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Interdisciplinary food systems training to address global food challenges

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(Summary of presentation prepared by Martin Evans and Emily Marr)

Trained in soil science, John spent the 1980s working in Africa and Asia in agriculture and forestry research projects. In 1991, he was recruited by the UK's Natural Environment Research Council (NERC) to help coordinate research on global change and agroecology. In 2001, he was appointed Executive Officer for the international research project 'Global Environmental Change and Food Systems' (GECAFS); and on the close of GECAFS in 2011, he was appointed NERC Food Security Leader. In 2013, he assumed his current role of Food Systems Programme Leader at the University of Oxford's Environmental Change Institute (ECI). John also leads the multi-university post-graduate food systems training programme 'Innovative Food Systems Teaching and Learning' (IFSTAL), and the UK Global Food Security programme on 'Resilience of the UK Food System'.

Introduction

One of the great human achievements over the last half-century is that advances in global food production have largely kept pace with global demand. Today, around 6 billion people are not hungry, up from about 2 billion 50 years ago. Nevertheless, nearly 1 billion people are hungry and at least 2 billion more lack sufficient nutrients. Paradoxically, there are also already more than 2.5 billion people who are overweight or obese. Different, overlapping forms of malnutrition are now the 'new normal'. We also know that food system activities will continue to have a significant impact on the natural resource base. With population growth, increasing wealth and a strongly emerging middle class apparent in many nations, food demand will continue to rise in coming decades, with potential over-consumption resulting in increased costs to our health, our society and our environment. How do we bring about systemic change in the food system to mitigate these potential costs, while also addressing the needs of those who do not have enough food or enough food of the right kind?

The lecture is in two parts:

- An overview of the nature of the challenges we need to address, bringing these into sharper focus.
- The role of the *Innovative Food Systems Teaching and Learning (IFSTAL)* programme.

The global food security situation

What is 'food security'? The term came into use during the world wars, but was subsequently little heard of until relatively recently. About 20 years ago, FAO formally defined food security as a situation, which:

"… exists when all people, at all times, have physical, economic and social access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life".

A notable thing about this statement is that there is no mention of agriculture or food production capacity – the focus of food security is now more on *access* to food.

Undernourishment. The good news is that the proportion of undernourished people in the world has been falling over time; in 1992, for example, it was about 19 percent but by 2014 had dropped to under 12 percent (FAOSTAT, 2017). Of course, the absolute size of the total population has also increased and the most recent FAO assessment puts the number of hungry people at 793 million in 2015. This is rather a precise number and given that estimates of hunger involve qualitative judgements, it is reasonable to work on the basis that approximately 1 billion people are still hungry today. The 793 million figure for undernourishment approximately breaks down geographically into 525 million in Asia and the Pacific, 225 million in sub-Saharan Africa, 28 million in Latin America and 15 million in the developed world.

Nutrient deficiency. This is a 'hidden' hunger: people may have enough, or more than enough, calories but the quality of their food may not be adequate. Diets are often lacking sufficient vitamin A, iron, iodine and zinc, for example, among other micronutrients. WHO estimates that at least 2 billion people worldwide could be affected. One-third of the global population is zinc deficient (Barret & Bevis, 2015), while half of all children aged between 6 months and 5 years old are micronutrient deficient (CDC, 2017). Even in the UK, 20 percent of the population has low vitamin D levels (NHS, 2016)

Food wastage. Roughly one-third of food produced for human consumption is lost or wasted, about 1.3 billion tonnes per year. The average family in the UK, for example, throws away £500-worth of food annually. Food is wasted at all stages of the supply chain – in the field and post-harvest during processing and distribution – often simply because its appearance does not meet consumer expectations even though it may be perfectly wholesome.

Excess weight and obesity: another form of 'food insecurity'. In the definition of food security quoted above, the word 'sufficient' is significant. According to the Oxford English Dictionary, it means *"enough for a particular purpose; as much as you need"*. In other words, not too much and not too little. However, an increasing number of people are eating too much food and it is not always the right kind of food (excess calories, inadequate nutrition). A

Table 1. Numbers of people globally affected by different forms of malnutrition.

