SHINING A LIGHT
ON THE UK FOOD SUPPLY SYSTEM

ITS SCALE & COMPLEXITY

BIRMINGHAM
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Contents

Preface: When gut instinct works and when it doesn't

This filthy pair is myself & a colleague, a few minutes after arriving back up from the Daw Mill coalface.

A coal mine is alien environment to human life. Life support systems have to be organised, even the very air you breathe is pumped down, soon to be perilously dust-ridden.

When we visited a mine (see photo left) the manager had given us precise safety instructions before entering. The top priority was as to do as we were told. Even if we saw people badly injured or dying, he said, we should not stop to help, however strongly our instincts told us to do so. Our gut instinct in this alien world could easily endanger lives.

Both the scale and complexity of today's food supply system is beyond our comprehension, our gut instinct of little use.

1. The scale of what it takes to feed the UK

1.1 We can't instinctively 'see' big numbers

Gut instinct is little help in calculating the scale of what it takes to feed everyone on these northern, often misty isles.

If we assume the UK population is 68 million and each person has, on average, a calorie requirement of 2000kcal per day, the total UK annual consumption is an impossible-to-compute 49.6 trillion kcal.

(*note*: Our average per person calorie consumption is some 3.5K. And, of course, the UK population is a tiny fraction of the eight billion or so people alive on Earth today.)

1.2 A workaround: Using time scales

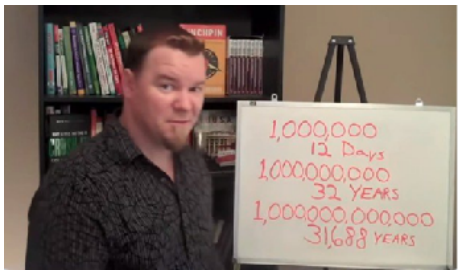


Figure 1: from Diffen: Million vs Billion?

To me, and I suspect to you, my gut instinct doesn't distinguish much between 68 million and 49.6 trillion; they're both merely, (*merely*!) huge numbers with lots of zeroes.

Translate 'lots of zeroes' into *time*, however, and we can begin grasp the enormity of the difference between them (see also Figure 1).

A million seconds is a mere 12 days. **68 million seconds is 816 days, about two years three months.**

A trillion seconds is 31,688 years. **49.6 trillion seconds is over 1.5 million years**; i.e. well before the first *home sapiens* evolved.

2. The complexity of the UK food supply system

2.1 Regional specialisation

A dense population requires production efficiencies, so UK farmers and growers have specialised production strategies for the different terrains and climate across the country.

For example, arable farming needs nutrient-rich soils, ideally on flat or undulating land for ease of large-scale combine harvesting. It's not for nothing that East Anglia is often referred to as 'Britain's bread-basket'.

In contrast, only livestock farming can make good use of the poorer, thinner soils on the mountains, hills and moors of Wales, Scotland and the Pennines. Dairy cattle thrive on the wetter and so richer grasslands of the Cheshire plain or parts of Northern Ireland.

Growing many fruits and vegetables requires warmer climes than ours. Always a challenge during the 'hungry months', Brexit greatly adds to it, while investment returns on artificial micro-climates, such as Thanet Earth, rely on scarce expertise and efficiencies of scale.

2.2 From grower to consumer

Regional specialisation means we need a system in place to deliver the breadth of diet we need for a healthy life, whether we live in an urban area or the countryside.

This is achieved by many interconnected organisations exchanging goods and information in real-time. Even the journey a single fruit or vegetable takes to reach the retail shelf is contingent on these exchanges. The video (right) gives a simple account of these events.

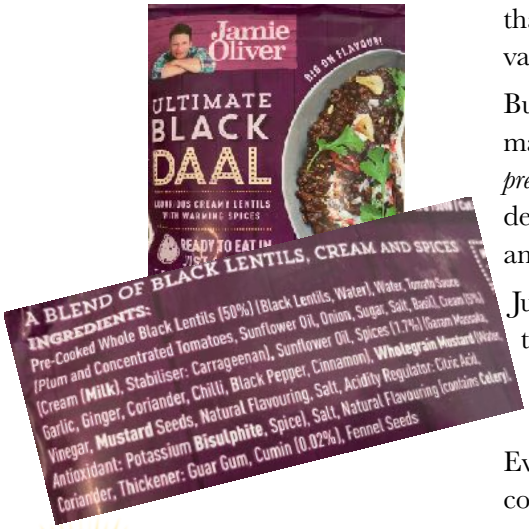
Few products, however, are as simple as these.

