The Quadram Institute and the Internet of Food Things Network (IoFT) Plus: Data, science and policy for a healthy food system: 1 November 2021 – Workshop Report

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Introduction

The Agri-Food sector is worth approximately £122 billion to the UK economy and it employs around 4 million people. Its importance to the UK cannot be overstated. In recent years, the strategic value of the Agri-food industry has taken on new prominence as a consequence of supply chain challenges caused first by Brexit and then amplified during the current Covid-19 pandemic. The importance of the food supply chain and its impact on the wider economy and society require it to be designated as critical infrastructure, on a par with power, digital telecommunications, transportation and water utilities.

The Quadram Institute and the Internet of Food Things Network Plus (IoFT) held an online strategic workshop on 1 November 2021 addressing the interplay of data-driven science and innovation in the food system, food safety and food-related health.

The half-day workshop sought to set the scene and establish the kind of strategic thinking needed to apply the interdisciplinary activities of IoFT and the Quadram Institute to UKRI research topics in order to address government food strategy goals as well as broader sustainability goals.

The aim of the event was to:

- Establish a better understanding of government policy and wider societal needs for the food/health system
- Initiate more collaborative thinking across disciplines and between institutions to prepare approaches to addressing these opportunities
- Share this thinking with representatives from various policy and regulatory bodies, such as Defra, FSA, UKRI, OAI and Innovate UK

- To identify opportunities for future collaborations combining digital, health, medical, food and industrial research

This report summarises the three keynote presentations and key points from the breakout groups and plenary session.

Keynote speaker summaries

Professor Guy M Poppy is a Professor of Ecology in Biological Sciences at the University of Southampton and was until recently Chief Scientific Adviser to the Food Standards Agency (UK Govt). He is currently Director of Transforming the UK food system for healthy people and a healthy environment (UKRI SPF programme for £47.5 million), chair of the strategy board of the Public Policy at the University of Southampton, and now spending 60% of his time seconded to UKRI.

Keynote one: Professor Guy Poppy (Director, Transforming food systems for UK human health and environmental health)

> *"Never before has the role that the food system plays in both environmental and human health been so centre stage."*

