinal system, metabolic disorders such as type 2 diabetes, cardiovascular diseases and the ageing process.
2. Allergy: Further the knowledge of links between diet and allergy by improvement of the allergome databases of plant- and animal-derived foods, additives or contaminants, and understanding their detection and persistence after processing. Determine a healthy diet in terms of type and timing of introduction of specific dietary constituents with regard to maternal and infant nutrition, in order to optimise immune function and decrease the risk for allergy.
3. Obesity: Determine the factors influencing metabolic profiles in relation to body weight control and/or the risk for development of obesity related co-morbidities such as type 2 diabetes or metabolic syndrome, with an aim to develop effective food ingredients and/or dietary strategies for prevention of obesity and related disorders.
4. Cognitive Function and Mood: Further understand the impact of nutrition on brain and cognitive development (in utero and in neonates, infants and young children) and prevention of cognitive decline in ageing. Map the impact of specific food.

5. Food intake regulation and hunger/satiety: Identify brain pathways that regulate hunger/satiety; identifying dietary components that can help control food intake.

6. Food and Consumer: Evaluate the effectiveness of nutrition/food related health promotion initiatives, including impact of nutritional interventions on nutritional status of under- and over-nourished groups, on behaviour change and health related knowledge. Examine relationships between health inequalities and consumer behaviour and/or knowledge, specifically relating to food and health.

**Expected Impacts**

Greater awareness and understanding of nutrition and diet as a key determinant of population health across the lifecourse. Tools for identifying, assessing and investigating the efficacy and influence of foods on diet in relation to chronic disease settings such as metabolic disorders, cardiovascular disease, cognitive function and the ageing process. The development of tailored nutritional strategies to help prevent and/or control/treat chronic disease. Opportunities for the food industry to develop nutritional solutions to prevent or treat disease. An improved evidence base to inform the design, implementation and evaluation of public health interventions to prevent diet-related disease. A healthier and more productive population with an associated reduction in health care costs.
2.9. CROSS-CUTTING ISSUES

Key Investment Area: 2.9.1 Data, ICT & Sensors

High Level Objectives

1. Integration of data sets arising from various sources (e.g. animal genetics, animal health & disease, remote sensing, environmental monitoring, meteorology, soil geochemistry and economic datasets) to inform policy, practice and drive innovation in the agri-food sector.
2. Establish data science ("big data") systems that help underpin/support the Irish agri-food sector and society.
3. Further improve and develop the metrics for evaluating the sustainability of food production systems, including greater facilitation of benchmarking of the sustainability credentials of Irish foods against international standards and market demands.
4. Exploit the convergence of food and agriculture science with ICT and sensor technologies in order to strengthen innovation in the agri-food sector.
Priority Research & Innovation Areas

1. Integration of soils, land use and environmental data to provide opportunity for gains in resource use efficiency and productivity.
2. Develop a holistic approach to data capture, modelling and sustainability assessment for Irish farming and aquaculture systems, including the provision, utilisation and exploitation of verifiable data on the environmental impact and sustainability of grass-based food production and aquaculture in Ireland.
3. Develop metrics and advanced systems to better quantify and manage the greenhouse gas footprint (and general sustainability – see Section 4.3) associated with Irish food production and land use, including the use of big data and linking different data sources.
4. Establishment of credible data streams (including pooling of existing datasets) to benchmark and underpin the development of improved genetics, health and welfare status in Irish food production systems.
5. Develop and integrate decision support resources to improve on-farm management and decision making (Linkage with existing Decision Support Systems software systems such as Pasture Base, Nutrient Management Planning Online, ICBF HerdPlus and the Carbon Navigator).
6. Create sufficient capacity in Agricultural Informatics to allow agriculture, marine and food scientists to take leading roles in linking closely to those in the sensor and ICT communities.
7. Development and application of novel sensor and ICT based technologies to support capture of phenotypic data at farm and industry level, including the use of this data in animal genetic improvement and management systems.
8. Develop and apply novel sensor and ICT based technologies to support precise, rapid and automated systems for measurement of crop/grass growth and nutrient content to assess progress and improve the targeting of inputs, precise area allocations in the case of grazing, and other management interventions.
9. Develop and test sensor-based systems of determination of nutrient requirements of crops to accommodate more site and season specific levels of nutrient inputs to crops, while targeting yield and quality objectives.
10. Develop novel/precision farming techniques for data collection and the application of targeted crop inputs.
11. Develop the application of remote sensing and existing data to predict productive and environmental performance under contrasting environmental, land and ocean use scenarios.
12. Benchmark labour efficiency on Irish cattle farms and investigate the role of sensor and ICT technologies to increase efficiency.
13. Optimise the use of equipment and automation, human resources and farm system to reduce the labour input per unit of output.
14. Development of versatile and affordable sensors to be applied for the quantitative, real-time, on-line or in-line control of critical microbiological quality and performance attributes for raw and in-process materials during food processing.
15. Development of autonomous forecasting systems for harmful and toxin producing phytoplankton.
16. Develop a holistic and comprehensive cross-sectoral benchmarking analytics and food sector intelligence platform, which can be used to analyse and benchmark Irish food processing and supply chain operations across a range of sectors and compare against major global processors in terms of key indicators (e.g. labour, consumables, yield, losses, waste and utilities, and supply chain). This could subsequently be used as a key intelligence driver to inform and identify approaches to optimising processing and manufacturing efficiencies with a focus on automation and standardisation, and development of best practices in management and implementation of efficiency initiatives.
17. The development and exploitation of food consumption databases as outlined in section 2.8.1.

