LEADING

FOOD 4.0

GROWING UNIVERSITY-BUSINESS COLLABORATION FOR THE UK’S FOOD ECONOMY

TASK FORCE CHAIRS

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# Introduction

Why Does the Food Economy Matter? 5
Steering Group Members 8
Conclusions 9
Recommendations 10

## 01. An Industrial Strategy and Single Plan for Food

## 02. Self-Help

## 03. Trusted Brokerage, Intelligent Networks

## 04. Making an Impact

## 05. Sharing the Place

## 06. Signals from the Landscape

## Case Studies

## Appendix

1. Work Stream Members 64
2. Organisations Participating in Interviews on Innovation and R&D in the Food Sector 66
3. Landscape Signals and Cooperative Behaviour 67
UK CONSUMERS SPENT £196 BILLION ON FOOD, DRINK & CATERING IN 2012

THE SECTOR CONTRIBUTED £103 BILLION TO THE ECONOMY

THE SECTOR CONTRIBUTED £19 BILLION IN EXPORTS

THE SECTOR CREATED 3.7 MILLION JOBS IN CLOSE TO 200,000 FIRMS
INTRODUCTION
Why Does the Food Economy Matter?

UK consumers spent £196bn on food, drink and catering in 2012. The sector contributed over £103bn to the economy, £19bn in exports, and 3.7 million jobs in close to 200,000 firms\(^1\). It encompasses seemingly disparate businesses such as farms and fisheries, high-tech manufacturers, mass-market retailers and industrial caterers. It is intimately bound up in competition for the use of land and water, in the management of climate change, and in the nation’s health and well-being.

As the food related riots of 2007-8 in countries such as Egypt, Bangladesh, and Haiti demonstrated, food shortages and spikes in prices can quickly escalate into food revolts with wide political ramifications\(^2\). Food supply clearly has national and international geo-political significance.

Government and devolved administrations in the UK have recognised the vital importance of this industry. In establishing an Agri-Tech Leadership Council, the UK government said:

‘We want the UK to become a world leader in agricultural technology, innovation and sustainability; exploit opportunities to develop and adopt new and existing technologies, products and services to increase productivity; and contribute to global food security and international development\(^3\).’

\(^{1}\) www.ons.gov.uk/ons/rel/abs/annual-business-survey/index.html
\(^{3}\) www.gov.uk/government/publications/uk-agricultural-technologies-strategy/uk-agricultural-technologies-strategy-executive-summary#industrial-strategy
The Scottish government notes that:

‘The vast majority of land in Scotland is under agricultural production and the sector is responsible for much of Scotland’s food exports⁴.’

It has established the Scotland Rural Development Programme 2014 - 2020 to support farming, forestry, crofting, and rural development projects.

In launching Green Growth Wales, the First Minister Carwyn Jones said:

‘I want Wales to be a leader in Green Growth. In the same way that the availability of our natural resources put Wales at the forefront of the Industrial Revolution, driving the growth of iron and coal and then steel and manufacturing, it is our abundant natural resources that drive the growth of a new and different economy that will be rooted in the sustainable and intelligent use of those resources⁵.’

The Northern Ireland Executive’s Agri-Food Strategy Board set out its ambitious vision in Going For Growth. It wants to:

‘...Grow a sustainable, profitable and integrated Agri-Food supply chain, focused on delivering the needs of the market⁶.’

Improved innovation, leadership, entrepreneurship and talent for the food sector are fundamental to the UK’s economic success, not only today but in the very different future of what we call: Food 4.0.

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⁴ www.scotland.gov.uk/Topics/farmingrural/Agriculture
University-Business Collaboration to Lead Food 4.0

The next food revolution is under way\(^7\). Food 1.0 was simple cultivation; food 2.0 was built on mechanisation and manufacturing; and 3.0 was the product of advanced technology, processing, and genetics. In Food 4.0, nine billion people around the world must be fed safely, sustainably, affordably, and securely. And consumption is changing. As populations become wealthier, there is strong evidence that they call for a more meat and protein-intensive diet, with all that implies for food production and the consumption of scarce resources.

The Food 4.0 revolution is likely to be knowledge-intensive, collaborative and integrative. It may be built on big data, nano-technologies, genomics, and communications technologies. Or it may be the product of renewables, ecological policies, better consumer education and environmental literacy. In all likelihood, it will be birthed by all of these. However it emerges, the UK's food sector wants to be a leader in this new world. To lead, firms must benefit from highly talented graduates as well as from world class science and inventiveness. Here the UK is well-placed. It has 0.9% of the world's population, but produces 4.3% of its researchers, 9.5% of research paper downloads, 11.6% of citations, and 15.9% of the world's most highly-cited articles\(^8\). Cambridge, Oxford, and Imperial are in the global top ten universities for the life sciences\(^9\), and the University of Reading is eleventh for agriculture.

The Food Sector must pull more of this excellence in inventiveness through into innovation if it is to prosper in Food 4.0, and food companies must attract talented graduates into the whole supply chain. They need high quality engineers and marketers to work alongside farmers and horticulturists. These pressing business needs must be integrated into and supported by long-term industrial strategies from government.

Recognising the vital importance of the food economy for the UK and the world, the National Centre for Universities and Business convened a Task Force to review ways of increasing the intensity, variety and nature of business-university collaboration for the sector. It was led by Justin King, then CEO of Sainsbury's, and Quintin McKellar, Vice-Chancellor of the University of Hertfordshire and former Principal of the Royal Veterinary College. They were supported by a steering group of senior figures from across the industry, civil service and the academy (see following page). Supporting these were work streams on talent and skills, science and translation and land use (see appendix 1). Following extensive research and consultation the Task Force has come to ten conclusions and made six recommendations.


### Steering Group Members

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<tr>
<th>Name</th>
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<tr>
<td><strong>Task Force Co-Chairs</strong></td>
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<tr>
<td>Prof. Quintin McKellar</td>
<td>Vice-Chancellor</td>
<td>University of Hertfordshire</td>
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<tr>
<td>Justin King</td>
<td>Former Chief Executive</td>
<td>Sainsbury’s</td>
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<td><strong>Steering Group</strong></td>
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<tr>
<td>Prof. Tim Benton</td>
<td>UK Champion for Global Food Security &amp; Professor of Population Ecology</td>
<td>UK Global Food Security Programme and University of Leeds</td>
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<td>Dr Chris Brown</td>
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<td>Dr Paul Burrows</td>
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<td>Syngenta</td>
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<tr>
<td>Judith Batchelar</td>
<td>Director of Sainsbury's Brand</td>
<td>Sainsbury’s</td>
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<tr>
<td>Joanne Denney-Finch OBE</td>
<td>Chief Executive</td>
<td>IGD</td>
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<tr>
<td>Dr David Docherty</td>
<td>Chief Executive Officer</td>
<td>NCUB</td>
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<tr>
<td>Prof. Peter Downes</td>
<td>Principal and Vice-Chancellor</td>
<td>University of Dundee</td>
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<tr>
<td>Prof. Chris Elliott</td>
<td>Director, Institute for Global Food Security</td>
<td>Queen's University Belfast</td>
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<td>Iain Ferguson</td>
<td>Chairman</td>
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<tr>
<td>Justine Fosh</td>
<td>Chief Executive</td>
<td>National Skills Academy for Food &amp; Drink, and Improve Ltd</td>
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<td>Prof. Sir David Greenaway</td>
<td>Vice-Chancellor</td>
<td>University of Nottingham</td>
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<td>Richard Greenhalgh</td>
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<td>Lindsay Harris</td>
<td>Deputy Director Food Policy Unit</td>
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<tr>
<td>Prof. John Hughes</td>
<td>Vice-Chancellor</td>
<td>Bangor University</td>
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<tr>
<td>Melanie Leech</td>
<td>Former Director General</td>
<td>Food and Drink Federation</td>
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<tr>
<td>Dr David Llewellyn</td>
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<td>Harper Adams University</td>
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<tr>
<td>Prof. Duncan Maskell</td>
<td>Head of the School of the Biological Sciences and Marks &amp; Spencer Professor of Farm Animal Health, Food Science &amp; Food Safety</td>
<td>University of Cambridge</td>
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<tr>
<td>Robin Mills</td>
<td>Managing Director, Chartwells</td>
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<td>Chris Millward</td>
<td>Director (Policy)</td>
<td>HEFCE</td>
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<td>Jim Moseley</td>
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<td>Food and Drink Federation</td>
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<td>Prof. Nigel Scollan</td>
<td>Head of Animal Systems and Waitrose Professor of Sustainable Agriculture</td>
<td>Aberystwyth University</td>
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<td>Professor Mark E. Smith</td>
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<td>Chris Stott</td>
<td>Partner, Deal Advisory</td>
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<tr>
<td>Paul Willgoss</td>
<td>Director of Food Technology</td>
<td>Marks &amp; Spencer</td>
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<tr>
<td>James Withers</td>
<td>Chief Executive</td>
<td>Scotland Food &amp; Drink</td>
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Conclusions

01 Despite its demonstrable success, the UK’s food industry is fragmented, with a long value and supply chain and hundreds of thousands of small companies, including farms and fisheries.

02 Food lacks the unified voice with which to address government, research funders, universities and the education system that other sectors – such as automotive or pharma – have developed.

03 The problems of a fragmented sector contribute to the generally weak links between businesses and universities. They must be improved through effective collaboration and research.

04 There is enormous value to legislators, universities, colleges, schools, and the public in growing the value of the food sector. Universities and colleges will benefit from more research and better graduate employment prospects. Business will have access to greater inventiveness and more tailored graduate talent. And government will have a growing and strategically vital industry, alongside evidence to support policies that deliver sustainability. It would be a major strategic error to miss the opportunities created by the next food revolution.

05 The UK government’s industrial strategy is primarily focussed on agricultural technology development. Its remit needs to be broadened to include the entire end-to-end value chain from lab to landfill. Scotland, Wales, and Northern Ireland share many of the collaboration challenges faced by England, but have developed more integrated strategies to deal with them. These could be broadened and shared across the UK to increase innovation and produce a better educated workforce for the sector.

06 Only a few universities have a clear sense of the research, innovation and educational needs of the food economy. And few partner with universities across Europe on the challenges of the food economy. Conversely many, if not most, food businesses do not have a strategic and long-term relationship with universities. This is not uncommon for sectors dominated by small and mid-sized businesses.

07 There are too few high-quality collaborative mechanisms that join up the food industry with universities and the publicly-funded innovation system. And there are not enough translators able to work across industry, universities, and research institutes.

08 The sector fails to present a coherent, consistent, and visible message to school children, their parents, and their teachers, which can attract them into food-related courses at university and college, or from higher education into food economy jobs.

09 The production of food requires access to land, water, and energy, and it impacts on the environment in many ways. These include the emission of greenhouse gases, the amount and quality of water use, biodiversity, and human health via nutrition. The food industry, therefore, is inherently connected to other sectors. This interdependence needs to be recognised and navigated.

10 Agricultural landscapes supply fresh water, have a role in flood prevention, offer significant cultural, amenity and recreational value, and provide habitats for biodiversity. These services often arise not from the management of single fields or farms, but from all land management in an area. For example, downstream flood risk may depend on all upstream farms. We call this approach the landscape perspective. The market is not currently incentivising approaches that unite business, government, universities, and the publicly-funded innovation system to promote farm management to deliver multiple benefits for society at the landscape scale.
Recommendations

UK government\(^\text{10}\) to work with devolved administrations to produce a UK-wide plan for the education, skills, and innovation needs of the food economy. The Agri-Tech Leadership Council’s remit and membership should be broadened to include the entire end-to-end value chain from lab to landfill. A UK minister should take the lead on the food economy and its education, skills, research, and innovation needs. Similarly the devolved administrations should ensure a single ministerial overview.

The Agri-Tech Leadership Council and the NCUB to work with food businesses and universities to create new collaboration programmes and forums. These would grow and promote the talent, skills, educational, research, and innovation pipelines of the food economy.

NCUB to create a trusted information, advice, and guidance portal for food businesses looking to grow the value of their relationship with universities, and for universities wishing to discover the research needs of businesses.

The food economy research, impact, and innovation agenda should be more strongly promoted by all administrations in the UK and by the research funding bodies, and should be more coordinated at ministerial level.

