

# Exploring the resilience of the UK food system in a global context



# Executive summary

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- The UK imports around half of its food and our diets are very varied, demanding a wide range of foodstuffs to be available all year round.
- Environmental, biological, economic, social and geopolitical stresses interact to make the UK's food system vulnerable to disruption.
- The 'Resilience of the UK Food System in a Global Context' (GFS-FSR) is a major five-year programme, launched in 2016 by the Global Food Security Programme (GFS), the UK's cross-government programme on food security research.
- Food system resilience can be defined as the system's capacity to maintain a desired state of food security when exposed to stresses and shocks. There are three ways of considering resilience:
  - o **Robustness:** The ability of the food system to resist disruptions to desired outcomes. Food system examples include developing more heat-tolerant crops, more diverse farming systems, strategic grain reserves and stronger food distribution infrastructure (e.g. harbours, railways). This requires considerable political and financial investment.
  - o **Recovery:** The ability of the food system to return to desired outcomes following disruption. Food system examples include, insurance to re-instate crops or physical infrastructure and emergency food distribution systems. This requires contingency planning and funding.
  - o **Re-orientation:** the ability of food system actors to **accept alternative outcomes** following disruption. Examples include changing to reduced meat diets, being satisfied with more seasonal produce, and accepting vegetables of lower cosmetic quality.
- There are three main approaches to enhancing food system resilience: adapting food system activities, adapting food system drivers, and adapting our world views on what we want from food systems.



# Why does the UK food system need to be resilient?

The UK imports around half of its food and our diets are highly varied, demanding a wide range of foodstuffs to be available all year round. Environmental, biological, economic, social and geopolitical stresses interact to make the UK food system vulnerable to disruption. For example, extreme weather (an important aspect of climate change), changes in trade arrangements and currency fluctuations all affect food availability. The effects of these food system 'drivers' (especially powerful when they occur together), lead to volatility in food supply and affordability – and hence food security. We therefore need to enhance our food system's resilience to such shocks and stresses.

## Key UK food system facts

- The food sector contributes approximately £111 billion a year to the UK economy.
- It accounts for over 13% of national employment and is the UK's largest manufacturing sector.
- The UK imports around 50% of the total food consumed and the proportion is rising.
- Changes in international trade arrangements will affect both our imports and exports.
- The UK imports large volumes of fruit and vegetables from water-scarce countries notably Spain and South Africa.



# About the research programme

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The 'Resilience of the UK Food System in a Global Context' (GFS-FSR) is a major five-year programme, launched in 2016 by the cross-government Global Food Security Programme (GFS) with a budget of £14.7m. GFS-FSR aims to help policymakers and practitioners improve the understanding of where the major vulnerabilities of the UK food system lie and how its resilience to environmental, biological, economic, social and geopolitical shocks can be enhanced. GFS-FSR is coordinated by the Food Systems Group of the Environmental Change Institute at the University of Oxford.

GFS-FSR consists of 13 collaborative research projects across UK universities and institutes producing new evidence and recommendations for policy and practice. These will help create a more efficient and resilient UK food system in a rapidly changing world. Results from its Projects will identify and develop interventions to strengthen UK food security.

## Research themes

The research funded by the GFS-FSR programme falls into three general themes:

- Optimising the productivity, resilience and sustainability of agricultural systems and landscapes
- Optimising the resilience of food supply chains
- Influencing food choice at individual and household level to both improve health and enhance food systems resilience.

The GFS-FSR programme thus spans all the activities that constitute the UK food system. As these activities are all closely connected, a whole-systems perspective is required to assess the consequences of any potential intervention on any one activity aimed at enhancing overall food system resilience.



# What is a food system?

A food system is an assemblage of a number of different 'activities', undertaken by a range of different 'actors' as influenced by a variety of 'drivers' which give rise to a set of outcomes. Activities include producing, processing, trading and consuming food (Figure 1a), outcomes from which include food security status, other socioeconomic issues and environmental footprint (Figure 1b).

