Future skills needs in the York, North Yorkshire and East Riding Local Enterprise Partnership Area

More Developed Area: York and North Yorkshire

Agri-Tech: Research and Development

Beyond 2030 has produced this Report on behalf of Calderdale College and as part of the College's delivery of the 2017-18 ESF funded Skills Support for the Workforce programme across the York, North Yorkshire and East Riding Local Enterprise Partnership Area.

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Executive Summary

- York, North Yorkshire and East Riding Local Enterprise Partnership (YNYER LEP) has commissioned a series of research reports, which will allow key decision makers to understand more fully the future skills needs of the YNYER LEPs eight identified priority sectors.
- Agri-tech, where technology is being utilised to provide solutions to problems in agriculture, farming, and food production and distribution, are being developed to allow farmers to increase productivity and reduce costs.
- It is estimated that Agri-tech directly accounts for £14.3bn in value-added and 542,000 jobs across the UK. The sector is dominated by the agriculture (farming) subsector, but other key subsectors include research and development and the supply of technologies.
- This report considers the research and development subsector within the wider Agri-tech sector.
- Beyond 2030 spoke with employers and stakeholders such as the Stockbridge Technology Centre, the Processors and Growers Research Organisation, the Society of Dairy Technology, Lantra, Chartered Institute of Horticulture, Fera Science Ltd and Askham Bryan College to inform this report, in addition to drawing on the sources mentioned in the bibliography.

More Developed Area (MDA) of York and North Yorkshire

- York and North Yorkshire is divided into eight Local Authorities: Craven, Hambleton, Harrogate, Richmondshire, Ryedale, Scarborough, Selby and the City of York.
- In 2016, it had a resident population of 813,300. Over 411,000 individuals are employed in the area. Employment rates stand at 80.7% for North Yorkshire and 77.5% in York compared to the LEP average of 78.8%.
- The largest employment sectors across North Yorkshire and York are health and social work, accommodation and food services, and retail.

Research and Development in Agri-tech

- The YNYER LEP has five priorities in its Strategic Economic Plan, with the aim to be 'a global leader in food manufacturing, Agri-tech and bio-renewables' its second priority.
- The Research and Development (R&D) base in York competes on the international stage in Agri-tech and biorenewables. It is home to Fera Science Ltd and to two internationally recognised research groups at the University of York: the Centre for Novel Agricultural Products and the Green Chemistry Centre of Excellence.
- In 2011/12 the Government spent £450 million on R&D in agriculture and food combined. Conservative estimates of private sector investment in agricultural R&D suggest it is at least £100 million a year.
- An excess of 400 individuals work in the Agri-tech R&D subsector in the area, with further R&D opportunities in private sectors firms such as Nestle and McCain, which are outside of the SIC codes.
- Roles are highly skilled in the subsector with 84% of the workforce holding a degree or higher-level qualification.
- Many R&D organisations offer in-house and supported PhD opportunities.

- Across the UK the R&D subsector is expected to grow by 8.9%. Including replacement demand, it is anticipated that there will be 67,000 jobs openings in R&D between 2014 and 2024.
- The combined challenges of global population growth, volatile food prices, climate change and pressure on finite natural resources have brought a renewed focus on the importance of scientific and technological innovation in agriculture.

Acknowledgements

Beyond 2030 would like to extend thanks to the employers in the LEP area as well as both local and national stakeholders who provided their time and assistance in giving us valuable insights into the issues facing the subsector. These included:

- The Stockbridge Technology Centre.
- The Processors and Growers Research Organisation.
- The Society of Dairy Technology.
- Lantra.
- Chartered Institute of Horticulture.
- Askham Bryan College.
- Fera Science Ltd.

Beyond 2030 is indebted to Calderdale College for the guidance and support received in completing this report.

Contents

1 Introduction to the LEP and the research

The York, North Yorkshire and East Riding Local Enterprise Partnership (YNYER LEP) has commissioned a series of research reports which will allow key decision makers to more fully understand the future skills needs of the eight identified priority sectors in the medium term. These sectors are:

- Visitor Economy.
- Food Manufacture.
- Voluntary, Community and Social Enterprise (VCSE).
- Health and Social Care.
- Construction.
- Engineering.
- Agri-tech.
- Bio Renewables.

As the economic and political situation changes, it is nearly universally acknowledged that improved skills and the link to enhanced productivity is a key way by which to improve economic well-being. Consequently, LEPs across England are looking at how best to support sectors with the potential to grow and generate wealth and prosperity.

In this research Beyond 2030 sought to fully understand the future skills needs required to ensure that within the YNYER LEP area, priority sectors can recruit and develop world class employees who have the skills to deliver exceptional service now, but also that they are equipped with the relevant skills to ensure a highly productive and world class sector throughout their working lives.

As well as wanting to more fully understand the characteristics and future needs of the eight sectors, the LEP wanted to drill down to develop an understanding of the most significant subsectors in each priority areas by geography.

1.1 Agri-tech sector

The YNYER LEP has five priorities in its Strategic Economic Plan, with the aim to be “a global leader in food manufacturing, Agri-tech and biorenewables” it’s second priority (YNYER LEP 2014).

Agri-tech is not an industry that has been clearly defined in existing Standard Industrial Classification (SIC). It is a broad sector that encompasses more than on-farm activities: there is also the Research and Development (R&D), as well as the manufacturing and selling of the technology.