**Expected Impacts**

The opportunity to better integrate new and existing data from various sources (research, production, service providers, Public Bodies, retailers and consumers and others involved in food supply chains) will lead to benefits in production, breeding, resource use efficiency, environmental and sustainability performance as well as informing policy and creating opportunities to drive innovation in the agri-food sector. The establishment of capability in Agricultural Informatics will create a global presence that will enable collaboration with emerging groups around the world, attract diverse funding and further position Ireland as an international leader in agriculture and food production.

Innovative ICT including sensors, global positioning and decision-support systems can play a considerable role in the development of sustainable and efficient farming systems. They permit the optimized application of inputs, thereby reducing the adverse impacts of agriculture on the environment. At the producer level, it can contribute to improving efficiency, reducing labour costs and enhancing flexibility on the farm, thus delivering effective farm management information. The development and deployment of novel technologies and tools to quantify and forecast food safety challenges will underpin the safety and quality attributes of Irish foods.
Key Investment Area: 2.9.2 Socio-Economic

High Level Objectives

1. Provide the evidence base to identify least cost solution for disease control and environmental issues. Assess the impacts of land use and land use change on ecosystem service, GHG emissions and carbon stocks, biodiversity, etc and identify the best strategies to optimise these.
2. Provide the evidence base to quantify the economic, social and environmental sustainability of Irish food production systems, and to assess the vulnerability of food production systems to climate change
3. Investigate the opportunity to develop and improve minor and alternative food production systems in Ireland
4. Investigate consumer attitudes in order to improve behaviour change and new technology adoption.

Priority Research & Innovation Areas

1. Cost/benefit co-analysis of various disease control options to optimise and combine where possible effective control measures and ensure best value for money for the industry and the state. Included in this is a need to better understand and predict the behaviour of stakeholders (breeders, professional breeding organisations or governments) in health management, to estimate the effectiveness of intervention measures.
2. Create inventories of ecosystem services provided by farmers in agricultural catchments, including those associated with protected and enhanced biodiversity, and place economic values on these services.
3. Identify novel measures which protect and enhance biodiversity in all (including intensive) food production and harvesting systems, and conduct cost-benefit analysis to identify the most cost effective measures.
4. Ecosystem Services and Sustainability. Developing new tools in the field of ecological engineering and early-warning systems. Gaining a better understanding of the socio-economic aspects, governance and behavioural changes associated with this area, including issues of preservation vs. restoration costs, the demonstration of the economic value and social benefits of ecosystem services.
5. Assess the interactions between land/ocean use, biodiversity and associated ecosystem services, including analysis and evaluation at multiple scales.
6. Assessment of management options for peatlands and wetlands, including for example, water table manipulation, enhancement of ecosystem services, having regard to the potential for food and/or energy production systems that are tailored for peatlands.
7. Environmental and climate analysis of food production and consumption patterns including systems/life cycle analyses and carbon footprinting, including development of CAPRI modelling for upscaling life cycle analyses to the regional/national scale.
8. Develop systems models and decision support tools to assess the impacts of agriculture and land-use change on GHG emissions, carbon stocks and enhance understanding of carbon sequestration, including the better exploitation and linking of existing big data using GIS and top down analysis including remote sensing.

9. Assess vulnerability of fisheries and aquaculture to climate change and investigate how species and populations adapt to changing marine environments.

10. Improved understanding in climate related changes in marine biodiversity and what measures could effectively improve ecological resilience to climate change.

11. Investigate the opportunity to develop and improve minor and alternative food production systems in Ireland: organic and paludiculture.

12. Develop a deeper understanding of consumer attitudes towards sustainability in order to gauge consumer sentiment with a view to educating the consumer in terms of 'sustainable' food choices thereby stimulating long term positive behavioural changes.

13. Develop a deeper understanding of consumer attitudes towards food and nutrition with a view to educating the consumer in terms of better nutritional food choices and to stimulate long term positive behavioural changes.

14. Investigate consumer attitudes to novel ingredients or processes in order to inform new product development and develop marketing strategies.

**Expected Impacts**

Research in this area will provide the evidence base to support the environmental credentials of Irish food production, and will help to identify least cost solutions for disease control and environmental issues. It will help to improve the economic, social and environmental sustainability of Irish food production systems, and will identify the vulnerability of food production systems to climate change. It will also support the improvement and development of minor and alternative food production systems in Ireland. A greater understanding of consumer attitudes to sustainability, food and technology can lead to more effective responses from industry and positive consumer behavioural change.
3. FRAMEWORK FOR IMPLEMENTATION

Sustainable Healthy Agri-Food Research Plan (SHARP)
3. FRAMEWORK FOR IMPLEMENTATION

Preceding SRIAs in the agri-food space, namely FRI and SSAPRI, have proved very useful in guiding the content of Calls for research proposals - especially those under DAFM’s FIRM and Stimulus programmes - to the point where the vast bulk of the priorities identified have been funded in one way or another over the last three years.

