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## Our science strategy

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### MISSION

Translating research into  
real-world solutions across  
the agri-food supply chain



FOREWORD

**Dr. Rick Mumford**  
Director of Science



Welcome to the Fera Science Strategy. With the formation of Fera Science Ltd in April 2015, it was essential to develop a new scientific roadmap that reflected the aspirations of the new organisation, whilst recognising the legacy of what had gone before. We have now achieved this and created a new science strategy that provides:

- Clarity on our purpose and mission - the science we currently do and our overall approach to delivering it
- A vision of where we want to be in the future - the areas of science where we will focus in coming years

*Science solutions for a changing world*

We live in a changing world, one that faces global challenges such as climate change, increasing globalisation and population growth. In turn, these all affect our food security. Our food supply chains are also impacted by further drivers, which influence the ways we produce, manufacture, sell and consume food. Issues such as loss of pesticides (due to resistance and withdrawal), water security, health & nutrition, food fraud, invasive species and environmental sustainability have all become major challenges. The impact of these and others will continue to grow for the foreseeable future.

As a science-based organisation that works across the agri-food supply chain, Fera is ideally placed to address these challenges, providing effective solutions that solve real-world problems.

*Rick Mumford*

A UK science business, based at the National Agri-Food Innovation Campus, near York, which...



Has a scientific heritage that stretches back over 100 years



Employs more than 350 scientists & technical specialists including around 70 with PhDs



