FSA Science Update 2022

FSA 22-12-07 - This paper gives an annual update on FSA's science.

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1. Summary

1.1 This paper gives an annual update on FSA's science, including:

1. The development of our science, evidence and research capability
2. A review of achievements and the progress made since the last update
3. A summary of our future plans including

    - The impact of prioritisation
    - Our Science Capability plans to support the FSA Strategy

1.2 The Board is asked to:

- Note achievements over the last year and progress against our strategic priorities.
- Note areas that have been deprioritised.
- Comment on our future capability plans.
- Comment on our science KPIs and progress against them.

2. Introduction

2.1 This paper builds on the 2021 FSA Science Update (footnote 1). It covers all aspects of the FSA's multidisciplinary science and evidence. Whilst this paper provides an overview of science activities within the FSA, it should be considered alongside other relevant science updates delivered throughout the year, including but not limited to:

- The annual report of the CSA (footnote 2)
- The annual report of the Science Council (footnote 3)
- The annual report of the Advisory Committee for Social Science (footnote 4)

2.2 The paper shows how we are aligning our science to support the FSA strategy, highlighting the central role the science team plays as an evidence provider and watchdog (alongside supporting the FSA's role as policy maker, regulator and convenor).

2.3 It also provides an overview of the whole FSA science system, including our investment in people and research, how the various components fit together to ensure we are providing robust evidence, and how we align with wider government science related initiatives.

2.4 In 2021, we presented our priorities for the coming year. This paper reports progress against those objectives and how we will be prioritising our work for the coming 12 months.

2.5 Finally, we outline the three-year FSA Science Capability Plan.

3. Achievements and Progress Against Priorities

3.1 In the previous FSA Science Update, presented to the Board in December 2021, we laid out a series of short-term priorities for the coming year.

3.2 In this paper, we present the key achievements over the last year, including progress against the previous priorities.

Risk Analysis/Regulated Products

- Across 21-22, working with colleagues in Policy, we have continued to embed and develop the FSA's Risk Analysis Process (RAP), including the ongoing recruitment and training of 26 new risk assessors, funded under our CSR21 settlement bringing the total number of risk assessors in the FSA to approximately 90.
- We have reconstituted the Advisory Committee on Animal Feeding stuffs (ACAF), with a new remit as an independent, risk-assessment only body, in line with our other Science Advisory Committees (SACs).
- We have worked with other government departments through the FSA-led Cross-government Risk Assessors Network (CRAN) to continue to address the challenges of implementing consistent cross-government risk analysis processes. Activities have included horizon scanning workshops and joint training activities.
- We made significant progress in the area of precision breeding, including investigating consumer understanding and awareness, establishing a dedicated subcommittee of the ACNFP (Products of Genetic Technologies; PGT) to consider food and feed applications for GMOs and developing the scientific underpinning for the regulation of precision bred organisms (PBOs). The work of the Committees will be brought for consideration by the Board in a Spring update.
- In addition, we have continued to support major incidents, for example in response to the war in Ukraine, by providing risk assessments and evidence on other legitimate factors related to the emergency substitutions of oils (Annex 1 lists published risk assessments from November 2021 – October 2022).

Expert Analysis

Analysis of socio-economic factors supports our key priorities and programmes. Behind the scenes, our teams provide expert analysis which is fully integrated into FSA decision-making. For example:

- Supporting FSA's change programmes, for example, building the case for the Food Hygiene Delivery Model. (footnote 5)
- Providing impact assessments, modelling and evidence on trade, and operational research support to the new Borders Target Operating Model (BTOM).
- Informing policy on food hypersensitivities by providing evidence on:

1. the information needs of people with food hypersensitivities (footnote 6);
2. the factors which impact most on their quality of life (footnote 7); and
3. views on the use of precautionary allergen labelling from businesses (footnote 8) and consumers with food hypersensitivities. (footnote 9)

- Supporting policy decisions in the FSA and the wider policy with swift access to consumer data:

1. Next year we will publish the first trend report from the first four waves of Food and You 2 (footnote 10), while our consumer tracker (footnote 11) now reports on fast moving issues on a monthly basis.

- Tracking consumer concerns and behaviours through the Ukraine and cost of living crises has been influential across Government and civil society. In parallel, we conducted and

published research with community food providers (footnote 12) such as food banks.
- The Public Interest in Food report (March 2022) (footnote 13) is a foundational piece of consumer insight which sets out consumers' own priorities for the food system:

1. Equitable, affordable access to safe, healthy food.
2. High quality UK food safety, hygiene and standards.
3. Ethics, environment and systems issues.
4. Ability to make healthy, nutritious choices.

- Building capability in systems thinking. The food system is a complex network. We have developed a partnership with the Universities of Oxford and York, supported by a research fellow, to develop and deliver tools, workshops and briefings to help instil systems thinking into the way the FSA works.
- Anticipating the impact of emerging trends and technologies including:

1. alternative proteins (footnote 14);
2. personalised nutrition;
3. the future of animal feed;
4. the future of meat production;
5. animal by-products; and
6. mechanical meat separation.

Research and Evidence Programmes

- In line with the recommendation of the cross-Government 2019 Science Capability Review (footnote 15), we have reviewed and updated our Areas of Research Interest (ARI) (footnote 16), building on those published in 2021. Our revised ARI now include specific reference to food that is healthier and more sustainable in line with the FSA strategy.
- The FSA portfolio of coordinated research programmes have improved efficiencies and the impact of our science. The outputs from these programmes are listed in Annex 1.
- In addition to the breadth of science that has been delivered, the programme-based approach has enabled us to maximize the efficiency of science spending by improving coordination across workstreams, sharing lessons learnt and creating better transparency (see Annex 2).
- We are increasing the impact of FSA research, reviewing our web presence to make our research more accessible. To ensure impact is considered as core part of project design and delivery, a new process (EPI) is now being used to capture the proposed impact of new projects, thus enabling the evaluation of progress towards our intended aims.
- We have mapped our current scientific relationships to identify gaps and enhance those we already have established. This is the first step in our engagement plan which now includes, amongst other things, a quarterly science newsletter. We have so far published two newsletters and uptake has been increasing (footnote 17). The next will be released this month (December 2022).
- We have continued to build upon our now established relationship with UKRI, to leverage funding in areas relevant to the remit of the FSA. This has included:

1. The launch of a new Food Safety Research Network (FSRN), co-funded by FSA and BBSRC (total funding £1.45M) to facilitate fresh interest and run research pilots, focused on food safety related microbiology.
2. A joint programme of citizen science pilot projects (footnote 18) with UKRI to test the effectiveness of these new methods in addressing our research interests. Citizen science both engages the public in our science and provides new ways of gathering data. Recently, our joint citizen science event attracted more than two hundred attendees, with speakers including our CSA, NASA and other leaders in this innovative area.
3. A co-funded series of behavioural trials (total budget £7m) into healthy sustainable diet shift alongside Defra, UKRI and a consortium of academic and NGO partners, supported by the

HMT Evaluation Accelerator Fund will help us discover what works to address this shared challenge (see paragraph 23 below).

