



Understanding Northern Ireland's Food Supply Chain/Safety and Agri-Tech capability, and future windows of opportunity

August 2023

About this report

Commissioned by



Researched and produced by



Disclaimer:

This report can only be relied upon by the Department for the Economy (“DfE”) on the terms and conditions agreed and recorded in the services contract dated 22 December 2022 that governs this report, and shall not be copied or referred to in whole or in part, to any other party without receipt of appropriate permission.

The report cannot be relied upon by any other person or entity unless it has been explicitly agreed by KPMG in writing that they may rely on it.

To the fullest extent permitted by law, KPMG accepts no liability for any loss or damage suffered or costs incurred by any entity or person, other than DfE under the terms of the services contract, arising out of, or in connection with, our report and any information provided within, however the loss or damaged is caused.

Executive Summary

The Department for the Economy's (DfE) 10X Economic vision outlines a transformative plan for the economy of Northern Ireland (NI). The publication sets out a long-term ambition for a more innovative, inclusive, and sustainable economy. The goal is for NI to be one of the top performing small advanced economies in the world.

The 10X Economic vision identifies several priority sectors where NI has the potential to be world class, the Agri-Tech sector is one of these priority sectors. NI has well-established primary agriculture and food and drink sectors, which play an important role in the economy. These sectors enable the production of high-quality food and drink products, much of which is exported to Great Britain, Ireland and beyond.

Food Supply Chain/Safety (FSCS) and Agri-Tech solutions offer an opportunity to support the growth, efficiency and environmental sustainability of the primary agriculture, food and drink sectors. In addition, growing NI's FSCS and Agri-Tech capabilities as a sector presents an opportunity to drive the region's economy forward.

Within this context, DfE commissioned KPMG to prepare this research report. The report aims to facilitate a broader understanding of Northern Ireland's FSCS and Agri-Tech capability, and future windows of opportunity. The objectives of this report are to:

- Identify the specific FSCS technologies, within NI's Agri-tech sector, where NI has current or future world class competitive advantage
- Identify NI's research strengths in terms of FSCS technologies and the level of alignment with areas where NI has world leading capability. Identify the levels of knowledge transfer/commercialisation and alignment of these strengths with the needs of NI's Agri-Tech sector
- Analyse and map NI's industrial and research strengths in FSCS technologies against national and international windows of opportunity, including horizon scanning and opportunities from NI's City and Growth Deals
- Evaluate and score the FSCS technology strengths against these opportunities to identify a prioritised set of "winning" innovative and cutting edge FSCS technologies
- Develop an economic profile of the NI Agri-Tech sector in terms of size (e.g., GVA, employment, average salary), scope (e.g., occupations, specialisms, and applications across the economy), and composition (e.g., business size, overseas owned vs. indigenous, regional spread)
- Analyse the enablers/policy levers required to capitalise on these opportunities, grow trade and exports and support adoption / diffusion of these innovative FSCS technologies across the NI Agri-Tech sector
- Identify the top five challenges to be addressed to enable NI's FSCS technologies and Agri-Tech sector to be world leading over the next 10 years
- Provide a list of key recommendations for government and businesses, framed over the short to medium and longer term, to maximise the windows of opportunity identified and propose metrics to measure success.

This report is structured into seven sections:

- Section 1 provides background to the project and defines Agri-Tech
- Section 2 provides an appraisal of the FSCS and Agri-Tech landscape, considering the sector definition, sector technologies, research strengths, application of technologies in NI and the funding landscape
- Section 3 provides an economic profile for the sector, based on the sector definition outlined in section 2. This includes a market sizing, outline of our methodology and assumptions, as well as findings and implications
- Section 4 provides international benchmarking, considering Australia, Ireland, Israel, the Netherlands, and New Zealand. This section highlights global trends and key lessons for NI
- Section 5 provides a SWOT analysis for the sector, including the underlying approach. Key challenges and opportunities are highlighted
- Section 6 outlines our methodology and assumptions for ranking Agri-Tech and FSCS technologies, the ranking results, and the associated implications for NI
- Section 7 presents the conclusions, recommendations, and proposes metrics for measuring the success of implementing the recommendations.