Tests & analyses over 90,000 samples per year



Has over 100 procedures accredited to ISO 17025



Is the UK National Reference Laboratory in 9 different areas

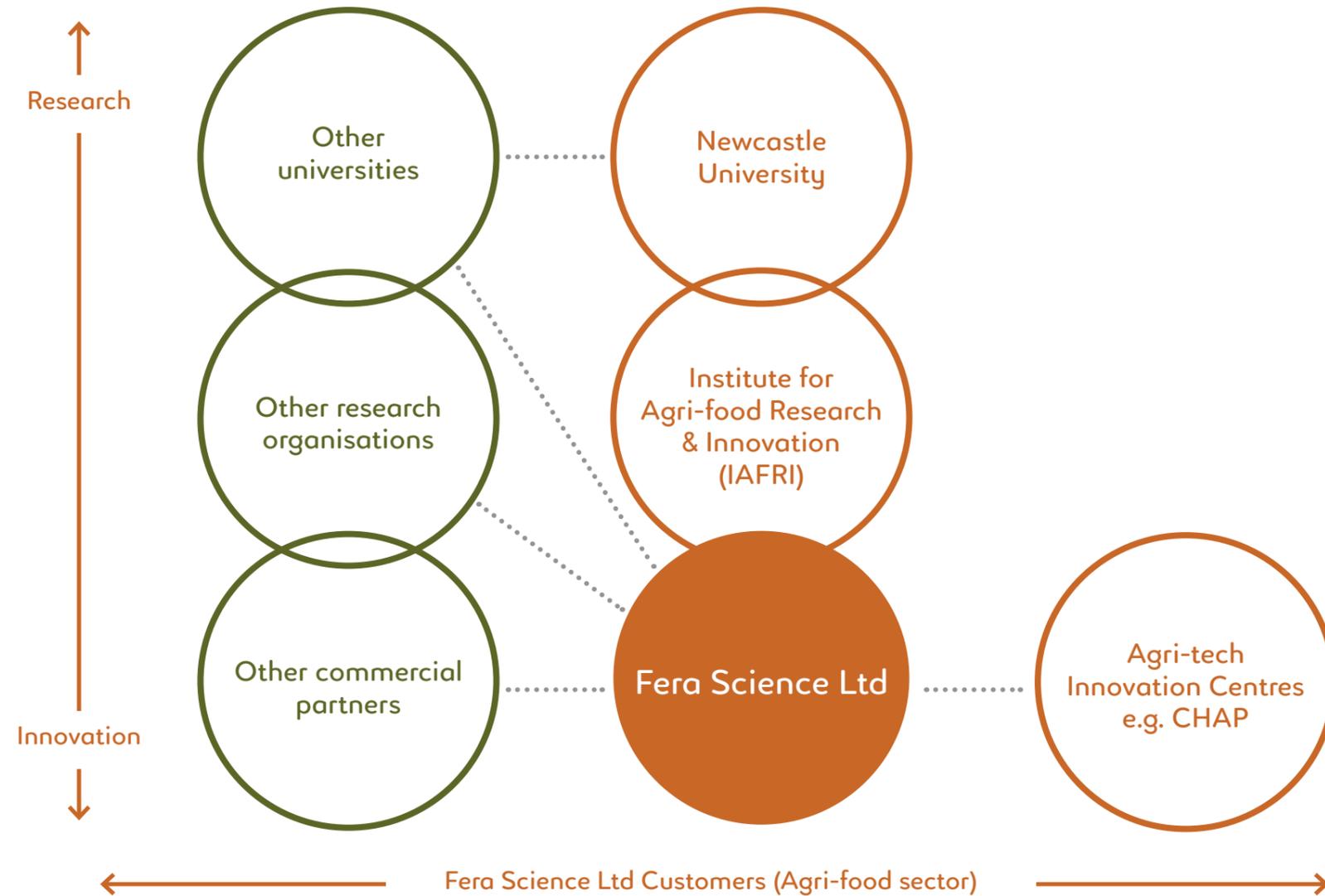


Publishes over 100 peer-reviewed papers per year



Has collaborated on 33 EU projects working with over 440 partners & co-ordinated 16 major projects in last 5 years

## Our strategic partnerships



## Our science

As an organisation our focus is translating research into evidence and science-based products and services. As we move forward, we will encourage an approach that is more entrepreneurial, internationally-focused and integrated into cross-cutting, interdisciplinary programmes that are underpinned by our strategic partnerships and driven by the needs of our customers.

- Experts in agri-food science, working across the entire food supply chain
- Pioneers in applying diagnostics, measurement & analytical science
- Internationally-recognised authority on regulatory science & provider of scientific services, including proficiency testing, knowledge solutions & consultancy
- Conducting research to drive the development of innovative products & scientific solutions to:
  - Protect crops, food & the environment from emerging & established threats, including pests, pathogens & chemicals
  - Enhance our customers' brands, minimise waste and improve their environmental sustainability

Working across the agri-food supply chain

## Our core science capabilities



Plant & Bee Health



Risk Assessment & Analysis



Novel Diagnostics & Surveillance Systems



Food & Feed Safety



Proficiency Testing & Reference Materials



Crop Protection



Sustainable Agriculture



Chemical Safety & Stewardship



Food Quality & Authenticity



Waste Reduction & Biorenewables

FROM **Farm** TO **Fork**





## Our science values

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With a heritage stretching back over 100 years, we built our reputation on delivering science for the public good. As we embark on the next stage of our history, we will build upon our established strengths: trust, independence, quality; whilst working to develop a fresh culture that is innovative, customer-focused and which reflects our new status and future aspirations.

- We will conduct science that benefits society
- We will be open, ethical and impartial; with a reputation for independence
- We will align our ingenuity and innovation to our strategy and the goals of our business
- We will deliver collaborative, multidisciplinary science by working as a single entity
- We will focus our science to effectively meet the needs and expectations of all our customers
- We will ensure quality underpins all of our science



## Setting the direction: Our underpinning science approach

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- Focus on **translational science**, creating an effective innovation pipeline channelling R&D into science solutions
- Be more entrepreneurial, with a greater focus on **IP generation & commercialisation**
- Develop a stronger **international** outlook; building partnerships overseas
- Greater integration of our science capabilities into **cross-cutting, interdisciplinary programmes**
- Provide **freedom to invest** in the development of breakthrough technologies in new, prioritised areas
- Work with our academic partnerships to share our skills & knowledge bases
- Optimise our **horizon scanning & intelligence gathering** to better focus our science on the needs of our customers & partners

# Our science priorities

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## Crop health

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Around the world, plant pests and diseases have a huge impact on both global food security and our natural environment. To meet this challenge we need improved plant biosecurity to control new threats and better crop protection to manage existing ones. To be effective, we need innovative, integrated approaches, which also need to be both environmentally and economically sustainable.