Devolved administrations will wish to create policies and structures appropriate for their own unique systems, but there should be coordination and knowledge-sharing between them to create more shared value.

Universities, businesses, and government must collaborate to deliver sustainable land use at the landscape level. Agri-businesses must address the challenge that farm management poses for landscape level outcomes. For example, no single farmer may be responsible for the loss of bees from a landscape, but collectively their actions may ensure it. DEFRA and the devolved administrations must ensure that the regulatory instruments for which they are responsible are aligned with this objective and provide signals which encourage collaborative action.

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\(^{10}\) When we speak of the UK Government, the primary departments are Business, Innovation and Skills (BIS), and the Department of Environment, Food and Rural Affairs. However, our argument throughout is that a successful food sector requires engagement from and coordination with other departments, such as Education and Health.
The Food Economy – Channelling Scale and Harnessing Diversity

Every report on the food economy begins with a definition. This in itself encapsulates one of its major problems. The sheer diversity and complexity of the sector muffles its voice and confounds its policy problems. A thought experiment sums up the issue. Imagine a ‘Jack Sprat’ dinner: you have fish, chips, mixed salad, wholemeal bread, and a glass of white wine, and your companion is served steak, mashed potatoes, green beans, and a beer. And you both have coffee to follow. This simple meal requires lab research, seeds, machinery, fertilisers, veterinary products and services, crop protection, animal feed, fisheries, trawlers, straw, slurry, manure, abattoirs, feed compounders, grain merchants, milk processors, maltsters, brewers, millers and bakers, manufacturers, wholesalers, retailers, and recycling or disposal for the packaging and leftovers. Then envision cooking it for a thousand people in a factory. Then work out how to feed nine billion people sustainably and affordably for the next century. Then work out how to get rid of the waste.

So the food economy is the entire network of scientific innovators, producers, distributors, consumers, and disposers of food and drink. It stretches from the lab to landfill. It is the biggest manufacturing sector in the UK, and is one of the biggest contributors to the UK economy.

Figure 1: Gross value added of the UK agri-food sector

Although there are global firms in the sector, 98% are small companies that employ 40% of the employees. So the industry may appear disjointed, fragmented, and disconnected to the outside world, including universities. For example, although there are ten key trade associations, there are over forty bodies for food manufacturing alone. Although each has a clear role, it is difficult for organisations outside the sector, including universities, to have a clear view of the collective or individual requirements of food businesses (see figure 2).

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Behind this complexity is a common need to engage with the science and research base, and a desire to attract more and better talent from universities and colleges in order to be in the race to the top. But to achieve the breakthroughs that will make the UK a global leader in food, government needs to treat the sector as a strategic priority.
The UK government is clearly committed to ‘behaving like a business’ by sticking to long-term planning that tackles strategic weaknesses in the economy, and has established leadership councils for eleven key sectors\(^\text{12}\). Most look at a whole industry such as the life sciences, nuclear, automotive, aerospace, and construction. But it has focussed mainly on just one sub-sector of the food economy, namely agricultural technology.

Despite this decision, we strongly support the work of the Agri-Tech Leadership Council. It now oversees an investment programme including:

- A £70 million government investment in an Agri-Tech Catalyst to provide a single fund for projects, all the way from the laboratory to market.
- £90 million for a Centre for Agricultural Innovation.
- A Centre for Agricultural Informatics and Metrics of Sustainability.

This Leadership Council is potentially the source of a stronger and more cohesive voice not only to government, but also to the research, innovation, and education base. It could, if properly constituted, act as a focus for collaboration on skills and innovation for the whole industry across the UK. But we believe that to increase its effectiveness, it needs a more comprehensive remit and representation.

Food needs a body that speaks for all parts of the supply chain, not just agri-tech, and which can leverage and focus investment. There is already good work being done by the Industry Skills Partnership that brings together 50 food and drink manufacturing companies, and a range of trade associations, in a programme supported by £2m of BIS funding and £1m of

industrial support to develop future skills and talent for this part of the sector\textsuperscript{13}. But, as we have consistently noted, we need a lab-to-landfill view of the relationship between business, universities, and the public innovation system. Therefore the agri-tech strategy, and its associated funding, must embrace the whole sector.

We also recommend that a reconstituted Agri-Tech Leadership Council work with the devolved administrations, NCUB, and others to establish a food economy Business-University Forum. This would be a permanent body that ensures a long-term focus on strategic skills and on innovation collaboration between sectors.

Although the current Council has cross-departmental support from Department for Environment, Food and Rural Affairs (DEFRA), Department for Business, Innovation and Skills (BIS) and the Department for International Development (DFID), we note that other industries that cut across industrial boundaries have ministers with responsibilities in different departments. For example, the Minister of State for Culture and the Digital Economy has both BIS and Department of Culture, Media and Sport accountabilities; and the Parliamentary Under-Secretary of State for the Life Sciences is a shared role between BIS and the Department of Health.

Such is the importance, broad impact, and complexity of the food economy, we recommend that the Prime Minister ensures there is a shared ministerial role that can coordinate the relevant departments – DEFRA, BIS, DFID, the Department of Health (including Public Health England and the Food Standards Agency), the Department of Education and Department for Communities and Local Government (DCLG). This change will enable government to develop an integrated regulatory, research, educational, and policy response to food. Furthermore, as we noted in our conclusions, the market is not resolving major issues at the landscape level. This too calls for coordination and catalysing by government.

Many of the collaboration challenges we identify are shared across the UK. The devolved administrations in Scotland, Wales, and Northern Ireland have produced more integrated strategies for food. The Task Force feels that these can be further developed to include its wider definition of the skills and innovation needs of the food economy. These should form part of a shared plan for business-university collaboration in food across the UK.

Finally in this group of recommendations, we believe that the food economy will grow more effectively if food science in schools is more highly valued and helps raise the profile of the food industry. We also think that food should be more broadly integrated into other parts of the school curriculum including biology, geography, and other subjects.

In Scotland, the Higher qualification in Home Economics focuses on the physical, chemical, nutritional, biological, and sensory properties of food. Food is also taught across the science curriculum and is supported by, amongst others, the Scottish Food and Drink Federation’s Future in Food\textsuperscript{14} schools programme. As one would expect from the centrality of food to the Northern Ireland economy, the schools' curriculum there integrates food into STEM education\textsuperscript{15}. The proposed CCEA GCE in Food and Nutrition will launch in Northern Ireland in 2016. It aims, amongst other things, to ‘take account of rapid technological changes and the growth of
scientific knowledge and understanding. In Wales, food is included in the GCSEs for design and technology, as well as Home Economics and additional applied science. We strongly support the creation of the GCSE in Food Preparation and Nutrition in England, not least because it might contribute to tackling the health problem of obesity in young people. But we also believe the government could go further in emphasising the scientific nature of this qualification.

A good model of industry working with the education and business departments of government is the UK Space Agency’s Education, Skill and Outreach strategy, where the sector intends to use space for education, and education for space.

We note also the launch of a new employer-backed careers advice and guidance company, supported by the Department for Education. We anticipate a concerted effort by the Food Sector and universities to coordinate with one another and cooperate with this new organisation to ensure a strong representation there of the needs of the whole industry.

Recommendation

01 UK government to work with devolved administrations to produce a UK-wide plan for the education, skills and innovation needs of the food economy. The Agri-Tech Leadership Council’s remit and membership should be broadened to include the entire end-to-end value chain from lab to landfill. A UK minister should take the lead on the food economy and its education, skills, research and innovation needs. Similarly the devolved administrations should ensure a single ministerial overview.

Contributory Recommendations

i. NCUB to work with the Agri-Tech (Food) Leadership Council and devolved administrations to establish a new food economy Business-University Forum that would bring together business, universities, and research institutes to take a long view of the skills and innovation needed to grow the food economy.

ii. The Department for Education (DfE) should continue to encourage pupils to study subjects, such as the new Food Preparation and Nutrition GCSE, as well as science and geography, that will provide them with the knowledge, skills, and understanding they need to consider further study and employment in the food sector. The DfE should also ensure that reforms to A levels, due in 2017, build on the rigour of the new GCSE. And we encourage each of the devolved administrations to continue their development of science-focussed food and nutrition courses.

“Agriculture and food are thriving, undergoing necessary shifts to adapt to the current climate (economic, cultural, ecological). It is an exciting place to be, with lots of career opportunities and the possibility to grow”
Although government can play a vital catalytic role in developing collaboration on skills, education, research and innovation, the Task Force is firmly committed to programmes of self-help. The ‘Industrial Strategy and Single Plan for Food’ outlined previously should not stop at the front door of government. For too long, sub-sectors of the food economy have failed to speak with a single voice of the need for shared solutions to its educational, research and innovation challenges. This approach must improve if it is to shape and respond to the Food 4.0 revolution.

One of the most pressing difficulties is that of persuading schoolchildren and graduates to enter the industry, and it is to this that we now turn.

Talent, Talent, Talent

To understand the nature and depth of these issues, and possible ways of resolving them, we commissioned a survey of five hundred first and second year undergraduates, and one hundred and fifty four recent entrants to the sector, across the full range of sub-sectors and roles.20

20 For the full report go to www.ncub.co.uk/foodsurvey
The good news for the sector is that most of the graduates working in it see it as a good career option and score it almost six out of seven for attractiveness. But there is a perception gap between those working in food and undergraduates without that experience.

Figure 3:
Perceived career options in the sector (variable bases)

And they would recommend it to others.

Figure 4:
Recent entrants’ experience of working in the sector

The reasons for this enthusiasm range from the personal to serving the public good.
“Agriculture and food are thriving, undergoing necessary shifts to adapt to the current climate (economic, cultural, ecological). It is an exciting place to be, with lots of career opportunities and the possibility to grow.”

“The agricultural sector has a direct impact on the health and wellbeing of the UK (sometimes even world) population. Agriculture also faces its greatest challenge with a rising world population, water and (fertile) land scarcity and a changing climate. Thus, working in the agricultural sector is both altruistic and also intellectually challenging.”

“The individual development is good, there are opportunities to move around and learn new skills and gain new experiences. It is fast paced, challenging and overall a significant sector to be in.”

“It’s a fascinating area, where you have many choices to work according to your abilities and interest, e.g. food processing operations, sensory evaluation, food safety, quality assurance, etc...”

These enthusiastic employees have degrees in management studies, media, and marketing as well as the sector’s more traditional subjects of nutrition, biology, and agriculture. Our research shows that undergraduates need to receive strong and well-marketed messages that within agri-food, you can work on a range of exciting challenges and in a variety of roles including climate change, sustainable agriculture, traditional food-making, high-tech farming, processing, manufacturing, and retail. Graduates must be exposed to the potential for a broad, long-lasting and interesting career in the sector.

To be successful in Food 4.0, businesses need graduates capable of leadership and vision, and with commercial acumen and entrepreneurial instincts. Such attributes and skills can be developed in university courses of all kinds. However, not enough talented undergraduates know about, care for, or have enough experience of the food economy to find it attractive.

Figure 5:
Undergraduates’ and recent entrants’ perceived attractiveness of the sector (variable bases)
According to our undergraduate respondents, the biggest problem was the image of the sector and a lack of information about the kinds of roles available in it.

This was confirmed in their comments:

“More advertising - I’ve barely heard/seen anything to do with it until now! If it is presented as an actual option for a full career, people will be interested.”

“Break down the stereotype that the sector is low skilled and poorly paid”.

“Making it ‘cool’ in the media. I personally think that a food technician is a ‘cool’ job but farm manager is very dull.”

“By raising awareness of the different job roles and opportunities. When I was studying for A-levels, the specific roles were not explained or advertised to me. Equally, when I was at university, these roles were not promoted until I started on a graduate scheme where I learned the different roles, experiences and sectors of a food business.”

Figure 6: 
Key suggestions from undergraduates’ and recent entrants’ to help more young people to pursue a career in the sector (variable bases)
No food company made it into the top twenty of a recent survey of engineering graduates’ perceptions of the top hundred companies to work for in the UK, and only a handful made the list at all\(^1\). And in general, as the NCUB’s Student Employability Index demonstrates, undergraduates rate the attractiveness of food production well below that of health or the media.