2.3 Composite products

From the earliest written recipes some 3,700 years ago to Master Chef, all give instructions on how to take different ingredients and make them into something more digestible, tasty or attractive to eat.

Some twenty years ago, the buyer for a large pub chain was asked to list the ingredients that went into their meals, for safety and quality control purposes. Perhaps she shouldn't have been surprised to learn that 40+ ingredients went into a single burger, their composition varying according to what supplies they could get.

Burgers are what's known now as composite products; i.e. they are made with lots of ingredients. Such recipes aren't a new idea. *Pre-prepared* portions and meals, however, are recent innovations, dependent on today's increasingly efficient preservation, processing and packaging technologies.



Just as specialists prepared food for our forebears' sustenance, today's do too, in the making of pre-prepared, often long shelf-life foods. They now comprise a large part of our diet; e.g. Jamie Oliver's 'ultimate black daal' (left) with its 30+ ingredients.

Even a supposedly simple product, such as mustard, is usually a complex mix of ingredients; e.g. different varieties of mustard seed, perhaps ground or whole with added vinegars and other acids, wine with or without sulphites, an acidity regulator of some kind plus water, salt, sugar and the catch-all 'other flavourings'.

2.4 What food supply system organisations do

Given the scale and complexity of our supply system, it's useful to think of the physical entities within a system (aka its 'structure space') *and* their function (aka its 'function space').

Their function often provides a simpler means to 'see' the system, as in the Figure 2 map below. This map shines a light on what millions of entities in the food supply system actually *do*.