- Sustain our capabilities as a plant & bee health reference laboratory to ensure **UK biosecurity**
- Working with our **international** partners to extend the reach of our crop health science for the benefit of the emerging economies
- Develop new sustainable **pest & disease management solutions**, including biopesticides, to mitigate emerging risks including pesticide resistance & new invasive pests
- Develop tools for understanding the behaviour & interaction of pathogens, microbes & chemicals in soil to improve management of **soil health**
- Adopt interdisciplinary approaches & data integration to develop effective **risk management & decision support systems**

## Measuring the impact of agriculture on pollinator health

Over the last half century the global cultivated area of insect-dependent crops has trebled, whilst several key insect pollinator groups have declined. Insect pollinators help to ensure human nutrition resilience and as the global population increases, it is important that we understand how we can support pollinator populations. As a collaborator on a project, funded by the Insect Pollinators Initiative, Fera worked different strands of research which impact on pollinators in different ways. Areas studied included: insect pollinated wild plants, pollinator responses to different agri-environments, the relationship between various factors (such as floral resources and landscape) & pollinator populations and farming benefits of insecticide usage alongside any relationship to colony losses. Factors that affect the population size or diversity of pollinators were identified in all of the research strands.

The results of the research has advanced knowledge of how different factors affect pollinator populations and some of the research findings have been able to inform the design of the new agri-environment scheme in England, as well as contribute to the policy debate on the impact of neonicotinoid insecticides on pollinators.

The analyses investigating benefits of neonicotinoid usage have developed into the development of crop production models. The outputs of these models could inform pesticide usage policy as well as farming groups interested in resource use efficiency.

## Food integrity



With increasing globalisation, our food supply chains are often complex, making them vulnerable to contamination or fraud. We need to give consumers confidence in the food they eat and industry protection for their brands and reputations. To achieve this it is necessary to take a holistic approach that integrates food safety, quality and authenticity.

- Strengthen our core capabilities and sustain our position as National Reference Laboratory to provide world-leading **food analytical science, proficiency testing & reference materials**
- Use non-targeted, omic-based approaches & horizon scanning to identify & provide solutions for **emerging risks**
- Work with partners to develop new capabilities to **link bio-analytical finding with health effects**, including nutrition, toxicology & endocrine disruption
- Integrate advanced technology, informatics & risk-based targeting to deliver **smart surveillance systems**
- Integrate our capabilities in **microbiology & genomics** to deliver better control measures & address emerging challenges including antimicrobial resistance

## Ensuring the authenticity of Manuka honey

Manuka honey is produced in New Zealand by bees foraging on the Manuka bush. The honey contains unique antimicrobial activity, which has led to its use as a health supplement and in medical applications such as wound dressings. This means that this type of honey can command a premium price based on the level of antimicrobial activity it contains. Labelling of Manuka honey has become a particular concern as many different grading systems are used which can be very confusing. For this reason it is important to be able to verify labelling claims so that consumers can have confidence in their purchases.

Fera scientists working on the European Union funded TRACE project (2005-2009) developed and published profiling methodology for the identification of novel biomarkers of honey using high field NMR spectroscopy. We then began specifically looking at the antimicrobial properties of Manuka honey with the then Health Protection Agency (HPA). It was whilst carrying out this work that the unknown active ingredient that is responsible for the antimicrobial activity only found in Manuka honey was identified and Fera published further work using NMR spectroscopy to quantify the main active ingredient, methylglyoxal.