	Sufficient calories	Insufficient calories	Excess calories
Sufficient nutrients	3 billion	NA	NA
Insufficient nutrients	2 billion	1 billion	>2.5 billion

third of the world's adult population is overweight or obese (in Australia, the proportion is as high as 60 percent).

The overall situation. The estimated numbers of people affected by different, overlapping forms of malnutrition – the 'new normal' (IFPRI, 2015) – are shown in the bottom row of Table 1.

Malnutrition does not only mean *under*nutrition; it can also mean *bad* nutrition.

Food system activities and environmental concerns

The food system leaves a big 'footprint' on the natural environment. Food system activity has already led to 35 percent of soil being degraded, 20 percent of freshwater aquifers being exploited, and more than 80 percent of minerals are lost between farm and fork, especially phosphorous and potassium. The food system is a major driver of climate change, not just because of the primary production, but throughout the entire chain of food storage, processing, packaging, transport, wholesaling, retailing, cooking, consumption and waste disposal activities. Some of the processes involved are summarised in Figure 1.

Land-using agricultural activities are thought to account for 15-25 percent of greenhouse gas (GHG) emissions, and the rest of the food chain for 5-10 percent. Leakage from cold stores of various kinds is a big concern, despite the significant improvements made in reducing GHG emissions from refrigeration. At the 2015 climate change conference in Paris, an estimate of 30 percent of all GHG emissions being food-related in 2010 was used as a baseline for comparing future scenarios. In order to reduce the projected temperature increase to 2°C by 2050 we must reduce greenhouse gas emissions by 40-70 percent. If *all* other sectors reduced emissions to zero during this period, then it follows that current food system activity would "use up" the entire emissions budget. However, if we want to limit the temperature increase to 1.5°C (reduction of GHG emissions by 70-95 percent needed), and we have to meet the higher target of 95 percent reduction, then even with all other sectors completely eliminating their GHG emissions, maintaining current food system activity and its emission levels would clearly result in the emissions budget being exceeded. These scenarios underline both the urgent need for GHG emission reduction in the food system and the real opportunity that success here offers for limiting global temperature increase.

The challenge ahead

Essentials. The fundamental problem is conceptualised in Figure 2, which plots daily per person calorie consumption against the size of the global population for the years 2000 and 2017; and linearly extrapolated for 2027 and 2040 (the chart is indicative; it is not to scale). A sufficient intake is taken as 2,250 kcals per day, and the four horizontal bars indicate the proportions of the population that

Example contributions of FSAs to Env	Producing food	Processing & Packaging food	Distributing & Retailing food	Consuming food
Climate change	CO_2, CH_4, N_2O, albedo	Factory and materials emissions	Transport and cold chain emissions	Cooking and washing emissions
N cycle	Fertilisers	Factory effluent	Transport NO_x	Waste
P cycle	Fertilisers	Detergents		Waste
Fresh water use	Irrigation	Washing, heating, cooling	Cleaning food	Cooking, cleaning
Biodiversity loss	Deforestation, soils, fishing. monocultures	Paper/card Metal mining	Invasive spp	Consumer choices
Atmos. aerosols	Deforestation, tillage		Shipping	Smoke from cooking
Chemical pollution	Pesticides	Factory effluent	Transport emissions	Cooking, cleaning

Figure 1. Food system activities (FSAs) and environmental concerns (Env) (Adapted from Ingram, 2011).

are consuming more than this (LHS red segments), about this level (middle green segments), and less than this (RHS red segments) for the different years. The sloping lines above show the same thing, but also give an idea of how the absolute magnitude of excessive and deficient intake, in terms of total global calorie consumption, will change as the years go by if past dietary trends continue.