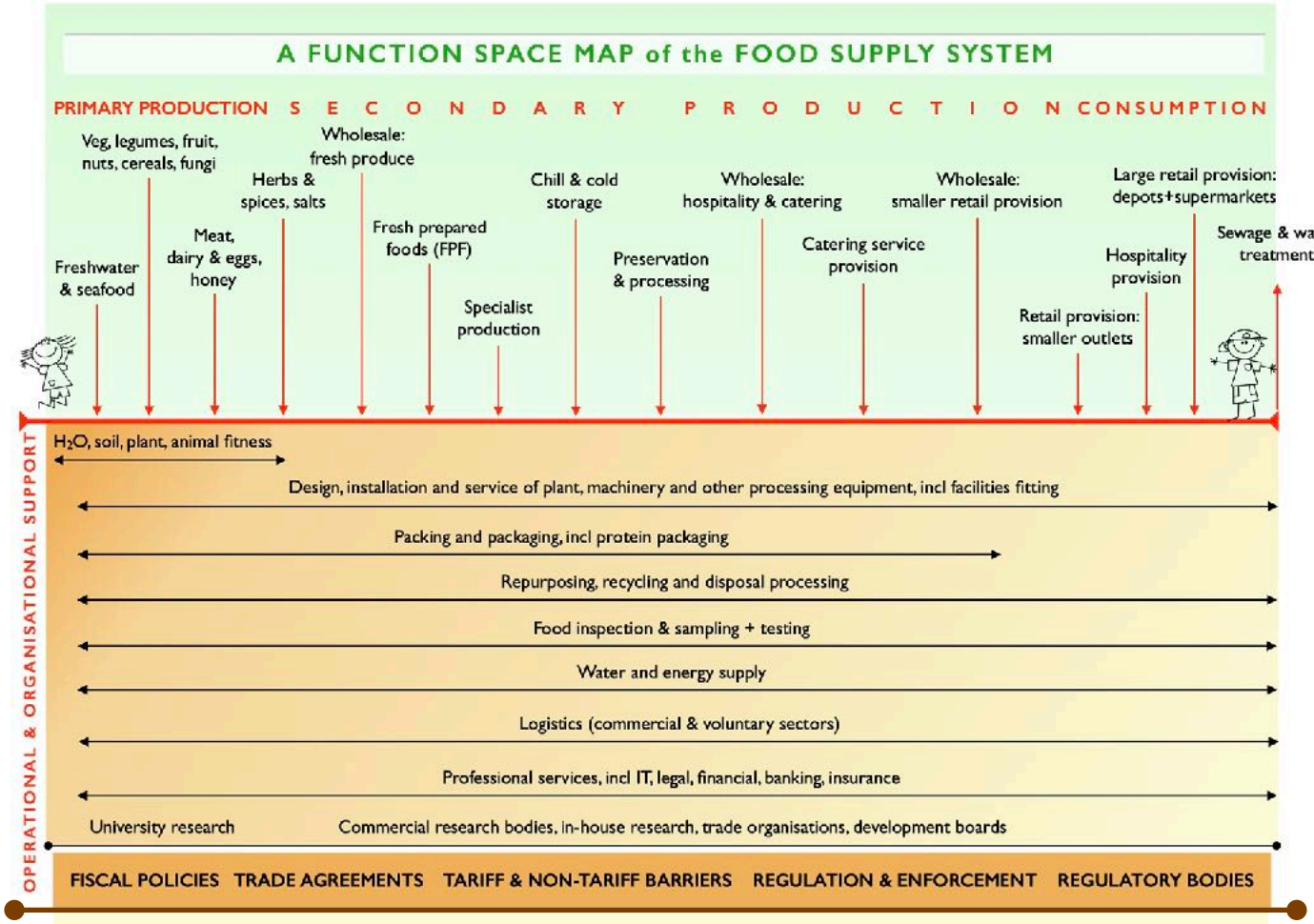


Figure 2

This function map allows us to 'see' that the system comprises far more than farm to fork production and consumption; i.e. everything *above* the red line.

Much of the food system activity (and economic value) is, however, *below* the red line; i.e. in operational and organisational support.

The whole system is underpinned by the Government using the economic and policy levers that only they have the authority to use. The Government's function is to set the parameters of engagement between all the players in the system.

Behind each function space are physical entities, millions of organised interconnections of people, plant and product. Out of this complexity, emerges an unimaginable range of foods and food stuffs.

If one or more functions fails, the connectivity within the system means there will be ripple effects. If the effects start to cascade, the scale of operations required to feed a large population will mean many will go hungry — unless the Government intervenes.

3. Efficiency versus robustness in a complex system

3.1 Fail-safe capacity

The natural world is testament to the trade-offs between robustness and efficiency in all complex systems. The natural system usually favours robustness. Many human-made complex systems, however, shift that balance. Without external interventions such as subsidies, and enforced regulation, commercial systems will favour efficiency over robustness. Fail-safe capacity will therefore be reduced.

3.2 Failures in the food supply system

This presents three challenges for the UK food supply system. *First*, the complex operations to feed the population mean failure in one part of the system, whether caused by internal or external events, can easily cascade further.

Secondly, if failures compound or affect a highly interconnected node in the system (e.g. water or energy supplies), many millions will soon not have the means to access the food they need for their survival.

Finally, it's impossible, even for insiders, to assess what the next food shock might be, where it might originate or what its effects are going to be, as happened in these two examples:

A minor perturbation: A carbon dioxide shortage in June 2018

It began with maintenance shutdowns in a couple of fertiliser and ethanol plants in Europe and a breakdown at a few key ammonia plants in the UK. Suddenly, CO2 was in short supply.

No-one had realised how much of the food system depended on CO_2. Remarkably, even a carbonated drinks manufacturer declared surprise at their dependence on it.

The news of the shortage broke when a farmer reported his chickens were worthless. CO_2 is used to stun before slaughter, so the processing plant had refused them. Within 48 hours the birds had grown too big to sell.

It was not only UK meat supplies affected. Brewers and bakers, as well as soft drinks manufacturers were too.

A sudden shock: Lockdown across the UK in March 2020

With the first lockdown, the hospitality sector closed overnight. About half UK food supplies was immediately inaccessible. Cold and chill stores rapidly filled, trucks were parked, people laid off. The population turned to retail outlets for the food they needed, resulting in empty shelves, even supermarket-imposed rationing.

Within hours, there was a rapidly evolving food system function space as food system began to reconfigure itself.

Fifteen months on, there's still evidence of this sudden shock; for example, too many households, often with children, don't have enough healthy food to eat, some produce is still in cold store and who knows how many unscrupulous or outright criminal people are exploiting *de facto* lower food standards.

3.3 Building robustness into the system

How to make the food supply system more robust will be the subject of another paper in this series, based on our 2020 scenarios work.

in conclusion

Neither the scale nor complexity of today's food supply system can be intuitively grasped. It is therefore unwise to base socio-political decision-making about food supplies on gut instinct.

It's worthwhile for all of us, too, to remind ourselves often about the unreliability of our gut instinct in many circumstances. These four books are useful in this regard:

- Gut feelings: Short cuts to better decision-making
  Gerd Gigerenzer. Penguin, 2008
- How to make the world add up: Ten rules for thinking differently about numbers
  Tim Harford. Bridge Street press, 2020
- Thinking, fast and slow
  Daniel Kahneman. Allen Lane, 2011
- Factfulness
  Hans Rosling. Hodder and Stoughton, 2018

This short paper is one of a series under the heading *Shining a light on the food supply system*, all published on-line here.

For simplicity's sake, none has references. Information sources are in other articles and posts on our website. Alternatively, do email if you'd like to know more, via info@birminghamgfoodcouncil.org.