Governance and Assurance

- We continue to ensure that we have the right science governance and assurance processes in place and follow best practice from across government.
- We have worked with the Government Office for Science (GO-Science) to ensure we are implementing the recommendations of the cross-Government Science Capability Review (SCR). GO-Science are the policy owner for the SCR across government, with all departments holding an obligation to implement its recommendations. Recommendation 1 of the SCR stated that every government department should have a clearly defined science and evidence system (SES). The description of the FSA system will be published shortly once internal approval processes have been completed.
- The FSA SES will include a summary of our progression against the recommendations of the SCR, including, the publication of our ARI (see paragraph 12 above) and the formal recognition of the deputy CSA role to further support the FSA's CSA in delivering our cross-government science commitments (and as recommended by GO-Science).
- The FSA is committed to conduct periodic reviews of our five Scientific Advisory Committees (SACs) and three Joint Expert Groups (JEGs). In line with Cabinet Office guidance, that Tailored Review process has started, beginning with completion of the new self-assessment model (SAM) provided by Cabinet Office. As no serious flaws and only a limited number of recommendations were identified, this SAM alone is considered a sufficient review. However, as both the Advisory Council on Social Science (ACSS) and the Science Council were created since the last review cycle, and therefore not considered previously, we have initiated a deep review of both. This is due to complete in Spring 2023. Full details have been published separately (footnote 19)
- We have continued to address the recommendations of the Science Council's Working Group 5 (footnote 20) (review of the FSA's work on food hypersensitivity) through our research and evidence programme. This has led to closer working between science and policy. We are making good progress with Working Group 6 reviewing possible implications for food safety from changes to achieve net zero carbon on the food system (footnote 21) with the publication of the interim report in July 2022 (footnote 22) and the final report expected in March 2023.

Surveillance and National Capability

- The FSA continue to support the UK's national food testing capability and strengthen our surveillance.
- In September 2022, as the culmination of an intensive review of the current Official Control Laboratory system in England and Wales, our future laboratories plan was approved by the FSA Board (footnote 23). As laid out in that paper, sampling remains a critical part of our wider surveillance system (alongside other forms of intelligence gathering, data analytics and horizon scanning) In 21-22, the FSA tested over 11,000 samples in total and this has helped inform our knowledge and the work to manage the risks to the UK's food system. This included the delivery of a strategic, targeted sampling programme; undertaking almost 2000 tests on 1000 samples with 107 non-compliances found. This targeted surveillance enabled the assessment of intelligence on food risks and allowed for the targeting of official control sampling (more details in Annex 3). The results were published in the first Annual Food Standards Report in 2022.

PATH-SAFE Programme

- PATH-SAFE (Pathogen Surveillance in Agriculture, Food and the Environment) is an FSA-led, £19M programme funded through the second round of HM Treasury's Shared

Outcomes Fund, designed to improve surveillance systems for foodborne pathogens and antimicrobial resistance (AMR) More details are available in Annex 3 and from the programme website. (footnote 24)

- Critical to delivery has been the building of a consortium, led by the FSA, with over 40 partners from across government departments, academia, public sector research establishments and businesses, covering all four nations.
- Delivering a programme of this size and complexity is challenging and the programme has experienced some delays, through initial delays in the announcement of funds, the impact of the Covid-19 response on partners, procurement and recruitment issues across all partners. However, the majority of projects now are either contracted or in the contracting stage, and most key roles are filled. As a result, the programme is on track to deliver its ambition; albeit with the impact of the delays leading to some reduction in scope (e.g., the main data system will now focus on 1-2 exemplar pathogens rather than multiple ones, in order to demonstrate proof of concept).
- Now in its second year, the programme includes 27 Individual projects/work elements in four workstreams:

1. WS 1: National foodborne disease genomic data platform;
2. WS2: New surveillance approaches;
3. WS3: Portable diagnostics as inspection tools;
4. WS4: Environmental AMR surveillance system pilot.

Key highlights include:

- The data system for the rapid interrogation of genomic data, will be delivered via a UK consortium of experts from across government and academia. The University of Oxford and Professor David Aanensen (programme Data Fellow) will be leading, and delivery is due to begin in January 2023.
- Fera Science Ltd and the University of Lincoln, will deliver a technology readiness and landscaping study on remote diagnostics as inspection tools, and work is underway.
- A number of publications have been produced as part of the Environment AMR surveillance system pilot, led by Defra, Environment Agency (EA) and Veterinary Medicines Directorate (VMD).
- UKHSA have begun a study investigating the use of Loop-mediated Amplification (LAMP) technology in wastewater as an in-field diagnostic technology, building on learning and experience from the pandemic.
- Cefas and Bangor University have begun to deliver a surveillance pilot in England and Wales, building on existing networks (e.g., Covid-19 wastewater) to determine feasibility of scaling up to the testing of wastewater for the detection of foodborne pathogens and AMR, as part of a future, improved national surveillance network.
- The FSS E.coli pilot is well underway with several hundred samples, across a range of collection sites, sent for whole genome sequencing. The project is working on access to sequencing data from clinical isolates to allow comparison of E.coli genomes from animal, food and environment settings, with clinical datasets.
- Public Health NI and Queens University Belfast will be utilising the infrastructure developed for NI SARS-CoV-2 wastewater surveillance programme to investigate prevalence of norovirus and antimicrobial resistance within care home settings.

4. Prioritisation for 2022-23

4.1 Our science and faces significant new demands for evidence, which represent opportunities as well as additional work. We were already preparing for a surge of work on regulated products but in addition we will be providing support to borders reform and the review of EU laws (REUL). This has meant some hard choices about our science priorities and has significant impact on our analytical capacity.

4.2 To ensure that we can provide the most immediate relevance and impact from our science and evidence to meet the top priorities for the FSA in the coming year, SERD will continue:

- To provide risk analysis to support policy decisions on:

1. the review of EU Law
2. incidents
3. borders and trade negotiations
4. regulated products and
5. high-priority risk assessments

- To deliver our future laboratories plan and sampling programmes, which underpin surveillance and national resilience
- To deliver the PATH-SAFE programme (noting this funding is ring-fenced by HMT under the Shared Outcomes Fund)
- To publish evidence on the impact of household food insecurity and the cost-of-living crisis on consumers
- To broaden and deepen the evidence base that supports the Food Standards Report over the coming years.