The context

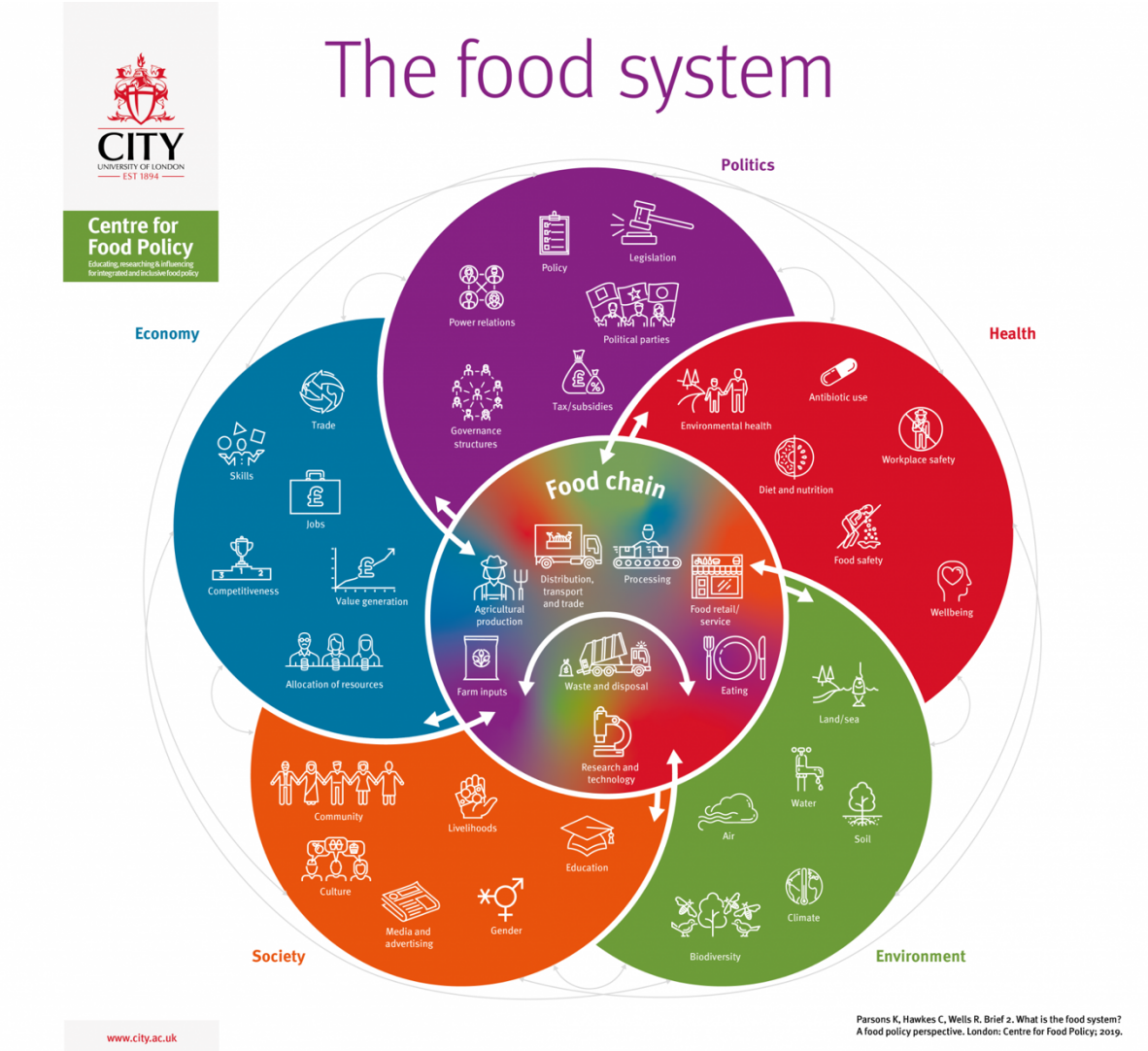
Professor Poppy set the scene by outlining how the food system has never been so central to the economy, health and the environment, with its impacts on current major issues from the Covid-19 pandemic to climate change, public health to trading relationships. He highlighted figures collected in 2018 which show:

- Poor diet is the biggest risk factor for early deaths worldwide, leading to one in seven deaths in Britain every year
- Two-thirds of adults in the UK are overweight or obese
- Diet-related chronic disease accounts for £6.1bn (around 9%) of annual NHS spend
- Food production accounts for 70% of all fresh water withdrawals, one-third of all greenhouse gas emissions, and contributes to biodiversity loss, soil degradation and impacts on aquatic ecosystems
- Around 85% of the UK's total land footprint is associated with meat and dairy production, which contributes just 48% of our total protein consumption and 32% of our total calories
- Greenhouse gas emissions from UK agriculture were estimated to cost the UK £3.1 billion per annum in 2015

- The trade deficit is £22.6bn – we import twice as much economic value as we export with changing diet patterns since the 1960s
- For every £1 UK consumers spend on food, society incurs extra costs of around £1 but these health and the environment costs are currently externalised by the market

Food systems approach

The food system needs transformation, with research considering the interplay between production and consumption, environment and health. The complexity of the food network with its interlap of politics, health and economics means that working on any one element in isolation is unlikely to deliver a successful outcome. The trade-offs need to be understood if one is to intervene or develop solutions which lead to beneficial change at the systems level.



***The Food System – Centre For Food Policy*[1]**

The Food Systems Strategic Priorities Fund programme is a £47.5m research programme supporting interdisciplinary research and training focused on:

- Transforming UK diets to be healthier and more sustainable
- Changing the behaviour of actors across the food system
- Modelling the interdependencies across the UK food system
- Co-producing research between academia and stakeholders (UK government, business and civil society)
- Developing a pipeline of skilled people who are able to apply critical interdisciplinary systems thinking to the food system

The programme's Mapping the UK Food System report highlighted the role of the 'missing middle' – processing, manufacturing, catering and retailing – in contrast to the usual focus on farmer or consumer. There are 600,000 food businesses that need to be engaged.