This new SRIA is more ambitious and complex in the sense that it has a wider scope and is intended to guide and inform the content of competitive funding Calls (and therefore the funding decisions) operated not only by DAFM but also by a range of other research funding organisations (see Appendix 5) over the next few years. It will also prove useful in guiding the mainstream grant-in-aid supported research and innovation activities undertaken by Teagasc on foot of its statutory remit and indeed by other parties in the agriculture and food industries and the health sector.

Guiding Decisions underpinning Implementation Plan

In order to be truly strategic, therefore, it needs an implementation roadmap providing some degree of clarity for the industry and the research performing community, public and private, about what to expect in terms of the nature and timing of funding interventions relating to the research and innovation priorities identified in the preceding parts of this document. Therefore, having regard to their own particular remit and interests, all funders hereby commit to actively engaging in an on-going open dialogue to ensure a fully coordinated approach to implementation such that the various pieces of the agenda are addressed in the most appropriate manner. In doing so account will need to be taken, inter alia, of the following factors:

► NRPE systemic recommendation number 6:

“There should be an ongoing review of all funding programmes to ensure continued relevance and clarity of purpose, that programmes have sufficient scale and that unnecessary duplication is avoided. The review should ensure that the costs of the programme are commensurate with the benefits achieved. New programmes should be avoided if the objectives can be achieved through the adaptation of existing programmes.”

In this regard, all parties involved in the preparation of this document agree that the vast bulk (80% +) of the R&I priorities listed can be addressed using existing instruments and mechanisms available in the collective arsenal of all relevant funders and the industry. The funding instruments operated by the main funders broadly comprise projects, programmes, fellowships, networks, centres, and partnerships and are outlined in Appendix 7. These vary
considerably in terms of their intended purpose and target audience in that some cater for R&I needs of a wide range of sectors and disciplines as well as agri-food whereas others are dedicated exclusively to the agri-food sector (e.g., those operated by DAFM, Teagasc and MI). However, in general, all these funding mechanisms are quite complementary in nature as they comprise a mix of relatively open undefined ‘bottom up’ programmes (e.g., HRB programmes & SFI Centres programme) and quite specified ‘top down’ type measures (e.g., DAFM’s FIRM & Stimulus). In the case of the former, the priorities identified in this document will be addressed through the inclusion of a general reference in the relevant Calls to the need for compliance with the SRIA, while for the latter, a range of the individual prioritised research topics listed in this document will be specifically included in FIRM and Stimulus Calls over the next few years in accordance with priority gaps and opportunities prevailing at the time.

- Does a topic require multi-annual investment over the long term (10 – 15 years)?
- Is the topic suited to core mission-centred funding or is it better addressed through open competitive Calls?
- Nature of the research required …… whether basic, applied, pre-commercial, commercial or a mix of some or all of these. This can have a bearing on the most appropriate funder(s) given that the funding programmes operated by each of the main funders cater for different parts of this continuum (see Appendix 10) such that some dovetail nicely and are complementary while some others overlap thus requiring dialogue in order to avoid unnecessary and wasteful duplication.
- Can it be addressed through a relatively small project or does it require a larger vehicle e.g. Centre / Programme?
- Is the topic amenable to being funded (a) via a JPI / ERANET in which Ireland is participating or (b) should it be funded and conducted at national level alone? In this regard it is clear that certain elements of the Key Investment Area’s identified in this SRIA align with numerous JPI and ERA-NET SRA’s and topics contained within Horizon 2020. In ensuring strategic alignment with such SRAs, national funders will in the first instance favour investments which enable Irish participation in European consortia and attempt to address them through these pan-EU funding instruments.
- Should the research be funded (i) entirely by the State, (ii) part-funded by industry (if so, how …….. partnering with particular companies or group of companies or via pan-industry levy) or (iii) entirely undertaken by industry?
- Is the topic suited to one particular funder or does it cut across the remit of a number of funders and, if so, should it be funded in a joint or at least aligned manner? If yes, how? One area that could be the focus of joint funding, at least initially, (and which would help all funders meet RPAG targets for such funding) is infrastructure as this often serves the needs of all funding bodies seeking to be active in this space.
Is a major piece of new infrastructure required? If yes, what’s the most appropriate way of funding it e.g. can non-Exchequer funding be leveraged? Also, once in place a formal access protocol will need to be agreed.

Striking a balance between, on the one hand, providing sufficient national investment to ensure research capacity and capability is built and/or maintained and, on the other, ensuring that the level of that national funding is not acting as a disincentive to the pursuit of external funding particularly via Horizon 2020 thereby undermining the achievement of the national drawdown targets both overall and as applied to individual RPOs. In doing this, account will need to taken of the likely broad focus and content of upcoming H2020 Calls and the efficacy of mechanisms in national funder Calls to provide some assurance that publicly funded researchers are actively pursuing external funding opportunities.