4.3 However, in order to be able to do this at sufficient pace and quality, we will need to reduce:

- The number of commissioned research and evidence projects, focusing on those with the highest impact and strategic fit. This will mean that our evidence base will grow more slowly than in previous years.
- The volume of routine risk analysis work we deliver, where this does not constitute a risk to consumer safety.
- The volume of analysis that we can provide to FSA change programmes.
- The pace of delivery of certain aspects of our capability plan, focusing on the areas needed most to deliver the priorities set by the Board. This will mean prioritising improvements to the quality of research but delaying the expansion of scope to cover 'other legitimate factors' e.g., nutrition, sustainability and welfare impacts, by a year (see paragraph 21 below).
- The pace at which we can develop new data sources for the Annual Food Standards Report.

5. FSA Science Capability Plan

5.1 One of our guiding principles in the FSA Strategy is that we are **science and evidence led**. The evidence we generate from our science and analysis is critical to our decision making, management of risks, and improving food and feed regulation and policy. We also produce insights and analysis that inform our own work and the policy and practice of other organisations in the food system.

5.2 In the 2021 paper, we discussed the development of a 'science strategy'. This has been reviewed in line with the FSA Strategy, the FSA's three-year corporate plan, and the priorities set by the Board for this year. These provide clear direction and do not need to be duplicated. Instead, we have moved to a Science Capability Plan for 2022-25, which sets out the actions being taken to develop the people, methods, processes, and governance to support the roles set out for us in the FSA Strategy, over the next three years. We have started to deliver some elements of the plan already.

5.3 We will continue to develop and enhance our capabilities to better support food and feed policy and regulation. For example:

- Continuing to build our risk assessment capabilities and capacity to meet the FSA's increased responsibility (and vastly increased demand) for this work since the UK left the EU. We will focus on building our skills and methods, through the delivery of our quantitative risk assessment strategy, which includes:

1. Introduction of Novel Analytical Methods (NAMs). These NAMs include the use of in silico methods to support toxicological risk assessment
2. Working with academic partners to build an enhanced bioinformatics capability for both microbiology and regulated products
3. Working with the British Toxicology Society (BTS) and others across government, to build on the existing discovery work, to develop a higher-level toxicology apprenticeship scheme

- Work with colleagues in Food Policy to scale-up our regulated products risk assessment process. By enhancing our ways of working and improving our processes, we will seek to build extra capacity for delivering a future service that is both fit-for-purpose and efficient. Risk management decisions based on risk assessments take account of a range of 'other legitimate factors' as well as an assessment of the hazard to human health. Work to expand the scope of the factors (such as social and environmental impact and impact on animal welfare) that we are equipped to consider in evidence packages has been deprioritised for this year so that we can support the volume of urgent work likely to come in due to reform of borders and EU Law (see paragraph 16 above). However, we remain committed in the coming years to doing this as set out in our Risk Analysis model.

5.4 Underpinning our credibility as an evidence generator, is a focus on quality and good governance. To achieve this, we will benchmark our work against best practice and adopt/adapt as required. This includes:

- Working with GO-Science to implement the recommendations of the Science Capability Review. This will include adoption of the Research Integrity Concordat (RIC) and using the Government Science & Engineering (GSE) and Analytical Profession careers framework to support development, including the role of 'generalists' (recognising the critical importance of these roles alongside specialists).
- Assuring the quality of our social research; we have asked Dr Phil Davies (ex-head of the Government Social Research Profession and Fellow at the of the Oxford Centre for Social Policy and Intervention) to assess our work against the standards set for the profession and give recommendations for improvement. We have also recruited new expertise to the ACSS, and its Assurance Working Group and the FSA CSA, now advises on the questions and method of every social science project.
- Working with University College London we have developed toolkits for the FSA science team, piloting these in social science, but now rolling them out across disciplines, and are also developing a social science training programme.

5.5 Through science and evidence collaboration, we can also play the role of convenor, helping us build our capability and that of others, by bringing diverse experts together to solve complex problems. Key examples include:

- The FSA-led PATH-SAFE programme has brought together a consortium of 40 partners, from across government, academia and industry. Beyond the life of the existing programme, the power of this cross-cutting partnership has the potential to change the way we do foodborne disease and AMR surveillance in the UK. Alongside the technologies being developed, we will work to maximise the impact of this collaboration.
- We will work with UKRI, building on current initiatives (e.g., the UK Food Safety Research Network, FSRN), to look to build food safety research skills capacity within the UK. Through the development of an effective risk analysis web presence, where industry and other regulators can easily find our risk assessments and other scientific 'opinions,' we will seek to engage more widely with others nationally and internationally. In doing so, we

intend to facilitate better knowledge exchange and further collaboration on risk assessment and analysis.
- Our behavioural trials on healthy sustainable diet will bring together the ESRC, Defra, DHSC, and DfE with a consortium of delivery partners, supported by the HMT evaluation accelerator fund. This will allow a more joined up approach to the challenge of finding out what works to encourage diet shift and reduce duplication of effort on a shared goal, pooling our resources and networks to encourage the generation, translation and adoption of evidence on interventions at scale and 'in real life' that are often only tested in labs or with small sample sizes.
- Likewise, we are building and activating networks within the academic community to support our horizon scanning activity and to develop relationships with organisations with a common interest in household food insecurity, mapping the work that is being done across civil society, in order to learn, to bring people together and to avoid duplication of effort.

5.6 As well as evidence gathering to support policy and regulation, FSA science and evidence also has a key role in driving innovation including our own innovation in methods: for example, enhancing national surveillance and testing capabilities. Key examples include:

- As part of the future laboratory plan (see above), we are providing resources to enable the laboratories to enhance capabilities including a research and development programme for innovative methods. We will also be considering how to maintain the national capability beyond 2025 (the end of the current programme) and this will include working with partners across government who are investigating innovative ways to deliver the suite of laboratory capabilities that are required for government, including, but not limited to, issues surrounding food and feed.
- Building on PATH-SAFE, with the current programme ending in March 2024, we will take tools and knowledge delivered by the research pilot projects and seek to implement across the UK and thus establish as part of our wider foodborne disease and AMR surveillance system. A key example would be the use of wastewater testing for pathogen monitoring.
- Ground-breaking projects like Kitchen Life 2 (footnote 25) – shortlisted for Best use of Data and Technology in the upcoming Civil Service Awards - combine pathogen transmission modelling, innovative methods of social research and latest thinking on behavioural insights to provide a new perspective of consumer and business behaviours drawn from observed rather than reported data (see case study in Annex 3).
- We have commissioned a new strategic-level assessment of the emerging macro level trends likely to impact the food system which will help us to be ready to support consumers and businesses. This will be published in early 2023. We will also publish the results of projects to understand the impact of technologies such as new alternatives to plastics and 3D/4D printing.
- We will increase our engagement with the novel foods/regulated products innovation sector. By working with Innovate UK, we will be able to better understand the innovation pipeline in developing fields such as alternative proteins and precision bred crops. This will allow us to better understand the technical innovation of novel foods and food production processes and ensure we have the tools and knowledge to deliver the required risk assessments and other evidence (e.g., having the right analytical testing capabilities).