While food security is an obvious primary goal, the array of food system activities also give rise to numerous business and livelihood aims. Together they may be a major aspect of an economy; the food sector contributes approximately £111 billion to the UK economy annually, 6.4% of Gross Value Added, and accounts for over 13% of national employment; it is the UK's largest manufacturing sector.

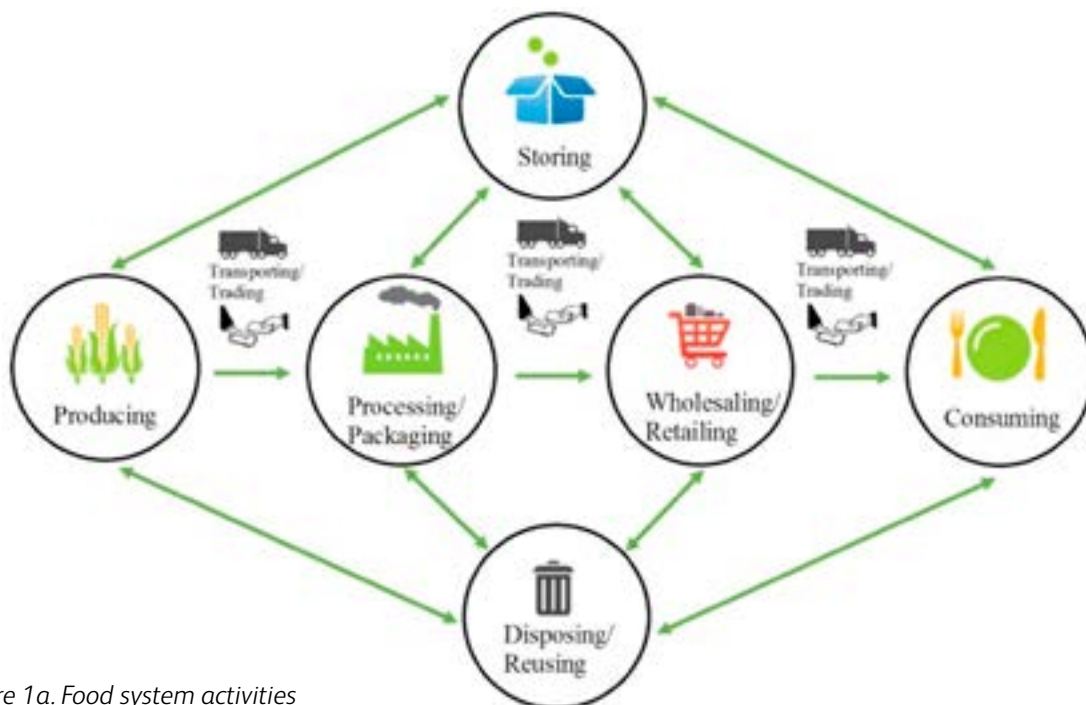


Figure 1a. Food system activities

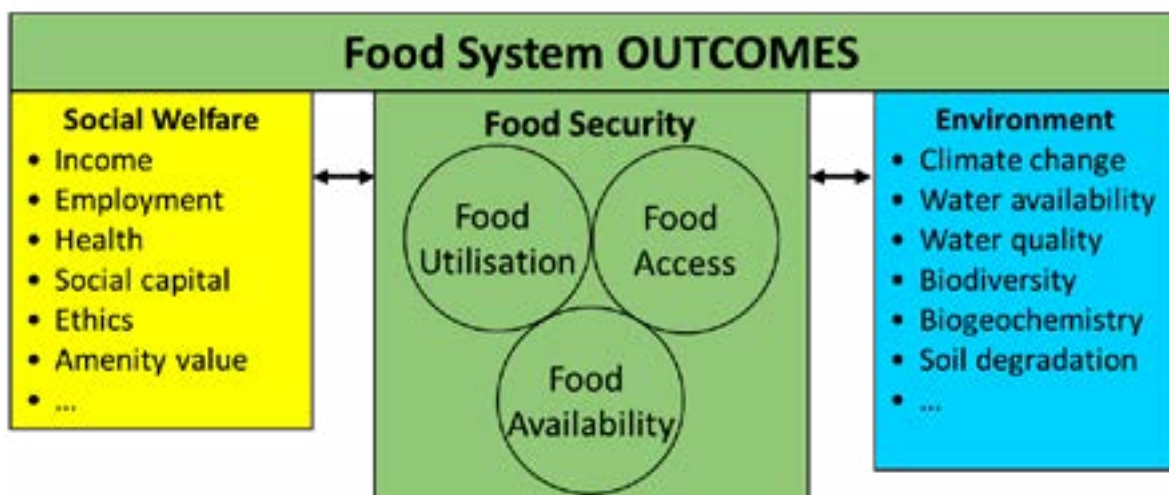


Figure 1b. Food system outcomes

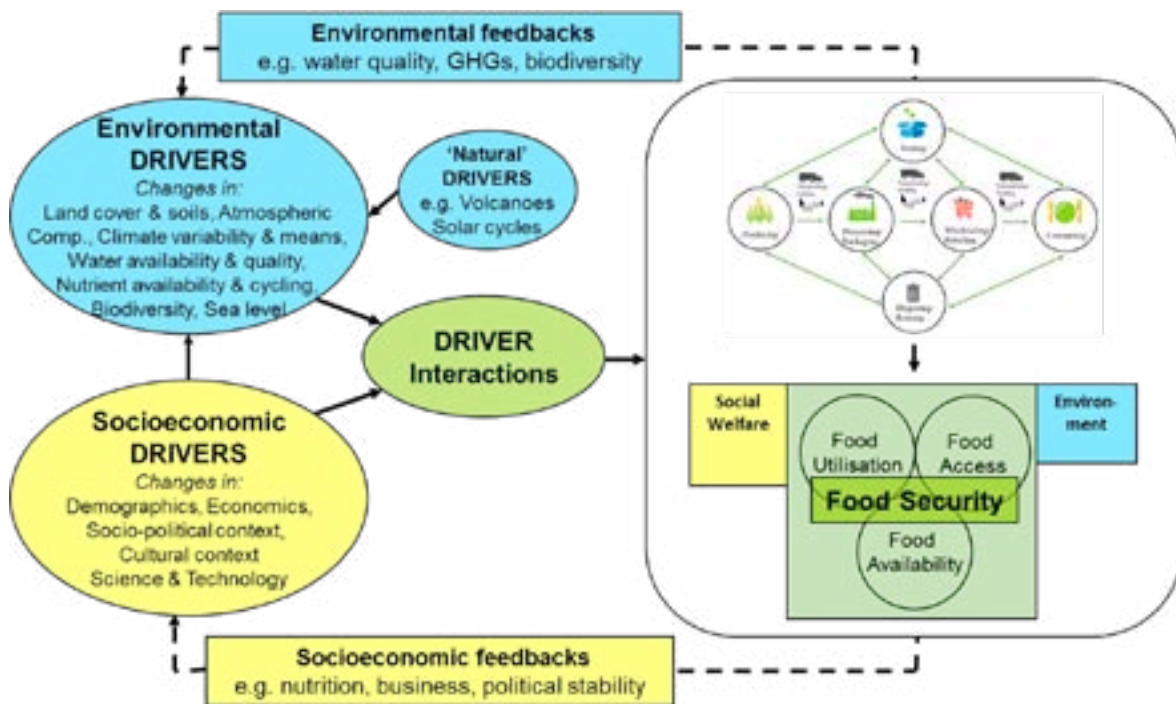


Figure 2 Food system drivers and feedbacks

In addition to the economic and social outcomes (e.g. the competitiveness of the food sector, and equitable and fair working conditions within the food system, and food safety), there are a number of environmental goals that both actors within the food system as well as the policy- and decision-makers trying to influence its outcomes are considering. These include the food system's environmental performance with respect to its impacts on greenhouse gas emissions, soil health, biodiversity loss and water resources and provision of other ecosystem services such as amenity value.