Opportunities

> *"The public sector needs to show leadership and trust around sharing data. There have been a lot of nice words and little action – and now it's time for that action."*

Professor Poppy called for the sector to come together and use its talents, whether in data or the food system, to rise to the challenge and take action. The opportunities in the digital age are unparalleled, from creating big signals from big data to sensing/AI, blockchain and assurance, and open data. Nestle carries out 100,000,000 analytical tests every year, generating analytical data which, if mapped with metadata and incorporated with other datasets from the food industry, regulators and Governments, could provide the food industry with insight into every area of food safety, customer relationships and operations.

But that data must be not simply gathered but moved up the data pyramid and turned into a signal from which wise decisions can be made. Data becomes more valuable as it moves up the data pyramid and this becomes even more valuable to have collected in the first place.

References / further reading

Website: Transforming UK food systems SPF
Report: Mapping the UK food system (November 2020) - download it here
Article: How blockchain and genetic engineering could made food safer for people with allergies Nature 588, S10 (2020) - read it here

[1] https://www.foodsecurity.ac.uk/blog/what-transforming-food-systems-means-for-policy-from-ideas-to-action/

Report: Chief Scientific Advisers Science Report, Issue six Data Science website: https://www.food.gov.uk/sites/default/files/media/document/chiefscientificadviserssciencereport%20%281%29.pdf

Keynote two: Julie Pierce (Director of Wales, Information and Science, FSA)

Julie joined the FSA in September 2015. She has previously been the Chief Information Officer for Defra and Director of Corporate Services for the Animal Health and Veterinary Laboratories Agency (the predecessor organisation to the Animal and Plant Health Agency). In these roles she has driven new digital solutions to business problems, restructured and developed the organisation, and launched a new open data initiative.

Julie Pierce laid out the principles of the Food Standard Agency's (FSA) approach to using data to better understand the food system and suggested the challenges that need to be addressed.

Principles

> *"We move fast. We start small and gradually expand. We need to show people what we can do with data - then we know they come back for more."*

Start small, expand gradually and reuse: a model that found strong correlations between the weather and levels of the hazard Aflatoxin in figs from Turkey has been extended to other commodities from other countries, and then to pesticide residue levels.

Tackle real solutions to real problems: a 'Risk Likelihood Dashboard' is helping FSA Imports, Port Health Authorities and local authorities to plan which commodities from where should be sampled and when.

Build on experience: a 'Signal Prioritisation Dashboard' helps the FSA to stay informed about the latest food and feed issues occurring / reported in different parts of the world. Every day it draws on data from 40 regulators and 10 trusted websites to work out what might impact on the UK – "as near to real time as the users can cope with".

Focus on repurposing existing tools: such as with its Covid response where the FSA used dashboards to understand and monitor changes in imports and port activities, and insights from listening to social media to map out the relationship between social deprivation and food access. It looked for change in attitudes through the pandemic – and put out rapid messages if need be ("don't wash your food in bleach!").

Build solutions that help modernise regulations: the FSA built a prototype that used deep learning artificial intelligence to support authorities in the inspections of food businesses by predicting Food Hygiene Rating Scheme (FHRS) scores.

Share data through the food system in innovative ways: the FSA is working on a blockchain pilot, data trusts research and an intelligence sharing network (a technology agnostic toolkit which enables collaboration between people, organisations and machines in a way that is scalable, repeatable, and extensible).

Challenges

> *"We want to enable data to flow so that the data follows the food and those who need to access it to generate insights can do so."*

- There are great opportunities to apply data but what is the underpinning data infrastructure that is needed to allow all this potential to be unlocked? A data trust, standards, ethics, all have a way to go. What is the role of government? Where should FSA do more and less? Does everything need to be open for the sake of it?