The Research and Development (R&D) base in York competes on the international stage in Agri-tech and biorenewables. It is home to two internationally recognised research groups at the University of York: the Centre for Novel Agricultural Products and the Green Chemistry Centre of Excellence. In addition, Fera Science Ltd (formerly the Food and Environment Research Agency), is based in Sand Hutton, outside York.

This report therefore considers the R&D subsector within the wider Agri-tech sector in the More Developed Area (MDA) of York and North Yorkshire, which as seen above, is a key component of Agri-tech.

In this report Beyond 2030 sets out the skills and productivity of the area as a whole and at Local Authority level to provide context, before considering the subsector in further detail.

1.2 York and North Yorkshire, MDA

North Yorkshire covers an area of 8,654 square kilometres (3,341 sq. mi), making it the largest county in England. The majority of the Yorkshire Dales and the North York Moors lie within North Yorkshire's boundaries, and around 40% of the county is covered by National Parks.

York and North Yorkshire is divided into eight Local Authorities: Craven, Hambleton, Harrogate, Richmondshire, Ryedale, Scarborough, Selby and the City of York.

In 2016, it had a resident population of 813,300, which equated to 71% of the LEP's resident population (ONS 2017). Over 411,000 individuals are employed in the area. Employment rates stand at 80.7% for North Yorkshire and 77.5% in York, compared to the LEP average of 78.8% (The largest employment sectors across North Yorkshire and York are health and social work, employing 13% of all workers, accommodation and food services, employing 11% of all workers, and retail which employs 10% of the workforce .

Table 1).

Using YNYER LEP as the standard, the various differences in the productivity, skills and employment across North Yorkshire and York can be seen. The largest employment sectors across North Yorkshire and York are health and social work, employing 13% of all workers, accommodation and food services, employing 11% of all workers, and retail which employs 10% of the workforce .

Table 1 highlights where the area performs better (green) or worse (red). Self-employment in North Yorkshire, for example, stands at 13.9% - greater than within York, the LEP as a whole and the English average. However, the number of individuals qualified to level 4 or above is lower and the proportion with no qualifications is greater in North Yorkshire.

The largest employment sectors across North Yorkshire and York are health and social work, employing 13% of all workers, accommodation and food services, employing 11% of all workers, and retail which employs 10% of the workforce (ONS 2016).

Table 1 Productivity, skills and jobs:

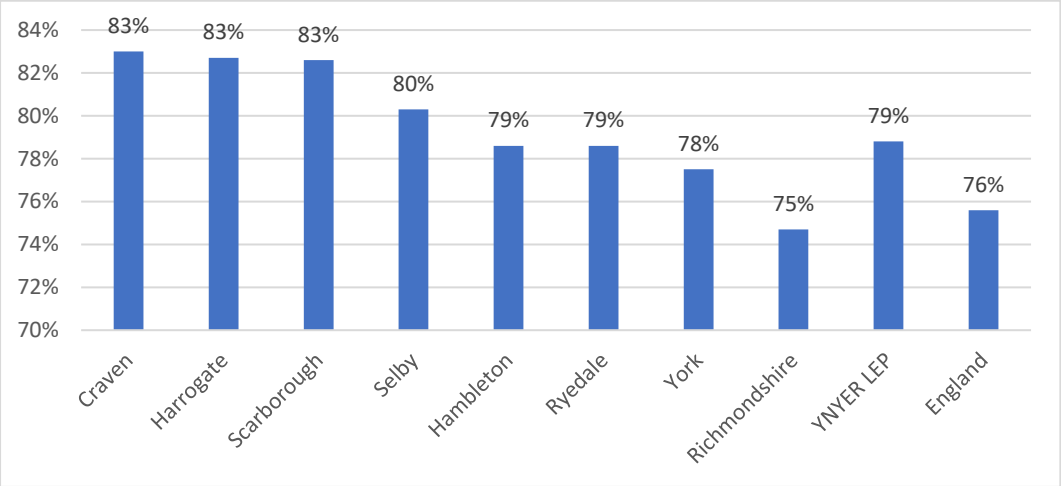
Measure	North Yorkshire	York	YNYER LEP	England
Gross Weekly pay full time (£) (place of residence, 2016)	£489.10	£509.60	£504.70	£544.70
Job density (the ratio of total jobs to population aged 16-64, 2015)	0.96	0.85	0.86	0.84
Employment Rate (Apr 2016-Mar 2017)	80.7%	77.5%	78.8%	75.6%
Self-Employment (Apr 2016-Mar 2017)	13.9%	9.7%	12.0%	10.9%
Full-time workers	63.1%	62.7	63.8%	69.1%
Unemployment Rate (Apr 2016-Mar 2017)	2.9%	3.0%	3.2%	4.4%
Economically Inactive (Apr 2016-Mar 2017)	16.8%	20.0%	18.5%	20.9%
Level 4+ (Jan 2016-Dec 2016)	35.9%	42.7%	37.5%	37.9%
No Qualifications (Jan 2016-Dec 2016)	6.5%	6.1%	6.3%	7.8%

Source: Office for National Statistics: LEP and National Labour Market Profiles; GVA for Local Enterprise Partnerships

1.3 Local Authorities

Looking in more detail at Local Authority level, variations in the employment rate can be seen: Craven, Harrogate and Scarborough have the highest at rate 83% while Richmondshire has the lowest at 75%. However, the employment rate in seven of the local authorities is greater than the national average (Figure 1).