The UK food system involves the interconnected set of activities, which are all influenced by social, policy, technological, market, environmental and economic forces, trends and shocks. A change in any activity has repercussions across the system, affecting not only food security but also other socioeconomic and environmental goals. As shown in Figure 2, changes feed back to the food system's social, economic, political, technological and/or environmental drivers.

### What is food security?

*'Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.'*

UN-FAO World Food Summit 1996, 2012



# Why do we need to enhance food system resilience?

The challenge ahead is to achieve food security for a growing, wealthier, urbanising population, while minimising further environmental degradation but also maintaining vibrant enterprises and livelihoods. This needs to be achieved against a background of climate change and natural resource depletion, concurrent with changes in socio-economic-cultural conditions. Some of these changes are gradual (e.g. global mean temperature increase, demography, sea level rise), and can be thought of as increasing stresses. Others are sudden (e.g. extreme weather events, financial market crashes, disease outbreaks, conflict), and can be thought of as shocks. So how do we increase the resilience of our food systems to these stresses and shocks?

This question has come into sharp focus in recent years. This is due to increasing recognition of the many and varied negative environmental and health trends in food system outcomes, and the nature and potential magnitude of stresses and shocks. There is also a recognition of the need to maintain vibrant, competitive agri-food enterprises (and their associated livelihoods), which underpin our food systems.

## What is food system resilience?

We can think of food system resilience in general terms as the system's capacity to maintain the desired state of food security when exposed to stresses and shocks. However, the resilience of a food system can be considered from a number of different angles:

- **Robustness:** The ability of the food system to **resist** disruptions to desired outcomes. Food system examples include developing more heat-tolerant crops, more diverse farming systems, strategic grain reserves and stronger food distribution infrastructure (e.g. harbours, railways). This requires considerable political and financial investment.
- **Recovery:** The ability of the food system to **return** to desired outcomes following disruption. Food system examples include, insurance to re-instate crops or physical infrastructure and emergency food distribution systems. This requires contingency planning and funding.