5.7 Finally, the FSA strategy sets out our role as a watchdog in the consumer interest. To be able to act in this role, we are:

- Starting to build our evidence base beyond food safety risks to more systemic issues like affordability, access, nutrition, sustainability and welfare. This remains a challenge in terms of both scope and capacity; currently we do not have this expertise in the same way that we have on food safety risk, and it will take time to develop/acquire.
- This year we have prioritised building and swiftly publishing our evidence base on the impact of the cost-of-living crisis.

6. How we measure progress

6.1 We have developed a set of Key Performance Indicators (KPIs) to measure the status of science at the FSA. These are presented in Annex 4 and indicate that we are making good progress towards four key outcomes:

- We are a trusted provider of independent evidence
- Science will continue to sit at the heart of the FSA
- We have a motivated and inspired team of experts
- We have a culture of openness and collaboration

7. Conclusions

7.1 The Board is asked to:

- Note achievements over the last year and progress against our strategic priorities
- Note areas that have been deprioritised
- Comment on our future capability plans
- Comment on our science KPIs and progress against them

Annex 1 – FSA Science Publications

As part of our impact workstream, we monitor access to FSA research projects published on food.gov. The top 5 projects which have seen the most page views from November 2021 – October 2022, include:

- Rapid risk assessment on the risk of allergic reactions in UK consumers if sunflower oil is substituted with refined rapeseed oil – 3651 page views
- The COVID-19 consumer research – 3336 page views
- Survey of consumer perceptions of alternative, or novel, sources of protein – 2767 page views
- EAT Study: early introduction of allergenic foods to induce tolerance – 2701 page views
- Understanding of labelling terms 'Lactose free', 'Milk free' or 'Dairy free – 2146 page views

Published assessments from November 2021 – October 2022:

- Rapid risk assessment on the risk of allergic reactions in UK consumers if sunflower oil is substituted with refined rapeseed oil
- Rapid risk assessment on the risk of allergic reactions in UK consumers if sunflower oil is substituted with certain vegetable oils
- Rapid risk assessment: what is the risk to consumers from consumption of the seven edible insects' products currently available in the UK market?
- Rapid Risk Assessment: What is the long-term risk of erucic acid to UK consumers if sunflower oil in food is substituted with refined rapeseed oil?
- Risk assessment of the risk to consumers as a result of disruption to the cold chain during direct supply of Qurbani meat and offal
- Quantitative risk assessment of radiocaesium in Japanese foods
- Assessment of genetically modified oilseed rape GT73 for renewal authorisation
- Assessment of genetically modified cotton GHB614 x T304-40 x GHB119 for food and feed uses, import and processing
- Assessment of genetically modified maize 1507 x MIR162 x MON810 x NK603 for food and feed uses
- Assessment of genetically modified maize MON 87427 x MON 87460 x MON 89034 x 1507 x MON 87411 x 59122 for food and feed uses

- Assessment of genetically modified maize MON 88017 x MON 810 for renewal authorisation under Regulation (EC) No 1829/2003.
- Assessment of an application by Dow AgroSciences (EFSA-GMO-NL-2013-116) for placing on the market of genetically modified insect-resistant soybean DAS-81419-2 for food and feed uses, import and processing under Regulation (EC) No 1829/2003
- Assessment of genetically modified soybean SYHT0H2 for food and feed uses, import and processing, under Regulation (EC) No 1829/2003
- Assessment for the Application for a change in the Steviol Glycoside Specification in Great Britain to Include a New Manufacturing Method for Steviol Glycosides Including Rebaudioside M.
- Assessment of new Flavouring Substance 3-(1-((3,5-dimethylisoxazol-4-yl)methyl)-1H-pyrazol-4-yl)-1-(3-hydroxybenzyl)imidazolidine-2,4-dione
- Assessment of the safety of Vitamin D2 Mushroom (Agaricus bisporus) powder as a novel food ingredient
- Assessment of application EFSA-GMO-NL-2016-132 for authorisation of genetically modified, insect-resistant and herbicide-tolerant soybean DAS–81419–2 x DAS–44406–6 for food and feed uses, import and processing submitted in accordance with Regulation (EC)
- Assessment of the safety of the extended uses of UV-treated Baker's yeast (S. cerevisiae) as a novel food

Scientific peer-reviewed papers published with FSA co-authors or by FSA funded research fellows since the last update:

1. Choudhury, Samira, Medina-Lara, A., Daniel, N., Smith, R., 2022. Seafood safety: A need for greater awareness. J. Public Health Res. 11, 22799036221124056.
2. Choudhury, S., Medina-Lara, A., Smith, R., Daniel, N., 2022. Research on health impacts of chemical contaminants in food. Bull. World Health Organ. 100, 180-180A.
3. Lane, D.C., Husemann, E., Holland, D., Khaled, A., n.d. Foodborne transmission of norovirus: mechanism modelling, seasonality and policy implications (2020 System Dynamics Applications Award paper). Syst. Dyn. Rev. n/a.
4. Konold T., Arnold, M., and Adkin, A. 2022. Prions: detection of bovine spongiform encephalopathy and links to variant Creutzfeldt Jakob disease. In: Present knowledge in food safety: A risk-based approach through the food chain. Ed. Knowles, M., Anelich, L., Boobis, A., and Popping, B. ILSI ISBN: 978-0-12-819470-6
5. McPhedran, T, Patel, K, Rayner A, Patel, M, Disson, J, Food allergen communication: An in-business feasibility trial - Food Control, 2021
6. Shi Zhuo, S, Ratajczak, M, Thornton, K, Jones, P, Ibrahimi-Jarchlo, A, Gold, N, Testing the impact of overt and covert ordering interventions on sustainable consumption choices: A randomised controlled trial, Appetite, 2022
7. Reynolds, C., Oakden, L., West, S., Pateman, R., Elliot, C., Armstrong, B., Gillespie, R. and Patel, M. (2021) Citizen science for the food system. Future directions for citizen science and public policy. in Cohen, K. and Robert Doubleday, R. (eds). Centre for Science and Policy, Cambridge. 55-59.
8. Patel, M (commentary piece), Beyond Opinion Polls, Food, Science and Technology, Volume 35, Issue 4, December 2021, Pages 41-45
9. Panton, A, Purdie, D, Dinophysis spp. abundance and toxicity events in South Cornwall, U.K.: Interannual variability and environmental drivers at three coastal sites, Harmful Algae, Volume 112, 2022, 102169, ISSN 1568-9883

FSA reports published since the last update:

1. A survey of AMR E. coli on beef and pork on retail sale in the UK (2021)
2. EU Harmonised Surveillance of Antimicrobial Resistance (AMR) in E. coli from Retail Meats in UK (2020 - Year 6, chicken)
3. What is the Burden of Antimicrobial Resistance Genes in Selected Ready-to-Eat Foods?