Need for flexible and nimble implementation modalities that are sufficiently responsive to ever changing needs. The SRIA will, therefore, provide an enabling environment, within which the appropriate processes are employed to implement different activities in a timely and effective manner.

In order to address these issues the funders that are party to this SRIA hereby commit to meeting together at least twice annually to:

(a) agree programme of interventions for the year ahead. In undertaking to work in this manner the relevant funders agree to make use of a decision tree approach an example of which is outlined in Appendix 8. This is not intended as a rigidly defined blueprint but rather will be used as a means of providing clarity among funders on “who will do what and how and when” so as to make best use of the various existing inter-locking instruments at the disposal of all relevant public funding bodies and private stakeholders.

(b) keep track of SRIA implementation using a template along the lines of that at Appendix 9 to map the foregoing prioritised research topics against funding awards over time.

Additional issues to be considered at these meetings include:

- In thematic areas of agreed mutual interest, cross-funder partnerships will be explored with a view to achieving efficiency and ease of delivery.
- In thematic areas with pre-commercial potential, scope for industry engagement will be explored.
- In Key Investment Area’s where it is found that no suitable funding instrument exists, funders will explore the possibility of developing an appropriate mechanism.
SRIA Alignment to EU/International Strategic Research Agenda's

As mentioned earlier some elements of this SRIA Investment Areas will be funded in collaboration with other countries in the EU and beyond as a consequence of the close alignment between this SRIA and strategic agenda of JPIs, Eranets, etc. Information about such arrangements will be made available periodically by funders through their respective websites.
APPENDICES

Sustainable Healthy Agri-Food Research Plan (SHARP)
### Appendix 1: Glossary of Terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>DAFM</td>
<td>Dept. of Agriculture, Food and the Marine</td>
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<td>EIP</td>
<td>European Innovation Partnership</td>
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<tr>
<td>ERA-NET</td>
<td>European Research Area Networks</td>
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<tr>
<td>FACCE</td>
<td>Agriculture, Food Security and Climate Change</td>
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<td>FDI1</td>
<td>Food and Drink Industry Ireland</td>
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<td>FH2020</td>
<td>Food Harvest 2020</td>
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<td>FP7</td>
<td>EU Seventh Framework Programme for Research &amp; Development</td>
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<td>FRI</td>
<td>Food Research Ireland</td>
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<td>HOOW</td>
<td>Harnessing Our Ocean Wealth</td>
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<td>HDHL</td>
<td>A Healthy Diet for a Healthy Life</td>
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<tr>
<td>H2020</td>
<td>Horizon 2020 (EU 8th Framework Programme for Research &amp; Innovation)</td>
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<tr>
<td>ICT</td>
<td>Information and Communication Technologies</td>
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<td>JPI</td>
<td>Joint Programming Initiative</td>
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<td>NAFRI Group</td>
<td>National Agri-Food Research and Innovation Group</td>
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<td>NRPE</td>
<td>National Research Prioritisation Exercise</td>
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<td>RPAG</td>
<td>Research Prioritisation Action Group</td>
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<tr>
<td>PRTLI</td>
<td>Programme for Research in Third-Level Institutions</td>
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<td>RPAG Food WG</td>
<td>Research Prioritisation Action Group Food Working Group</td>
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<td>RPO</td>
<td>Research Performing Organisation</td>
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<td>SFSI</td>
<td>Sustainable Food Systems Ireland</td>
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<tr>
<td>SRA</td>
<td>Strategic Research Agenda</td>
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<tr>
<td>SRIA</td>
<td>Strategic Research and Innovation Agenda</td>
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<tr>
<td>SSAPRI</td>
<td>Stimulating Sustainable Agricultural Production through Research &amp; Innovation</td>
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Appendix 2: Skills needs and deficits relevant to the achievement of R&I activities identified in this SRIA

The first HEA annual report on System Performance was published in June 2014. At the same time, the set of 2014-16 institutional performance compacts agreed between the HEA and higher education institutions through the Strategic Dialogue process were published. These articulate higher education plans and progress for a number of objectives, at both system and institutional level, including the identified priority to “meet Ireland’s human capital needs across the spectrum of skills”. Performance against these compacts will be monitored by the HEA and this complements the extensive ongoing work undertaken at institutional level on curriculum review and refreshment in consultation with regional and enterprise partners. In addition, the institutions are, in dialogue with the HEA, developing plans for regional clusters, one objective of this process being improved shared academic planning.

Finally, during the course of this exercise a number of critical senior and/or permanent research posts in RPOs needed to implement this agenda were identified and these will be made available to the HEA and relevant agencies/Departments’ for further work in this area.
Appendix 3: Infrastructure needed to undertake priority R&I activities identified in this SRIA

The HEA has compiled a database of significant research equipment and infrastructure in the HEIs plus an accompanying set of guidelines for access to the equipment. This complements the European MERIL database (www.portal.meril.eu) and was launched by the Minister for Research and Innovation in June 2014. It is available through both the HEA (www.hea.ie/lire) and KTI web sites. In the future, the database will be developed with a view to expanding the range of research infrastructure available through it.

The recent EPA/Teagasc co-funded National Soils Database and the Soil Information System (launched in September 2014) constitute a major e-Infrastructure in relation to Soils and Land use.