Figure 1 Employment rate across the LEP and North Yorkshire Local authorities (Apr 2016-Mar 2017)



Source (ONS 2017)

Using YNYER LEP as the standard, additional variations in the job, skills and productivity levels of each of the local authorities are highlighted in the table below. Where the area performs better, these have been highlighted in green with relatively poor performance being highlighted in red in Table 2. In summary:

- Four Local Authorities have a lower weekly wage than the LEP average (Craven, Hambleton, Ryedale and Scarborough).
- In three Local Authorities (Craven, Harrogate, and Ryedale) the job density is above one - meaning that there is more than one job for every resident aged 16-64.
- Self-employment is particularly high in Harrogate and Scarborough.
- The proportion of full-time workers is low in Scarborough.
- The proportion of workers with a level four qualification ranges from 23.4% in Hambleton to 50.3% in Craven.

Where the local authority area performs better than the YNYER average, this has been highlighted in green, or worse, in red in the table below.

Table 2 Productivity, skills and jobs by local authorities in York and North Yorkshire MDA

	Craven	Hambleton	Harrogate	Richmondshire	Ryedale	Scarborough	Selby	York	YNYER LEP	England
Gross Weekly pay full time (£) (place of residence, 2016)	£413.10	£496.80	£535.50	£507.20	£443.10	£460.30	£549.40	£509.60	£504.70	£544.70
Job density (the ratio of total jobs to population aged 16-64, 2015)	1.16	0.98	1.06	0.80	1.02	0.93	0.73	0.85	0.86	0.84
Employment Rate (Apr 2016-Mar 2017)	83.0%	78.6%	82.7%	74.7%	78.6%	82.6%	80.3%	77.5%	78.8%	75.6%
Self-Employment (Apr 2016-Mar 2017)	*	12.0%	16.9%	*	12.9%	19.1%	*	9.7%	12.0%	10.9%
Full-time workers	60.0%	65.0%	61.5%	62.5%	69.6%	58.5%	68.6%	62.7	63.8%	69.1%
Unemployment Rate (Apr 2016-Mar 2017)	3.0%	3.1%	3.3%	3.4%	3.5%	3.5%	3.8%	3.0%	3.2%	4.4%
Economically Inactive (Apr 2016-Mar 2017)	15.6%	18.2%	14.4%	25.3%	19.3%	15.0%	16.0%	20.0%	18.5%	20.9%
Level 4+ (Jan 2016-Dec 2016)	50.3%	23.4%	42.8%	25.3%	36.8%	37.7%	31.1%	42.7%	37.5%	37.9%
No qualifications (Jan 2016-Dec 2016)	*	9.1%	*	*	*	7.4%	8.9%	6.1%	6.3%	7.8%

Source (ONS 2017) * data not available, sample too small

2 Research and Development in Agri-tech, MDA

Before Beyond 2030 looked in detail at the Agri-tech R&D, we first outlined the total R&D expenditure in the Yorkshire and Humberside area.

2.1 Introduction to R&D

To respond to challenges and present new growth opportunities and help drive productivity, new ideas, processes and techniques are required.

R&D expenditure in the UK across all sectors, expanded by £1.2 billion to £31.6 billion in 2015, an increase of 4% (ONS 2017).

The business sector performs the most R&D in the UK. Business accounted for 66% of R&D spend, followed by Higher Education 25%, Government and research councils 7% and private non-profit 2%. Across Yorkshire and Humber, a greater proportion of R&D expenditure is through higher education compared to national data (Table 3).

Table 3 Expenditure on R&D performed in the UK by sector, country and region, 2015 £ million

	Yorkshire and the Humber		**UK**	
	£ million	%	£ million	%
Business	779	54%	20,885	66%
Higher Education	545	38%	8,009	25%
Government & Research Councils	111	8%	2,097	7%
Private Non-Profit	4	<1%	634	2%
Total	**1,439**		**31,626**	

Source (ONS 2017)

2.2 Agri-tech R&D

The UK is recognised as a place of agricultural research. For example, The John Innes Centre, the Roslin Institute, the National Institute for Agricultural Botany (NIAB) and East Malling are just a few agricultural research organisations located within the UK.

Furthermore, there are many institutions including agricultural colleges, universities and institutes as well as private research organisations.

The Government spent £450 million on R&D on agriculture and food combined, in 2011/2012 (BIS, Defra and DfID 2013). In addition to this spend is private sector research. Conservative estimates of private sector investment in agricultural R&D suggest it is at least £100 million a year (BIS, Defra and DfID 2013). Large companies like Syngenta and British Sugar as well as major retailers all fund substantial research activities.

Research covers a range of disciplines. It includes crop and livestock genetics and genomics, agri-engineering, nutrition and health in crops and livestock, environmental sciences, food science and human nutrition. Additionally, research covers new and emerging fields including functional foods, nutraceuticals, clean technology and energy generation from waste.

2.2.1 Subsector definition

Scientific research and development includes the activities of three types of research and development (ONS 2009):

1) Basic research: experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without particular application or use in view.
2) Applied research: original investigation undertaken to acquire new knowledge, directed primarily towards a specific practical aim or objective.
3) Experimental development: systematic work, drawing on existing knowledge gained from research and/or practical experience, directed to producing new materials, products and devices, to installing new processes, systems and services, and to improving substantially those already produced or installed.