4. Healthy and Sustainable Diets: Consumer Poll
5. The third study of infectious intestinal disease in the UK (IID3)
6. Prioritising Foodborne Disease with Multi-Criteria Decision Analysis
7. A survey of AMR E. coli on beef and pork on retail sale in the UK (2021)
8. Radioactivity in Food and the Environment (RIFE) report 2020
9. A microbiological survey of campylobacter contamination in fresh whole UK-produced chilled chickens at retail sale (Y6)
10. Review of national food control plans in Australia, Canada, New Zealand and United States
11. Food and You 2 Wave 2 Secondary Report: FHRS
12. Survey of consumer perceptions of alternative, or novel, sources of protein
13. Thermal inactivation of Hepatitis E virus model
14. Food and You 2 Wave 3 Key Findings Report
15. Understanding platform businesses in the food ecosystem
16. Kitchen Life 2: Literature Review
17. Surveillance of Antimicrobial Resistance (AMR) in E. coli and Campylobacter from Retail Turkey Meat and E. coli from Retail Lamb in 2020/21
18. Summary Report: Trends in twitter conversations about food during 2019 – 2020
19. Psychologies of Food Choice: Public views and experiences around meat and dairy
20. Lit review: A rapid review of the evidence on the factors underpinning the consumption of meat and dairy among the general public
21. Lit review: Rapid evidence review of the Psychology of Food choice
22. Lit review: A rapid review of the acceptability and impact of approaches to reduce the salt, fat and sugar content of people's diets on consumers and industry
23. A survey of antimicrobial resistant (AMR) E. coli, Campylobacter and Salmonella on chicken and turkey meat on retail sale in the UK (2022)
24. Modelling framework to quantify the risk of AMR exposure via food products - example of chicken and lettuce
25. 21st Century Meat Inspector Project
26. A critical review of the microbiological colonisation of nano- and microplastics and significance to the food chain
27. Food Business Operators: Impact of a Changing Landscape
28. A survey of Salmonella, Escherichia coli (E. coli) and antimicrobial resistance in frozen, part-cooked, breaded or battered poultry products on retail sale in the United Kingdom
29. FBO Small and Micro FBO Tracking Survey
30. Precautionary Allergen Labelling Report and Non-Gluten containing Ingredients Labelling Report
31. UK Public's Interests, Needs and Concerns Around Food
32. Consumer insights tracker report: key findings from December 2021 to March 2022
33. Alternative Proteins for Human Consumption
34. Provision of allergen information in the Out of Home food sector
35. Surveillance of antimicrobial resistance (AMR) in E. coli on beef and pork meat on retail sale in the UK (October to December 2021)
36. A rapid evidence review on consumer and industry understanding of sustainable food and its importance when making food choices
37. Consumer responses to food labelling: A rapid evidence review
38. Turmeric Survey for curcuminoids, piperine and trace elements – Final report
39. Food and You 2 Wave 4
40. Food Sensitive Study; Wave Two Survey
41. The Future Delivery Model Citizen Panels: qualitative research findings
42. Qualitative research exploring community food provision
43. Consumer Handwashing Tracker
44. Feasibility study for in vitro analysis of infectious foodborne HEV
45. Simulating value creation opportunities for FSA inspection processes using digital twins
46. Food Hygiene Rating Scheme (FHRS) Audit of Display and Business Survey 2021
47. Levels and trends of antimicrobial resistance in Campylobacter spp. from chicken in the UK

48. Survey of public attitudes precision breeding
49. Consumer insights tracker (monthly reporting)

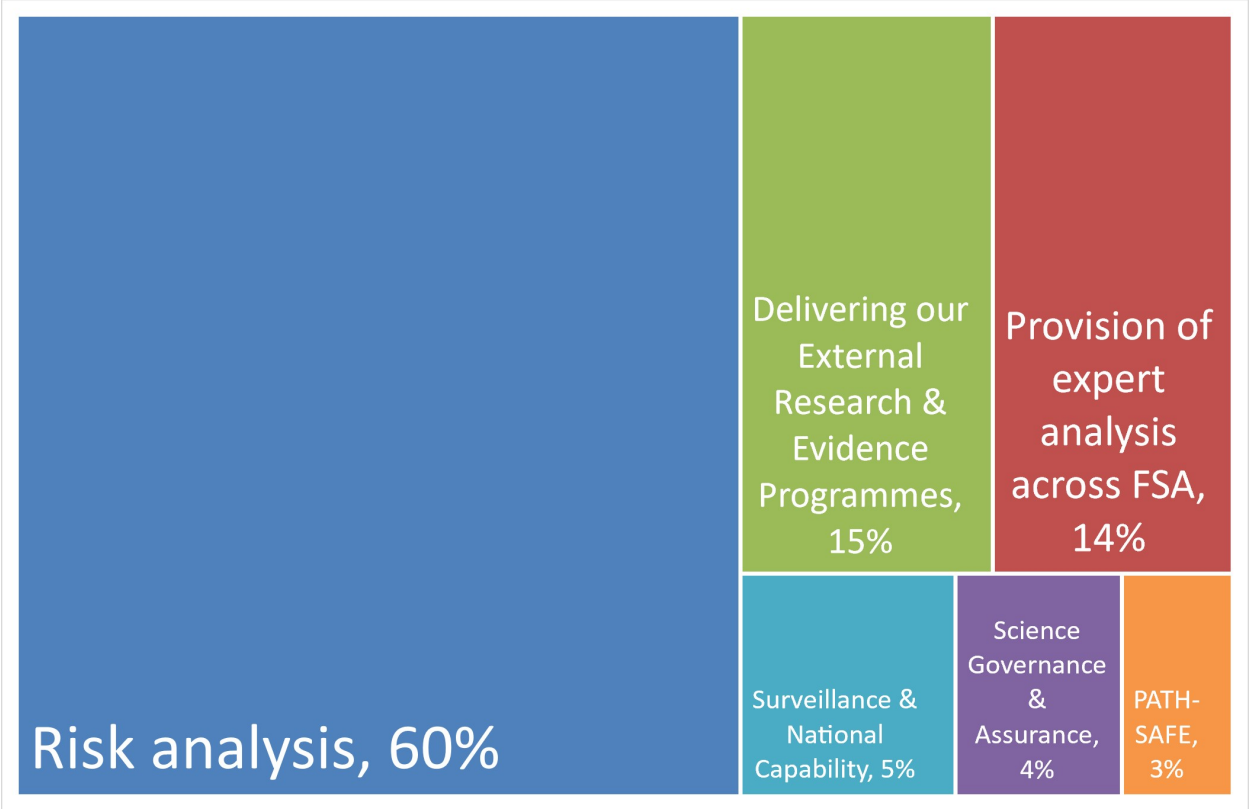
Annex 2 – Science Spending and Resource Allocation

FSA Science is comprised of 5 main functions:

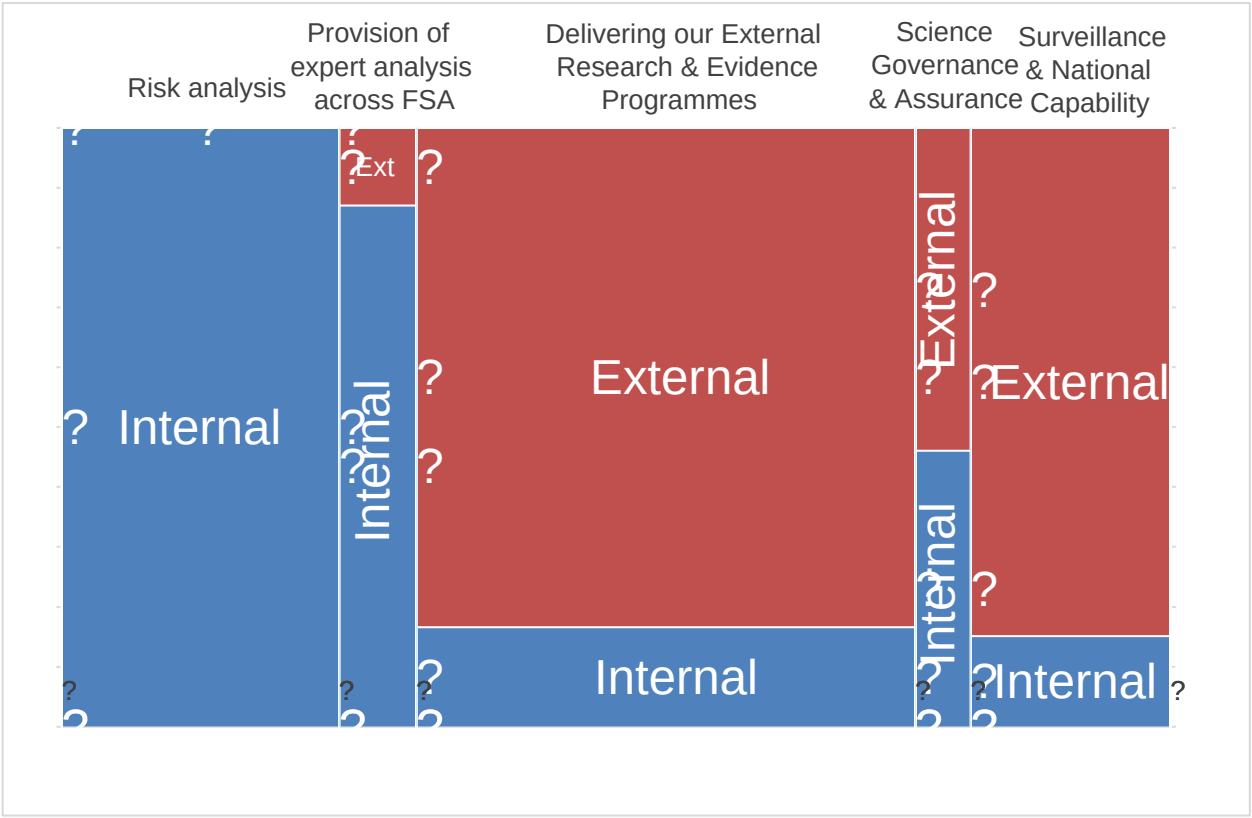
1. Risk analysis
2. Provision of expert analysis across FSA
3. Delivering our External Research & Evidence Programmes
4. Science Governance & Assurance
5. Surveillance & National Capability

In addition, there is also the PATH-SAFE programme. This is led from SERD but with ring-fenced funding that sits outside of the annual SERD budget.

The current distribution of FTE across each function within SERD is:



Each function is delivered through a combination of in-house resources and external spend as follows which for the 5 main functions is as follows.



As discussed in previous board papers, we are now delivering our research through a series of Research and Evidence Programmes and the distribution of our £6.5m R&D spend in 2021/22 across the different programmes is as follows.

Total science spending in 2021/22 was £16.6 million, compared to £10.2 million in 2020/21. This is both external spend and on FSA staff costs. This means science spending accounts for 12.7% of the Annual FSA Net Expenditure which is an increase over previous years. This can be seen as follows.

Annex 3 – Case Studies of FSA Science

Case Study: PATH-SAFE

Foodborne disease (FBD) and antimicrobial resistance (AMR) are major public health risks in the UK/. Building on existing initiatives across the four nations of the UK and utilising new technologies to enhance our surveillance capability, the PATH-SAFE programme will deliver on the FSA strategy pillar of "Food is safe," which prioritises the reduction of FBD and AMR. The programme is supporting the use of Whole Genome Sequencing (WGS), improved data analytics and environmental sampling to improve the detection and tracking of FBD and AMR through the whole agri-food system from farm-to-fork, and thus generate comprehensive data sets to enable rapid decision making. The application of this approach offers two key routes to improving control and reducing disease:

1. Source tracking: working back from outbreaks in humans or findings in food to the source of the infection/contamination and thus being able to remove this or mitigate its risk and thus prevent future outbreaks.
2. Earlier detection: enabling more efficient detection of pathogens at an earlier point in the chain and thus prevent the contamination of food or outbreaks.

As well as sequencing pathogens and building new data systems, the PATH-SAFE programme is also looking to build on testing new and innovative approaches and technologies, developed elsewhere. One such key area that the programme has sought to build upon is the extraordinary advances made during the Covid-19 response across the UK. The four nations quickly established wastewater (WW) sampling, testing and coordination to detect SARS-CoV-2 in samples from water treatment plants. The establishment of this testing network during the pandemic, demonstrated the speed and sensitivity of this system in the early detection of pathogens and its effectiveness of population-level disease monitoring. Building on this network offers a wealth of opportunity for the detection and monitoring of foodborne pathogens and AMR, across a range of WW scenarios, to study the epidemiology and distribution of pathogen loads in a population, without the requirement for individual human testing. PATH-SAFE is seeking to exploit this potential and a number of pilot projects are in progress across all four nations, including: Food Standards Scotland-led study focussing on the detection E. coli in WW; Cefas/University of Bangor-led study on WW surveillance of norovirus, Salmonella spp. and Listeria monocytogenes in agri-food and environmental settings; PHA NI/Queens University-led WW based epidemiology study for tracking norovirus and AMR within care homes; Defra group/UKHSA-led environmental AMR surveillance system pilot; and Cefas-led AMR in abattoirs WW study.

The programme is also exploring novel technologies to enhance our pathogen surveillance capabilities, utilising remote DNA testing technology that could be potentially deployed as an

alternative to laboratory-based testing. A key example of this is a project being led by UKHSA investigating the use of Loop-Mediated Isothermal Amplification (LAMP) DNA technology in WW surveillance for rapid in-field diagnostics, deployable to critical sites within the agri-food chain.