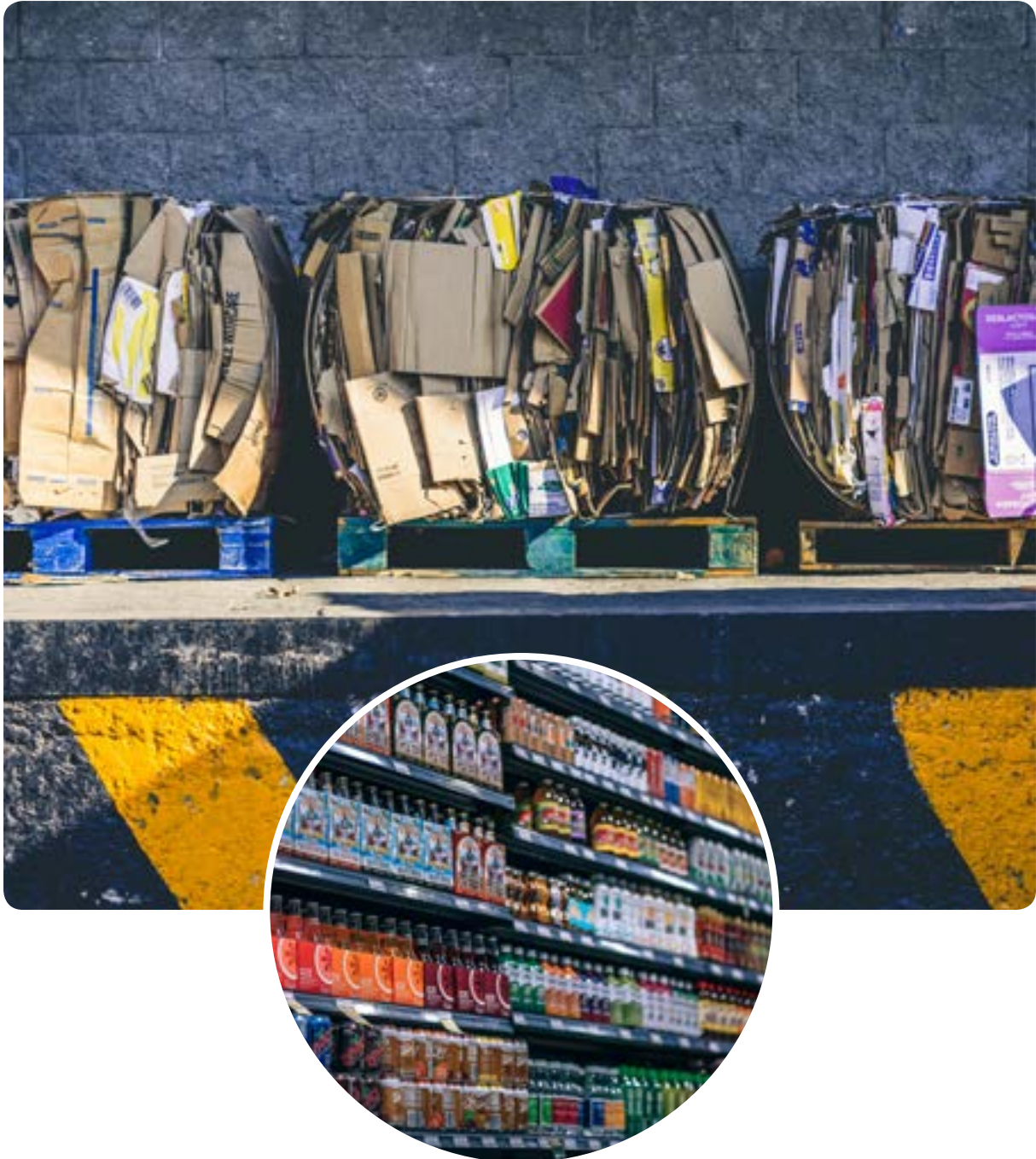
- **Re-orientation:** the ability of food system actors to **accept alternative outcomes** following disruption. Examples include changing to reduced meat diets, being satisfied with more seasonal produce, and accepting lower cosmetic-quality vegetables.

Aiming for any of these notions of resilience requires **re-organisation**.

Making changes in the system in order to deliver desired outcomes is also termed 'adaptation', and food system examples include changing farming systems, diversifying sources of primary ingredients and food chain operations, and making market infrastructure more robust. This requires lateral thinking

Changing food preferences, i.e. accepting a different diet composition (an example of re-orientation), would also help enhance food system resilience if it involves accepting a diet less dependent on those foods more susceptible to disruption or reducing foods with high environmental impact. Changing diets would also help address the sustainability agenda by reducing the environmental footprint of our food. Further reducing physiologically-unnecessary (and often unhealthy) over-consumption would increase food system resilience by lowering demand in the face of perturbations.





Elements of **robustness** and **recovery** will be important components of increasing food system resilience. However, an extrapolation of recent and current consumption patterns over coming decades due to increases in both population and wealth, together with the potential stresses and shocks, indicates that a radical shift in consumption patterns of the over-consumers is needed. So, while there is a clear need to develop more productive food producing systems that are more environmentally benign, a major advance (i.e. **re-orientation**) also needs to be made in the demand side of the equation. Re-orientation can also be termed transformation, and

ultimately could prove to be the most important as it is the one that most significantly combines the notions of sustainability and robustness. Food system examples include consumer education/awareness programmes, taxes on more environmental- and health-impactful processes and products, and subsidies for more sustainable food system activities. Thus, we need to think of ways we can understand how food systems react to various shocks, as well as ways we can actively facilitate transformations and manage the resilience of the food system with different goals in mind.