For the following report Beyond 2030 have defined the subsector using the below Standard Industrial Classification (SIC) codes. Please note that this will include R&D across all sectors not just Agri-tech. However, using the modelling proportion from the BIS Agri-tech scoping report, a proxy estimate of the proportion of activities seen to be within Agri-tech can be calculated (BIS 2016).

Table 4 Standard Occupation Classification

SIC	Definition	Proportion of activity in Agri-tech
72.11	Research and experimental development on biotechnology	0.4%
72.19	Other research and experimental development on natural sciences and engineering	0.4%

Source (ONS 2009)

2.3 Scientific research and development subsector economy and employment

70 businesses operate in the scientific research and development subsector, employing 3,800 individuals across the York and North Yorkshire area (ONS 2017). Harrogate district has the greatest employment number accounting for 36% of the workforce. A further 24% are employed in Ryedale district and 19% in York.

64% of businesses employ less than 10 individuals, 21% employ between 10 and 49 individuals and 7% employing more than 250.

As noted above, employment figures account for R&D activities which are wider than just Agri-tech. If Beyond 2030 use the modelling proportion from the BIS Agri-tech scoping report a proxy estimate of the proportion of activities seen to be within Agri-tech can be calculated (BIS 2016). The report estimated that 0.4% of R&D work in Agri-tech, which would provide an approximation of just 15 individuals working in this field. However, this would not be a true reflection. Fera, for example, has 350 scientists and 70 PhD students (Fera 2018), while Stockbridge Technology Centre Ltd (STC) had an average number of employees of 35 in 2017. It is not possible to say exactly how many organisations and employees there are but data from STC and Fera alone, highlights the importance of the area for Agri-tech R&D and how it differs from national averages. It is clearly a hotspot for the subsector.

Key firms involved in R&D in the area include:

- Fera, a joint Venture between Defra and Capita plc with an annual turnover of £40m employs 350 science specialists at the National Agri-food Innovation Campus a few miles from York. https://www.fera.co.uk
- Centre for Innovation Excellence in Livestock (CIEL). http://www.cielivestock.co.uk
- Crop Health and Protection (CHAP). http://chap-solutions.co.uk
- Stockbridge Technology Centre (STC), near Selby, ensures continued technological developments for the horticultural industry. http://www.stockbridgetechnology.co.uk/
- Raft Solutions Ltd, registered in Ripon, looks for innovative research, advanced breeding and training solutions to the food sustainability questions that farmers, vets and industry colleagues ask. http://raftsolutions.co.uk/
- Convance, is a global contract research organisation, that works across a number of industries including agricultural biotechnology. They have a food lab in Harrogate researching nutritional chemistry and contaminants testing. https://www.covance.com/foodsolutions/industries-we-serve/agricultural-biotechnology.html

It is also important to remember that private sector businesses, such as Nestle and McCain both which have locations in the MDA, as well as universities and colleges in the area, also undertake a R&D function that will contribute to the Agri-tech R&D employment total.

Askham Bryan College, for example, undertakes research and scholarship activities across focused research themes, such as Animal Science, Ecology & Conservation, Equine Science, Farm Trials, Plant Science and Rural Business. The work the college undertakes concentrates on near market, applied research which is very much about addressing the land-based industries' drivers and needs (Askham Bryan College 2018).

Other organisations that have R&D functions relating to Agri-tech in the area include C&D Foods, Cranswick Plc, ForFarmers and Origin Group (which including Westpoint Farm Vets).

2.3.1 Jobs people do

The major occupational groups for the subsector at a UK level are shown in the table below. The greatest difference in the proportion of employment for the subsector compared to the all economy occurs in professional occupations. 61% of the workforce are within this occupational group compared to 20% in the all economy.

Job roles can include chemists, horticulturist, microbiologist, pathologist, research associate, researcher, laboratory technician, scientific technician, field trail technicians.

Table 5 Occupational groups

	R&D (UK)	All economy (UK)
Managers, Directors and Senior Officials	6%	11%
Professional Occupations	61%	20%
Associate Professional and Technical Occupations	21%	14%
Administrative and Secretarial Occupations	7%	10%
Skilled Trades Occupations	1%	11%
Personal care services	1%	9%
Sales and Customer Service Occupations	1%	8%
Process, Plant and Machine Operatives	2%	6%
Elementary Occupations	2%	10%

Source (Office for National Statistics; Social Survey Division; Northern Ireland Statistics and Research Agency. 2017)

The job roles with the greatest number employed in the R&D subsector across the UK[1] are:

Table 6 Top five jobs roles in research and development subsector, UK

Occupation	Number employed
2112 'Biological scientists and biochemists'	14,200
2113 'Physical scientists'	11,700
2119 'Natural and social science professionals n.e.c.'	8,500
2150 'Research and development managers'	7,500
3111 'Laboratory technicians'	7,300

Source (Office for National Statistics; Social Survey Division; Northern Ireland Statistics and Research Agency. 2017) * not elsewhere classified

