University of Nottingham
Future Food

Why future food?

Because whether we like it or not, food supply and security is a global issue, and one that will only grow in importance.

By 2050 climate change will hit current food production by up to 34%, when there will be 2 billion more mouths to feed. Agriculture is a major factor in climate change, producing over one-third of human-made emissions. This means we need to rethink food. That is what the University of Nottingham is doing with its Future Food beacon. It is a model for how researchers, producers, consumers and governments can combine so our food is secure, healthy and sustainable by 2050.

This is a complex challenge. On the one hand there is a technical production challenge to produce sufficient food to match the increased demand. This is where there is a real need, for example, to research more resilient crops that can cope with more extreme environments, or alternative and less environmentally damaging sources of food.

However, it is not just a technical production challenge but it is a food distribution, food wastage, health and cultural challenge as well. It is a challenge for how we make our diets sustainable.

Producing more food is not sufficient. There is also a need to distribute this food to the populations that need it most without damaging the environment. Our current food systems evolved to support a few billion people. But as the population has grown our food systems have struggled to keep pace. We now need to reconfigure our food systems to be kinder to the environment and supply those people most in need.

Our food systems are wasteful. One-third of the food produced for human consumption worldwide is lost or wasted. We produce 1.3 billion tonnes of food that is not eaten that could be, often in regions that need it most. It is critical that we address this through a combination of new technologies and reconfigured supply chains, preventing food from ending up in landfill and recycling value from unused food.

Food is essential to health. Malnutrition comes in many forms and is often hidden. Presently there are around 821 million undernourished people, and 672 million obese. This represents the double burden of malnutrition. At one end there is a lack of sufficient food and a lack of essential micronutrients. While at the other end there is adequate, or even excessive, calories but still a lack of essential micronutrients. This is true hidden hunger and in fact one in five of deaths worldwide are linked to poor diet.

But food is more than just a life-sustaining fuel. It is one of life's pleasures, it is embedded in our diverse cultures and rituals, it shapes our landscapes.

Food is a significant part of the world and the UK economy, with one in three people worldwide employed in agriculture alone. Big companies and individual livelihoods depend on the food economy as producers, processors and retailers.

This is a multi-dimensional challenge that demands a multi-dimensional solution. That is why we have created the Future Food Beacon at the University of Nottingham, to bring together researchers from across disciplines with communities, producers and retailers worldwide to look at food as a whole, from soil to plate and beyond, to secure healthy, sustainable diets.

The Future Food Beacon

The Future Food Beacon's mission is to ensure that the world's population in 2050 – which will be 2 billion larger than now – will have enough food for their needs. The Beacon does this by working towards food systems that are equitable, prioritises health, and are sustainable for both people and the planet.

The Beacon was established in 2017 under the leaderships of Professor David Salt. Its researchers have expertise across food systems and have so far published 38 papers in peer-reviewed journals, and 29 research proposals have been awarded £11 million in total. As part of the investment in the Beacon, there have been new appointments in research fields such as crop molecular genetics, phenomics, evolutionary and functional genomics, microbiome, sensory science, environmetrics, computer vision, and bioinformatics, as well as collaborations with social scientists, archaeologists, engineers, economists, historians and community activists.

The Beacon also includes researchers at University of Nottingham Ningbo China and University of Nottingham Malaysia.

Partnerships are central to its approach. The Beacon is working with the Brazilian Agricultural Research Corporation (Embrapa) on soils, animal production, livestock infectious diseases and crop quality. In China, the Beacon has a series of projects including developing precision nutrition – bespoke diets reflecting individual and environmental characteristics and limiting the use of antibiotics – in livestock production. In Colombia the Beacon is working with smallholder cocoa growers to improve the quality of their product to enhance the price they get at market. This improves livelihoods and communities.

The Beacon works with commercial partners too, from multinationals to small producers in the UK and globally.

What is distinct about the Future Food Beacon approach?

The big challenges the world faces for food supply don't neatly align with academic specialisms. Developing alternative sources of protein, for example, isn't just a technical challenge. It has significant economic consequences for producers and communities affected, it has implications for environments shaped by livestock production, and there are social, cultural and psychological challenges involved in encouraging people to radically change their diets.