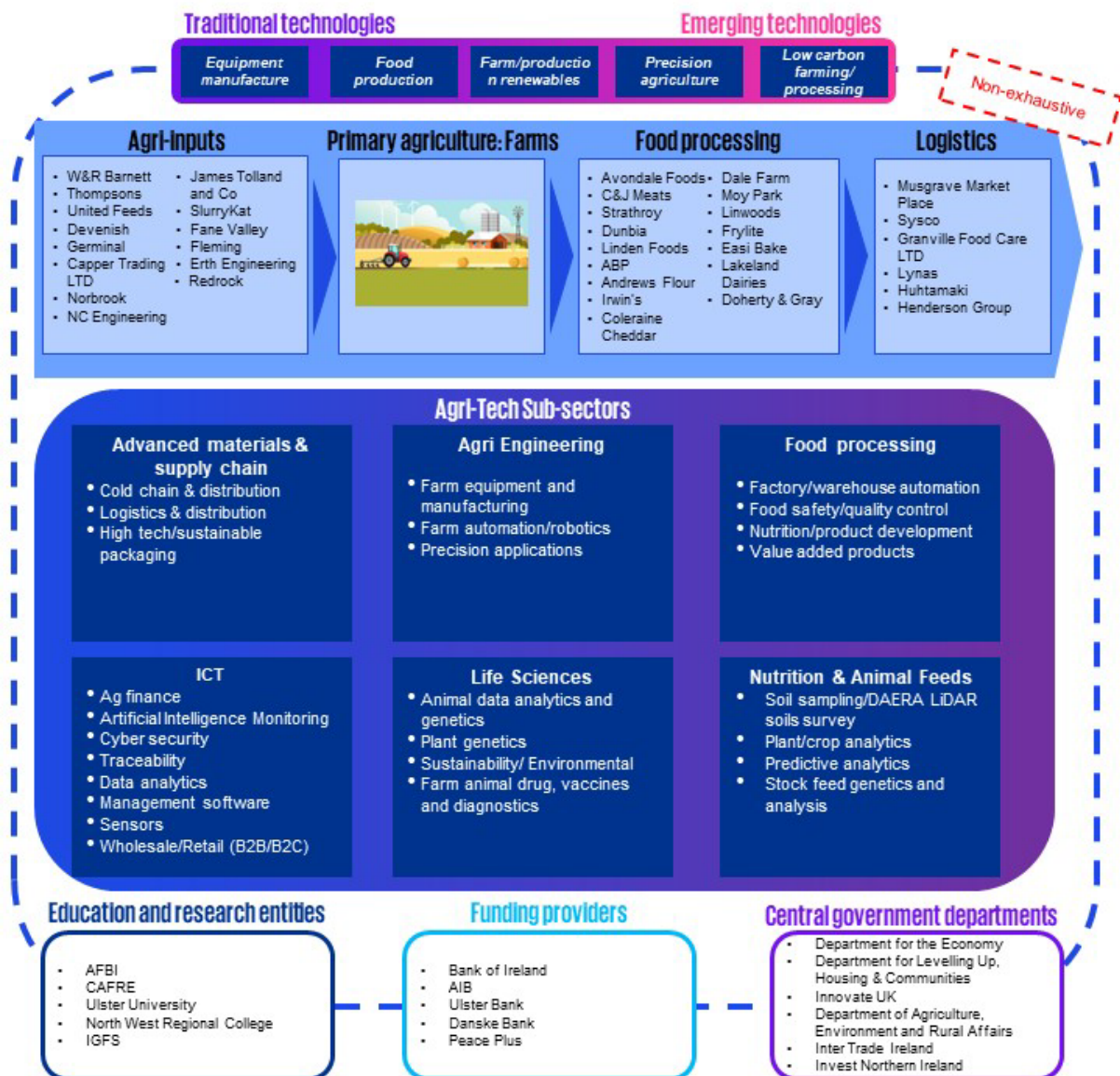
NI has had highly innovative and successful businesses producing goods and services for the Agri-Food supply chain for decades and, as the need for innovation across the supply chain has increased, the number of companies has increased to a small but growing sector in the NI economy with clear opportunities for innovative growth in the future. However, there is no single or standardised definition of Agri-Tech. Note that different countries use a number of variations for how each defines the sector.