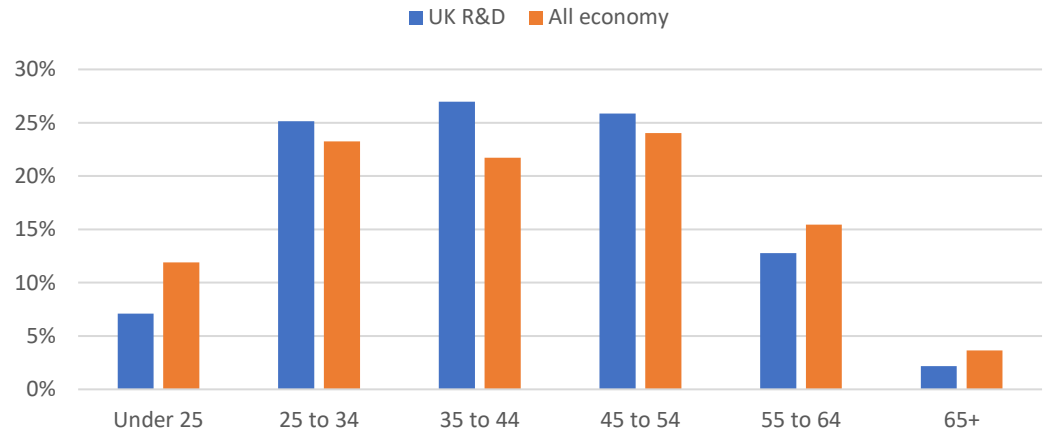
40% of the R&D subsector workforce is female across the UK. This is slightly below the national all economy average of 47%.

Young people are slightly underrepresented in R&D subsector compared to the economy as a whole. Only 7% are aged under 25, compared to 13% in the whole economy.

Where the roles are more technical, the longer learning pipelines, involved in the acquisition of the detailed skills might be one cause of low levels of young people in the subsector.

[1] Sample for LEP and Yorkshire and Humber area too small for reliability

Figure 2 Age profile of research and development subsector, UK



Source (Office for National Statistics; Social Survey Division; Northern Ireland Statistics and Research Agency. 2017) * not elsewhere classified

2.4 Skill needs - Primary research and testing the data

2.4.1 Recruitment and retention

Recruitment opportunities are occurring in the R&D subsector with positions available in the larger firms. Convance, for example, have a variety of vacancies advertised on their website[2], however few of these roles specifically relate to R&D in Agri-tech.

- Scientific advanced degree level – i.e. Clinical pathology laboratory scientists.
- Scientific bachelor's degree – i.e. Senior manager, proposal development job.
- Scientific entry level – i.e. Research assistants.
- Administration / Clerical – i.e. Data management associate.

Fera Science Ltd were recruiting. Their vacancies include:

- Higher Analytical Chemist.
- Sales Manager - Plant Protection Programme.
- PTG (Proficiency Testing Group) Customer Services Assistant.

Stockbridge Technology Centre did not have any recruitment opportunities at the time of this research. However, when discussing specific skills challenges they face, it was reported that recruitment and training can be a challenge. They found it difficult to recruit individuals with generalist skills – those with a broad range of skills and experience across a range of disciplines within this area.

[2] https://emeacareers-covance.icims.com/jobs/search?pr=1&searchLocation=13702--Harrogate&searchRelation=keyword_all&schemaId=&o=

Further recruitment opportunities in Agri-tech were advertised outside of the LEP area. These were across a range of disciplines, including:

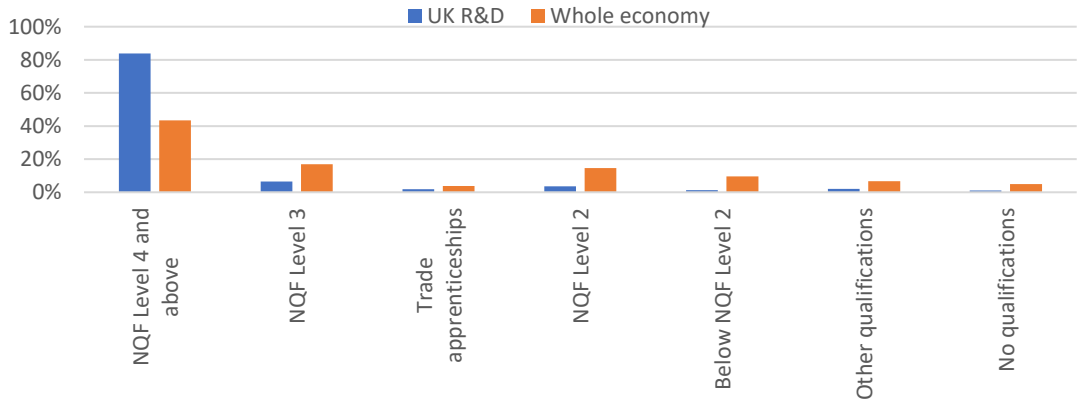
- Agrimetrics, the first Agri-tech innovation centre, were seeking individuals for the following positions in February 2018 in Reading and Harpenden https://agrimetrics.co.uk
    - Earth Observation Data Scientist.
    - Presales Consultant.
    - Semantic Web/linked Data Scientist.
    - Product Manager.
- National Institute of Agricultural Botany (NIAB) in Cambridge had vacancies for: http://www.niab.com/vacancies/index/
    - Trails technician.
    - Trails manager.
    - Laboratory technicians.
    - Seasonal field trail technicians.
- NIAB East Malling Research Centre (EMR) in Kent were seeking a Research assistant (Entomology) http://www.emr.ac.uk/vacancies/
- Genus, based in Nuntwich, Cheshire, had a vacancy for EMEA Genetic Services Research Specialist www.genusbreeding.co.uk/

2.4.2 What are the current skill needs and gaps

2.4.2.1 Skills levels

The R&D subsector is highly skilled with many holding a degree or higher-level qualification. Overall, 84% are qualified to level 4 or above, compared to 43% across the whole economy.