In addition, during the course of this exercise a number of additional infrastructural ideas were identified and these can be made available for further RPAG work across the full NRPE spectrum.
Appendix 4: Methodology

Following adoption by government of the National Research Prioritisation Exercise (NRPE) Report in 2012, Actions Plans for Sustainable Food Production and Processing and Food for Health were subsequently developed and published in July 2013. The plans set out in considerable detail the steps necessary in order that Ireland can realise the opportunity associated with the Priority Areas. For both action plans, the Department of Agriculture, Food and the Marine is charged with primary responsibility for their implementation. Furthermore, a DAFM official was appointed as Champion for both Priority Areas, having previously chaired the Working Groups that developed the corresponding Action Plans.

Objective 1 of both Action Plans outlines the development of a Strategic Research Agenda in line with Food Harvest 2020 which draws on existing relevant research plans which have been informed by the needs of all relevant stakeholders to facilitate growth within the Irish food sector on the one hand, and at the same time contributes to the mutual goal of improved population health through improved diet, nutrition and lifestyle strategies, and facilitates active participation in EU and International research activities.

Research Prioritisation Action Group – Food Working Group (RPAG - Food WG)

A DAFM led Working Group (WG) of the Research Prioritisation Action Group (RPAG) comprising representatives of all relevant funders formed to undertake this work.

Department of Agriculture, Food and the Marine
Irish Research Council
Marine Institute
Environmental Protection Agency
Higher Education Authority

Science Foundation Ireland
Teagasc
Health Research Board
Enterprise Ireland

29 Link to Action Plans: Sustainable Food Production and Processing
The Strategic Research Agenda (SRA) should also include Innovation (SRIA); that it should be a relatively short high level document capable of being regularly reviewed and updated comprising 4 chapters: Introduction/Context; SRIA content; Implementation modalities; and Methodology. It will also need to be cross-referenced to relevant Joint Programming Initiative (JPI)39 actions.

Draw on existing “intelligence” residing in each WG member organisation resulting from previous surveys and routine day to day contact with their respective client bases including, in particular, those involving industry stakeholders along the food production & processing chain.

Make use of input received from SIA Group31 moderated engagement session involving a broader range of agencies from the State sector held on 2nd October 2013.

DAFM to conduct an online stakeholder consultation with industry via its web page. Submissions from all interested parties but especially research end users e.g. farming representatives, agri-business, food industry, health sector professionals, etc. were welcomed in the consultation. The survey was live on DAFM’s web page during the period 18th February to 2nd April 2014. To ensure widespread reach to the industry, WG members posted a link to it via their websites, and each WG member plus Bord Bia and Food and Drink Industry Ireland (FDII) of IBEC alerted/encouraged their clients via email to avail of the opportunity to make a submission. A total of 46 individual submissions, many from major players in the food industry, were received. All material received was subsequently taken into account through the RPAG process for possible selection and inclusion in the final SRIA document.

The funder intelligence, SIA Group findings and the online survey material was collated into a manageable format and a first draft of the entire document prepared. This was then subsequently considered by the DAFM hosted, industry led, National Agri-Food Research and Innovation (NAFRI) Group (Refer to Annex 1) during the summer 2014 with a view to refining and prioritising the content and finalising all 4 chapters of the SRIA before submitting to the RPAG.

31 http://thesiagroup.com/
Three Sub Groups led by NAFRI representatives undertook completion of Chapter 2 (SRIA Content) covering:

- Sustainable Food Production (led by Andrew Cromie and Frank O’Mara)
- Food Processing (led by Dave McDonagh)
- Food for Health (led by Dolores O’Riordan)

A working methodology was agreed which included the possibility to work electronically, teleconference and / or hold actual meetings and to involve additional experts as deemed necessary.

In order to ensure consistency of approach across the 3 sub-groups, DAFM Research Division officials shadowed progress across the 3 sub-groups.

During the course of the exercise a number of cross sectoral issues needing research also emerged in addition to research relating to economics, policy analysis, modelling and it was agreed that this would be captured under the investment area Cross Cutting and Socio-Economic Issues.

The NAFRI Group was informed of, and reviewed progress on, the development of the research agenda at each of its meetings throughout the process.

Finally, towards the end the RPAG Food WG reviewed the format and research content of the NAFRI-developed SRIA and also elaborated the Implementation Plan part of the document prior to signing off on it for presentation to the RPAG plenary.
## Annex 1 NAFRI Group Membership