The imbalances depicted in Figure 2 reflect systemic failings in food systems that will only get worse unless action is urgently taken to make them more effective and efficient. Interventions are needed that will in effect 'pull down' the sections of the sloping lines in Figure 2 that are above the 2,250 calorie line and 'push up' those sections below it. All actors in the food system will need their skills enhanced if food security and environmental outcomes are to improve. These actors will have to operate against a backdrop of natural resource depletion, stagnating rural economies in many cases, climate change and social and socio-cultural change.

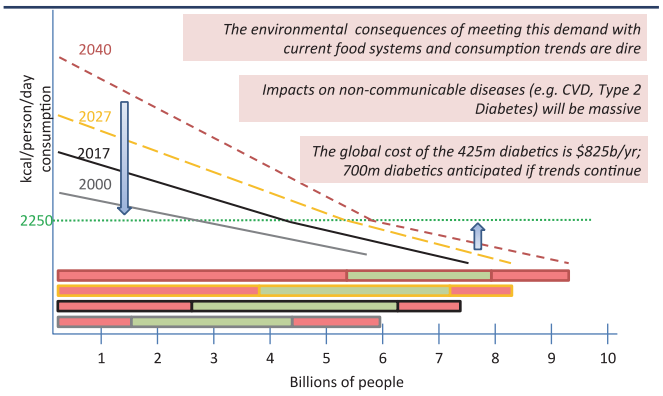

Figure 2. Calorie consumption: dietary trends (indicative; not to scale)

Drivers and feedbacks. The food system is a 'classic' dynamic system, with feedback loops returning to the key drivers (Figure 3). *Environmental drivers* (such as changes in land cover, atmospheric composition, climate variability, water availability and quality, nutrient availability and cycling, biodiversity and sea level) result from *socio-economic drivers* (such as changes in demography, economy, science and technology in their socio-political and

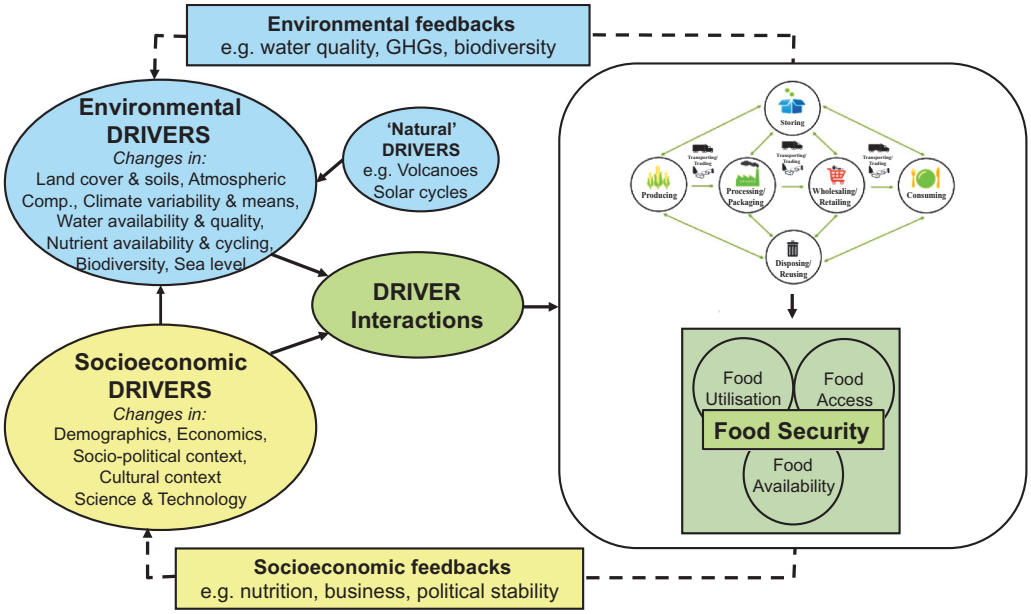

Figure 3. The need to consider drivers and feedbacks when analysing the interconnected challenges.

cultural contexts) as well as by *'natural' drivers* (such as volcanic and solar activity). Interactions among these drivers impact on the food system activities, and thereby affect food security outcomes (food utilisation, food access and food availability). System responses to these changes feed back to both the environmental and socio-economic drivers, which react and adapt, causing further responses, and so on. Any intervention in the food system leads to both environmental and socio-economic feedbacks to some degree.