Table 1: Undergraduates’ perception of the attractiveness of sectors

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<td>Agriculture / Forestry / Fishing</td>
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<td>Education</td>
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<tr>
<td>Health Sector / Medicine / Pharmaceuticals / Veterinary</td>
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<td>Media / Broadcasting / Publishing</td>
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Source: NCUB Student Employability Index\(^2\).

A crucially important method of overcoming this prejudice and pulling undergraduates into the industry is work experience. There simply is not enough of it, or a simple means to access it, as our findings on the factors that might influence graduates to enter the sector show (see figure 7).

There is already considerable evidence on food economy skills gaps, such as the United Kingdom Food Supply Chain report\(^3\), the agri-skills forum, and the Food Research Partnership skills sub-group\(^4\). However, government still needs to work with universities and industry to monitor pressing overall skills challenges, especially those created by the high-tech/high-spec economy of Food 4.0. There are strong case studies of individual success in Sheffield Hallam, Harper Adams, and Lancaster universities. These must be built on to develop the highly-skilled talent needed to make the UK’s food firms globally successful.

Recognising the good work being done on forecasting skills needs and in the development of innovative new courses, the Task Force concentrated on the challenge of raising awareness and aspiration, improving perception, offering conversion, and facilitating work experience.

\(^1\) [Link](http://universumglobal.com/rankings/united-kingdom/student/2014/engineering-it)
\(^2\) [www.ncub.co.uk/sei](http://www.ncub.co.uk/sei)
\(^3\) United Kingdom Food Supply Chain (2011, Improve)
In particular, it is important to build on the good work of sub-sector career guidance sites such as www.brightcrop.org.uk and www.tastesuccess.co.uk. One issue is that there are many such sites and initiatives (see table 2). We believe that if these are coordinated, their collective impact will be substantially greater. As a direct result of being in the Task Force, Improve Ltd. and Bright Crop have already agreed to coordinate their Ambassadors programmes.
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We also support campaigns and initiatives such as Feeding Britain’s Future, which in 2014 expanded to include employability skills training in schools\(^\text{25}\), and Tasty Careers, which has received support from the governments of Scotland and Northern Ireland.

**Figure 8: Tasty Careers, careers map\(^\text{26}\)**

IGD, the food and consumer goods research and training organisation, runs summer schools with universities, such as Reading, Nottingham and Leeds, to give young scientists an insight into roles in the sector such as product technology, safety, quality, and product development. We encourage other HE providers to engage in this programme.

We also back digital approaches such as the upcoming Countryside Classroom\(^\text{27}\). This will be a web portal that pulls together teaching resources, venues, and experts to connect schools with food, farming, and the countryside. It will relate food and farming to all subjects from reception to A Level.

Our research shows conclusively that the food sector needs to be able to make a simple offer to undergraduates, and we call for the establishment of a single portal that links to and curates sub-sector work. It is vitally important that universities themselves develop...

\(^{25}\) www.igd.com/our-expertise/Feeding-Britains-Future/

\(^{26}\) http://improvemedia.loyaltymatters.co.uk/tastycareers/resources/8-job-map.pdf

\(^{27}\) www.face-online.org.uk/face-news/countryside-classroom-building-a-brand-new-sector-wide-educational-resource
approaches to the food economy that promote interdisciplinary cross-fertilisation for undergraduates as well as for postgraduates and researchers.

We also look to industry experts in marketing to develop a cross-food economy campaign that targets school students and undergraduates. With these measures in place, we anticipate that universities will be able to contribute more effectively to outreach programmes on behalf of the food sector.

Recommendation

The Agri-Tech Leadership Council and the NCUB to work with food businesses and universities to create new collaboration programmes and forums. These would grow and promote the talent, skills, educational, research and innovation pipelines of the food economy.

Contributory Recommendations

i. NCUB to coordinate industry and universities to create a single student portal that links to all other food economy sub-sector sites. This will be a single port of call for graduate careers advice, courses, work experience offers, inspiration, and advice.

ii. Agri-Tech Leadership Council to work with higher education funding councils, the UK Commission on Employment and Skills, and Research Councils on a review of skills gaps in the food economy.

iii. The Agri-Tech Leadership Council and the NCUB to collaborate on developing a national graduate work experience and placements framework for the food economy.

iv. Food Economy Business-University Forum to share successful practice in developing conversion courses and graduate apprenticeships that fill pressing skills gaps identified by industry.

v. Universities to develop interdisciplinary food programmes in collaboration with industry.

vi. Businesses should commit to a high-profile Food Economy Inspiration Programme that ensures that all current outreach activity is shared and that a registry of speaking and engagement opportunities is maintained and promoted. This should be hosted on the student portal.

vii. Businesses and Universities to collaborate on integrated outreach programmes to schools to promote, coordinate, and expand upon initiatives such as Feeding Britain’s Future, Bright Crop and the NSA’s Ambassador scheme. Details of initiatives should be hosted on the single student/ambassador portal.

viii. Food businesses to co-fund and coordinate a whole-industry food economy marketing programme for schools that promotes the single vision advocated by the Task Force and excites schoolchildren about careers in Food.

28 This will build on organisations with strong student engagement, such as the Institute of Food Science and Technology.
“The problem is that you know that there is a university out there that will have the expertise that you need to access but we certainly wouldn’t have known which university to approach and short of emailing them all or asking them all one-by-one I don’t know how to get the information out”
The development of an industrial strategy for the food economy will encourage business and university investment by providing clarity over what will be funded and for how long.

Such a strategy will enable the kinds of cooperation and collaboration that creates smarter supply chains and long-run innovation similar to the United States Department of Agriculture’s Cooperative Research and Extension Services programme in which the Land Grant University work with a network of local or regional offices. These USDA offices are staffed by one or more experts who provide useful, practical, and research-based information to agricultural producers, small business owners, youth, consumers, and others in rural areas and communities of all sizes.

What are the drivers of innovation?

Before turning to our own original research on innovation, it is worth reflecting on two recent reviews of the drivers of innovation. One was commissioned from the consultants, Arthur D Little for DEFRA, and the other from the Knowledge Transfer Network (KTN), laid some of the groundwork for the Sustainable Agriculture and Food Innovation Platform – a £90m joint venture between Innovate UK, DEFRA, and the
Biotechnology and Biological Sciences Research Council (BBSRC). The public funding will be match-funded by industry²⁹.

The latter report identified ten opportunity areas for research which could maintain and enhance the UK’s competitive position in global food manufacture³⁰. These are:

- Next Generation Integrated Retail
- Waste Minimisation
- New Approaches to Food Manufacturing
- Health & Wellbeing Through Diet
- Smarter Packaging
- Food Safety
- Understanding & Changing Behaviours / Drivers
- Authenticity & Traceability
- Energy & Water
- New & Smarter Ingredients

The DEFRA report identified ten innovation drivers, both for large firms and for small and mid-sized businesses³¹.

**Figure 9: Large businesses’ top ten drivers for R&D and innovation**

![Image of bar chart showing the top ten drivers for R&D and innovation for large businesses.]

Source: Survey results. Arthur D. Little analysis.

²⁹ www.bbsrc.ac.uk/business/collaborative-research/innovate-uk-competitions/saf-ip.aspx
³⁰ https://connect.innovateuk.org/documents/3285671/0/A+Pre-Competitive+Vision+for+the+UK’s+Food+And+Drink+Industry.pdf
³¹ www.adlittle.co.uk/uploads/tx_extthoughtleadership/ADL_farmgate_appendices.pdf
Figure 10: SME’s top ten drivers for R&D and innovation

Although the balance of drivers is different for small and large companies, there are shared issues in these reports that call for action. Arthur D Little concluded that further work had to be done on “packaging up” the results of research to achieve innovation. They note that: “Capabilities in modelling, testing, trialling and scale-up for food manufacturing already exists in, for example, the National Centre for Food Manufacturing at Lincoln University, and the Centre for Process Innovation in Teesside but needs to be more widely publicised and SMEs given access to them.”

There are other food research centres besides these three, such as those at Cardiff Metropolitan University, Reading, and Nottingham. In addition, major manufacturers have their own R&D capabilities. The idea of publicising and curating information from them chimes strongly with the Task Force’s own research on innovation and R&D.

In our study of this issue we drew on semi-structured interviews with thirty technical directors, innovation managers, CEOs, and managing directors from twenty six companies (see appendix 2 for details).

The following quotes sum up one of the challenges of knowing what research exists and how to access it:

“The problem is that you know that there is a university out there that will have the expertise that you need to access but we certainly wouldn’t have known which university to approach and short of emailing them all or asking them all one-by-one I don’t know how to get the information out.”

*Large manufacturer*

“Most of our communication tends to be because there’s relationships...somebody went there, or somebody’s worked with them in the past. It’s not because we have a good communication system that tells me x or y research institute is up to this or that. There doesn’t seem to be a nice forum for finding information, it tends to be experience and personal contacts.”

*Horticultural Producer*

Although twenty five universities were mentioned by respondents, most referred only to one or two, and they felt keenly their lack of knowledge of what might be going on elsewhere. Furthermore, only half of the executives felt that they wanted their academic contacts to be restricted to a local university. Indeed, only a handful felt that locality was a strong driver, and that was mainly because they were working with a specific PhD student.

Our respondents often used intermediary organisations to help them find an academic partner - including the UK’s Global Food Security programme, the BBSRC, Knowledge Transfer Networks (KTNs), Innovate UK, Interface Scotland, and the Food and Drink Federation. This reliance on others to broker a relationship demonstrates that even this knowledgeable group struggled to find the right researcher or research teams. Indeed of all potential government interventions, this group most often cited the need for improved information provision.

Most respondents felt that looking at academic journals or searching LinkedIn is too time-consuming and random, and that a dedicated website or portal where they are able quickly, easily, and intuitively to access information would be a far better option. The Task Force believes that the NCUB is best placed to coordinate the development of a food economy digital platform that can bring together sub-sector sites and networks already active in the public sector.

This approach is consistent with the NCUB’s development of an intelligent brokerage platform, funded by the public sector, through which businesses will have access to data, contacts, consultancy, and research funded by Innovate UK, the research and funding councils, and in the longer run, charities.
Figure 11:
Areas of recommendation for government intervention

To accompany this digital platform, the food businesses in our survey wanted shared online spaces where universities and business can discuss what they are working on, as well as forums and industry-wide trade shows and conferences where they could network with university researchers.

Finally, there is a pressing need to develop and promote the use of ‘translators’ – intermediaries with a deep understanding of the relevant academic research, who understand the financial and cultural issues facing businesses, and who can navigate successfully between these worlds. They are also sometimes known as ambassadors or champions. We encourage universities to fund such people as part of their impact strategies, and to invest in creating them by funding the training and outreach activities of such researchers. We believe that such examples of self-help will attract industry funding, assist impact case studies that contribute to a university’s reputation and Research Excellence Framework (REF) scores, and add to the standing of the higher education sector as a whole.
Box 1:  
Research Excellence Framework: demonstrating impact

The Research Excellence Framework (REF) is the Higher Education Funding Council for England's system for assessing the quality of research in UK higher education institutions. Quality is now partly judged by the impact of research outside the university, shown through case studies.

**Case studies include:**

- Climate-resilient crops for global food security.
- Creation of new ingredients for the food industry.
- Food for thought: Shaping Europe-wide policy on Additives and Colourings.
- Mathematical methods to improve food safety and traceability.
- Modification of hydrocolloids to produce novel and enhanced food products.
- Radical energy, cost and water savings from recycling food waste.
- Reducing fat for healthier foods.³⁴

Finally, the food industry must become more systematic and effective in accessing sources of interdisciplinary expertise – such as Innovate UK’s Knowledge Transfer Partnerships (KTPs), in which an early career researcher enters a firm to help solve pressing innovation challenges³⁵.

**Figure 12:**
Example of KTP

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³⁴ [http://results.ref.ac.uk/Search?uoaId=&orgId=&formId=REF3b&searchText=food](http://results.ref.ac.uk/Search?uoaId=&orgId=&formId=REF3b&searchText=food)

³⁵ [www.ncub.co.uk/reports/knowledge-transfer-partnerships-a-best-practice-approach-to-open-innovation.html](www.ncub.co.uk/reports/knowledge-transfer-partnerships-a-best-practice-approach-to-open-innovation.html)
Recommendation

NCUB to create a trusted information, advice and guidance portal for food businesses looking to grow the value of their relationship with universities, and for universities wishing to discover the research needs of businesses.