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
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<tbody>
<tr>
<td>Dr. Dave McDonagh (Chair)</td>
<td>Glanbia Ingredients Ireland</td>
</tr>
<tr>
<td>Dr. Donal Sammin</td>
<td>DAFM</td>
</tr>
<tr>
<td>Dr. Andrew Cromie</td>
<td>ICBF</td>
</tr>
<tr>
<td>Dr. Kevin Conlon</td>
<td>SFI</td>
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<tr>
<td>Dr. Keith O’Neill</td>
<td>EI</td>
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<tr>
<td>Dr. Dermot Hurst</td>
<td>MI</td>
</tr>
<tr>
<td>Dr. Teresa Maguire</td>
<td>HRB</td>
</tr>
<tr>
<td>Dr. Frank O’Mara</td>
<td>Teagasc</td>
</tr>
<tr>
<td>Mr. Donal Buckley</td>
<td>BIM</td>
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<tr>
<td>Ms. Tara McCarthy</td>
<td>Bord Bia</td>
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<tr>
<td>Ms. Marian Byrne</td>
<td>DAFM</td>
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<tr>
<td>Mr. Dara Lynott</td>
<td>EPA</td>
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<tr>
<td>Mr. Richard Howlett</td>
<td>DAFM</td>
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<tr>
<td>Mr. Declan Troy</td>
<td>Teagasc</td>
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<tr>
<td>Mr. Matt Dempsey</td>
<td>Farmer</td>
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<tr>
<td>Mr. Brendan Barns</td>
<td>APHA</td>
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<tr>
<td>Mr. James Fitzgerald</td>
<td>ACA</td>
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<tr>
<td>Mr. Pat Smith</td>
<td>IFA</td>
</tr>
<tr>
<td>Mr. Ray Doyle</td>
<td>ICOS</td>
</tr>
<tr>
<td>Mr. Paul Kelly</td>
<td>IBEC - FDII</td>
</tr>
<tr>
<td>Mr. Conor Cahill</td>
<td>Dawn Farm Foods</td>
</tr>
<tr>
<td>Mr. Paddy Callaghan</td>
<td>Nature’s Best</td>
</tr>
<tr>
<td>Prof. Alan Kelly</td>
<td>UCC</td>
</tr>
<tr>
<td>Prof. Micheal Devereux</td>
<td>DIT</td>
</tr>
<tr>
<td>Prof. Dolores O’Riordan</td>
<td>UCD</td>
</tr>
<tr>
<td>Prof. Alan Reilly</td>
<td>FSAI</td>
</tr>
</tbody>
</table>
Appendix 5: Research for Evidence-based High Level Policy Formation

1. Identification and evaluation of agricultural measures (including GLAS and GLAS+ schemes) at both farm and catchment scale which will contribute towards meeting water quality targets (e.g. WFD and MSFD), with concurrent evaluation of the positive and negative impacts of these measures on production and cost-benefit analysis to identify the most cost effective measures.
2. Further develop criteria to identify High Nature Value farmland and develop measure to address risks.
3. Assess how engagement with landowners (public and private), Authorities (local and National) communities (business and residential) can be harnessed to implement initiatives that effectively protect and enhance ecosystems, and assess how environmental issues faced by rural areas can be addressed over large areas beyond the scope of individuals farms.
4. Further improve and develop metrics of farm and sector level environmental, economic and social sustainability to facilitate benchmarking of Irish food produce.
5. Development of stakeholder decision-support tools and land use strategies for delivery of multiple production and environmental functions and services under current and future climate scenarios.
6. Develop and make available to farmers milk pricing mechanisms to mitigate the negative effect on farm incomes of milk price and input cost volatility.
7. Further development of general equilibrium models in agriculture
8. Understand the factors that influence demographic change and farm transitions
9. Understand forces that generate the current gender imbalance in agriculture and processes that can improve this.
10. Economic and environmental assessments of the benefits of the implementation of CAP measures.
11. Collect enterprise level data for the food horticulture sector and conduct an evaluation of the economic performance of the food horticulture sector.
12. Conduct an impact assessment of the investment in agri-food research.
13. Provide an up-to-date review of the literature concerning farmer behaviour vis a vis adoption of new/different land uses and how this behaviour is conditioned by personal, household, extended family, immediate community and social and professional networks, e.g. discussion groups or membership of farm organisations.
14. Using the National Farm Survey or administrative data, evaluate the subset of those farm enterprises that have transitioned from one specialist system to another to identify the factors associated with these behaviours.
15. Assess the potential economic benefit attributable to the use of Electronic Identification Tagging of cattle in Ireland.
16. Generate and assess research evidence appropriate to the delivery of the policy objectives of the Healthy Ireland Framework through the Research, Data and Innovation Plan and the Outcomes Framework, where these relate to diet-related health and disease.
17. Ensure generation of appropriate research evidence to evaluate the broader implications of current and forthcoming legislation and regulations as they relate to food and health.
### Appendix 6: Overview of National Funding Bodies Research Funding Programmes relevant to the implementation of the SRIA

<table>
<thead>
<tr>
<th>National Funding Bodies</th>
<th>Programmes</th>
</tr>
</thead>
</table>
| *Teagasc* | • Food Institutional Research Measure (FIRM)  
• Research Stimulus Fund (Stimulus)  
• Research Plus |
| • CIA-supported mainstream research programme  
• Walsh Fellowship Programme  
• Public-Private Partnerships |
| • Shiptime Programme  
• MU/Fulbright Irish Scholar Award |
| *Marine Institute* | • Cullen Fellowships |
| • Industry Fellowship  
• Advance Fellowship  
• SFI/E/IDA Award |
| • Research & Development Fund  
• Commercialisation Fund/Feasibility Award  
• Food works (EI/Teagasc/Bord Bia)  
• Business Partners |
| *Enterprise Ireland* | • Investigators Programme  
• Research Centres Programmes  
• Partnerships |
| • EI/IDA Technology Centres  
• New Frontiers  
• Innovation Vouchers/Partnership  
• Technology Gateway |
| *EPA* | • Research Programme (Climate, Water & Sustainability)  
• EPA/Fulbright Irish Scholar Award |
| *Rusheen Research Council* | • IRC Government of Ireland Postgraduate Scholarship Scheme  
• Employment Based Postgraduate Programme |
| *HEA* | • Enterprise Partnership Programme |
| • Health Research Awards  
• Interdisciplinary Capacity Enhancement (ICE) Awards  
• Research Centre for Diet and Health |
| • PRTLI  
• Block Grant |
## Appendix 7: NRPE National Metrics and Targets