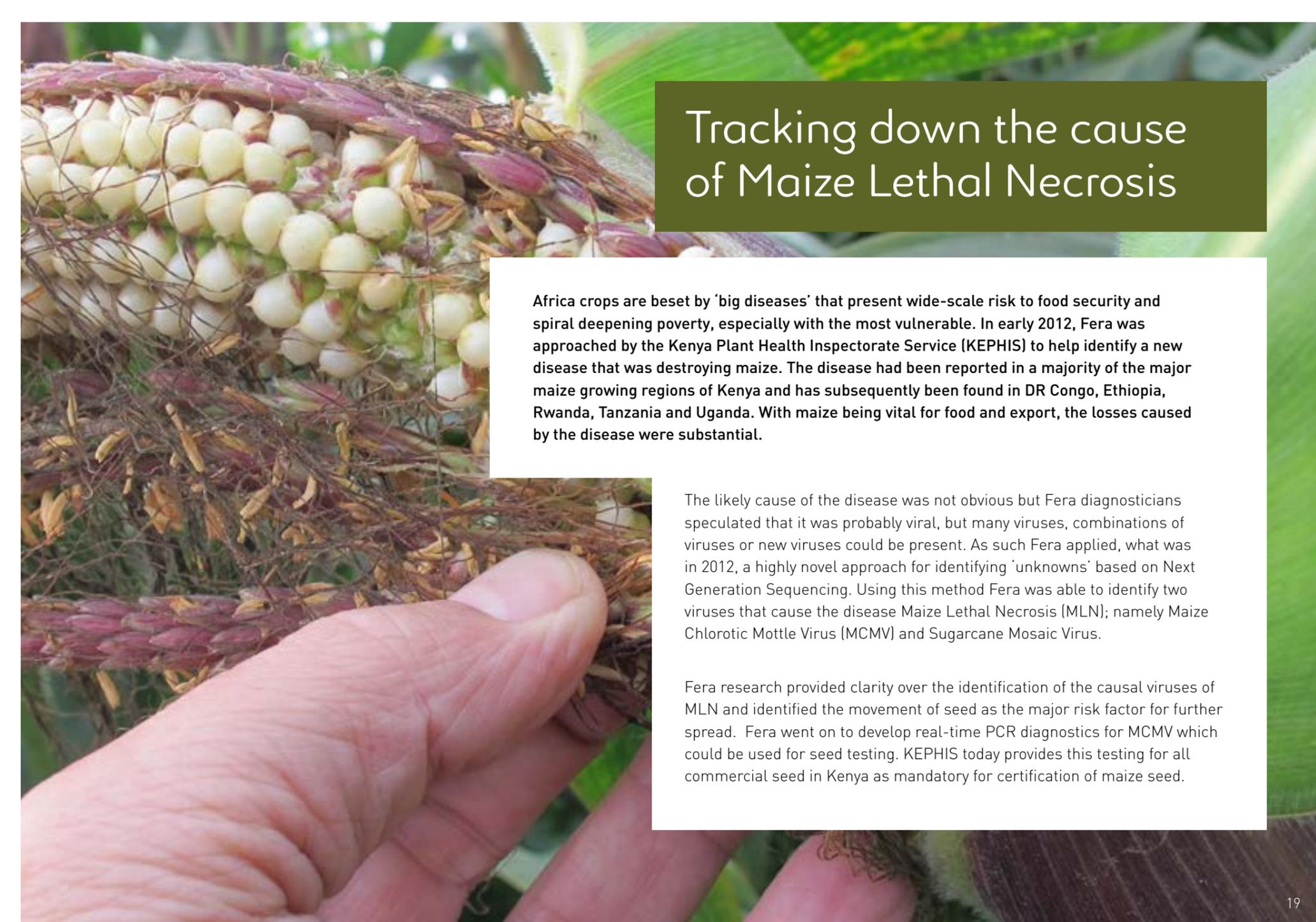
Working side by side with the Unique Manuka Factor Honey Association (UMFHA), the trade body that oversees all use of the UMF® trademark, Fera has implemented a range of methods to safeguard the Manuka honey supply chain and brand. A number of research projects are currently being undertaken to develop a robust set of naturally occurring biomarkers that can be used to determine if Manuka honey has been labelled appropriately. These international projects are highly collaborative and include government and commercial collaborators particularly in New Zealand and China.

## Next generation diagnostics



Measurement is core to what we do. In order to face future challenges in this field, we need to continue to pioneer new diagnostic and analytical technologies, allowing us to identify emerging threats and detect them earlier. We also need to use these approaches to develop innovative solutions and novel applications.