Contributory Recommendations

i. NCUB to create a Food Economy Collaboration Portal on its current web site for businesses which want to work with universities. This will contain information, advice and guidance about how to work with universities, links to academics, success stories, blogs and inspiration.

ii. NCUB to ensure that the food economy is a priority sector for its intelligent brokerage platform. This will offer curated and easily understood access to research in universities and research institutes.

iii. Innovate UK, RCUK, NCUB and the Knowledge Transfer Network to establish a systematic programme of workshops, events and networking opportunities with universities and businesses, building on current initiatives such as RCUK’s research clubs.

iv. NCUB to promote and link to information and guidance from all relevant sub-sector websites.
"There are many candidates for open innovation in Food 4.0. They include: achieving the efficient use of water and the recycling of non-drinking water"
Universities are naturally good at being inventive, while firms have incentives and governance structures which should allow them to be innovative\(^36\). The relationship between businesses and universities in the food economy resembles that in four industries that the NCUB reviewed as part of its Task Force on growing the value of innovation in the UK\(^37\).

That Task Force concluded that:

- Universities increasingly play a strategic role in sector-specific innovation.
- Businesses are developing fewer, but longer-term, strategic partnerships with universities.
- Open Innovation is an increasingly important means of developing new products and services\(^38\).
- Unidirectional models of knowledge exchange and technology transfer from universities to business fail to capture the richness of the interaction or the associated value creation.
- Innovation for grand challenges requires cross-disciplinary, cross-institution collaboration.
- Each industrial sector needs collaboration suitable to its structure and needs.

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36 See Foray and Lissoni Handbook of the Economics of Innovation p282
37 www.ncub.co.uk/gvbook The four sectors were: pharma, energy, creative & digital and construction.
38 The Task Force adopted Henry Chesbrough's definition: “Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology. Open Innovation combines internal and external ideas into architectures and systems whose requirements are defined by a business model.” Henry Chesbrough, Open Innovation: The New Imperative (2003)
Each of these trends and insights applies in some way to innovation in the food industry, where the single vision approach is as relevant for research as it was in skills and graduate talent development. Too many sub-sectors such as agriculture, manufacturing, processing, support and inputs and retail speak to government and research funders separately. There is no powerful unified voice representing the food economy as a whole.

This awareness cuts both ways. Many of the executives in this Task Force’s survey noted that government departments and research funders speak to food companies in a way that is more appropriate for long pay-back, big-science industries such as pharmaceuticals. They emphasised their desire to collaborate with universities, and were supportive of the various impact initiatives from the funding and research councils. As a Task Force, we support the culture changes being brought about by a balanced focus on impact, and are committed to working with public bodies and organisations to ensure that the multiple and multidisciplinary needs of the sector are publicised and met.

The UK food and drink sector invested over £425m in R&D in 2013 and is second only to the US in new product variants. However, many sub-sectors operate by small-scale process innovation, for example by delivering incremental changes to make packaging more attractive, food healthier and goods less expensive, rather than on step changes in technology.

“Innovation is matching ourselves and our products with the changing customer.”
Large retailer

“Done well and managed well [regulation] can really drive innovation. It can make industry look at itself and look at how to change.”
Large manufacturer

“The supply chain is so lean it makes innovation hard to do... I think the whole supply chain could move forward a lot quicker if we had longer-term view of value supply chain deals.”
Agricultural producer

If the UK is to be a leader in Food 4.0, and if it is to extract more value from publicly-funded research, it must embrace a more open and collaborative culture. The executives in our research noted that some problems need to be tackled from a systems or supply chain perspective, particularly where the impact of an innovation is felt in a different part of the supply chain from its origin. The most commonly reported examples were disease control and resistance to herbicides. These impact all competitors and involve low risk of a collaborative project benefiting only one of the project partners.

A fine example from a related sector is Dundee University’s International Centre for Kinase Profiling. Here the university works on the pharma

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| The Division of Signal Transduction Therapy (DSTT) was founded in 1998. The concept grew from their recognition that signal transduction was becoming important to the global pharmaceutical industry...

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industry’s most important class of drug targets in an entirely open way. The centre collaborates with eight large companies including Pfizer, GlaxoSmithKline, Boehringer-Ingelheim, Merck-Serono, AstraZeneca, Janssen Pharmaceutical NV, Novo-Nordisk and Merck & Co, and has overcome most of the issues to do with publications, intellectual property management, and intercompany collaboration.

Given the fragmented and small company-dominated nature of the food sector, another model for collaboration is the two Fuse projects that emerged from the NCUB’s Task Force on the Creative and Digital Industries. These identified the need to coordinate small companies in order to increase their ability to use university research, and for programmes to improve their planning and strategic thinking. It also pointed to the catalysing role of intermediaries.

There are many candidates for open innovation in Food 4.0. They include: harnessing big data and precision agriculture sustainably to double yields; achieving the efficient use of water and the recycling of non-drinking water; the use of manufactured nanoparticles in food production; the convergence with bio-pharma; and the reduction of waste along the chain. The grand challenges of health, well-being and sustainability are fundamental to Food 4.0 and researchers in business and universities must collaborate in multi-disciplinary teams to achieve the necessary breakthroughs in these areas.

Whether innovation is fundamental or incremental, it must involve strategic, structured engagement with the public research base. We call on the funders of that research to build on initiatives, such as the Global Food Security programme, that engage systematically with the sector as a whole rather than just with its sub-sectors.

Agriculture is of necessity regionally specific, and innovation strategies must be sensitive to that specificity. Many of the Local Enterprise Partnerships (LEPs) in England have developed agricultural growth strategies that are supported by research. For example, Agri-Tech East is a £3.2m programme to support the agri-tech industry in Peterborough, Cambridgeshire, Norfolk and Suffolk.

We look to BIS and the Department for Communities and Local Government to support NCUB in providing an information service which allows LEPs to engage with universities and business on local food economy strategies. For their part, universities are willing partners in innovation, but they must intensify interdisciplinary training (both for students and staff), incentivise staff to engage with the food economy, and value staff better who work with industry and create academic ambassadors and champions.

Finally, and in recognition of the complexity of working with universities and the public research base, we look to experts in university Intellectual

41 Academic and universities on the Task Force show, in various ways, how this might be achieved: For example, Nigel Scollan is Waitrose Professor of Sustainable Agriculture and works closely with the Waitrose supply chain; Tim Benton is UK Champion for Global Food Security; Simon Blackmore, Chair in Agricultural Engineering at Harper Adams University, is a regular contributor to television coverage of these issues.
Property to establish an online education programme to simplify and demystify the process. We also look to the online brokerage tools outlined in a previous section to help food businesses find out where university IP is available and how to clear or licence the use of it.

**Recommendation**

The Food Economy research, impact and innovation agenda should be more strongly promoted by all administrations in the UK and by the research funding bodies, and should be more coordinated at ministerial level.

**Contributory Recommendations**

i. Universities and research institutes should publish their mission-based impact strategies for the food economy.

ii. Research Councils to build on the work of programmes such as Global Food Security, and their multidisciplinary Food Security Programme, to establish a Cross-Council approach to the food economy.

iii. NCUB to work with the Agri-Tech Leadership Council to coordinate a Funders Forum that brings together all parties engaged in funding food economy research, and in particular the Government office for Science's Food Research Partnership.

iv. Food economy businesses must engage with research funders by joining University Councils and faculty Liaison Boards, participating in peer-review panels etc. This activity should be actively marketed with companies and time allowed for participation. NCUB will work with others to create a single digital source where these opportunities are offered.

v. NCUB, Research Councils, Innovate UK and the Intellectual Property Office (IPO) to promote the use of IP management tools such as Lambert Agreements\(^4\) and Easy-Access IP\(^4\) to agri-food firms.

vi. As part of its work on smart specialisation, NCUB to market the single food economy vision and plan to LEPs and promote business-university engagement on potential food economy projects.

vii. Research funders, universities and Innovate-UK to promote and develop translators who can move between businesses, universities and research institutes. ADAS, previously the research arm of the Ministry for Agriculture, Fisheries and Food, has provided this service for the environment, agriculture and rural affairs, but with the increased complexity of the food economy, the industry requires more organisations and research teams with translational missions.

Although many of the first four recommendations are as relevant to Scotland, Wales and Northern Ireland as they are to England, we recognise that these parts of the UK have their own unique industrial structures, administrative processes, funding mechanisms and food policies.\(^{44}\) In addition, the connectivity between universities and businesses changes when there are smaller populations and fewer higher education institutions. In this report we have chosen to celebrate success in the devolved administrations, while focussing on collaboration and knowledge-sharing across the UK.

From world-leading whisky production in Scotland to specialist livestock rearing in Wales, there are areas of strength across the UK food economy. Each nation has the opportunity through different policy drivers and structures to maximise its opportunities for comparative advantage, and has the ability to use business-university collaboration in a coordinated and coherent manner. Each Devolved Administration wishes to use food economy innovation and skills to build on its strengths and to help prioritise areas of strategic focus. But businesses operate across the UK, and internationally. So we look to these governments to reduce the impact of duplication, where each of the home countries attempts to specialise in the same part of the

\(^{44}\) We are also conscious of the emerging debate about devolution within the English regions, where the lessons drawn from the devolved administrations may be highly valuable.
food economy, and fragmentation, where the UK as a whole, as well as its constituent parts, fails to make the most of an opportunity, for example for European funding.

**Recommendation**

05 Devolved administrations will wish to create policies and structures appropriate for their own unique systems, but there should be coordination and knowledge-sharing between them to create more shared value.

**Contributory Recommendations**

i. NCUB and the Agri-Tech Leadership Council to work with the Devolved Administrations to share information, intelligence and development plans for innovation and skills, and for university-business collaboration.

ii. NCUB to ensure that its Intelligent Brokerage Platform is connected with intermediary organisations in the Devolved Administrations.
“As a retailer we spend a considerable amount of time with our suppliers, farmers and growers working on our specific supply chains. The addition of landscape scale activities will unlock more value and resilience for everyone involved.”

*Head of Sustainable and Ethical Sourcing, Major Retailer*

Throughout this report, we have emphasised that a successful food industry is a sustainable food industry. Sustainability is embedded in all agricultural policy in the UK and across the EU, and university-business research and collaboration already play their part in ensuring that targets are met. However, there is a specific aspect of sustainability that current policy is insufficiently focussed on, which the market on its own is not currently resolving, and where collaboration is key – namely, management of the landscape.

**Why Landscape-Level Cooperation?**

Farmers and growers need to make a profit to remain in business, and they are at the base of the agricultural food chain. But the production of food competes with other industries for land, water and energy, and impacts on the environment in many ways, such as the emission of greenhouse gases, the amount and quality of water it uses, its impact on biodiversity in the countryside, and its effect on human health.
As well as being fundamental to the food sector, agricultural landscapes have significant cultural, amenity and recreational value, and provide habitats for biodiversity. These services often arise not from management of single fields or farms but from all land management in an area. For example, downstream flood risk may depend on all upstream farms. Or to give another example, a pollinator such as the bumblebee will not stay within the confines of one farm (even if it could recognise property boundaries), but will use different resources such as food or nesting sites within a larger land area. Moreover, it will use resources differently at different times of year. A single farmer’s activities will not provide enough resources to maintain viable populations of wild pollinators, which need different types and patches of habitat scattered across a whole landscape. We call the view that emerges from the approach the landscape perspective on land use.45

Governments around the world are responding to these challenges. In 2014, DEFRA noted that: Ministerial priorities of (i) growing the rural economy and (ii) improving the environment often come into conflict46.

At a practical level, DEFRA offers Environmental Stewardship grants to farmers to deliver effective environmental management of their land47. But more fundamental research and knowledge exchange are required to make the dramatic shifts in performance needed for Food 4.0. To investigate ways of increasing farm productivity whilst improving environmental performance, the department has invested £4.5m in three interlinked research projects to establish a Sustainable Intensification Research Platform (SIP)48. This will consist of a physical network of agricultural study sites in England and Wales, and a community of collaborating agricultural, environmental and socio-economic researchers from over thirty organisations.

