

Project title and location:

Big data based Early Warning Systems for biosecurity and food safety: challenges and economic value.
Newcastle-upon-Tyne and York

IAFRI background:

The Institute for Agri-Food Research and Innovation (IAFRI) is a joint venture between Newcastle University and Fera Science Ltd and a unique model for how universities can work with private sector research organisations. It operates under a private-public ownership to deliver both public good research and services as well as innovation and wealth creation in strategically important industrial sectors in the UK. Students will have a unique opportunity to benefit from supervision and facilities at both the Newcastle and Sand Hutton campuses to deliver research with real-world impact.

Lead Supervisors (and contact): For more information and details on how to apply please contact Diogo Souza Monteiro (diogo.souza-monteiro@newcastle.ac.uk) and Glyn Jones (Glyn.d.Jones@fera.co.uk)

Key research gaps and questions:

Horsemeat in beef burgers, plastics in milk powder, petrochemicals in vanilla and floor polish dyes in spices – these are just some example frauds in the food supply chain that have caused international scandals and cost millions of pounds worth of reputational damage. When retrospectively reviewed, there are simple information that could have warned of these frauds much earlier, but these opportunities were missed.

The UK imports a substantial proportion of consumed foodstuffs and other biological material from many regions of the world, associated with many different potential hazards. Plant and food supply networks are dynamic systems with many actors, environmental and social drivers. The complex nature of these systems is due partially to the interconnection of three networks: a physical, a financial, and an informational one, connecting agents performing different activities worldwide. These networks have vulnerabilities and are exposed to multiple hazards which can disrupt their normal operation and, in extreme cases, cause food insecurity. The sheer volume of data required to spot these crimes is overwhelming for us to grasp, yet this task is ideally suited to a computer algorithm.

The high-profile food scares of the last decade have exposed the vulnerabilities of the global food supply chains and prompted the development of surveillance semi-automated tools aimed at understanding the origin and distribution of risks in the system. An AI based early warning system (EWS) has been built in Fera but requires some human intelligence optimisation. The work supported by this scholarship aims to build on these data based ‘early warning’ systems, as well as considering the is implications around intelligence and risk within the global supply network. More specifically, the research proposed has two specific goals: a) to benchmark and understanding how to improve the “early warning system” developed in Fera which currently identifies ‘abnormal’ trade conditions as potential indicator for risky behaviour associated with food safety or food fraud, and b) to determine the value of this system to its commercial users and identify how the information it provides can best be communicated to stakeholders or integrated on their decision support systems.

To improve the resilience of the British Food chain, the research team at FERA and Newcastle have recently focused on developing ‘early warnings’ for potential risky patterns of behaviour in the context of agri-food systems (originally developed under the EU food integrity). These data and analytical based approaches aim to help brand owners, regulators, and other relevant stakeholders, detect the presence of potential markers for risky behaviour and to support these actors in their response to a changing data environment.

Project Description:

To tackle the aims and goals described above this project comprises three main work areas. FERA Science has developed an Early Warning System (EWS) that monitors publicly available data on international trade to report disruptions, which may be associated with increased risks or threats. However, the complexity of trade relationships and their association with biosecurity and food safety issues require further development in the system's robustness and effectiveness. Therefore, the PhD will work on the following tasks:

Task 1: Evaluate and benchmark the existing early warning systems developed by companies and public organizations, identifying strengths and weaknesses as well as opportunities and challenges for improvement.

Task 2: To develop a robust EWS to alternative data sources and monitor factors that lead to biosecurity and food safety issues.

Task 3: To profile the EWS users to characterize shared information with users' needs, and to evaluate the economic value of alternative features of the EWS.

Desired skills:

This is a multi-disciplinary project aiming to integrate aspects of data science and economics as applied to the UK agri-food system. A successful candidate will demonstrate:

- An interest and understanding of the ('big') data environment around the UK agri-food sector, and this might be leveraged in the context of biosecurity, food safety, and/or food fraud.
- Interest in the development of conceptual frameworks around risk in the agri-food sector, the possible markers for risky behaviour, and how these might be realised in the context of available data sources.
- Interest or experience in policy evaluation and risk-based approaches to decision making and how these can be communicated to policy and decision-makers.
- An understanding of the conceptual elements of economic decision making and the approaches that might be used to identify the preferences and values of various relevant stakeholders.
- An interest in understanding system level processes associated with a complex economic network and how these might be understood in the context of resilience to disruption or potential threats.

Experience with a scripting programming language (such as R, Python, or Stata) would be highly advantageous, as would any previous experience with databasing, data processing or system automation. Communication of warnings to non-technical stakeholders is a key component of early warning systems. Hence, any experience in the development of informative data or model visualisation and/or policy communication would also be considered beneficial.

Knowledge of statistical analysis, particularly around unsupervised machine learning and/or the analysis of time series is important in the development and analysis of warning systems, as well as understanding the econometric analysis to support decision making. Candidates would be expected to demonstrate a strong understanding of core principals of analysis and how these might be applied to the study questions.

The successful candidate must be able to work within an existing team, including experts in economic analysis and detection of biosecurity issues, food fraud and safety risks, as well as technical and statistical support staff. The candidate must demonstrate the ability to work independently and to take ownership of projects and outputs, as well as the ability to communicate their findings within the team and to stakeholders within the agri-food sector.