Agri-Tech definition

For the purposes of this report, the “Agri-Tech sector” is defined as consisting of the businesses providing Agri-Tech related solutions (products and services) to a range of end users across six Agri-Tech sub-sectors. The Agri-Tech sub-sectors include advanced materials and supply chain, agri-engineering, food processing, information and communications technology (ICT), life sciences, and nutrition and animal feeds. Agri-Tech is considered with a wide lens to include technologies that range from traditional/current solutions to emerging/novel solutions. NI’s Agri-Tech sector is a component in a wider ecosystem (illustrated in Figure ES.1), that includes Agri-Tech businesses, end users of Agri-Tech solutions and organisations that support the sector.

A non-exhaustive illustrative summary of NI’s Agri-Tech ecosystem is provided below.

Figure ES - 1: NI's Agri-Tech ecosystem



Key aspects and categories of the ecosystem include:

- Technologies in the sector range from traditional/current solutions to emerging/novel solutions
- End users of Agri-Tech solutions are spread across the value chain, ranging from producers of agricultural inputs, primary agriculture (farms), food processors and logistics
- Agri-Tech solutions are categorised into specific sub-sectors, based on the type of solution in question. The sub-sectors were identified by considering the existing sector classifications used by Invest NI and through input from stakeholder consultations
- These sub-sectors include nutrition and animal feeds, information and communications technology (ICT), life sciences, agri-engineering, food processing, and advanced materials and supply chain. Sector technologies are described in more detail in section 2.4
- Organisations that support the sector fall into three categories: education and research entities, funding providers, and central government departments

The FSCS and Agri-Tech landscape

The Agri-Tech sector consists of the businesses providing Agri-Tech related solutions (products and services) to various end users including FSCS technologies, for example, technologies serving the farming, food and drink, processing, logistics, cold chain, retail, and safety components of the broader value chain. For the purposes of this study, the Agri-Tech sector is split into six sub-sectors:

- Advanced materials & supply chain technologies
- Agri-engineering
- Food processing technologies
- ICT
- Life Sciences
- Nutrition & animal feeds.

Specific technologies are considered as part of each sub-sector, and these have been ranked by the degree to which NI has current and/or future world class competitive advantage.

Ranking technologies

A Multi-Criteria Analysis (MCA) was used to rank technologies where NI has a competitive advantage. The starting point for the MCA was to shortlist technologies and to identify the most impactful NI technologies to be considered for analysis. This was achieved through an industry survey and stakeholder consultations. The technologies, from highest to lowest rank, are:

Table ES - 1: MCA Results

Technology ranking	Technologies
1	Food safety / quality control
	Food nutrition / product development ¹
3	Animal data analytics & genetics
	Sustainability / Environment
5	Logistics & distribution
6	Data analytics
	Traceability
8	Crop / feedstock genetics and analytics
9	Farm equipment & manufacturing thereof
10	Cold chain management
11	Factory / warehouse automation

¹ Note: this refers to human food rather than animal

Research strengths and windows of opportunity

Northern Ireland's Agri-Tech research strengths primarily flow from the work of a number of key education and research entities, including Queen's University Belfast, Ulster University, the Agri-Food & Biosciences Institute (AFBI), and the College of Agriculture, Food and Rural Enterprise (CAFRE). Each of these entities plays a valuable role in supporting the development of NI's Agri-Tech sector.

Considering the number of academic staff, position in world and UK university rankings, research citations, industry income and research, as well as the types of research conducted by research institutes, NI has research strengths in the following areas:

- Sustainability & environmental
- Genetics
- Traceability
- Food packaging
- Farm data
- Robotics
- Food integrity & security
- Nutrition
- New product development (primarily food products)
- Value added products (primarily food products)

Local and international windows of opportunity are considered for the shortlisted/top technologies and mapped against NI's research strengths. The local (NI) windows of opportunity include technology solutions that can increase yield, efficiency, profitability, sustainability, reliability, and quality or adding any other kind of value.