- Establish **omic technology-based systems** that allow the routine identification of biomarkers and the development of high-throughput diagnostics
- Accelerate the development of **rapid, non-lab based testing** technologies to enable remote deployment
- Develop generic, **integrated diagnostic platforms**, including risk-based sampling, quality assurance & proficiency testing to allow for faster, more effective deployment & to ensure their on-going sustainability
- Establish Fera as a nationally recognised **centre of diagnostic excellence** in agri-food & an innovation hub to accelerate the pull-through of emerging technologies into real-world applications



## Tracking down the cause of Maize Lethal Necrosis

Africa crops are beset by 'big diseases' that present wide-scale risk to food security and spiral deepening poverty, especially with the most vulnerable. In early 2012, Fera was approached by the Kenya Plant Health Inspectorate Service (KEPHIS) to help identify a new disease that was destroying maize. The disease had been reported in a majority of the major maize growing regions of Kenya and has subsequently been found in DR Congo, Ethiopia, Rwanda, Tanzania and Uganda. With maize being vital for food and export, the losses caused by the disease were substantial.

The likely cause of the disease was not obvious but Fera diagnosticians speculated that it was probably viral, but many viruses, combinations of viruses or new viruses could be present. As such Fera applied, what was in 2012, a highly novel approach for identifying 'unknowns' based on Next Generation Sequencing. Using this method Fera was able to identify two viruses that cause the disease Maize Lethal Necrosis (MLN); namely Maize Chlorotic Mottle Virus (MCMV) and Sugarcane Mosaic Virus.

Fera research provided clarity over the identification of the causal viruses of MLN and identified the movement of seed as the major risk factor for further spread. Fera went on to develop real-time PCR diagnostics for MCMV which could be used for seed testing. KEPHIS today provides this testing for all commercial seed in Kenya as mandatory for certification of maize seed.

# Sustainable agri-food systems



While we need to intensify our agri-food systems to meet the challenge of a growing population, we need to do so in a way that has less impact on our environment and which is more resilient to climate change. To achieve this we need to increase sustainability, by reducing waste, pollution and our reliance on non-renewable resources, whilst improving biodiversity.

- Reduce pre- & post-harvest losses due to spoilage & contamination, including finding alternative uses for **agri-food waste** to minimise its environmental impact & maximise its economic value
- Develop novel approaches to integrate traditional survey methods with technology-driven innovations, including remote sensing & meta-barcoding to enhance **environmental monitoring**
- Create new solutions (including eDNA, aquatic ecotoxicology & hi-resolution analytical methods) for monitoring pollution, contamination & biodiversity in aquatic environments to address resource challenges facing **water** in the agri-food chain
- Sustain our leading edge capabilities for assessing the **environmental safety of chemicals** to help minimise their impact on the wider environment



## Using insects to produce protein for animal feed

The growing global population coupled with a change in dietary patterns, with increasing consumption of meat and fish, requires that a sustainable protein source for livestock is made available. Insects are a good source of protein and can be incorporated in animal feed for poultry, fish and pigs. Although rearing of insects with the intention of feeding to domestic animals/fish has been evaluated for several decades there has been no adoption at a large scale and little attempt has been made to assess the safety, social and acceptability issues.

An Innovate UK funded project and the EU Seventh Framework Programme project PROteINSECT have been working to establish the potential for the use of insects as a source of protein for animal feed, and Fera has researched the potential use of the house fly, *Musca domestica*. The research has examined rearing methods, the nutritional profile and the value of insects as a source of protein for inclusion in feed material for monogastric livestock. A comprehensive safety analysis has also been undertaken to screen for chemical risks such as heavy metals, pesticides, dioxins, veterinary medicines and mycotoxins, microbiological risks and the potential for allergenicity. The findings on the quality and safety of insect protein have provided data that will be required by regulatory authorities to assess the potential for incorporation of insect protein in animal feed in the EU.





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Fera Science Ltd  
National Agri-Food Innovation Campus  
Sand Hutton  
York, YO41 1LZ  
United Kingdom

[www.fera.co.uk](http://www.fera.co.uk)

Tel +44 (0)300 100 0321

 @FeraScience

 /FeraUK1

 /fera-science