- The FSA seeks to work in the open, publish in the open and co-create as much as possible. "We want people to come and engage and join us."

References / further reading

The following were the outcome of an in depth investigation into data trusts and trust frameworks undertaken by the University of Lincoln for the FSA:

- Food Data Trust: A Framework for Information Sharing
- Food Data Trust - Legal, Structuring and Governance Report

Keynote three: Maria Traka (Deputy Head of Food Databanks National Capability (FDNC), Quadram Institute)

The FDNC is responsible for creating and managing current data on the nutritional composition of foods eaten in the UK and Maria Traka outlined the need for food composition data, which is used by industry, consumers, policymakers, regulators, researchers and clinicians. For example, FDNC has analysed how the composition of pork has changed since the last analysis in 1992, works with SMEs on product content and released a labelling dataset to help SMEs calculate the values of their own recipes.

The FDNC seeks to:

- Improve delivery of food composition data for nutrients, bioactives and other food information

- Develop and apply new tools and methodologies for dietary assessment
- Deliver increased stakeholder awareness, engagements and exploitation of data and knowledge for food and health research

It promotes FAIR data principles.

Food Nutrition Security Cloud (FNS-Cloud)

This 48-month long, €10.9m Horizon 2020 project with 36 partners across the EU is addressing the fragmentation of food and nutrition data using FAIR data principles. Now entering its third year, FNS-Cloud is dealing with three types of data: agrifood data, nutrition and health data, and food intake and lifestyle data. The project is developing a catalogue to identify and map existing data and tools and create a catalogue to be able to find such data.

The project is taking a multi-step approach to dealing with the heterogeneity of food and nutrition data: firstly collecting the data; secondly extracting the information and developing a new ontology to harmonise and integrate the various different ontologies; thirdly, to integrate the data food by food; finally, analysis and visualisation.

Five use cases and four fields will focus on making existing and emerging FNS data FAIR; generating proof-of-principle new data where existing data are not available; developing and testing FNS-Cloud infrastructure, services and tools. The five use cases are:

- Food traceability and metrology search engine
- Food labelling data and reformulation tools
- Total diet studies risk assessment
- Food intake consumer behaviour and lifestyle
- NCDs and microbiome

Food and Gut Microbiome - DIME study

Understanding food and gut microbiome interactions and harnessing them for the benefit of populational health requires data infrastructures that facilitates data sharing between stakeholders (scientists, policy makers, industry). However, data availability in this emerging field that spans multiple disciplines (nutrition, microbiology and health) is limited. Within the FNS-Cloud project, the Dietary Bioactives and Microbiome Diversity (DIME) study is investigating whether a diverse diet rich in plant bioactive compounds leads to a diverse gut microbiome, and does our microbiome influence our metabolic response to food? It is undertaking a human intervention trial looking at diverse diet, postprandial glucose response and sleep data in relation to diverse gut biome. The project is collecting traditional clinical biomarker and anthropometric data plus microbiome data and developing new tools to integrate

multiple signals from the microbiome and metabolome for the volunteers, developing the tools to support research that links to nutrition, and making them accessible via the FNS cloud.

Challenges

- New hybrid model of analytical food composition data and industry data is required. How do we fill missing nutrient composition data gaps to extend beyond labelling nutrients? How do we maintain data quality?
- Incorporating environmental indices in food composition data and food labels is needed
- New 'big data' collected by industry (eg purchasing data from food baskets)
- Consistent data classification (coding) across stakeholders (COFID, industry, environmental indices, intake) is required
- Developing a national infrastructure/capability to support FAIR food system data
- Requirement for multi-stakeholder approach [eg QIB-FDNC, academia, industry, policy]