Due to the cross departmental nature of the programme and the existing WW capabilities across government, the programme has also set up a "community of interest" to enable technical discussions and cross pollination of ideas in this space. While currently focused on the programme, we have been in discussion with UKHSA and Defra to expand into a cross-government WW group to encourage share best practice, so that the best evidence can be used in decision making across a wide array of pathogens. Showing how PATH-SAFE is convening, as well as innovating.

Case study: Kitchen Life 2

This three-year project seeks to answer questions about what people really do in domestic and commercial kitchens by using used motion sensitive cameras to automatically record food hygiene behaviours. We want to know this for two reasons, firstly to inform gaps in our risk assessment modelling of pathways for the transmission of foodborne pathogens, and secondly to develop hypotheses for behavioural interventions.

With consent, we installed cameras in a hundred kitchens. Each behaviour was coded, and analysed through the COM-B framework (footnote 26), utilising a range of research methods to understand the capability opportunity and motivation for each behaviour of interest. The method was designed to overcome potential biases in self-reported behaviours, and the limitations of ethnographic approaches (footnote 27) to data collection. Specifically, the method was designed to observe behaviour in as close to 'real life' conditions as possible.

For domestic kitchens, sample characteristics included household composition, location, social group, lifestage and diet. For commercial kitchens, firmographic information included size of business, location, cuisine type, and food hygiene rating. The final achieved sample was 68 domestic and 32 commercial kitchens.

Significant focus was given to the ethical oversight of the research, with privacy impact assessments, ongoing consent processes, data security and quality protocols developed.

Behavioural data was captured on video over a 1-week period. The video was encrypted and streamed to a platform for coding. As well as hygienic behaviours, coding included contextual factors such as food type, who performed the behaviour and where, and any utensils or cleaning products used. Just under 300,000 behavioural tags were applied in total, organised in a database and dashboard. A range of other data was captured including:

- Fridge and freezer temperatures data
- Photographs of the kitchen layout
- For households only:

1. photographs of fridge and freezer food storage
2. food diaries
3. shopping receipts

Videos were housed in a searchable platform, allowing target behaviours to be observed and codified in detail. In addition to observed data, surveys were used to determine participants beliefs and attitudes to food hygiene, and interviews to explore potential behavioural influences in depth. For each behaviour, findings from each research method were triangulated to identify influences in terms of psychological and physical capability, social and physical opportunity, and automatic and reflective motivation.

It proved very challenging to recruit FBOs to take part in the study, both due to concerns around privacy and how the data may be used by the FSA, and due to the need for consent from each person working in the kitchen. Additionally, the focus on detailed analysis of behaviours also risked underplaying how non-food actions and activities interact with food hygiene.

The first outputs of the project – a literature review – was published this year. Analysis of the data continues, and we will publish further reports next year, including a handbook of potential behavioural interventions.

Case Study – Sampling

Sampling underpins the work of the FSA in maintaining the safety and authenticity of the food supply chain through providing intelligence and evidence, supporting enforcement action to protect consumers and enabling the FSA to meet its statutory obligations as a regulator. The insights provided by sampling generate wider secondary benefits including enhanced consumer trust and reputation as well as improved direction of policy and risk assessment and subsequent use of public money.

To deliver this the FSA undertakes a range of sampling activities, including an annual retail surveillance survey delivered in partnership with the five Public Analyst Official Laboratories (OLs) in England and Wales. A range of tools and approaches are used to identify commodities for sampling including surveillance, intelligence, the UK's National Reference Laboratories, horizon scanning, policy and scientific expertise and consultation across government.

The 2021-22 survey comprised two elements; a 'basket of foods' and 'targeted surveillance'. The basket of foods aimed to take a snapshot of compliance levels with respect to food safety and standards year on year whereas the 'targeted surveillance' was a one-off look at products with suspected issues.

Commodities in the basket of foods included those with known authenticity issues (for example Basmati rice, herbs and spices) and commonly consumed foods (for example bread and milk). Results revealed 89% of products were compliant with respect to the relevant standard. The majority of non-compliances related to labelling (for example readability of the font type used to provide allergen information) and composition (for example declared vs actual milk fat %). Notable results included detection of undeclared allergens in 5% of samples and authenticity breaches for oregano and Basmati rice. These results were published in the FSA's 2021 Food Standards report.

Examples of commodities in the targeted surveillance group include soya lattes, breakfast cereals, and herbs and spices as well as samples in support of Opson XI which focussed on the authenticity of seafood and alcohol. Overall, 90% of samples tested were compliant. Examples of non-compliance include 1 out of 30 salmon products was found to be substituted for a different species (trout in a fish pie mix) and a number of small-batch gin and vodka products (26 of 92 products) were found to have alcohol-by-volume levels (ABV) which were not consistent with that declared on the label. Notable results of concern included undeclared allergens reported in 47% of takeaway soya lattes unauthorised colours or colours above the permitted levels in 20% of breakfast cereals.

Whilst only a small number of safety issues were identified, the sampling results reinforce the need for a regular sampling programme and enforcement, especially for allergens as well as further guidance for industry and ongoing monitoring in relation to product labelling.

Results from the surveys have directed and inform other sampling programmes such as those carried out by local authorities (LAs). Further official control sampling is being funded to follow up on areas of non-compliance identified through the retail surveillance survey. The FSA is carrying out further retail surveillance sampling in 2022-23 across England, Wales and Northern Ireland.

Case Study – Risk Analysis – Fukushima import controls

This is the first issue in the UK Risk Analysis process to deliver its evidence package to support evidence-based decision making. Risk analysis issues can be raised from any area of the FSA's remit. The majority of issues, where a risk assessment and other evidence such as economic impact assessments are commissioned and particularly those that are considered non-routine, are described in separate papers to the board including the regular business committee risk analysis and regulated product service reports. In this way, both the risk management and supporting evidence can be drawn together to provide the board with a full picture of current risk analysis issues.

In March 2011, an earthquake struck off the east coast of Japan resulting in a tsunami. This caused damage to the Fukushima Daiichi nuclear power station which resulted in radioactive contamination affecting areas of Japan and the food and animal feed grown in these areas.

Retained Regulation 2016/6 put in place controls on the import of certain types of food and feed, which were regularly reviewed by the European Commission. These controls included enhanced checks and a maximum level of 100 becquerels per kilogram (Bq/kg) for certain species of fish, wild mushrooms and foraged Japanese vegetables from certain prefectures (regions) of Japan.

In 2021/2022, FSA and FSS reviewed the regulation using our risk analysis process.
The evidence package comprised:

1. A **quantitative risk assessment** that was produced by FSA risk assessors and independently reviewed by the Committee on Medical Aspects of Radiation in the Environment (COMARE), a scientific advisory committee of the Department of Health and Social Care. The risk assessment concluded that the removal of the 100 Bq/kg maximum level on radio caesium for imported Japanese food would result in a negligible increase in dose and a negligible associated risk to UK consumers.
2. A **UK-wide Impact Assessment**. The Net Benefit (Present Value) for the preferred option of removing import controls is estimated to be £0.018m (low estimate £0.002m, high estimate £0.034m). Other key non-monetised benefits include perishability savings (a reduction in products spoiling at port while official controls take place) and trade facilitation.