Global windows of opportunity include the provision of technologies that can increase efficiency in the growing agri-food sub-sectors of middle- and low-income countries, including India and China. Similarly, with an expected focus on increasing productivity and an increase in poultry meat production, Sub-Saharan Africa, and Near East and North Africa present an opportunity for solutions that increase productivity as well as technologies applicable to the poultry sector. On a policy level, with regional policies on sustainability set to become more stringent, North America and Western Europe show potential for technologies that support sustainability and animal welfare.

Economic profile

As outlined in the definition, Agri-Tech is considered with a wide lens to include technologies that range from traditional/current solutions to emerging/novel solutions. The sector plays a key role in improving productivity for both primary agriculture and the processing sector.

An economic profile of the sector is constructed, using a survey of 54 NI Agri-Tech businesses as the starting point. Using publicly available information, a list of 97 Agri-tech businesses was compiled and considered as an indication of the total number of active Agri-tech businesses.

To account for businesses not included on the list, a sensitivity of 10% was assumed, giving a total of 107 businesses. Accordingly, the total number of businesses currently active in the sector is assumed to range between 97 (lower estimate) and 107 (upper estimate). These are spread across areas including advanced materials and supply chain technologies, agri-engineering, food processing technologies, information and communication technologies (ICT), life sciences, nutrition and animal feeds. Based on the available data and our assumptions, the sector accounts for up to £813 million in annual revenue and up to 4,380 full time employees.

International learnings

Several jurisdictions are considered as international case studies of the Agri-Tech sector. These include Australia, Israel, New Zealand, Ireland, the Netherlands, and the United Kingdom (excluding NI).

Case studies of these jurisdictions are used to identify key lessons for NI, several of which are set out below:

- The Australian Government has allocated funding for specific programmes within the Agri-Tech sector, identifying opportunities which could support multiple farms. This highlights the importance of funding support. Australia has lots of start-ups, driving innovation across the sector. Supporting start-ups can grow the NI Agri-Tech ecosystem
- Israel has developed Agri-Tech to provide food stability in a challenging agricultural environment with unfavourable growing conditions. Lessons could be learned for a similarly challenging environment in NI. Israel has more than 500 Agri-Food Tech start-ups, which are supported by accelerators and incubators. Accelerators and incubators can support NI Agri-Tech start-ups, providing an environment for testing new products and developing ideas
- New Zealand is a world leading exporter of quality food with a history of innovation across the primary sector. The Government has published an Agri-Tech Sector Transformation Plan (2020) which provides a clear outline and plan for the sector. Development of a NI plan for the sector can set out a clear path to grow the sector
- The Irish Agri-Tech sector has a strong backing from the state, including funding, accelerator programmes and industry bodies. This organisational structure allows for collaboration, funding applications and a wider international reach. Funding, accelerator programmes and industry bodies can support the NI Agri-Tech sector
- The Netherlands' agri-food sector is innovative at adopting new technologies at scale. The Netherlands hosts 15/20 of the largest global agri-food players' major research and development centres. Promoting technology adoption can help to grow the NI Agri-Tech sector
- The UK Government encourages innovation in the Agri-Tech sector through funding, developing centres of excellence and supporting research. A clear action plan sets out a pathway for the UK to become a world-leader in Agri-Tech. NI could develop a similar approach through using centres of excellence and targeted funding for innovation
- Several of the international technology examples are based on technologies that are easily adopted and can be linked to a farmer's / processor's phone. This means the technologies are easier to implement without equipment or need for significant capital investment. This can include the use of generative AI and the likes of ChatGPT to use publicly available data on weather, soil monitoring, application rates, and current events to provide insight to farmers/producers

Seven global Agri-Tech trends were identified, each of which has relevance in a NI context and is applicable to the NI Agri-Tech sector:

- 1 **Efficiency:** There is a focus on increasing efficiency to make inputs go further, creating a market opportunity for technologies that can automate processes, eliminate waste and save time. For example, automation technologies (e.g., PLCs, SCADA systems, temperature control) and human replacement technology (e.g., optical scanners rejecting unsuitable food)
- 2 **Environmental sustainability:** There is increased awareness of, and policy focus on, reducing the agri-food sector's environmental footprint. This creates a market opportunity for technologies that can reduce emissions, such as anaerobic digestion technology and methanogenesis inhibiting ruminant feed additives
- 3 **New product development/value added products:** There is an increasing focus on developing novel/value added products and developing waste streams for both the primary agriculture and the food processing industry, linked to trend one and two above. Examples include the use of technologies to create nitrate free bacon
- 4 **Novel meat products:** Evolving consumer preferences² are providing a space for the sector to create alternative protein sources such as plant-based meat and lab-grown meat products. This is linked to the broader sustainability focus, mentioned in trend 1
- 5 **Data systems:** The collection, processing, use and ownership/custodianship of data is a challenge for the wider adoption of smart data/data analytics and the interoperability of technology solutions. This is also a constraint in the NI context
- 6 **Skills and training:** A lack of relevant skills and technical training is generally a constraint in the sector. In particular, a lack of candidates with Science, Technology, Engineering and Maths (STEM) qualifications. In NI, more students need to be attracted to study STEM subjects across all levels, and current employees need to be upskilled. Career initiatives could help to attract STEM candidates into food and drink processing, and Agri-Tech businesses. Developing and attracting a pipeline of STEM talent is needed to address this challenge
- 7 **Funding and capital investment:** In terms of technology adoption, access to capital funding for investment is a constraint for the food processing sector. During consultations, stakeholders have strongly indicated that expanded capital grants, especially for large businesses, could help to support the adoption of Agri-Tech within NI.

² Note that consumer preferences are not static and continue to evolve. In addition to price, purchasing decisions are driven by factors such as culture, taste, health, and environmental concerns, including concerns over animal welfare and meat consumption. Alternative dairy products have gained more appeal with mainstream consumers, while alternative meat products (especially lab-grown meat) still have some way to go to garner a similar appeal with mainstream consumers.

Challenges and opportunities

Through stakeholder consultations and an industry survey, a number of key challenges and opportunities for the NI Agri-Tech sector have been identified:

- The top five challenges include high competition with international products; labour, skills and training; inflation/increase in cost of doing business; improving productivity/adoption of smart data and a lack of environmental and sustainability data/metrics
- Key opportunities include collaboration between agri-food, health, life sciences, and advance engineering sectors; establishing data systems for the agri-food sector; encouraging new value-added product development and the development waste streams; exploring export opportunities for food safety/quality control technologies³; and technologies contributing to lower carbon emissions and climate change mitigation.

Recommendations

Considering the key challenges facing the sector, **the top five recommendations** include the following:

- 1 Promote technology adoption
- 2 Expand and better signpost the support available
- 3 Address skills shortages
- 4 Develop an Agri-Tech sectoral plan
- 5 Support the development of environmental and sustainability metrics

The overall recommendations, including the top five, are grouped into three themes and are summarised in the tables below.

³ The Institute for Global Food Safety (IGFS) at Queen's University Belfast has a research strength in food safety and can collaborate with NI Agri-Tech businesses to explore export opportunities.

Table ES - 2: Summary of recommendations: Theme 1

Recommendation	Actions	Lead	Partners	Timescale
Theme 1: Technology, research strengths and windows of opportunity				
<p>Technology adoption</p> <p>Note: consider the technologies that the local farming and processing sectors need to adopt, even if there is a need to buy in from outside NI</p>	<ul style="list-style-type: none"> • Increase the adoption of Agri-Tech solutions within NI's primary agriculture and processing sectors • DAERA to consider inviting local Agri-Tech businesses to their knowledge transfer events, where possible • Increase technology adoption for food and drink processors by introducing a capital scheme to promote the 10x triple bottom line of Innovation, Environmental Sustainability, Inclusion plus improving productivity and the adoption of digitalisation/data analytics 	<ul style="list-style-type: none"> • DAERA lead, DfE, Invest NI, primary production, and processing sectors • Invest NI to lead with input from DfE 	<ul style="list-style-type: none"> • Industry bodies, Agri-Tech businesses, Sustainability Body⁴ 	<ul style="list-style-type: none"> • Short to medium-term
<p>Grow the NI Agri-Tech sector's global footprint</p>	<ul style="list-style-type: none"> • Grow the NI Agri-Tech sector's global footprint by focusing on the international windows of opportunity for these technologies 	<ul style="list-style-type: none"> • Lead by Invest NI, industry bodies, and Agri-Tech businesses 	<ul style="list-style-type: none"> • DAERA, DfE, industry bodies, Sustainability Body 	<ul style="list-style-type: none"> • Medium to long-term
<p>Expand and better signpost the support available</p> <p>Note: This would generate benefits for Agri-Tech businesses and end users</p>	<ul style="list-style-type: none"> • Government entities should expand and better signpost the support available for primary producers and food and drink processors. This would generate benefits to both AT businesses and the primary producer and processor end users 	<ul style="list-style-type: none"> • For primary producers: DAERA lead • For food and drink processors: Invest NI lead with input from DAERA 	<ul style="list-style-type: none"> • Industry bodies, Agri-Tech businesses 	<ul style="list-style-type: none"> • Short to medium-term