References / further reading

Website: https://fdnc.quadram.ac.uk/
FNS-Cloud: https://www.fns-cloud.eu/

Discussion: challenges / opportunities / priorities

Key points from the breakout groups and plenary discussion

Priority actions

- Food strategy is diverse and complex – how do we judge the success of the food system? If we haven't defined what success looks like then it is hard to develop policy and an effective outcome. **Defining success** is one of the key questions that needs to be tackled quickly.
- In relation to data sharing, there are questions that need urgent attention. **Who owns the data?** Who is responsible for making it available? Is there a legal personality behind it? If I have access to the data, assume I can trust it and make a business decision based on it and it is incorrect, do I have some legal redress? Who will stand behind the quality assurance of the data and can a data provider be rewarded for provisioning the data? How to weed out bad actors who may want to corrupt that data?
- Capitalise on the momentum of Cop26 and the technology and will that exists by defining simple messages and devising a regulatory review to create a positive push along with real, coherent policy to pull data together. There needs to be a **roadmap for digitising the food industry** and outreach to engage all stakeholders.

Priority opportunities

- Look at other sectors which have achieved success, such as the pharmaceutical industry where companies developed best practice on data sharing linked to clinical trials. Methodologies rather than sensitive details were shared and all gained a benefit from it. The key is having a **senior leader on the board directly responsible for data sharing and data policies**, rather than someone in IT.
- Emphasise the **tangible benefits** to be gleaned from sharing data. High-quality accurate, timely data showing that a company is compliant with a range of activities at the highest levels could result in lower business rates or insurance for even a small restaurant or hotel.
- The **reengineering of the CAP** offers public good benefits, such as water, soil, carbon, and biodiversity, which are seen as important and worthy of incentives but high-quality food being produced on the land should also be an incentive. Currently, it does not seem to be getting the same level of attention in the plan.
- **Trusted trader status** already exists as a model for the HMRC, could it also work as a model for good food practice? It would act as a benchmark that gets the business an assumption of rectitude when they make a declaration of certificate of origin or phytosanitary. Ongoing compliance will be assured by a supply web (a platform based on 'data access' rather than 'data sharing') so there would be a built-in commercial incentive to comply, as well as an eg 5% reduction on business insurance etc. It would apply to SMEs as well as larger companies and would meet FSA requirements with the same data as HMRC, reducing the number of processes.
- Important to ensure that **smaller companies** are not pushed out. Larger companies have the budget, technology and systems to engage with larger-scale incentives but SMEs and those entering the supply chain for the first time will not have money to invest in the technology and staff with the skills to deal with it. It needs to be clear that they will also enjoy benefits.
- There must be **'direct evolution' not 'revolution'** in order that it is seen as an advantage, not a threat, to be part of these business innovations.

Next steps

There are many challenges to explore going forward:-

- Improving Data trust in the Food Supply Chain
- The role of IoT/Cloud Computing in Food Supply Chains
- Improving tracking and surveillance decision making using AI and Machine Learning
- Consumer Facing Interventions to promote Health Ageing

- Coping with Data Obesity from an integrated Food Supply Chain
- Ensuring Security and Robustness of Agri-Food as Critical Infrastructure
- Smart Borders- Food Assurance Tools for quality Assurance and Public Safety

There are several funding schemes worthy of attention:-

Horizon: https://www.ukri.org/apply-for-funding/horizon-europe/

Innovate UK
https://www.ukri.org/our-work/our-main-funds/industrial-strategy-challenge-fund/clean-growth/transforming-food-production-challenge/

UKRI- Potential Centre for Doctoral Training in Digital Food- planning ahead
Exemplar- https://foodsystems-cdt.ac.uk/about

EPSRC- Improving Data Trust and Resilience in the Food Supply Chain

Further reading

IoFT report: Digital collaboration in the food and drink production supply chain – report
doi.org/10.5281/zenodo.3368237
https://www.foodchain.ac.uk/digital-collaboration-in-the-food-and-drink-production-supply-chain-report/

IoFT briefing document: digital technologies for improving productivity in food manufacturing
DOI: 10.5281/zenodo.3457891
https://www.foodchain.ac.uk/briefing-document-digital-technologies-for-improving-productivity-in-food-manufacturing/

Nature: A trust framework for digital food systems
https://www.nature.com/articles/s43016-021-00346-1