Other landscape-level initiatives include a £70m strategic collaboration between the Bill and Melinda Gates Foundation and the UK’s Department for International Development (DFID)49. This will focus on near-market R&D which aims to get the benefits and outputs of research into widespread use quickly to improve nutrition, food security and incomes. It will aim to translate known science into technological solutions for use by researchers, crop breeders, development programme workers and farmers in developing countries. Finally it will commission high pay-off, higher risk, high-impact research on global scientific priorities.

The collaboration’s near-term projects are protection against a rapidly-spreading stem rust disease attacking wheat; cheap, effective and simple, paper-based biochemical test kits for use in the field; increasing rice yields by 50% and water use efficacy by 100%; the development of new varieties of maize that are better adapted to Africa’s nutrient deficient soils; and faster genetic gains for improved yield and stress tolerance in important tropical legume crops including groundnut, cowpea, common bean and chickpea.

Innovate UK’s Sustainable Agriculture and Food Innovation Platform aims to invest £90 million over five years to stimulate the development and adoption of new technologies that improve the productivity of the UK food and farming industries, while decreasing their impact on the environment. The priorities are crop productivity, sustainable livestock production, waste reduction and management, and greenhouse gas reduction50.

45 This is based on the Task Force’s Working Group Report. www.ncub.co.uk/landscapecollaboration
47 www.gov.uk/environmental-stewardship#overview
48 www.exeter.ac.uk/news/featurednews/title_415125_en.html
49 http://r4d.dfid.gov.uk/Project/60792/Default.aspx
50 https://connect.innovateuk.org/web/sustainable-agriculture-and-food-innovation-platform
All three of these programmes show that universities and research institutions are natural partners in sustainability and landscape-scale analysis. Their fundamental research projects need not bring any immediate financial benefit, so that universities can take risks with time and resources that are beyond the reach of individual businesses or farmers. But, as a Major Retailer notes at the head of this section, business has a vested interest in landscape-scale cooperation. The Task Force’s working group on land use investigated practical ways of developing joint projects that would increase the value for business of landscape collaboration, whilst at the same time increasing beneficial environmental outcomes.

**Landscape Signals and Cooperative Behaviour**

The focus of many sustainability initiatives is agriculture – and mainly farms. But as we noted earlier, broader ecosystem needs must be integrated into sustainable solutions for landscape management. This approach comes into sharp relief in cases where the benefits of cooperation (or the risks of not cooperating) are at their clearest. Examples include increasing pollination, controlling pathogens and trading water (see appendix 3). Linking the delivery of public goods such as amenity and leisure to agri-environment policy increases the potential to develop an integrated approach to the management of the landscape that will benefit farmers, businesses and the rest of society.

Our interviews with retailers have confirmed their desire to reduce the risk to their supply chain, and to enhance their reputation and goodwill by engaging at a landscape level. Furthermore retailers compete for strong farmer relationships and their biodiversity, water use and waste management are part of their marketed points of difference. Despite this, unrealised business opportunities exist for coordinated action between growers supplying different product categories. Collectively, they can address production challenges and achieve sustainable UK-wide intensification of agricultural output. The landscape-level approach could optimise decisions by whole groups of farmers, and along the supply chain. It could also address shared production risks from landscape signals such as pest infestations, pollinator loss, soil management, water availability and biodiversity.

**Business-University Collaboration on Landscape Signals**

Civil society and regulatory agencies are already responding to these challenges, and offer models to the business sector (see box 2).

Our analysis of these existing landscape initiatives shows that landscape signals foster collaboration. Most cases involve more than one such signal. In Food 4.0 the food sector needs to be better at this kind of collaboration, while universities and research organisations can be strategic delivery partners in developing collaborative solutions for business and government.

Researchers are used to examining complex information and data sets, and can play a key role in identifying, capturing and interpreting landscape signals. Furthermore, the complexity of the landscape approach requires different ways of collaborating. The ability to keep diverse interests working together constructively is not straightforward, and the role of an effective, often independent, facilitator is essential to success. Universities must work with businesses to grow the knowledge, skills and experiences required to develop the landscape approach.
Box 2: Landscape initiatives responding to landscape signals

Existing landscape initiatives illustrate these landscape signals. Note that all of them respond to multiple rather than single signals:

**Signals: Water Quality and Flood Risk**

The Poole Harbour Catchment Initiative began as a pilot project in 2012 as the Frome & Piddle Catchment Initiative. In 2013, its boundary was extended to include the whole catchment, incorporating all rivers and streams that drain into Poole Harbour. One of the principal motivations for the initiative was that aquatic biodiversity was failing to meet Water Framework Directive targets, largely because of nitrogen and phosphorus pollution and high rates of water abstraction.

The Dee Pilot Catchment's primary aim is to reduce flood risk through river channel restoration. It is one of four pilot catchment projects being undertaken by the Scottish Environmental Protection Agency. The work is in the detailed preparation stage, with the implementation of management activities expected in 2016.

**Signal: Biodiversity Conservation**

Many initiatives are explicitly responding to biodiversity conservation as a primary goal. Examples include the Poole Harbour Catchment Initiative (see above), within which is the Frome River SSSI and which lists improved biodiversity habitat as one of its primary aims. The Lincolnshire Coastal Grazing Marshes Partnership (Annex 3) is responding in part to the impact of the loss of traditional grazing land on birdlife and rare plants.

The 'Living Landscapes' approach of the Wildlife Trusts aims to work in partnership to improve the value of landscapes for biodiversity. This approach was launched in 2006 and includes 150 landscapes. For example, the Gwent Levels living landscape covers one of the largest surviving areas of ancient grazing marshes and reen (drainage ditch) systems in Britain, and is home to many species of bird and mammal. The aim of the initiative is to restore and create wildlife, and to increase the connectivity between habitat patches by working with farmers.

**Signal: Cultural Heritage**

The Inner Forth Landscape Initiative (IFLI) covers 202km² of land around the River Forth, its estuary and inter-tidal zone. The overarching signal it is responding to is heritage. The aim is to conserve and restore the built and natural heritage features that define the Inner Forth Landscape, increase community participation in all areas of local heritage, increase access to the landscape and education about its heritage, and increase training and development opportunities in heritage skills.
The Task Force's working group on land use offers a working model for this action-oriented research.

Box 3: 
**Six steps to landscape collaboration**

<table>
<thead>
<tr>
<th>WHAT</th>
<th>WHY</th>
<th>WHO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prioritise an area</td>
<td>Establish where significant</td>
<td>Bus. or Bus. &amp; Uni. or Civil Society</td>
</tr>
<tr>
<td>Assemble spatial data</td>
<td>interest might be</td>
<td>Uni.</td>
</tr>
<tr>
<td>Expert input</td>
<td>Identify landscape signals</td>
<td>Uni.</td>
</tr>
<tr>
<td>Consult on the ground</td>
<td>Decide whether signals</td>
<td>Bus. &amp; Uni.</td>
</tr>
<tr>
<td></td>
<td>are strong enough to add value</td>
<td></td>
</tr>
<tr>
<td>Stop / go</td>
<td>Diagnose information</td>
<td>Bus. &amp; Uni.</td>
</tr>
<tr>
<td>Identify gaps and collaborators</td>
<td>and people still needed</td>
<td></td>
</tr>
<tr>
<td>Implement</td>
<td>Create structure, facilitation,</td>
<td>Bus. &amp; Uni. and Others</td>
</tr>
<tr>
<td></td>
<td>vision and actions</td>
<td></td>
</tr>
</tbody>
</table>
The Task Force offers the following recommendation on collaboration to maximise landscape use:

**Recommendation**

Universities, businesses and government must collaborate to deliver sustainable land use at the landscape level. Agri-businesses must address the challenge that farm management poses for landscape level outcomes. For example, no single farmer may be responsible for the loss of bees from a landscape, but collectively their actions may ensure it. DEFRA and the devolved administrations must ensure that the regulatory instruments for which they are responsible are aligned with this objective and provide signals which encourage collaborative action.

**Contributory Recommendations**

i. Universities and research councils must engage land management businesses in the development of research on sustainability and landscape-level ecosystems, as well as developing the interdisciplinary skills required to coordinate landscape research.

ii. Businesses to work with universities to help identify and use landscape signals as a practical way to collaborate and address sustainable land use.

iii. Businesses to move towards more open data on supply chains, and collaborate at landscape levels on a pre-competitive basis to realise new benefits and manage risks.

iv. Universities to work with businesses to develop cross-discipline courses that develop a pipeline of new professionals with the understanding and skills needed to foster the landscape approach.

v. DEFRA to incentivise landscape level programmes on sustainable land and water use and consider the use of current programmes, such as the Rural Development Programme, to do so.
Conclusions

This Task Force was convened to reflect on the talent, skills, innovation and research needs of businesses across the whole food economy, and the most effective methods of increasing collaboration with universities and research institutes. If the measures we have advocated are adopted we believe that the UK can be a global leader in Food 4.0 and meet the twin goals of increasing the competitiveness of UK Food Plc whilst at the same time reducing its environmental impact. Not to do so will be to risk food insecurity and the decline of a sector that is one of the UK’s great success stories.
CASE STUDIES
Scotland Food and Drink (SF&D) was established in 2007. It is a not-for-profit organisation created to guide food and drink companies of all sizes towards increased profitability. It aims to grow the industry to a value of £16.5 billion by 2017, from £10bn in 2007 and £13.9bn in 2012.

Over the past five years, food and drink has become the best performing sector of the Scottish domestic economy, and its fastest growing area for exports. It is regarded as a key part of the Scottish economy, and is one of seven growth sectors in the Government's Economic Strategy. The economic growth strategy for the industry produced by Scotland Food & Drink was the first comprehensive strategy developed jointly between industry and government.

Scotland Food & Drink is industry-led, and its Executive Group comprises the CEOs or senior directors of all the sector's major trade associations. It is also supported by the Scottish Government and its agencies, which are key partners. Initially pump-primed with public sector funding, the majority of its core funding now comes from the private sector, mainly through membership subscriptions from 350 member companies and organisations.

SF&D chief executive James Withers says that collaboration has been the key to success, bringing sectors of the industry together with a single set of targets, redefining working relationships and involving government as an integral component of the initiative. SF&D does not consider itself as a lobbyist, but as a partner with the public sector. This partnership invests jointly in growth initiatives, such as a new £4.5 million export plan.

Innovation was recognised as a key focus for SF&D at an early stage, and this realisation pointed to the need for a culture change in terms of innovation spending. Food and drink lagged behind the rest of the economy in terms of R&D investment. Only around 0.25% of Gross Value Added was invested in R&D, half the average for other sectors. The target for 2017 is to triple this investment to 0.75% of GVA, and the industry is on track to meet this ambition. SF&D has identified drivers of innovation including producing more with less, sustainable systems, new marketing opportunities (e.g. nutrition and healthier food) and export markets. The Food and Health Innovation Service has worked with companies on the development of healthier products.

A number of innovation initiatives have been established on the back of the SF&D strategy. INTERFACE (www.interface-online.org.uk) is a translation service that business can use to link through to Universities and Research Institutes. But Withers adds that the Scottish Government’s Rural and Environment Science and Analytical Services Division (RESAS) could provide more financial support for knowledge exchange. He values blue skies research, but sees room for improvement in translator mechanisms. SF&D has organised conferences for industry engagement with the research sector. These are more effective than academic fora where industry was invited but not always fully engaged.
The food and drink industry faces strong competition for engineers, with the aerospace and automotive sectors being first choice for many. To help address this issue, the Food and Drink Federation (FDF) and the National Skills Academy (NSA) set up a competition inviting universities to develop a food engineering programme which would raise the profile of the sector and help feed the future talent pipeline of the food and drink industry. The MEng Food Engineering proposal put forward by Sheffield Hallam won.

FDF, NSA and Sheffield Hallam University started raising the profile of this course with year 12 students choosing degree courses in May 2013. The first intake of 20, a worthwhile number for any new degree course, arrived in September 2014. As awareness of the course rises, the number of students taking it is expected to increase. FDF offered a £2500 bursary to all first year students in 2014, and will repeat the offer on a limited basis in 2015. Students joining the course generally have A-levels in Maths and two sciences.