Figure 3 Qualifications levels of the research and development subsector, UK



Source (Office for National Statistics; Social Survey Division; Northern Ireland Statistics and Research Agency. 2017)

2.4.3 Skills needs / gaps

From our primary work, Beyond 2030 can suggest that the following skills are particularly needed and valued by employers:

- Relevant degree (i.e. agriculture science, agronomy or plant science).
- Ability to work with attention to detail.
- Self-motivated.
- A determination to develop and apply technologies from the laboratory to the farm.

2.4.4 Training and apprenticeships

The colleges and universities in the LEP area provide the opportunity to gain the skills required to work in the sector.

York College Science department, for example, has a range of courses that can lead to a scientist position. These include (York College 2018):

- Laboratory Scientist Apprenticeship Level 5.
- Laboratory Technician Apprenticeship Level 3.
- Science Manufacturing Technician Apprenticeship Level 3.
- Higher National Certificate/Diploma in Biological Sciences in Industry.
- Applied Science BTEC 90 Credit/Extended Diploma Level 3.

Askham Bryan College, with its new Agri-Tech Innovation Centre and Land Based Engineering Workshop, and Bishop Burton College also have learning and research opportunities (Askham Bryan College 2018, Bishop Burton College 2018).

Fera Science Apprenticeship Programme

Launched in 2011, the programme includes over 30 months of training in core laboratory skills and a Level 3 NVQ qualification in Laboratory and Associated Technical Activities.

Apprentices work alongside experienced scientists to gain valuable knowledge and expertise.

Furthermore, Fera provides extensive support for its apprentices in their NVQ work, providing them with study time, learning facilities and coaching, as well as access to the dedicated on-site college tutor.

https://www.fera.co.uk/careers/apprenticeships

2.4.5 PhD / Collaborative Training Partnership grants

Many research and development organisations offer PhD opportunities to graduate students.

Fera works with the Institute for AgriFood and Innovation (IAFRI) at Newcastle University to developed targeted PhD training programmes that foster emerging talent in this area. Working with their extensive network of academic partners, they have co-sponsored between 20-30 studentships a year (Fera 2018). Starting in September 2018, Fera and IAFRI have 6 PhD awards available from 10 projects in:

1. Environmental fate of molluscicides - challenging the current risk assessment approach.
2. Packaging with nanomaterials from agri-food by-products for shelf life extension of food and feed.
3. Developing DNA-metabarcoding technologies for the nationwide surveillance of pest and beneficial insects.
4. Modular, cell-free synthetic gene networks to enable rapid deployment of infield diagnostics for plant health monitoring.
5. Druggability assessment of juvenile hormone receptor PAS-B domain for development of next generation insecticides.
6. Development of a detection system for bioinoculants based on 'in situ' metatranscriptomics.
7. Exploring receptor divergence between honey bees and mites to target future treatments.
8. Smart Labels for Intelligent Packaging.
9. Characterisation and Performance of Insect Chitin and Chitosan.
10. Diatom Recording Using Metabarcoding (DRUM).

Further afield, organisations such as NIAB have resources for research in molecular plant science, quantitative genetics, breeding, transgenic technology and plant pathology. NIAB's site in Cambridge provides first-rate laboratory facilities linked to a capability to study crop plants in controlled environments, glasshouses and in field plots. The majority of their PhD studentships are funded by grants. Grants may be part of a collaborative approach with private firms/retailers and universities.

6 BBSRC CTP four-year studentships for October 2018

The Biotechnology and Biological Sciences Research Council (BBSRC) have awarded a Collaborative Training Partnership (CTP) grant to a consortium led by Berry Gardens Growers Ltd and NIAB EMR. The Collaborative Training Partnership for Fruit Crop Research. focuses on research and development on important fruit crops in the UK. There are six four-year PhD studentships available to start from October 2018.