It is hard to make progress in food system management precisely because of the complexity of these interactions and the fragmented food system governance (different countries, organisations, multiplicity of parties with different powers and vested interests). Despite this, however, there are many opportunities to do things differently in terms of policy, fiscal, social and technological options available, and there are also multiple ways in which food system actors can cooperate with each other. There are many plausible futures, and not necessarily as Figure 2 indicates.

'Food systems thinking' – how does it help? Improving food system management needs an interdisciplinary view. Narrower-view, disciplinary approaches can fail to address issues or spin off further problems. 'Food systems thinking' integrates a collective understanding and co-ordinated response from a variety of stakeholders. A workforce is needed that is trained in food system concepts and tools, and able to implement interventions leading to better outcomes for food security, enterprise and environmental goals. This workforce will need to be equipped with both 'hard' (knowledge) and 'soft' (capability) skills. It will need to understand the complexity of the food system and its actors, including their motivations, activities and impacts. All sectors in the food system would benefit from such a workforce, and this would also engender stronger collaboration based on a common understanding.

IFSTAL

What it is and how it works. *Innovative Food Systems Teaching and Learning (IFSTAL)* is a pioneering consortium of five higher education institutions for delivering collaborative training and learning in the holistic study of food systems. (The consortium members are: Environmental Change Institute, School of Geography and Environment, University of Oxford; Centre for Food Policy, School of Arts and Social Sciences, City University; Leverhulme Centre for Integrative Research on Agriculture and Health; Centre for Food Security, University of Reading; and University of Warwick.) *IFSTAL's* goal is to create a cohort of Masters and PhD graduates equipped to address food system challenges, based on an understanding of the system and the ability to handle its complexity.

The *IFSTAL* programme is available to all post-graduate students at the participating institutions and is a voluntary programme, which one does in one's own time. There is no exam but a certificate of participation is awarded. On-line training is provided in four 'units' during the autumn and spring terms: Introduction to the Food System, Introduction to System Thinking, Methods for Analysing Food Systems, and Engendering Food System Change, each followed by a face-to-face workshop session. Throughout the year there are also away-days (*eg*, 30 students meeting food system professionals), surgeries, symposia (*eg*, the Royal Veterinary College hosted an event for 150 participants to consider the question *"To what degree is technology a fix?"*), tailored career workshops, and a summer school for 30-35 students providing training in soft skills such as communication and persuasion. This is all supported by the *IFSTAL* Workplace Engagement Lead, Rosina Borelli.

What it offers. For students, *IFSTAL* offers interdisciplinary learning, including exposure to cutting edge food systems thinking, access to faculty and student networks, and contact with experts from the workplace. Job prospects are enhanced by such opportunities and by dissertation placements, postgraduate internships and access to the graduate food systems network. For employers, *IFSTAL* offers well-rounded interdisciplinary postgraduates skilled in food systems thinking (there is a real need for this), people who can work effectively on systemic issues and risks and have enhanced professional capabilities based on soft skills, and access to other food system thinkers across the workplace, including alumni networks.

Current situation and prospects. More than 700 students have participated in *IFSTAL* so far (300 last year, 400 this year), with 12 internships secured for last year's graduates. This may seem a small proportion, but it needs to be borne in mind that not all the

participants engage with the programme to the same extent. The *IFSTAL* programme is being funded for three years by the *Catalyst Fund* from the Higher Education Funding Council for England (HEFCE). *IFSTAL* is currently about halfway through the Phase I pilot, and planning is underway to develop further in Phase 2, starting in October 2018.