Students on the course are guaranteed competitively-paid industry placements which expose them to various aspects of the whole supply chain. Industry has been supportive in offering placements, and there are more available at present than there are students taking the course. During their course, students gain 54 weeks’ experience with some of the industry’s top brands, such as Coca-Cola, Mars, McCain Foods, Nestlé, PepsiCo, Premier Foods and Warburtons.

“The Food and Drink industry needs to attract engineering talent to drive its growth potential. Graduate engineers who join the industry from traditional degree courses can take some time to learn about the particular requirements of our sector, for example working with natural variations in ingredients, and understanding the role engineers play in food safety. The new Master's degree has a curriculum which is tailored to the needs of the industry. It will deliver the new talent the industry requires and we are proud to have played our part in making it happen.”

Richard Martin, Technical Director, Nestle UK&I, Chair of Graduate Excellence

“We're proud to support the MEng Food Engineering degree at Sheffield Hallam University. Our industry needs high-end talent to lead our engineering into the future. We need people skilled in science, technology, engineering and maths to develop the wide range of products we enjoy every day, and to drive innovation in the food and drink industry.”

Ian Rigby, Engineering and Operations Manager, PepsiCo

“Innovation is critical to the competitiveness of the food industry and I’m passionate about encouraging home grown engineering talent that will help inspire future growth. The new MEng Food Engineering course at Sheffield Hallam University is a triumph of collaboration between academia and industry, and provides an excellent blend of academic study supported by industrial placements and professional mentoring.”

Gavin Darby, CEO of Premier Foods and Chairman of the Industry Advisory Board for the National Centre of Excellence for Food Engineering at Sheffield Hallam University
In 2012 Harper Adams University launched the National Centre for Precision Farming. The aim of the Centre was to work with the farming and food sectors to help develop new technology-based applications in agriculture to improve productivity and better protect the environment.

Harper Adams has the UK HE system’s only department of agricultural engineering, so there was also a role for the Centre in ensuring the department kept pace with advances in other disciplines such as sensor technologies, big data and machine to machine connectivity to capture ideas that were relevant to agricultural practice and the wider food economy.

In September 2012 the University was awarded the first HEFCE Catalyst Fund grant to create a £2.93m Agricultural Engineering Innovation Centre (AEIC), a multi-purpose building housing mechatronics teaching accommodation, ‘clean’ engineering laboratories for larger scale agricultural machinery and space for the development of new agricultural drones, robots and related software. An essential part of the case for investment was the support provided by the Marches Local Enterprise Partnership from its Growing Places Fund. The Growing Places award was linked to job creation and, with the support of the agricultural engineering sector, all targets in this area have since been achieved.

The building was completed in September 2013. It has led to new collaborations with major engineering companies; helped support the University’s work on other research projects, notably its long-term trials on controlled traffic farming to improve the management of soil and water resources; and has been the venue for several events aimed either at encouraging young people to consider a career in the agricultural engineering sector, or introducing farming and food sector representatives to new technologies. The University’s students using these facilities have also been successful in the European ‘Farming by Satellite’ competition, taking first and second places in 2013 and second place in 2014.

The AEIC has enabled the department to grow its research activity, with four successful bids to Innovate UK in the last year, and the first award from the national Agri-Tech Catalyst Fund towards the end of 2014. Some of these projects, such as a laser-weeding system and the use of sensor technologies in dairy production, have the capacity to radically alter the way in which food is produced and our environment is managed.

The University and LEP have collaborated again to develop the AEIC into a proposal for an Agricultural Engineering Innovation Park, this time located at the edge of a town close to the University. The concept, supported by several global agricultural engineering businesses, is at an early stage, but if successful it will lead to the creation of an innovation hub for smaller companies working in advanced technologies to co-locate, work with the University and engage with larger agricultural machinery manufacturers. The Government’s Science and Innovation Strategy highlighted the importance of, place, where people and organisations benefit from mutual proximity. This is an approach that Universities and LEPs will be able to address as both parties recognise the benefit of collaboration to drive economic growth in the Food 4.0 revolution.
Waitrose has initiated a professional training programme to raise understanding of a broad range of food chain issues in partnership with Lancaster University. The Lancaster Environment Centre has a strong international reputation for work in sustainable agriculture and food security, and is committed to raising understanding of food system challenges, particularly with young people.

Our motivation for this course is the global challenge to make food available to a population which will probably rise beyond 9 billion within the next 30 to 40 years, and to support this number of people in active and healthy lives.

This extra food must be produced in the context of a changing climate and with reduced usage of a range of resources required for crop production. Nearly all are already in short supply, including land, water, fertilisers, energy and labour. As economies grow, people want to eat more and they want to eat differently, often aspiring to a more meat-rich and resource-demanding diet. In addition, more people now live in cities. These social changes constitute significant challenges for those committed to supply more good-quality food to more people. Responsible food suppliers and retailers in the UK and elsewhere realise the importance of these concerns.

Waitrose, and its Agronomy Group, are committed to the responsible sourcing and supply of food. They recognise that it is important to raise understanding of food security issues along the supply chain and more generally. It is also important to develop best practice in the supply chain.

**Waitrose Postgraduate Professional Training Programme**

The course is intended to address these and related challenges. It is built upon a ten-year association between Waitrose and Lancaster University which has involved the development of innovative training courses and support for targeted research.

BBSRC has provided funding through its Modular Training Partnerships programme to enable us to build and deliver the first two modules in the course.

The programme will be open to all, but will be focussed upon staff from the John Lewis Partnership, Waitrose’s parent organisation, and suppliers who are involved in the production and supply of fresh produce for Waitrose.

**Postgraduate Courses in ‘Food Challenges for the 21st Century’**

This topical and unique new course provides flexible and accessible postgraduate training which is focused on food chain issues and on the challenges provided by the Perfect Storm of water, energy and food shortages envisaged by Sir John Beddington (Beddington, 2009).

The course modules reflect the interdisciplinary nature of the challenges faced by those working in the food chain. Students can choose to study a diverse range of topics identified by both academic and business providers as key to addressing food security challenges which exist now and which will develop in the future.

Delegates will benefit from the expertise of Lancaster’s world-leading environmental, bioscience and social science researchers and trainers, from industry-leading technical expertise drawn from within the Waitrose supply chain, and from additional contributions from leading practitioners, consultants and researchers from other key institutions.

Flexible delivery of the course, mostly on-line, enables students to continue working whilst studying. It leads to a Postgraduate Certificate with options to progress to a Postgraduate Diploma or an MSc.
Bright Crop started life as a Business in the Community initiative before being brought under the management of Farming and Countryside Education. It sought to address the problem, identified by numerous research reports, that the vast majority of young people would not consider a career in food and farming. In some cases this was due to pervasive negative perceptions of the sector, but more often it was due to a complete lack of awareness, particularly of opportunities available beyond the farmyard, such as engineering and trading roles.

Bright Crop is structured around three key principles – it seeks to inspire young people to find out more about what the agricultural sector could offer in terms of careers, to inform influential advisors such as teachers about the diversity of opportunities and pathways available and to connect schools with the industry as it is today, not as it has been perceived to be in the past.

The whole of the agricultural industry, at an individual and organisation level, is passionate about communicating the benefits and opportunities available to young people, something which is evidenced in the support of Bright Crop’s sponsors. Part of Bright Crop’s service to schools and young people is to unify all the voices that come from within the industry to ensure that they project a clear, engaging picture of what the sector can offer.

The central delivery mechanism of Bright Crop is the Ambassador programme, which mobilises industry employees to talk about their job and their career path in such a way that will inspire young people to consider a career that they perhaps hadn’t known about before. Amongst other sources of information such as the internet and teacher-led sessions, research shows that industry ambassadors are a source of information that is considered to be both trustworthy and engaging by young people.

For sponsor organisations such as Cargill, Bright Crop offers a bespoke package, tailored to their specific business capabilities and facilitating their connection between business and education. A member of staff coordinates the delivery of the Ambassador programme for their employees, providing training, resources and expertise. We also support Corporate Social Responsibility commitments and ensure our partners are informed about developments in the changing educational landscape.
Despite being Britain's largest private sector employer, the food industry struggles to attract and retain good science graduates. It is vital to recruit them if the industry is to have the necessary talent to tackle the technical challenges of food production in the future.

Despite recent growth, food science courses still have fewer applicants compared to other sciences. Students, teachers and parents are also often unaware of the career opportunities available in the food industry.

IGD’s Technical Leadership Forum (TLF) comprises technical directors from major food and drink retailers and manufacturers. Having experienced the industry’s skills gap first hand, this group wanted to address the issue collectively through food science summer schools.

The food science summer schools help to address the technical skills shortage by making students aware of the careers to which food science can lead, and providing a taster to food science degrees via educational, fun activities demonstrating practical processes such as product development. The aim is to dispel the perception that food science is ‘all about cooking’, and to show that it covers complex science with very practical application.

The summer schools are for students in Year 11 or Year 12. The students are already strong scientists and often have an interest in food. Places are free due to initial funding from TLF and subsequent sponsorship from the industry.

Since 2010, 540 students have attended the food science summer schools. Feedback has been positive:

- **98 per cent** of students agree or strongly agree that they understand more about food science
- **76 per cent** state they would like to study food science at university
- **81 per cent** state they would like a future career working in the food industry

Many summer school attendees have gone on to study food science and joined the food industry. Of those who attended the University of Leeds summer school in 2013, 55 per cent applied to study food science and related subjects. The TLF has pledged to set up a further two schools.

Paul Willgoss, Technical Director at Marks & Spencer, said: “Seeing first-hand the shortage of bright science graduates applying for jobs in our industry, the food science summer schools are invaluable in raising awareness of the importance of food science and related degrees, as well as showcasing the career opportunities they can lead to.”

If your organisation would like to get involved or for more info contact: Hannah.Pearse@igd.com

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**Example Agenda**

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Ice cream ice breaker</td>
<td>• Factory tour</td>
<td>• Physics of a melt in the middle</td>
</tr>
<tr>
<td>• Sensory activity</td>
<td>• Processing effects on orange juice</td>
<td>chocolate pudding</td>
</tr>
<tr>
<td>(identifying supertasters, sensory booths)</td>
<td>• Microbiology (yogurt under the microscope)</td>
<td>• Pizza design (specification, HACCP,</td>
</tr>
<tr>
<td>• Campus tour</td>
<td>• Meal with current students and</td>
<td>sensory and marketing)</td>
</tr>
<tr>
<td>• Dinner in halls</td>
<td>recent graduates</td>
<td>• Careers talks from industry</td>
</tr>
</tbody>
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54 | Leading Food 4.0 Growing Business-University Collaboration for the UK’s Food Economy
1. Is there a mechanism to capture value from basic research so that it can benefit growers and the food industry?

The US Land Grant University (LGU) system consists of universities in each state where professors conduct agricultural research and education programs. This century-old model, using public funds for public good, created value from producer to consumer. One example is potato storage research that extended the storage life of potatoes, reducing waste in the entire marketing chain.

Until recently the system has not included private property rights. LGU information, technology and varieties were available to the public at no fee. The system has evolved to include property rights that can help create even more value. For example, potato varieties developed at LGUs may now be licensed with the right to collect royalties.

2. How are industry research needs identified and funded in the public sector. Is the mechanism effective?

The LGU system uses advisory committees to help identify needs. Selected industry volunteers serve on advisory committees for potato conferences. Emerging problems are effectively identified and discussed at these conferences.

Through the LGU system, special needs funding is available. When potato Zebra Chip became a problem a group of LGU faculty in several states submitted a proposal to USDA for funds to conduct ZC research and extension programs. The ZC project was funded for five years, which indicates that the mechanism effectively develops programs that solve current problems.

3. In the USA there are regional meetings/conferences between growers and academia.

Are they good models for knowledge exchange?

There is a long history of regional US potato conferences but there has been some consolidation. The shrinking numbers of potato growers and efficiency for vendors have been two drivers. In the Pacific Northwest there were eight to nine annual potato conferences in Idaho, Washington and Oregon. Now there two, one in Washington and one in Idaho.