http://www.emr.ac.uk/vacancy/6-bbsrc-ctp-four-year-studentships-october-2018/

2.5 Future requirements

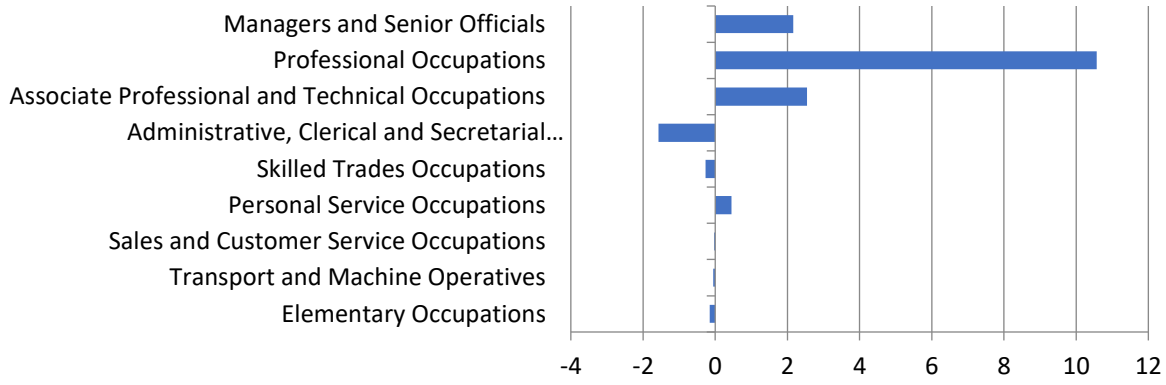
2.5.1 Sector growth

Future workforce projections for the subsector are available at the wider UK level only but this still provides a useful indication of changes in the workforce moving forward.

Employment in the UK research and development subsector is expected to increase by 8.9% between 2014 and 2024 – or by 14,000. This contrasts with the UK's all sector economy where growth of 5.5% is anticipated (UKCES 2016).

Employment growth is expected mainly cross the top three occupational groups of professional occupations, associate and technical occupations and managerial positions, reflecting the employment makeup of the sector (Figure 4).

Figure 4 Research and development subsector occupational change, 2014 -2024 (000s), UK



Source: UKCES Working Futures VI

2.5.2 Replacement need and total demand

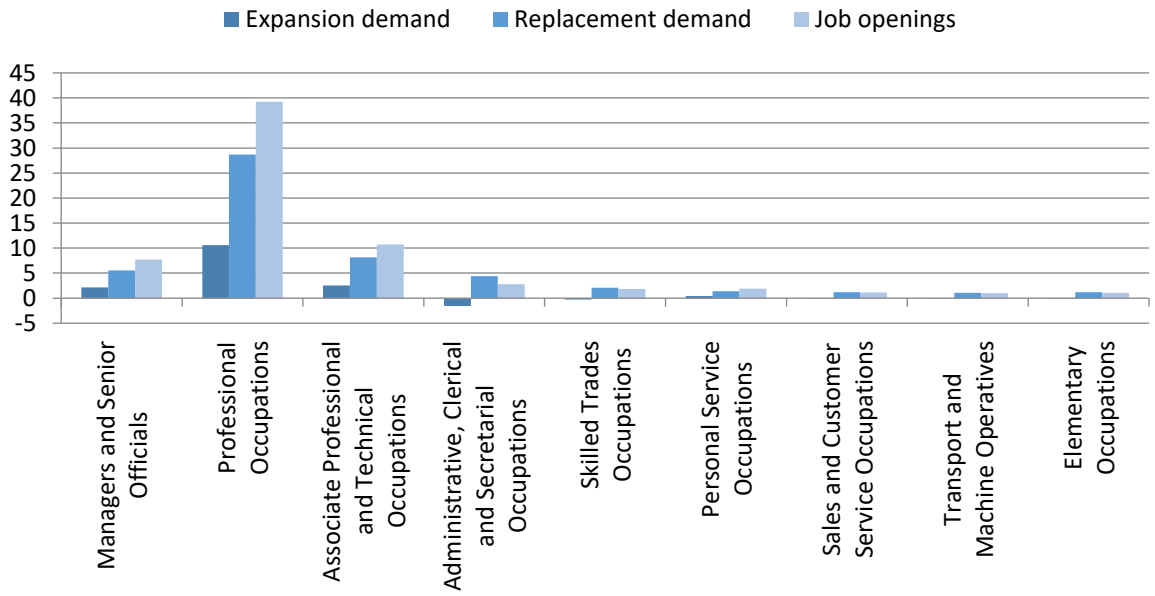
Overall the subsector in the UK is expected to have approximately 67,000 job openings between 2014 and 2024: but to note is that 54,000 will be replacement demand.

More than half (58%) of all job openings will be within professional occupations and a further 16% in associate and technical roles (

Figure 5).

Using the proxy that 0.4% of those in R&D work in Agri-tech, it can be estimated that 300 job openings will in this field across the UK. It is clear from our primary research that a high proportion of future job development will be in the area.

Figure 5 Job openings in the research and development subsector by occupation 2014 - 2024 (000s) in UK



Source: UKCES Working Futures VI

2.5.3 Qualifications

The subsector is already a highly qualified workforce, but there will continue to be a shift towards more people holding higher qualifications (Table 7).

Table 7 Change in qualification profile of the research and development subsector, UK

	No qualifications and level 1	**Level 2**	**Level 3**	**Level 4 – 6**	**Level 7 – 8**
Qualification example	GSCE (grades D – G) BTEC level 1	GCSE (grades A* - C) NVQ Level 2	AS & A level BTEC National	Certificate of higher education (L4) Foundation degree (L5) Bachelor's degree (L6)	Master's degree (L7) Doctorate (L8)
2014 level **2024 level**	12,639 8,133	16,086 14,955	16,825 12,161	73,215 92,195	34,651 39,628
2014 – 2024 % change	-36%	-7%	-28%	26%	14%
2014 % share	8%	10%	11%	48%	23%
2024 % share	5%	9%	7%	55%	24%

Source: UKCES Working Futures VI

2.5.4 Future roles and skills

The combined challenges of global population growth, volatile food prices, climate change and pressure on finite natural resources have brought a renewed focus on the importance of scientific and technological innovation in agriculture.