⁴ Sustainability Body has a role to play in supporting the adoption of technologies that improve sustainability and to collaborate in the adoption/promotion of industry data and data interoperability.

Table ES - 2: Summary of recommendations: Theme 1 (continued)

Recommendation	Actions	Lead	Partners	Timescale
Theme 1: Technology, research strengths and windows of opportunity				
<p>Support the commercialisation of research: Note: to create further alignment between research and industry needs, increasing commercialisation of research</p>	<ul style="list-style-type: none"> Review the R&D process between universities and companies, and facilitate industry engagement Establish innovation hubs, incubators, and accelerator programs to enable start-ups and established businesses to get involved in the R&D process. Use the proposed Mid South West Growth Deal Agri-Tech centre as a starting point 	<ul style="list-style-type: none"> Overall research and commercialisation: NI Diamond, universities and industry Incubators and accelerator programs: Lead by Invest NI, industry bodies and proposed Agri-Tech centre 	<ul style="list-style-type: none"> Industry bodies, AFBI, DfE, DAERA and Invest NI 	<ul style="list-style-type: none"> Medium to long-term

Table ES - 3: Summary of recommendations: Theme 2

Recommendation	Actions	Lead	Partners	Timescale
Theme 2: International learnings				
<p>Develop an Agri-Tech sectoral plan</p>	<ul style="list-style-type: none"> Develop an Agri-Tech sectoral plan to set out a clear path to promote the growth of Agri-Tech businesses in NI 	<ul style="list-style-type: none"> DfE lead, with input from Invest NI, industry bodies, DAERA, AFBI 	<ul style="list-style-type: none"> Invest NI, industry bodies, DAERA, AFBI 	<ul style="list-style-type: none"> Medium-term
<p>Foster Agri-Tech sector collaboration</p>	<ul style="list-style-type: none"> Develop key Agri-Tech initiatives that can foster collaboration within the NI Agri-Tech ecosystem and promote technology adoption Foster international collaboration with industry bodies in other jurisdictions to facilitate knowledge sharing 	<ul style="list-style-type: none"> Within NI: Universities, industry associations/bodies and Agri-Tech businesses International: Industry associations/bodies with support from Invest NI 	<ul style="list-style-type: none"> Invest NI, DAERA, DfE 	<ul style="list-style-type: none"> Medium to long-term