Summary of the post-presentation discussion

Question (Q) from a member of the audience: The first part of the talk portrays a dire situation. Most solutions are really only 'tweaks' to the system (*eg*, increase yields by 10 percent), *ie*, business as usual. How do we – the current generation with poor soft skills – get the message out that it is not business as usual? How do we get demand-side management? Do policy makers get it?

Answer (A) from the lecturer: Much emphasis is still being given to reducing under-nutrition, but the 'elephant in the room' is over-nutrition. We need to manage demand, not meet it. One thing that can be done immediately is to reduce food waste. Policy makers do not get it. They do not understand the meaning of malnutrition. There is a language problem here:

- 'Malnutrition' does not mean under-nutrition.
- 'Sufficient' does not only mean enough.

We may need a shift from the production paradigm to one that emphasises behavioural psychology if we are to change society's food consumption habits for the better.

Q: Is food too cheap? The proportion of households' budgets spent on food is declining all the time.

A: We first have to consider what we mean by 'food' – the farm commodity or the retail product? The value-adding process causes the cost to increase along the supply chain. By the time food reaches the shops, the issue is not price *per se*, but affordability. It could be argued that at the retail level, food is too affordable.

Q: Is the relationship between obesity and food price really 'linear'? In the US, those groups without access to nutritional food have more obesity.

A: FAO data show that calorie consumption per head is a function of GDP per head. However, once one investigates at the sub-global level, one does find differences in the detailed stories. It is true that the people with the worst diets are not the richest.

Q: Should the environmental impact of food systems drive the policy focus on what people eat?

A: It could – it's about awareness – but the calculation of the environmental impact of everything we eat during the day is massively complicated. There has been an attempt to introduce carbon footprint labelling on food products but this failed because it is so difficult to work out. Consuming the right amount of food in full knowledge of the environmental impact is challenging. Furthermore, while we're looking to reduce food's environmental footprint we mustn't lose sight of the fact that we need vibrant food enterprises. If these go down, then the food system crumbles. Nevertheless, we have an 'eat-well' plate so we could incorporate an 'environmentally-friendly' plate.

Q: Who are the regulators? Food and farming, the biggest industry in the UK, is not even mentioned in *Our Industrial Strategy* (Department for Business, Energy & Industrial Strategy, 2017). My remit is to get involved more along the food chain, but where should it go? DEFRA is completely focused on Brexit; their food and farming strategy will never see the light of day.

A: We have to ask the Food Standards Agency. If 'sufficient' nutrition is the right criterion, then the food system is not delivering. Is this a human rights issue, a litigation issue even? We have an opportunity to bring about change at the society level, but it will require change among all actors in the food system.

Comment (C): The *AgriFood Advanced Training Partnership (AATP)* (Comprising the University of Nottingham, Harper Adams University, Cranfield University and Rothamsted Research) funded by the Biotechnology and Biological Sciences Research Council already provides specialist training across the entire agri-food supply chain.

Response (R): Indeed, and there will be synergies between *AATP* and Phase II of *IFSTAL*. *AATP* is already very focused on people in the food industry and provides accreditation.

C: For many [older] people – like me – engaged professionally in the agri-food sector, the predominant issue during most of their working lives was that there wasn't enough food. Consequently, we perhaps find it a bit hard now to accept that producing more food is not necessarily the top priority. Maybe now we have to change this mind-set.

Q: Has the globalisation of food systems exacerbated the problem of short-term market imbalances, as we have seen recently for example in relation to the panic buying of lettuce in the UK because of poor weather in Spain, while excess UK cauliflower is sent to Poland? But we can't shift our surpluses to Africa and Asia.

A: In terms of the geography of global food consumption, it is notable that there are more overweight people in the developing world than in the rich world – by a large margin. As for Africa, the expanding demand for food there is such that it will require an extraordinary transformation of domestic agriculture. By helping people understand how the food *system* as a whole operates, we can hopefully build up a cadre of professionals that can tackle the issue.

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