### Table 1: National Targets

<table>
<thead>
<tr>
<th>Metric</th>
<th>Baseline</th>
<th>Target for 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Targets linked to Policy Instruments</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NT4 Total researchers in Enterprise sector</td>
<td>10,618 (2011)</td>
<td>11,718 (+1,100)</td>
</tr>
<tr>
<td>NT5 Productivity (value-added/employee) in Irish owned, research-active, manufacturing firms</td>
<td>€66k (2011)</td>
<td>€75k</td>
</tr>
<tr>
<td>NT6 Numbers firms with (1) small-scale ($100k-2m), (2) large-scale ($2m) R&amp;D</td>
<td>916 (2011)</td>
<td>1,016 (+100)</td>
</tr>
<tr>
<td>NT7 Proportion of FDI R&amp;D Investments involving MNC - MNC or MNC-SME collaborations</td>
<td>New metric</td>
<td>10%</td>
</tr>
<tr>
<td>NT8 Proportion of turnover attributed to new-to-firm or new-to-market product innovations</td>
<td>9.3% (1010)</td>
<td>10.3%</td>
</tr>
<tr>
<td>NT9 Number of enterprises engaged to collaborative research with HEIs/PROs</td>
<td>351 (2011)</td>
<td>386 (+35)</td>
</tr>
<tr>
<td>NT10 Share publicly-performed R&amp;D financed by Enterprise</td>
<td>€31.3m (2010)</td>
<td>€180m over 2013-7</td>
</tr>
<tr>
<td>NT10 Number HEI/PRO spinouts &gt; 3 years old + numbers mergers &amp; acquisitions of spinouts</td>
<td>44 (2013) by 2017</td>
<td>69 (+25)</td>
</tr>
<tr>
<td>NT11 Number of HEI/PRO licensing agreements</td>
<td>87 (2012)</td>
<td>105 (+18)</td>
</tr>
<tr>
<td>NT12 National drawdown from Horizon 2020</td>
<td>€1.96bn (2012e)</td>
<td>€2.2bn (+€240m)</td>
</tr>
<tr>
<td><strong>Targets from International Comparisons</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NT1 Gross domestic Expenditure on R&amp;D (GERD)</td>
<td>2.14% GNP (2011)</td>
<td>2.5% GNP by 2020 +</td>
</tr>
<tr>
<td>NT2 GERD provate : public ratio (% performed by business enterprise)</td>
<td>69.0%</td>
<td>66.6%</td>
</tr>
<tr>
<td>NT3 Business Expenditure on R&amp;D</td>
<td>€1.96bn (2012e)</td>
<td>€2.2bn (+€240m)</td>
</tr>
<tr>
<td>NT13 National citation ranking</td>
<td>20th</td>
<td>20th</td>
</tr>
<tr>
<td>NT14 Innovation Union Scoreboard ranking</td>
<td>10th (2012)</td>
<td>8th</td>
</tr>
</tbody>
</table>

### Notes

1. These National targets are underpinned by a set of 79 lower-level monitoring indicators; see Appendices D & F
2. This is a new metric intended to engender a new level of intra- and inter-agency cooperation
## Appendix 8: National Funder Funding Instruments