There is an emerging trend of proprietary conferences. These are educational programs designed for customers of an agribusiness. Processors, lenders and farm input suppliers develop their own conferences exclusively for their growers. It can be a brand-differentiating tool for firms to compete for the best growers. It is similar to the UK’s Cambridge University Potato Growers Research Association (CUPGRA) programs in which education is available to growers who are in the “club” (dues-paying members).

4. Any general comments you might have on what you consider to be the major drivers and barriers to innovation and translation of science.

One driver is plant variety property rights. US lagged behind EU in developing laws that allowed for ownership of plant varieties, but US corn and soybean farmers now plant mostly private GM varieties. For those crops intellectual property rights provided a financial incentive that accelerated research and development.

One barrier has been activist resistance to accept biotechnology in some parts of our food system. Greenpeace and other NGOs that want to be technology gate-keepers have delayed research and development in some crops.
SUSTAIN Lincolnshire is a partnership between the University of Lincoln’s National Centre for Food Manufacturing (NCFM) and Lincolnshire County Council, and is supported by the Council and the European Regional Development Fund. It encourages Lincolnshire’s small and medium sized food and engineering businesses to achieve sustainable growth, attaining resource efficiency while eliminating or reusing waste products.

Businesses qualify for membership of SUSTAIN by being SMEs located in Greater Lincolnshire and being engaged in food manufacturing or engineering.

A unique aspect of the project has been the support of larger companies, many of which have already applied resource efficiency techniques and the circular economy philosophy to their businesses. These exemplars have shared their experiences with smaller companies at regular networking meetings organised by the NCFM. These meetings have also established strong business relationships between large companies with waste streams, and smaller companies that can utilise that waste.

This peer to peer learning has proved effective in sharing knowledge and creating ideas for innovation. In addition, SUSTAIN has helped SMEs which have never had contact with knowledge centres in the past to use NCFM for business advice, environmental audits, access to equipment and assistance in accessing funds.

An example is Lincolnshire preserve maker, A Little Luxury. This small firm has been able to grow, save money and become more green by working with SUSTAIN.

Linda McWatt from NCFM was appointed as SUSTAIN consultant for the project and helped develop a strategy to reach sustainable growth targets faster than A Little Luxury had anticipated. The key to reaching these targets was to embrace the circular economy philosophy. To do this, Linda facilitated a collaborative relationship between the firm and a large local fruit distributor. Less than perfect apples and pears, which did not meet stringent supermarket specifications and which constituted waste for the fruit distributor, became an input to A Little Luxury’s production process. This symbiotic relationship embeds both companies in the Lincolnshire green supply chain and in its circular economy. In addition, a dozen new products were introduced after support from the NCFM helped develop new recipes for the newly-sourced fruit.

The company has increased output by 500% in two years, and turnover by 300%. And less usable fruit is going to landfill in Lincolnshire.

The SUSTAIN project has provided practical assistance to help many small companies reach their goal of sustainable growth. But its wider success, which is set to continue, has been in establishing the philosophy of the circular economy with companies of all sizes.
The Centre for Process Innovation is a UK-based technology innovation centre and part of the High Value Manufacturing Catapult. We use applied knowledge in science and engineering combined with state of the art facilities to enable our clients to develop, prove, prototype and scale up the next generation of products and processes.

Our open innovation model enables clients to develop products and prove processes with minimal risk. We provide assets and expertise so our customers can demonstrate the process and prove it is feasible before investing substantial amounts of money in capital equipment and training. New products and processes can be proven; on paper, in the lab and in the plant before being manufactured at an industrial scale.

By utilising our proven assets and expertise companies can take their products and processes to market faster. There is no down time in production as all of the process development is completed offsite and our technology transfer teams can help to transfer the product or process into full scale production.

What we offer:
- Product and process development
- Prototyping, demonstration and scale up
- Fabrication and pilot production
- Fuel, feedstock and materials investigation
- Manufacturability and process assessment
- Process modeling and consultancy
- Business and funding support
- Incubator space

An Exemplary Agri-food Project

Quorn is embarking on a project in collaboration with CPI to develop a process for both reducing effluent waste as well as recovering valuable products for which there is a market demand.

When the initial steps for the project are complete, it is hoped that subsequent work will focus on further opportunities to extract other high value products from the same waste stream, both decreasing the cost of disposal while increasing revenue by recovering high value products from waste. This project is ongoing.
The food and drink industry is Scotland's largest manufacturing sector, with a £9bn turnover and employing around 50,000 people. Challenging targets have been set for growth, and it is recognised that they can only be achieved by supporting a culture of innovation, within large manufacturing businesses and among the small and micro businesses which make up the supply chain.

Interface – The Knowledge Connection for Business www.interface-online.org.uk provides Scottish SMEs with a central point of access to the expertise of Scotland's Higher Education and Research Institutions. Over the past three years it has assisted more than 300 SMEs from the food sector. The team offers companies a bespoke service of research translation and brokerage intended to match their business need to the most appropriate academic expertise. Projects range from testing the feasibility of an initial concept to re-formulating a product for global markets.

Two recent emphases for its work have been healthier food and the need to reduce waste. Lightbody, the UK's leading supplier of celebration cakes, is working with the University of Strathclyde to adopt hyperspectral imaging to reduce wastage, by quantifying the eating quality performance of sponge cakes over their shelf life and increasing the overall life of the product. This is consistent with Lightbody's strategy to minimise expenditure through waste.

To encourage step-change innovation, the Interface team has united over 100 food and drink companies in seven Common Interest Groups. They bring businesses and academics together to solve industry-wide challenges, and provide critical mass to respond to UK and European calls for funding. They include the Scottish Rapeseed Group, the Industry Advisory Group on Resource Efficiency, the Scottish Craft Distillers Association and the Sea Buckthorn Common Interest Group.

Interface has facilitated collaborations which have led to the introduction of new products and processes, and access to new home and export markets. Macphie of Glenbervie has achieved over £1m in sales and cost savings from collaborative projects with eight academic institutions. Smaller companies have also benefited from funding administered by the team including the Scottish Funding Council Innovation Voucher scheme, Industrial Masters or PhD Studentships, and the annual Interface Food and Drink Competition.

These partnerships are also good for universities. They have gained ideas for new R&D projects, improved their understanding of business requirements, and developed a culture of knowledge exchange.

Advanced Microwave Technologies (AMT) is a small company whose unique technology is an alternative to conventional cooking methods for the food and drink industry. Collaboration between Queen Margaret University (QMU) and AMT began as the result of an Interface inquiry. The partnership has grown beyond the initial project to determine the nutrient content of raw fruit juice treated at different temperatures. The partners have won further Innovate UK funding to investigate the impact of salt reduction on flavour and shelf-life. The company has now established a demonstrator unit on the QMU campus within the newly opened Centre for Food Development and Innovation, as a focal point for other SMEs to underpin new product development by scientific research.
I firmly believe that more could be achieved through the effective use of what we term the Innovation, Research and Technology (IRT) sector, particularly those Research and Technology Organisations (RTOs) that are already well connected to industry and universities. They perform a valuable translational role. A recent report by Oxford Economics (2014) indicates that the sector’s turnover is £6.9 billion and that it directly employs over 57,000 staff, similar to the total academic staff at the Russell Group of universities.

A key organisation is AIRTO, the Association for Independent Research and Technology Organisations, which is the foremost membership body for organisations operating in this sector. AIRTO’s members deliver vital innovation and knowledge transfer services which include applied and collaborative R&D (frequently in conjunction with universities and academic groups), consultancy, technology validation and testing, incubation of commercialisation opportunities, and early stage financing. Most of AIRTO’s members operate in the important space between pure research and the pull of the market for the commoditisation of knowledge into new products and services.

A number of AIRTO members are specifically focused on supporting the agri-food sector (including Campden BRI, Leatherhead Food and SWRI), or bring specialist expertise to the sector.

Campden BRI is specifically focused on the agri-food sector and has been working on translational research for 95 years. We have over 2400 companies in 70 countries in membership (i.e. they pay an annual fee). These range from large multi-nationals to SMEs and cover the entire agri-food chain from agri-chemical and seed companies to growers, storage, manufacturing, retail and food service. The majority of their membership fees are pooled to form a pre-competitive fund for R&D with an annual budget of over £2 million. Project proposals are identified with the industry and are selected from the votes cast by industry. Some 800 votes are received each year. This gives an unparalleled engagement with the end user audience.

Essential to this process is a series of scientific and technical member-interest groups (MIGs), which are led by the industry. These bring together members across the food chain to discuss common issues by discipline, process or sector. The groups range from those dealing with agriculture and growing to the consumer and sensory sciences. They attract about 800 man days from industry per annum and provide an invaluable insight into the needs of the sector/discipline/process and their pre-competitive needs.

On a three-year basis we formally consult with the industry to identify the innovation needs of the food and drink supply chain, with the most recent version published in January 2015. This is the only UK consultation done exclusively by the industry for the industry. It influences the direction of our own business, and is widely circulated to others who fund or work in this area.

Professor Steven Walker, Director General
The Division of Signal Transduction Therapy (DSTT) was founded in 1998 by Sir Philip Cohen and Professor Peter Downes at the University of Dundee. The concept grew from their recognition that signal transduction was becoming important to the global pharmaceutical industry, that the University of Dundee was leading research in this field and that pharmaceutical companies could see the value in getting access to this research.

DSTT is amongst the world’s largest collaborations between academia and the pharmaceutical industry. It includes 15 research teams based at the University of Dundee (13 based in the The Medical Research Council (MRC) funded Protein Phosphorylation and Ubiquitylation Unit (MRC PPU) and the Scottish Institute for Cell Signalling (SCILLS). Industry and academic scientists working in the kinase and ubiquitylation fields carry out early-stage research in areas including cancer, arthritis, lupus, hypertension and Parkinson’s disease.

Since its conception the DSTT has attracted over £50 million in funding. Further core support of £14.4 million in 2012, helped to secure 50 research posts. DSTT is widely regarded as a model for how academia and industry can interact productively and is frequently cited by pharmaceutical companies at technology transfer events as a model of best practice.

DSTT is an early example of open innovation, where partners work together sharing risks, costs and outputs rather than competing, although the model also provides for one-to-one interaction between a partner company and the University on a confidential basis.

Five or six pharmaceutical companies are usually involved at any one time in DSTT. Companies share the costs and in return are given first call on developments from the DSTT, but the main benefit to them is close interaction with the scientific groups and other partner companies, and the advice, opinions and foresight of leading academics such as Sir Philip Cohen and Professor Dario Alessi.

The companies visit Dundee three times a year for scientific presentations, one-to-one consultations and a business meeting. A company meeting, which addresses topics of mutual interest to the pharma companies is used as a forum to showcase potential new drug targets from University labs both within and outside the DSTT consortium.

To facilitate the transfer and management of Intellectual Property, a structure is in place which includes option agreements, upfront licences and standard licence terms. The University’s Technology Transfer Office provides business management and support for the DSTT and helps facilitates new relationships between the companies and Dundee.
**Brighton Fuse**  
*Superfused companies embedding digital skills*

The Brighton Fuse project brought together the universities of Brighton and Sussex, the National Centre for Universities and Business, and Wired Sussex in a project to increase creativity and business success by connecting the arts, humanities and design with digital and ICT. Wired Sussex’s 2600 members, primarily small and mid-sized businesses, became key partners in research funded by the Arts and Humanities Research Council.

Key findings were:
- Digital entrepreneurs were as likely to have an arts and humanities degree as much as STEM.
- They network frequently and place great emphasis on creativity and innovation.
- Interdisciplinary skills are key to the continued growth of the creative digital economy and universities must be more innovative in course design.
- Small firms must articulate their skills needs to universities.
- ‘Superfused’ businesses embed digital technology skills throughout their operations.
- A diverse ecosystem of private firms, together with public sector and University involvement, can assist in reusing and diffusing knowledge within a local context – particularly if independent ‘brokers’ (such as Wired Sussex) are able to assist in coordination to generate mutual economic benefits and champion a cluster's sense of identity and brand to regional and international audiences.

For more information, visit:  
[www.ncub.co.uk/what-we-do/brighton-fuse](http://www.ncub.co.uk/what-we-do/brighton-fuse)

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**London Fusion**  
*Providing business support and inspiration*

London Creative and Digital Fusion was a programme of interactive, tailored support designed to help London’s creative and digital small and medium-sized businesses collaborate, innovate and grow.