Table ES - 4: Summary of recommendations: Theme 3

Recommendation	Actions	Lead	Partners	Timescale
Theme 3: Challenges and opportunities				
Address skills shortages	<ul style="list-style-type: none"> • Increase the level of skills in the sector through graduate, postgraduate, further education, and apprenticeship courses. Additionally, increase skills of existing employees through training and upskilling initiatives • Focus on STEM areas (science, technology, engineering, and mathematics). Schools can help in increasing the promotion and attractiveness of STEM subjects. This can follow through to support a greater uptake of STEM subjects when students go on to Further or Higher Education • Provide promotional activities to attract students on courses and promote careers in the sector • This could also include initiatives such as bursaries, marketing events, international student exchange programs and student internship programmes) 	<ul style="list-style-type: none"> • DAERA, UU, QUB, FE Colleges, DfE Careers Service and Industry 	<ul style="list-style-type: none"> • Department of Education (DE), Industry bodies, Agri-Tech businesses 	<ul style="list-style-type: none"> • Medium-term
Increase productivity and the adoption of smart data practices	<ul style="list-style-type: none"> • Government to continue to promote the use of smart data to improve productivity and efficiency • Expand capital grants, especially for large businesses, to support the adoption of Agri-Tech products and services • Promote interoperability of data across the supply chain 	<ul style="list-style-type: none"> • For primary producers: DAERA • For food and drink processors: Invest NI • For interoperability of data: DAERA lead with input by the Sustainability Body and Industry 	<ul style="list-style-type: none"> • DfE, industry bodies, Agri-Tech businesses, Sustainability Body DAERA and universities 	<ul style="list-style-type: none"> • Medium to long-term
Support the development of environmental and sustainability metrics	<ul style="list-style-type: none"> • Adopt a coordinated approach to develop and establish environmental and sustainability metrics across the agri-food value chain 	<ul style="list-style-type: none"> • NI Diamond⁵, DAERA, DfE, AFBI, Sustainability Body 	<ul style="list-style-type: none"> • Industry bodies, Agri-Tech businesses, universities, retailers 	<ul style="list-style-type: none"> • Medium to long-term

⁵ The proposed NI Diamond will identify research gaps and prioritise research needs for the wider Agri-Food sector with representation from Industry, Academia, civic society, and Government.

Table ES - 4: Summary of recommendations: Theme 3 (continued)

Recommendation	Actions	Lead	Partners	Timescale
Theme 3. Challenges and opportunities (continued)				
Foster collaboration with other sectors	<ul style="list-style-type: none"> Foster collaboration between Agri-Tech businesses and University research departments in other disciplines to assist with innovation or new product development 	<ul style="list-style-type: none"> Industry bodies and universities 	<ul style="list-style-type: none"> DfE, Invest NI 	<ul style="list-style-type: none"> Medium to long-term
Establish data systems for the agri-food sector	<ul style="list-style-type: none"> Establish data systems for the agri-food sector: for the collection, processing, storing and interoperability of data 	<ul style="list-style-type: none"> DAERA, DfE, Invest NI, Sustainability Body 	<ul style="list-style-type: none"> Industry bodies, retailers 	<ul style="list-style-type: none"> Medium to long-term
Support the development of technologies that can contribute to climate change mitigation	<ul style="list-style-type: none"> Develop and support technologies contributing to lower carbon emissions and climate change mitigation Align these efforts with the Green Growth Strategy, NI Energy Strategy and the draft Circular Economy Strategy 	<ul style="list-style-type: none"> Universities, DAERA, DfE, Invest NI, NI Diamond 	<ul style="list-style-type: none"> AFBI, DAERA, Sustainability Body 	<ul style="list-style-type: none"> Medium to long-term

There is no single solution that can ensure the successful development of the NI Agri-Tech sector. Success requires that a range of actions, focusing on policy change and collaboration between government, businesses, and industry bodies, be implemented.

Metrics to measure the success of actions, that should ultimately support the growth and development of the sector, could include the following:

- Increase in the number of Agri-Tech start-ups
- Increase in employment or sectoral employment in the Agri-Tech sector
- Increase in Agri-Tech sector revenue
- Export intensity
- The number of networking events and collaboration projects between government departments and industry bodies

Note that because each country defines their Agri-Tech sector differently, there is limited comparable Agri-Tech data available. This is likely to improve as the sector becomes better defined over time, and more research and analysis is undertaken within other countries.

Disclaimer:

The document and information contained herein (“Information”) is specific in nature and is only intended to address the circumstances of the Department for the Economy (“DfE”), as set out in the services contract dated 22 December 2022, and not any third party individual or entity. KPMG accepts no responsibility whatsoever and accepts no liability for any loss or damage suffered or costs incurred by any third party individual or entity arising out of or in connection with this Information, however the loss or damage is caused. No third party should act on such information without appropriate professional advice after a thorough examination of the particular situation.

Although we endeavour to provide accurate and timely information, the information contained herein is accurate only as of August 2023 and we cannot provide any guarantee of assurance that it will continue to be accurate in the future.

The Information may not be copied, reproduced, distributed or disclosed in whole or in part without receipt of appropriate permission.