Reflecting this the Future Food Beacon works across academic disciplines in a 'mission driven' way, bringing academics and external partners together to tackle real-world challenges holistically rather than breaking them up into discrete questions and then viewing them through different, unconnected lenses.

Some examples:

One project links a 'bean-to-bar' premium chocolate maker in Nottingham, Luisa's Vegan Chocolates, with cocoa growers in Colombia. Using hand-held DNA sequencing equipment, researchers and farmers will measure the microbes fermenting the cocoa beans, in order to better understand the fermentation process. Fermentation is a key part of the final chocolate's flavour, but little is understood about the fermentation process. By sequencing the microbes, we can then begin to identify how these microbes affect end flavours. By helping farmers improve the fermentation process, we help them gain a higher price for their beans, improving their livelihoods. Simultaneously, the flavour of the chocolate made by Luisa's Vegan Chocolates improves, providing a better product for consumers.

We are looking at **hidden hunger**. Malnutrition is not just a function of having too few calories to eat, it can also manifest in not obtaining essential micronutrients from the foods we do eat. These micronutrients are present in the crops we grow. By understanding how soils affect the kinds of micronutrients present in the crops, we can work to improve soils and thus crops. To address this we are deploying a **GeoNutrition** approach, mapping the presence or absence of essential micronutrients in the soil, through crops, and into human populations, across large geographical areas. We are then targeting solutions that alleviate the associated health and developmental implications. In Malawi, for example, we are exploring a connection between the levels of the micronutrient selenium and geographical disparities in educational attainment.

As our climate becomes more volatile, we are looking to learn from historic agricultures in the global south and elsewhere. Livestock and crops cultivated on 'marginal' land, previously dismissed as inefficient, may have a lot to tell us about how agriculture needs to develop to cope with climate change. What is it that allows them to survive in conditions that would be disastrous for modern agricultures? We are exploring this by bringing together geneticists and archaeologists with communities in the global south. In Zambia, for example, using historic soil maps based on pre-colonial knowledge of the land, soil scientists and historians are able to work together to better understand the long history of agriculture and learn from the past to inform the future.

We are exploring alternatives to protein. Proteins from livestock bring with them huge climate burdens. The Beacon's Future Proteins Platform is exploring alternate protein sources from mealworms and other insects that can be raised on waste material not edible by humans. These novel sources of protein will be developed not only for human consumption but for the livestock industry too. Animal agriculture uses huge amounts of human edible crops (wheat, soya, maize) as feed. By switching to such alternative protein sources, livestock industries may reduce their impact on climate change.

Realising the potential

The innovative approaches being developed in the Future Food Beacon have the potential to shorten the time it takes to move fundamental research into real-world action. This is not just useful; it is essential in the face of the global challenge of securing a healthy, sustainable supply of food against a backdrop of climate change which is both caused by and will have consequences for current agricultures.

The University of Nottingham invested a substantial £16 million in the Future Food Beacon, and to date **the beacon has attracted £10 million from other sources**. This has allowed us to test and prove our case that our approach has the potential to make a huge difference to tackling the pressing challenges of food security.

However, it is small scale against the enormity of the challenge. If, as a country, we want to start making a bigger difference then we need to follow the example of other countries who are developing similar models at larger scales. A good example is Wageningen in the Netherlands which brings together researchers from across the country and globe with partners: wur.nl/en/About-Wageningen.htm

Conclusion

How can we rethink food?

The UK needs a world-leading food systems innovation hub to rethink food locally, regionally and globally, and to secure equitable, sustainable and healthy food for all. Such a hub would deliver for the food system the same level of excellence as the John Innes Centre and Rothamsted Research have done for primary crop production, and would ensure the UK keeps pace with initiatives in the Netherlands and elsewhere

The University of Nottingham Future Food Beacon provides a model which could be scaled up into an innovation hub to generate practical and radical trans-disciplinary ideas across food systems. It would work with business and social entrepreneurs to deliver economically viable and socially just solutions, at the pace the climate crisis demands.

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