# Applying resilience thinking to the UK food system

In order to apply the resilience concept within the UK food system context we can ask a number of questions:

- **Where do we need to increase resilience?**

*Food system activities and outcomes.* The food system is comprised of a whole range of activities including producing, processing, packaging, retailing, storing and consuming food. As all of these activities interact to deliver the outcomes we want from the UK food system, we need to enhance the resilience of these activities so as to enhance the resilience of the outcomes. In order to achieve these outcomes, we need to understand which activities are vulnerable to which shocks and stresses.

- **What do we need to build resilience against?**

*Shocks and stresses.* The food system is influenced by various shocks and stresses. Stresses can be defined as pressures or tensions gradually exerted on a system, such as a gradual change in demography, climate, or social habits. Shocks are more surprising events, such as food scares, trade embargoes, new legislation and extreme weather event.

- **Whom will benefit from increased resilience?**

*Food system actors.* The food system activities are carried out by a wide range of direct actors such as farmers and fishers, processors, logistics and trading companies, retailers and consumers. Other actors, such as regulators and civil society groups, influence the activities of the direct actors. Both types of actors are affected by the wide range of stresses and shocks, and their changed activities determine how the food system outcomes change.

- **Over what time period do we need to build resilience?**

*The short and long term.* It is important to distinguish short-term interruptions due to shocks (e.g. disruption of grocery deliveries due to bad weather) from disruptions due to stresses that affect the longer term (e.g. climate change).

## Pathways to enhancing food system resilience

There are three main approaches to enhancing food system resilience: Adapting the food system activities, adapting the drivers shaping food system actors' choices and decisions, or adapting our world views on what we want from food systems.



### Adapting food system activities

One approach to resilience building is to adapt the activities carried out in the food system. This includes, for example, farming in new ways, processing food differently and changing patterns of consumption.

### Adapting food system drivers

Another possibility is changing the various drivers that influence and shape the decisions and behaviours of the actors in the food system. This can be done by for example changing food production policies, initiating policy discussion about agri-environment schemes, introducing new trade regulations or building consumer awareness on healthy eating patterns.

### Adapting our 'worldviews' of what we want from food systems

This third approach relates to our views on the trade-offs among the food security, other socioeconomic and environmental goals depicted in *Figure 1b*. For instance, we can aim for a different balance between profit for food sector enterprises that exploit natural resources and environmental outcomes by strengthening policies which protect natural habitats.

### Join the conversation

There are a great number of actors in the food system, from those directly involved in production, processing and packaging to retailers, consumers and those involved in food disposal, as well as the many 'influencers' such as regulators and civil society groups.

We want to hear your views.

- What do these concepts of resilience mean to your organisation and its role in the food system?
- What will enhancing the resilience of the UK's food system mean for policy direction? What could the future of the food system look like?
- We aim to help shape our food system into one that's resilient to shocks and stresses. If you want to join the conversation, please get in touch with the Programme Co-ordination Team.



# The GFS-FSR Projects

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## **BananEx: Securing the future of the nation's favourite fruit**

With more than five billion bananas purchased in Britain each year, just one variety – Cavendish – is internationally traded. Now, a new virulent strain of Panama Disease, known as Tropical Race 4, is emerging from Asia to threaten Cavendish. With no alternative tradable varieties available, and no chemical disease controls, supply is extremely vulnerable. This interdisciplinary research programme is investigating the resilience of banana production and supply from biological, ecological, economic and social perspectives to safeguard the supply of this important fruit.

[bananex.org](http://bananex.org)

## **FF&V: Increasing resilience to water-related risks in the UK fresh fruit and vegetable system**

Protecting the fruit and vegetable system from the risk of water insecurity.

Fresh fruit and vegetables, which are in demand all year round, are often grown in the driest parts of the UK or imported from countries such as Spain, South Africa, Morocco and Peru, where water resources are under stress. This project explores resilience across the value chain to three kinds of risk related to water: its physical availability (which might affect production, so raising prices); reputational risks (when environmental issues are highlighted in the media); and regulatory risks (such as restrictions on irrigation due to drought).