<table>
<thead>
<tr>
<th>Funder</th>
<th>Project</th>
<th>Programme</th>
<th>Fellowship</th>
<th>Network</th>
<th>Centre</th>
<th>Partnership</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAFM</td>
<td>FIRM Stimulus Research Plus</td>
<td>FIRM</td>
<td>FIRM Stimulus</td>
<td>FIRM Stimulus</td>
<td></td>
<td>Teagasc/Fulbright Irish Scholar Award</td>
</tr>
<tr>
<td>Teagasc</td>
<td>GIA- Research Programme</td>
<td>Walsh Fellowship</td>
<td></td>
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</tr>
<tr>
<td>MI</td>
<td>MI Shiptime Programme</td>
<td>MI Cullen Fellowships</td>
<td>MI Networking &amp; Travel Grants</td>
<td></td>
<td></td>
<td>MI/Fulbright Irish Scholar Award</td>
</tr>
<tr>
<td>EPA</td>
<td>EPA (Climate, Water &amp; Sustainability) Research Programme</td>
<td>EPA (Climate, Water &amp; Sustainability) Research Programme</td>
<td></td>
<td></td>
<td></td>
<td>EPA/Fulbright Irish Scholar Award</td>
</tr>
<tr>
<td>IRC</td>
<td></td>
<td>IRC Government of Ireland Postgraduate Scholarship Scheme</td>
<td>IRC Government of Ireland Postdoctoral Scholarship Scheme</td>
<td>Employment Based Postgraduate Programme</td>
<td></td>
<td>Enterprise Partnership Programme</td>
</tr>
<tr>
<td>Funder</td>
<td>Project</td>
<td>Programme</td>
<td>Fellowship</td>
<td>Network</td>
<td>Centre</td>
<td>Partnership</td>
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</tr>
<tr>
<td>HEA</td>
<td>PRTLI Block Grant</td>
<td>Health Research Awards</td>
<td>Interdisciplinary Capacity Enhancement (ICE) Awards</td>
<td>HRB Research Leaders in PHHSR</td>
<td>HRB Research Centre for Diet and Health</td>
<td></td>
</tr>
<tr>
<td>HRB</td>
<td>Commercialisation Fund Commercialisation Fund Feasibility Award</td>
<td>New Frontiers Foodworks</td>
<td></td>
<td></td>
<td>Research &amp; Development Fund Technology Gateway Innovation Vouchers Innovation Partnership Business Partners</td>
<td></td>
</tr>
<tr>
<td>EI</td>
<td>SFI/EI TIDA SFI Industry Fellowship SFI Advance Fellowship</td>
<td>SFI Investigators Programme</td>
<td>SFI Industry Fellowship SFI Advance Fellowship</td>
<td>SFI Conferences &amp; Workshops</td>
<td>SFI Research Centres Programme</td>
<td>SFI Partnerships SFI Industry Fellowship</td>
</tr>
</tbody>
</table>
Definitions:

Project: Classic basic/applied/pre-commercial research undertaken, usually collaboratively, by RPO(s) over 3-4 years period and involving mix of students (Masters & PhDs) & post doctorate contract researchers led by institute-based PI. Typically funded via DAFM’s FIRM & Stimulus programmes, SFI’s Investigators programme, HRB, EPA, Teagasc and MI programmes.

Programme: Large project with recurring funding over longer term.

Fellowship: Person-centred student/Post doctoral placements. Typically funded via Teagasc’s Walsh Fellowship Programmes, SFI & IRC programmes.

Network: ‘Project’ that is (a) designed to link all disparate national expertise relative to the particular issue and (b) provides some funding for networking activities in addition to actual research.

Centre: Large, multi-partner, RPO-based, usually industry-led, research consortium operating in the pre-commercial/commercial space. Mainly funded under EI & SFI programmes together with industry and typically costing in excess of €20m over 5 year period.

Partnership: Usually a relatively small and short research project carried out by a RPO on behalf of a particular company or groups of companies. Typically funded by EI (Vouchers initiative, Innovation Partnership programme, etc.) & SFI’s TIDA initiative.

In-Company: R&I performed within a company where all public support goes to the business. Typically funded under some of EI & IRC schemes.
Appendix 9: Funding Decision Tree
## Appendix 10: SRIA Implementation Monitoring Table

<table>
<thead>
<tr>
<th>Research Thematic Area</th>
<th>Key Investment Area</th>
<th>Funder(s)</th>
<th>Actions</th>
<th>Joint Funder Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Animal Production</td>
<td>2.1.1 Animal Well-Being, Breeding &amp; Reproduction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>2.1.2 Animal Nutrition &amp; Product Quality</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2.2 Grass, Clover, Forage, Crops &amp; Food</td>
<td>2.2.1 Plant Production</td>
<td></td>
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</tr>
<tr>
<td>Horticulture</td>
<td>2.2.2 Plant Health &amp; Breeding</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2.3 Sustainable Management of Natural Resources</td>
<td>2.3.1 Management of Natural Resources, Biodiversity and Ecosystem Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.3.2 Soils, Land Use, Climate Change &amp; Trans-boundary Gases</td>
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<tr>
<td>2.4 Food Processing Technology &amp; Engineering</td>
<td>2.4.1</td>
<td></td>
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<tr>
<td>Development</td>
<td></td>
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<tr>
<td>2.5 Food Product Development, Formulation</td>
<td>2.5.1</td>
<td></td>
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<tr>
<td>&amp; Sensory Science</td>
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<tr>
<td>2.6 Food Chain Integrity &amp; Safety</td>
<td>2.6.1</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>2.7 Functional Foods &amp; Health</td>
<td>2.7.1 Functional Foods/Bioactives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.7.2 Gum Health</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.8 Nutrition, Health &amp; Diet related Diseases</td>
<td>2.8.1 National Food Consumption and other Food and Health related Databases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.8.2 Diet and Lifecourse/Chronic Disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.9 Cross Cutting Issues</td>
<td>2.9.1 Data, ICT &amp; Sensors</td>
<td></td>
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<tr>
<td></td>
<td>2.9.2 Socio-economic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrastructure &amp; Skills</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Appendix 11: National Research & Innovation Funders’ Areas of Activity on the Research Continuum

The diagram below gives a broad overview of National Funder responsibilities across the different components of Sustainable Agri-Food Production and Processing and Food for Health priority areas.