In 2012 a group of industry organisations jointly commissioned a project to gather opinions about what the agriculture sector needed the scientific research community to prioritise over the next two decades. The project was funded by the Technology Strategy Board (now Innovate UK) and undertaken by the National Farmers Union, the Agricultural Industries Confederation, Royal Agriculture Society of England, AHDB and NFU Scotland. The report, *Feeding the Future* identified their research and development priorities for the next 20 years (Pollock 2013).

The research priorities identified in *Feeding the Future* formed part of the evidence base for development of the Agri-Tech Strategy, which and highlighted the critical importance of increased investment in applied research, supported by improved collaboration between public and private sector, as the platform to drive a competitive, resilient and innovative farm sector (BIS, Defra and DfID 2013).

An updated report *Feeding the Future, Four Years On*, sets out eight general research priorities that would boost the sector's contribution to the economic and environmental performance of the UK food production system (NFU 2017). These include:

- Digital, data-driven and engineering technologies.
- Crop and livestock genetics and breeding technologies.
- Interactions between air, soil, water and crop/animal processes within farming systems.
- Integrated approaches to management of crop weeds, pests and diseases.
- Integrated approaches to management of animal disease within farming systems.
- Evidence-based management and valuation of ecosystem service provision from farming systems.
- Skills, training and knowledge exchange.
- Use of social and economic sciences.

With new political developments such as the decision to leave the European Union in mind, the refreshed report calls for decision-makers, research funders, and providers to help create a funding and regulatory environment in which new technologies and innovative practices can be adopted on farms as quickly as possible (NFU 2017).

2.6 Drivers

2.6.1 Political

Industrial Strategy

As part of the Industrial Strategy's aim to improve productivity and create better and higher-paying jobs across the UK, the government has committed to working with industry to boost spending on R&D to 2.4% of GDP by 2027, which could increase public and private R&D investment by as much as £80 billion over the next 10 years (GOV.UK 2017). This in turn will no doubt create further recruitment opportunities in the Agri-tech field.

Brexit

Changes to migration rules and regulation may impact on the highly mobile and internationally collaborative researchers, entrepreneurs and the global workforce of large research-intensive businesses.

Stockbridge Technology Centre reported working on projects with universities funded by Horizon 2020, a European Research and Innovation programme. The uncertainty over future funding opportunities is a concern.

2.6.2 Economic

UK Research and Innovation

Due to fully operate in April 2018, UK Research and Innovation will have a combined budget of more than £6 billion, and will bring together the seven Research Councils, Innovate UK and Research England (UK Research and Innovation 2018). It intends to ensure that the UK maintains its world leading position in research and innovation.

Their objective is to invest every pound of taxpayers' money wisely in a way that maximises impact for citizens, in the UK and across the world. They wish to foster a collaborative environment for universities, researchers and businesses which is able to attract funding from new sources.

2.6.3 Social

Knowledge / promotion

Much high-quality and useful research is taking place. However, more can be done to help users, including potential inward investors, find the right knowledge, information and partnerships. If this can be achieved it could lead to more industry and research base co-investment than currently being achieved.

Organisations such as CHAP, CIEL and NFU will be key to helping to promote knowledge of new innovations.

Access to R&D and technologies

Effective dissemination of the research and findings is key. However, the availability of even simple, basic technology such as the internet is holding some farmers back. 13% of farmers don't have reliable access to the internet and 60% of those with a connection only have speeds of 2Mbps, which is insufficient to deal with the data heavy maps drones and sensors will generate (nesta 2015). Focus therefore needs to be on rural infrastructure in order to maximise the impact of research.

At 2018 NFU conference the Business Secretary Greg Clark announced a £90 million fund for Agri-tech (NFU 2018). The funding is designed to help food and farming businesses to access and use innovative technology, such as AI and robotics. This highlights the need to bridge the gap between R&D and end users.

2.6.4 Technological

The aim of research and development (R&D) is to improve the current technologies or to develop innovations that can help strengthen performance in the marketplace. In Agri-tech there are several areas of potential development including:

- New technologies and processes – develop, adopt and exploit new technologies and processes in Agricultural Innovation.
- Big data and the Internet of Things.
- Robotics and AI.
- Monitoring, satellite imagery and remote sensing.
- Increasing yields – including crops.
- Improving labour productivity through robotics and machines.
- Resource management.
- Biotechnology.
- Drones.
- Soil management and smart irrigation.
- Vertical farms.

Many of these research and development areas are being tested and applied in farming environments, with some commercial, ready to use technologies already on the shelf. For example, precision farming technologies (e.g. GPS auto-steering, drones etc.) have now become commonplace (London Economics 2015). However, harnessing new technology could further help improve productivity in agriculture.

2.6.5 Environmental

Genetically Modified (GM) Crops and Organisms

A farming industry embracing technology, including GM, can still claim to be environmentally friendly. Genetically modified (GM) crops are currently not grown commercially in the UK, but they are imported. These crops are primarily used in animal feed. There is no general prohibition on the planting of GM crops but planting them is only permitted 'if a robust risk assessment indicates that it is safe for people and the environment' (Defra 2015). There have been experimental trials of GM potatoes, wheat and camila sativa (false flax) in recent years (Defra 2017).

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