[www.cranfield.ac.uk/research-projects/resilience-to-water-related-risks](http://www.cranfield.ac.uk/research-projects/resilience-to-water-related-risks)

## **IKnowFood: Integrating Knowledge for Food Systems Resilience**

Systems of food production, trade and consumption are increasingly vulnerable to interconnected political, economic and ecological shocks associated with climate, environmental and ecosystem changes, shifts in farming practices and consumer lifestyles, and globalisation. This project uses the concept of resilience to investigate the sources of these vulnerabilities and to produce datasets, information resources, engagement approaches and business tools that will assist stakeholders in developing mitigation and adaptation strategies.

[iknowfood.org](http://iknowfood.org)   [@iknowfoodYork](https://twitter.com/iknowfoodYork)   [f /IKFProject](https://www.facebook.com/IKFProject)

## **PIGSustain: Predicting the impacts of intensification and future changes on UK pig industry resilience**

This project uses a multi-disciplinary, integrated systems approach to model and assess the resilience of the UK pig industry, currently and in the future. The research team will produce models to predict the impacts of intensification, changes in climate, trade, feed prices and demand, on the health, disease and welfare of the animals: how consumption patterns and retail prices are likely to be affected; how these changes will impact farmers; and how these in turn will impact on the health and welfare of the animals.

[welfare-epicentre.weebly.com](http://welfare-epicentre.weebly.com)   [@Pig\\_Sustain](https://twitter.com/Pig_Sustain)

## **RUGS: Resilience of the UK food system to global shocks**

An increasing global population needs more food, fuel and shelter than ever before, with changing demand shifting production towards commodities that are more land intensive to supply. The interconnected nature of the global food system means local shocks or changes can cause impacts in other regions. To mitigate and adapt to these we need a better understanding of where food supply chains are vulnerable and where they show resilience. This project examines how the global food system deals with shocks and changes while the research aims will develop our understanding of the impact that these events have on the UK food system.

[www.rugs-project.uk](http://www.rugs-project.uk)

### **RePhoKUs: The role of phosphorus in the resilience and sustainability of the UK food system**

Phosphorus (P) is an essential nutrient required for crop and livestock production, but the global reserves of phosphate rock from which fertilisers and feeds are derived are a finite critical resource. UK agriculture is entirely dependent on P imports of fertilisers, feeds and foods, which are becoming increasingly volatile in cost. Phosphorus is also an endemic water pollutant due to inefficiencies across multiple scales in the food chain. In this project we aim to enhance the resilience and sustainability of the UK food system by developing adaptive strategies that will reduce the vulnerability of UK farming to future P shocks and optimise the provision of ecosystem services linked to water quality.

[wp.lancs.ac.uk/rephokus](http://wp.lancs.ac.uk/rephokus)    [@RePhoKUs](https://twitter.com/RePhoKUs)

### **Modelling landscapes for resilient pollination services**

Pollination services by insects, particularly bees and hoverflies, underpin millions of pounds of crop production within the UK. Pollinator populations are under considerable pressure from a number of sources, including climate change, agricultural intensification and habitat loss. This project, involving a team of ecologists, economists and sociologists, explore the impacts of future scenarios on the resilience of pollinator natural capital, identify tipping points in service provision and assessing the feedbacks these have on economic and socio-cultural values.

### **Resilient dairy landscapes: Socio-technical innovation for dairy resilience and sustainability**

The UK has the tenth largest dairy sector in the world. This project explores the trade-offs between farmers' livelihoods, the natural environment and the stable supply of reasonably priced dairy products, to find better ways of working in the face of unpredictable future societal, environmental and climate change. It integrates the latest social, economic, natural, and veterinary science with the expertise of farmers and the dairy industry, to devise and test innovations that will increase the resilience and sustainability of dairy farming in a rapidly changing world.