Part-funded by the European Regional Development Fund, the Fusion programme aimed to inspire by hosting talks and events with leading speakers to spark ideas for innovation. The programme facilitated networking and collaboration opportunities with other businesses as well as providing access to experts on emerging trends.

The initiative offered practical support through mentoring, student projects, entrepreneurial learning and training in specialist areas such as service design and management for innovation. It also included tailored support in the form of Innovation Vouchers for 3-6 month projects which give companies access to student resources, academic time and university resources from a wider network of 19 Higher Education Institutions.

**Partnerships**  
*The project was delivered in partnership with:*
- Queen Mary University of London
- Centre for Creative Collaboration (University of London)
- Royal College of Art
- Lancaster University
- Imagination Lancaster
- The Work Foundation
- National Centre for Universities and Business

For more information visit:  
[www.ncub.co.uk/what-we-do/london-fusion](http://www.ncub.co.uk/what-we-do/london-fusion)
Launched by the Greater Cambridge Greater Peterborough Enterprise Partnership (LEP) and partners, the Eastern Agri-Tech Growth Initiative is a grants scheme that helps local business grow. Available to all businesses in Cambridgeshire, Rutland, North Hertfordshire, Uttlesford, Suffolk and Norfolk that are involved in the wider agricultural supply chain, the scheme funds vital research projects and helps businesses purchase new, more efficient equipment—ensuring that the East of England remains at the forefront of agricultural innovation.

To date, the scheme has invested over £2 million into agricultural projects across the area, including Suffolk Pork farmers and Salami producers, Lane Farm Foods Ltd.

Lane Farm Foods identified that to grow their business further, they would need to expand their existing premises to enable increased production. To support this expansion, Lane Farm Foods successfully applied for the Eastern Agri-Tech Growth Initiative for a grant to upgrade their production operation and bring it under one roof. The development would provide a greater flexibility of production, allowing the team to develop and expand new lines more quickly in the future.

Since Lane Farm Foods’ project was approved on the 30th May 2014, the team have moved into their larger premises, taken on more staff and have already expanded their production.

With the funding, Lane Farm Foods estimate that they will be able to create eight new, full time jobs and safeguard a further nine. What’s more, the positive publicity generated from the grant award itself has helped to significantly increase Lane Farm Foods’ sales and turnover.

Ian Whitehead from Lane Farm Country Foods, said:

“The money will kick start the next stage of our expansion plans, creating new jobs as well as securing existing ones. We have always worked hard on the quality of our products and this grant will enable us to invest in new technology and infrastructure to help us maintain this.”

To find out more about the Eastern Agri-Tech Growth Initiative Funding please visit: www.gcgp.co.uk
The Lambert toolkit can help users conduct effective negotiation of Intellectual Property in University-Business collaborations.

Negotiations over Intellectual Property generated in university-business research collaborations are often cited as taking too long and costing too much money. Following the Lambert Review of Business-University Collaborations the Lambert toolkit was launched in 2005 to help tackle this potential barrier to successful commercialisation of university IP.

The toolkit provides a set of Model agreements for the ownership and exploitation of IP in university-business research collaborations. These cover a range of typical scenarios. A decision guide is also included to aid selection of the right agreement. The toolkit aims to set expectations in negotiation and ease/speed the process by providing a neutral starting point for negotiation. It is hosted by the Intellectual Property Office (IPO) which provides a neutral platform for the tool.

An evaluation of the toolkit published in 2013 showed that it has had a positive effect on collaborative relationships between universities and businesses and has helped to save time and money in negotiations.

SMEs report that “It takes away administrative barriers to engaging with universities and spurs us to collaborate and innovate with partners” with universities saying “It works so well when both sides want to use it.”

One of the strongest supporters of the Lambert toolkit is GlaxoSmithKline (GSK) who were involved in the working group which developed the toolkit and were the industrial partner in the first ever Lambert agreement in 2005.

Dr Malcolm Skingle of GSK said:

“Lambert agreements have saved my team hours of negotiation. It is great to be able to point new collaborating organisations to an independent website with text that is in plain English describing what each of the clauses actually mean.”

The relationship between universities and businesses and the way they collaborate is continually evolving and the toolkit needs to keep pace with this change. The toolkit evaluation identified some areas where the toolkit could be improved to reflect the modern legal environment and the changing way in which parties are collaborating. The IPO is coordinating a group of practitioners from across academia and industry to update the toolkit so that it maintains its relevance and value.

Lambert toolkit:
www.gov.uk/lambert-toolkit

The Lambert Toolkit 8 Years On
APPENDIX

1. Work Stream Members

**Work Stream 1:** Developing the right graduate and research talent - now and for the future

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Justine Fosh (Chair)</td>
<td>Chief Executive</td>
<td>National Skills Academy for Food and Drink, and Improve Ltd</td>
</tr>
<tr>
<td>Prof. Elizabeth Baggs</td>
<td>Head of School of Biological Sciences</td>
<td>University of Aberdeen</td>
</tr>
<tr>
<td>Dan Corlett</td>
<td>Chief Executive</td>
<td>Farming and Countryside Education</td>
</tr>
<tr>
<td>Beverly Dixon</td>
<td>Group HR Director</td>
<td>G’s</td>
</tr>
<tr>
<td>Prof. Christine Foyer</td>
<td>Professor in Plant Science</td>
<td>Centre for Plant Sciences, University of Leeds</td>
</tr>
<tr>
<td>Dr Martin Howarth</td>
<td>Director</td>
<td>National Centre of Food Engineering, Sheffield Hallam University</td>
</tr>
<tr>
<td>Claire Hughes</td>
<td>Head of Science and Nutrition</td>
<td>Marks and Spencer</td>
</tr>
<tr>
<td>Dr David McAllister</td>
<td>Head of Skills &amp; Careers</td>
<td>BBSRC</td>
</tr>
<tr>
<td>Dr Nicola Mitchell</td>
<td>Strategic Advisor</td>
<td>NCUB</td>
</tr>
<tr>
<td>Kathryn Winrow</td>
<td>National Leader in Education and Head Teacher</td>
<td>Ranelagh School</td>
</tr>
</tbody>
</table>

**Work Stream 2:** Science and translation and the race to the top in global innovation

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Peter Downes (Co-Chair)</td>
<td>Principal and Vice-Chancellor</td>
<td>University of Dundee</td>
</tr>
<tr>
<td>Chris Stott (Co-Chair)</td>
<td>Partner, Deal Advisory</td>
<td>KPMG</td>
</tr>
<tr>
<td>Dr Alex Chaix</td>
<td>Senior Innovation Manager</td>
<td>BBSRC</td>
</tr>
<tr>
<td>Prof. Ian Crute</td>
<td>Non-Executive Director (and formerly Chief Scientist)</td>
<td>Agriculture and Horticulture Development Board</td>
</tr>
<tr>
<td>Dr Andy Cureton</td>
<td>Head of Business Interaction</td>
<td>BBSRC</td>
</tr>
<tr>
<td>Prof. Howard Davies</td>
<td>Research Consultant - Food Security and Biotechnology</td>
<td>James Hutton Institute</td>
</tr>
<tr>
<td>Dr David Docherty</td>
<td>Chief Executive Officer</td>
<td>NCUB</td>
</tr>
<tr>
<td>Damien Drumm</td>
<td>Public Affairs Advisor</td>
<td>Sainsbury’s</td>
</tr>
<tr>
<td>Lindsay Harris</td>
<td>Deputy Director, Food Policy Unit</td>
<td>Department for Environment, Food and Rural Affairs</td>
</tr>
<tr>
<td>Tim Ingmire</td>
<td>Foods Innovation R&amp;D Director</td>
<td>PepsiCo</td>
</tr>
</tbody>
</table>
### Work Stream 3: Use of land, resources, and pull through into innovation

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Tim Benton (Chair)</td>
<td>UK Champion for Global Food Security &amp; Professor of Population Ecology</td>
<td>UK Global Food Security Programme and University of Leeds</td>
</tr>
<tr>
<td>Prof. Peter Atkinson</td>
<td>Professor of Geography</td>
<td>University of Southampton</td>
</tr>
<tr>
<td>Prof. James Bullock</td>
<td>Individual Merit Scientist</td>
<td>NERC Centre for Ecology &amp; Hydrology</td>
</tr>
<tr>
<td>Dr Paul Burrows</td>
<td>Executive Director, Corporate Policy and Strategy</td>
<td>BBSRC</td>
</tr>
<tr>
<td>Dr Mike Bushell</td>
<td>Principal Scientific Advisor</td>
<td>Syngenta</td>
</tr>
<tr>
<td>Prof. Iain Gordon</td>
<td>CEO and Director</td>
<td>James Hutton Institute</td>
</tr>
<tr>
<td>Dr Andrea Graham</td>
<td>Head of Policy Services</td>
<td>National Farmers’ Union</td>
</tr>
<tr>
<td>Prof. Jim Harris</td>
<td>Professor of Environmental Technology</td>
<td>Cranfield University</td>
</tr>
<tr>
<td>Dr Sarah Jackson</td>
<td>Head of Strategic Engagement - Defra</td>
<td>Met Office</td>
</tr>
<tr>
<td>Keith James</td>
<td>Special Advisor – Environmental Research</td>
<td>Waste and Resource Action Programme</td>
</tr>
<tr>
<td>Robert James</td>
<td>Technical Director</td>
<td>Thanet Earth Marketing</td>
</tr>
<tr>
<td>Stuart Lendrum</td>
<td>Head of Sustainable &amp; Ethical Sourcing</td>
<td>Sainsbury's</td>
</tr>
<tr>
<td>Simon Miller</td>
<td>Managing Partner</td>
<td>3Keel</td>
</tr>
<tr>
<td>Dr Diane Mitchell</td>
<td>Chief Environment Adviser</td>
<td>National Farmers’ Union</td>
</tr>
<tr>
<td>Dr Nicola Mitchell</td>
<td>Strategic Advisor</td>
<td>NCUB</td>
</tr>
<tr>
<td>Prof. Simon Potts</td>
<td>Director, Centre for Agri-Environmental Research</td>
<td>University of Reading</td>
</tr>
<tr>
<td>Prof. Jules Pretty</td>
<td>Professor of Environment and Society and Deputy Vice-Chancellor</td>
<td>University of Essex</td>
</tr>
<tr>
<td>Laurence Smith</td>
<td>Senior Sustainability Researcher</td>
<td>The Organic Research Centre</td>
</tr>
<tr>
<td>Alan Wilson</td>
<td>Technical Manager</td>
<td>Waitrose Agronomy</td>
</tr>
</tbody>
</table>
2. Organisations Participating in Interviews on Innovation and R&D in the Food Sector
3. Landscape Signals and Cooperative Behaviour

<table>
<thead>
<tr>
<th>Signal</th>
<th>Elaboration</th>
<th>Risk/ Benefit</th>
<th>Sustainability Sphere</th>
<th>Potential Landscape Scale</th>
<th>Key Stakeholders (bold=strong) of Signal</th>
<th>Example(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pollinators &amp; Beneficial Insects</strong></td>
<td>Determined by biology and the make-up of the particular area in question. Beneficial insects may produce useful crop protection effects: pollination services are often bought in to increase crop &amp; fruit yield.</td>
<td>Benefit</td>
<td></td>
<td></td>
<td>• Farmers • Retailers • Conservation Community</td>
<td>Large orchards in North Kent cooperating to increase populations of natural pollinators.</td>
</tr>
<tr>
<td><strong>Pest / Pathogen</strong></td>
<td>Determined by biology and the make-up of the particular area in question, and also by variables such as flood, drought, and populations of beneficial insects.</td>
<td>Risk</td>
<td></td>
<td></td>
<td>• Farmers • Retailers</td>
<td>Farms having more problems with aphids because there are fewer lacewings or wasps.</td>
</tr>
<tr>
<td><strong>Water Trading</strong></td>
<td>Co-operation on shared resource such as river, aquifer, reservoir.</td>
<td>Benefit</td>
<td></td>
<td>Water catchment</td>
<td>• Retailers • Water Companies • Local Business • Farmers</td>
<td>Initiative with Sustainable Food Lab and Sustainable Agriculture Initiative Platform.</td>
</tr>
</tbody>
</table>