A **public consultation** was held in which policy officials asked for comments from industry, enforcement authorities, consumers and other interested stakeholders on our risk management options. The consultation included three options: to retain, remove or retain and adjust the controls.
Following the consultation, FSA and FSS advised Ministers in England, Wales and Scotland that, based on the outcome of the FSA's risk analysis, the enhanced sampling and import controls are no longer required to ensure food is safe as the requirements of general food law will suffice.
FSA policy officials then continued to work closely with FSS and the devolved governments to lay legislation to remove these controls in June 2022. An updated EU regulation which maintained most of the previous controls continued to be implemented in Northern Ireland because under the current terms of the Northern Ireland Protocol, Northern Ireland will continue to apply the EU Regulations.

During a speech at a reception at the Japanese Embassy to mark the end of the controls the former Secretary of State for Health and Social Care said he was grateful to the work of the FSA who brought the best science to bear.

Annex 4 Science Key Performance Indicators (KPIs)

The development of SERD KPIs has been an ongoing process involving input from Science Council.

While seeking to develop truly outcome focused KPIs in the future, we recognise that this is challenging whilst we are still in the early stages of delivering our strategic plan, and hence lack the long-term data to identify if outcomes are being/have been achieved. Outcome-focused KPIs are also challenging to measure and required significant resources to implement.

To address this, the current KPIs are output-related measures which act as leading indicators towards achieving our desired goals and outcomes. These will allow us to benchmark our position in terms of outputs, which will ultimately feed into delivering outcomes in the future. They are also more resource effective to implement, in most cases building on data that is already being collected or which is easily obtainable. Therefore, we have developed a series of output focussed KPIs that are indicative of 4 key outcomes:

1. We are a trusted provider of independent evidence
2. Science will continue to sit at the heart of the FSA
3. We have a motivated and inspired team of experts
4. We have a culture of openness and collaboration

Under each outcome we have 4 KPIs, creating a total of 16 against which we can measure our progress.

We see this current set of KPIs as an initial approach, which can evolve and develop over time, as measuring outcomes becomes more viable. The current KPI dashboard showing targets and current status is below:

Trusted provider of independent evidence (Delivery)

Key Performance Indicator (KPI)	Measure of success	Target	Current status
A1 Risk Analysis Process is followed, evidence is assured, and outputs fit for purpose	% of evidence packages meeting MVP	100%	No data yet
A2 Maintain and improve the use of research and evidence across FSA	SERD satisfaction	70%	Results due in quarter 4
A3 Optimise SERD Research and Development spending	Variance in research and design budget	+/- 10%	-3.6%
A4 Maintain or increase the total science investment	% of FSA spend on science	10%	12.7% (footnote 28)

Science sits at the heart of the FSA (Capability)

Key Performance Indicator (KPI)	Measure of success	Target	Current status
B1 Safeguard national science capacity through the network of NRLs	NRL spending	£1,000,000	£581,948 (footnote 29)
B2 Sustain or improve horizon scanning programme	Number of HS reports	3	1 (footnote 30)
B3 Retain access to external expertise through Science Advisory Committees	Number of experts on SACs	100	108
B4 Levelling up of SERD investments across the UK	% of FSA spend on research and development outside of London/South East	50%	78% (footnote 31)

Motivated and inspired team of experts (people)

Key Performance Indicator (KPI)	Measure of success	Target	Current status
C1 Sustain or improve SERD engagement index	Engagement score from staff survey	70%	Results due quarter 4.
C2 Support staff participation in learning and development activities	Learning and Development score from staff survey	70%	Results due quarter 4

Key Performance Indicator (KPI)	Measure of success	Target	Current status
C3 Effectively manage SERD staff turnover	Rate of SERD churn	10%	to date 4% (footnote 32)
C4 Maintain or increase SERD staffing	% of FSA staff in SERD	10%	9.8%

Culture of openness and collaboration (Partnership)

Key Performance Indicator (KPI)	Measure of success	Target	Current status
D1 Maintain or increase the use of SERD science	Number of SERD reports and papers published as a result of SERD funding	75	65 (footnote 33)
D2 Maintain or increase research collaborations by co-funding joint projects	Leverage of external fund	10%	No data yet.
D3 Retain and enhance support for fellows and PhD students working in the FSA	Number of fellows and students	15	15
D4 Retain and enhance SERD international science outreach	Number of international engagements	20	44 (footnote 34)

1. FSA Science update 2021
2. Chief Scientific Adviser annual report
3. Science Council annual report https://www.food.gov.uk/sites/default/files/media/document/FSA 22-03-08 - Science Council Chair%27s Annual Report to the FSA Board.pdf
4. Advisory Committee for Social Science annual report
5. Food Hygiene Delivery Model
6. Provision of Allergen Information in the Out of Home Food Sector
7. Food Sensitive Study: Wave Two Survey
8. Risk analysis and Precautionary Allergen Labelling research report
9. Precautionary Allergen Labelling Report and Non-Gluten Containing Ingredients Labelling Report
10. Food and You 2
11. Consumer insights tracker
12. Qualitative research exploring community food provision

13. UK Public's Interests, Needs and Concerns Around Food

14. Alternative Proteins for Human Consumption

15. Government Science Capability Review

16. Areas of Research Interest

17. The first newsletter had 921 subscribers, the second had 1035 subscribers and as of 1st November we already had 1120 subscribers for the 3rd newsletter (a 22% increase in external engagement since the start of the newsletter).

18. News story: FSA and UKRI join forces with the public to explore food safety

19. Review of Science Advisory Committees and Joint Expert Committees

20. Science Council Working Group 5 on Food Hypersensitivity

21. Science Council Working Group 6 on Food Safety and Net Zero Carbon

22. Science Council Working Group 6 - July 2022 Interim Report

23. FSA 22-09-06 - Public Analyst Official Laboratory System: Our Approach to Building a Resilient System

24. Pathogen Surveillance in Agriculture, Food and Environment Programme

25. Kitchen Life 2

26. Michie, S et al. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implement Sci. 2011; 6: 42.

27. This includes participant observation or the use of autoethnographic approaches where participants record their own behaviour.

28. Data from financial year 2021/22.

29. Data correct as of 1st November 2022, expected to meet target by year end.

30. Data correct as of 1st November 2022, expected to meet target by year end.

31. Data from Finacial Year 2021/22.

32. Data correct as of 1st November 2022, expected to change by year end.

33. Data correct as of 1st November 2022, expected to change by year end.

34. Data from financial year 2021/22.