[www.resilientdairylandscapes.com](http://www.resilientdairylandscapes.com)    [@ResilientDairy](https://twitter.com/ResilientDairy)

### **SEEGSLIP: Sustainable economic and ecological grazing systems – learning from innovative practitioners**

Grassland systems, which dominate the UK agricultural landscape, are largely economically unproductive, ecologically degraded, dominated by a single grass species, organic carbon poor and heavily reliant on inputs to maintain the productivity of both grass and associated livestock. Pasture for Life (PfL) certified producers feed grass only and have adopted pasture management practices that mimic natural systems using approaches which can potentially extend the grazing season while providing environmental, economic and livestock benefits in terms of health and productivity. This project will holistically evaluate the ecological, agronomic and social impacts of the pasture fed livestock approach to grazing management and its potential as the basis of a sustainable UK-wide system.

[@seegslip](https://twitter.com/seegslip)

### **ResULTS: Resilience in Upland Livestock Systems**

UK uplands form a substantial element of the UK's agricultural land resource and have an important role to play in addressing many wider environmental issues. Farming and other land uses in the uplands are extremely challenging, financially marginal, and need to respond to challenges such as climate change, livestock diseases and changing societal demands. This project will examine how beef cattle and sheep farmers in upland areas can improve their resilience to environmental, economic, and social change, and what impact their actions to improve resilience will have on food supplies, natural resources and society.

[upland-resilience.org](http://upland-resilience.org)    [@Hill\\_ResULTS](https://twitter.com/Hill_ResULTS)

### **DiverseaFood: Evaluating the potential of multi-trophic aquaculture to improve nutrition and ecosystem sustainability in the UK**

This project explores how the diversification of UK aquaculture and transition to integrated multi-trophic aquaculture (IMTA) can increase the contribution of seafood to a healthy and sustainable diet and lead to environmentally and socio-economically sound production. Using an integrated supply-demand approach, DiverseaFood will evaluate the nutritional contribution, environmental sustainability and socio-economic impact of IMTA. The project will investigate interventions at the levels of business models, regulation and policy, and consumer acceptance of IMTA products. The findings will inform understanding the key barriers to aquaculture diversification.

### **Rurban Revolution: Can ruralising urban areas through greening and growing create a healthy, sustainable and resilient food system?**

Our food system is facing multiple major challenges: with a growing obesity crisis; inequality in access to nutritious food; a dwindling land resource for supporting farming; ecosystem degradation from agricultural land use change and practice; and questionable supply resilience in the face of political instability. This project seeks to examine how the ruralisation of our urban areas – what we’re calling ‘rurbanisation’ – by increasing greening and food growing in urban areas could help tackle these challenges, by: increasing availability, access and preferences for fruit and vegetables; by alleviating pressures on land use and environment and enhancing urban ecosystems; and shortening supply chains.

### **TGrains: Transforming and growing relationships within regional food systems for improved nutrition and sustainability**

T-GRAINS combines a place-based approach with agricultural modelling to assess whether sustainable and nutritious diets that are socially, culturally, and economically desirable can be produced within regional landscapes. The research team works with producers, consumers and retailers to understand the impact that direct relationships between actors has on the flow of information, the building of trust, and food purchasing and consumption. The project seeks to understand how technology can catalyse these relationships to deliver healthier and environmentally sustainable diets.

This policy brief was written by the coordinators of the Global Food Security's 'Resilience of the UK Food System in the Global Context' (GFS-FSR) programme. It will help to inform policy and practice, which is based on a wide variety of factors, including evidence from research. This documentary does not necessarily reflect the policy positions of individual programme partners.

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Global Food Security (GFS) is a multi-agency programme, hosted by UK Research and Innovation, bringing together the main UK funders of research and training relating to food. GFS publications provide balanced analysis of food security issues on the basis of current evidence, for use by policy-makers and practitioners. [www.foodsecurity.ac.uk](http://www.foodsecurity.ac.uk) Email: [info@foodsecurity.ac.uk](mailto:info@foodsecurity.ac.uk) [@foodsecurityuk](https://twitter.com/foodsecurityuk)

Statistics were taken from Defra's 2018 report 'Agriculture in the United Kingdom 2017'  
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